SCIENTIFIC AMERICAN

The Megaphone Goes Modern (See page 60) ★

VOLUME 152
•
NUMBER 2

FIRE AT SEA!

By R. G. Skerrett

FEBRUARY 1935
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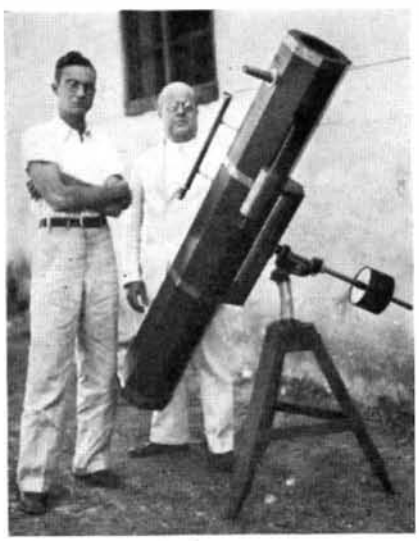

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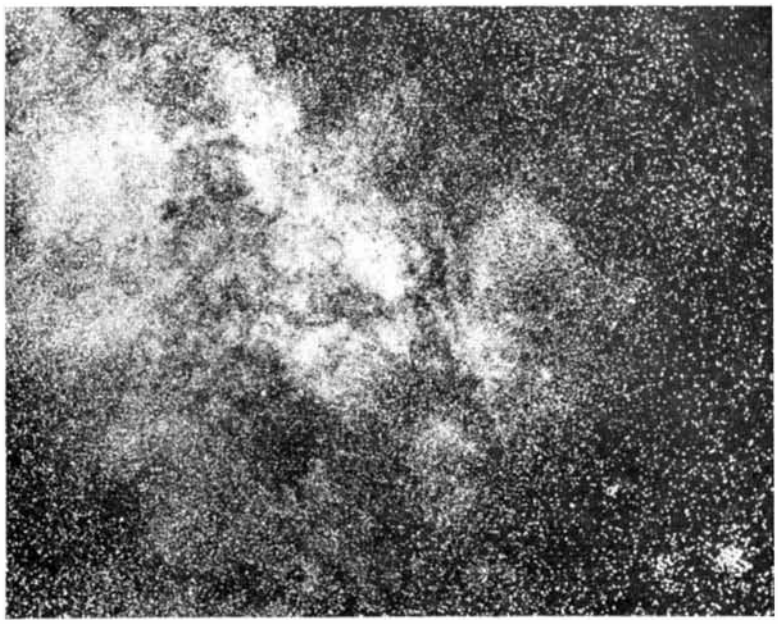

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SCIENTIFIC AMERICAN

1845-1935

ORSON D. MUNN, *Editor and Publisher*

ACROSS THE EDITOR'S DESK

A Job for Everyone

EVERYWHERE people are talking about building. The National Housing Program has gotten underway, with the durable goods industries expected to lead the way back to a permanent prosperity. James A. Moffett, housing administrator, has set a goal of 5,000,000 re-employed, one billion five hundred million dollars spent by private citizens for housing improvements.

The government has left the success of the program pretty much up to the industries and to the people. In hundreds of cities local better housing programs are underway with many more in a formative state. Booklets explaining the program have been circulated by building manufacturers. Radio programs, magazine advertising, and direct mail services have publicized the act. Three great organizations, Johns-Manville Corporation, manufacturers of everything in the building line from asbestos shingles to wall insulation; Sears-Roebuck, giant mail-order house; and the American Radiator Company, have all set up separate credit corporations supplementing and co-operating with banks in extending credit to home owners. Contractors are paid by these manufacturers who in turn are paid over a long time period by the home owner.

Some of the largest manufacturers of housing materials are planning to send out motorized display caravans which will tour the country demonstrating their products where the material is actually to be used. The companies which have thus far signified their intention to take part in the plan are the Johns-Manville Corporation, American Radiator and Standard Sanitary Corporation, General Electric Company, Westinghouse Electrical and Manufacturing Company, Armstrong Cork Company, Sherwin-Williams Paint Company, Crane Company, Weyerhauser Lumber Company, and Alexander Smith and Sons Carpet Company.

From a Letter to the Editor . . .

". . . Construction of homes—really livable homes with adequate provision for creature comfort and health—is the aim of this department. In this work, which will go far toward rehabilitation of many industries throughout the country, widespread publicity of aims and policies is essential . . ."

JAMES A. MOFFETT
Federal Housing Administrator

Just what *are* the housing conditions in the United States? We built during 1934 less than 50,000 houses. With a population of over 120,000,000, this is a poor showing against England's 300,000 houses built in 1934, and their population is only one third of ours. No central heating plants are possessed by 72 percent of our city dwellings; 29 percent have neither bathtub nor shower; 38 percent, no facilities for hot water; and 36 percent cook without gas or electricity. Of the 29,000,000 buildings in this country, 16,000,000 are in need of repair, 3,000,000 of these being so badly depreciated as to be unfit for human habitation. The Governmental estimates of the present housing shortage in this country as being 1,750,000 houses is indeed very conservative, but beyond this detail there is the added necessity for tremendous repair operations and for the addition to present homes of heating and sanitation equipment.

It has been said that could we but start a great activity in this line, we would then have found the key which will unlock the door to future prosperity. The start has been made and SCIENTIFIC AMERICAN will in future issues lend its full support to the movement in a series of articles pointing out pertinent facts regarding housing conditions in this country today. In hand already is an article by Dr. Haven Emerson, President of the American Public Health Association and Professor of Public Health at the College of Physicians and Surgeons at Columbia University, concerning mainly the appalling lack of sanitation in thousands of homes and the resulting effects on health. This will be published shortly.

Orson D. Munn

Editor and Publisher

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NINETY-FIRST YEAR • ORSON D. MUNN, Editor

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COVER

A RECENT development by the sound engineers of the Bell Telephone Laboratories is the 500-watt loudspeaker for marine use, described on page 92 of this issue. The voice pick-up is shown on our cover.

The SCIENTIFIC AMERICAN DIGEST

Books SELECTED BY THE EDITORS

AMERICAN MEDICINE

By Dr. Henry E. Sigerest

OTHER popular books have covered the growth of world medicine but on such a scale American medicine does not figure predominantly. This book is devoted wholly to the rise and progress of American medicine, peculiarly. The author is professor of the history of medicine at Johns Hopkins University and is the author of a recent popular book entitled "The Great Doctors." His books are distinctly human and readable.—$4.20 postpaid.—*A. G. I.*

NAVAL CUSTOMS, TRADITIONS AND USAGE

By Lieutenant Commander Leland P. Lovette, U. S. N.

THE groundwork on which this book depends was a series of lectures given to a group of student officers at the Postgraduate School, Annapolis, Maryland. The book comprises a special course in customs, traditions, social usage, and regulations pertaining to honors and ceremonies. It is a book which will be warmly welcomed to the lay library for it has a distinct literary flavor. The illustrations, while not many, take us from George Cruikshank to Zogbaum. The technical side dealing with such subjects as precedent, solutions, et cetera, are impeccable. The book is filled with much out-of-the-way information conveyed in an interesting manner. —$3.75 postpaid.—*A. A. H.*

INDUSTRIAL ELECTRONIC TUBES

A NON-MATHEMATICAL treatment of the uses of all types of electronic tubes in industry. Reproduced by the zincograph process from type-written copy, this 217 page volume is copiously illustrated with photographs, charts, and tube circuits. Paper covers, with sturdy cloth backbone; 8¼ by 11 inches. The essential purpose of this thoroughly practical book is to place before the reader the physical properties of all electron tubes—photo-cells, rectifiers, oscillators, amplifiers, ignitrons, X-ray tubes, cathode-ray tubes, glow lamps, and so on—and their possible applications.—$2.40 postpaid. Manual of Experiments with Industrial Electronic Tubes, supplementing the above book and going still farther with practical applications.—75 cents postpaid.—*A. P. P.*

WILD FLOWERS

By Homer D. House

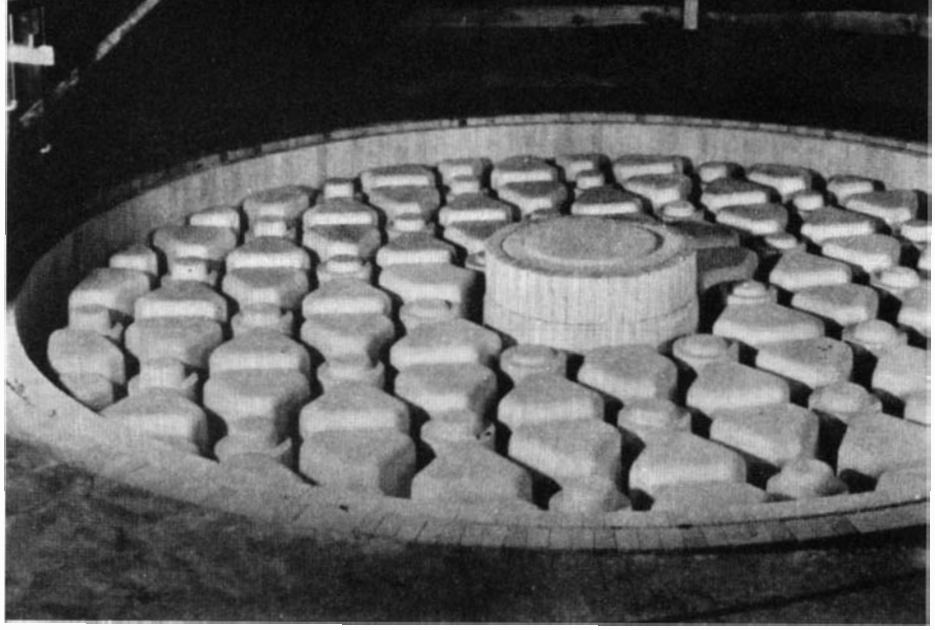
THIS is a book for identifying the wild flowers that grow by the wayside and in the woods. Of such books there have been many but this one is distinguished by the fact that it is the most ambitious piece of fine flower book production ever accomplished. Not only is it a large volume (1½ by 9 by 12 inches, 105 ounces) handsomely bound, but nearly all of its illustrations of plants—364 of them, to be exact—are in full color and many of them full size. The geographical range is the United States, and on thumbing it through we recognize scores of flowers we have seen growing wild, for the illustrations are as good as the flowers (or even better!). Descriptions accompany each plate. It is difficult to see how this book can be produced at the price given, except that a large sale throughout the nation must be expected.—$8.00 postpaid.—*A. G. I.*

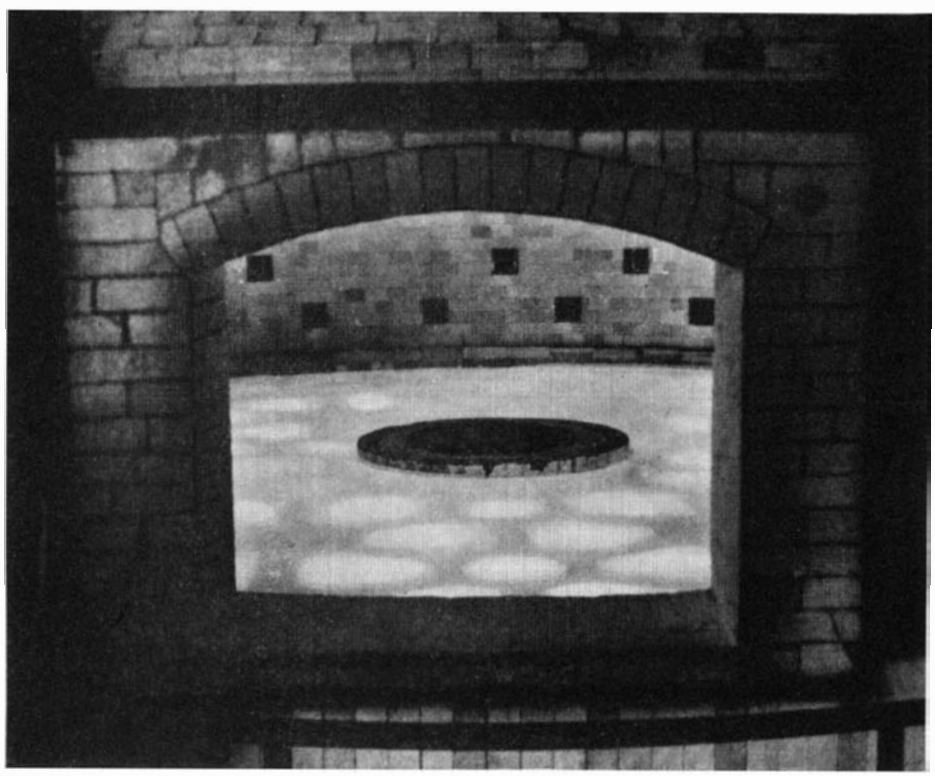
FOOD AND HEALTH

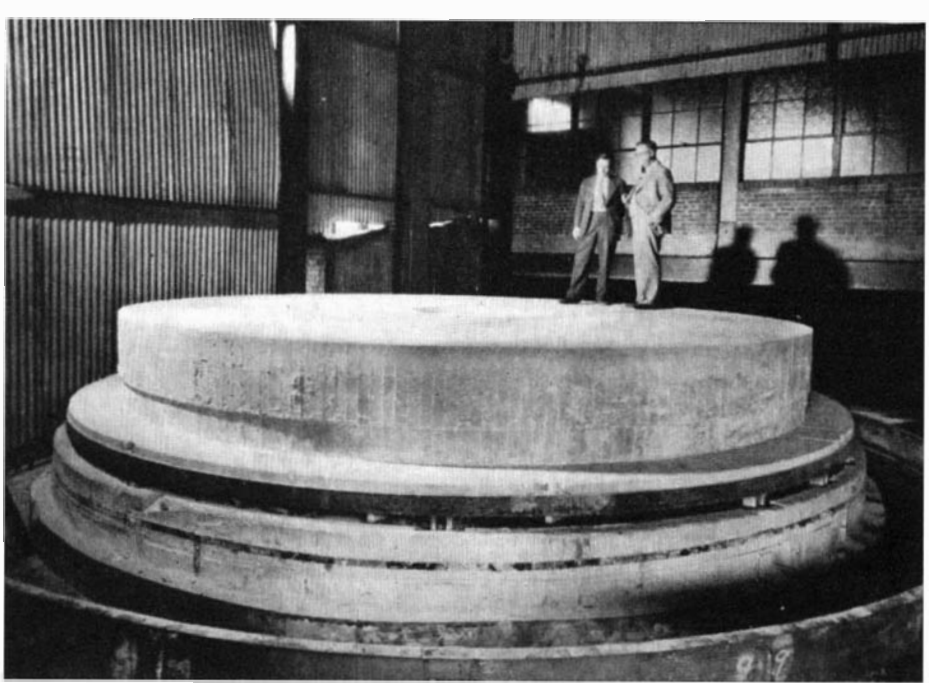
By Henry C. Sherman

"THIS book is the result of an attempt to crystallize the best from the voluminous findings of recent years, and especially seeks to convey a sound sense of proportion; first, as to sanitary safeguards in which the vigilance of the consumer should supplement and help to make fully effective the pure food laws; second, as to true economy in the budgeting of the food money; third, as to how far the principles of nutrition are valid for all and how far they are modi-

(*Please turn to page* 111)





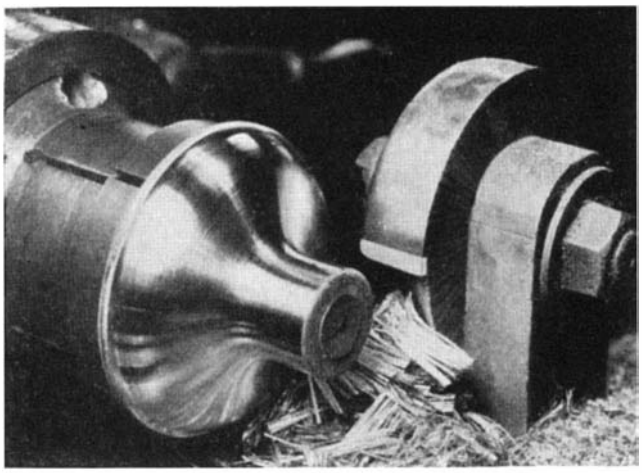


CASTING THE WORLD'S WIDEST EYE

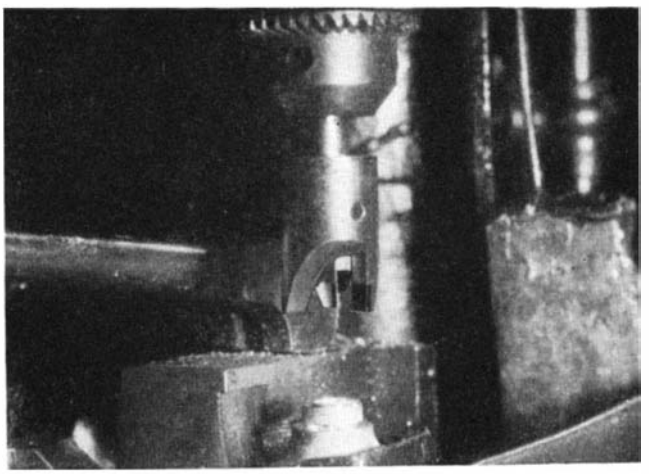
A PERFECT 200-inch disk of Pyrex glass for the world's largest telescope has now been cast at Corning, New York, by the Corning Glass Works. The upper photograph shows the mold of refractory brick with its large core which provides the central perforation needed for the Cassegrain type of telescope; also the 114 smaller cores which give the back part of the disk a hexagonal system of ribs in order to lighten it from 40 tons to about 18.

It was fascinating to watch the result when the first 400-pound ladles of molten glass were poured on this complex of cores. These resemble metropolitan buildings with canyon-like streets between. Pyrex brand glass has a high softening point and at the 2800-degree temperature which was the highest practicable it could not be brought to the consistency of water or even to that of molten iron. At best, though bright red hot, it was but "molasses in January," a very cold January at that, and the poured glass crept down the "streets" with great deliberation. It was kept hot in the covered mold by gas flames until about 100 ladles full had been added, and finally it overflowed the cores and crept up toward the top of the central core, when the pouring was stopped. There, after cooling a few hours, it most resembled the ice in a skating rink, but the skater would have required asbestos underwear, to say the very least, since the real temperature was still above 1000 degrees. The white spots in the middle photograph lie over the tops of the buried cores, the darker areas being above the deeper ribs.

Below is the 200-inch disk cast a year ago. Now that it is stone cold, it is as blue and "deep" as the turquoise Mediterranean.

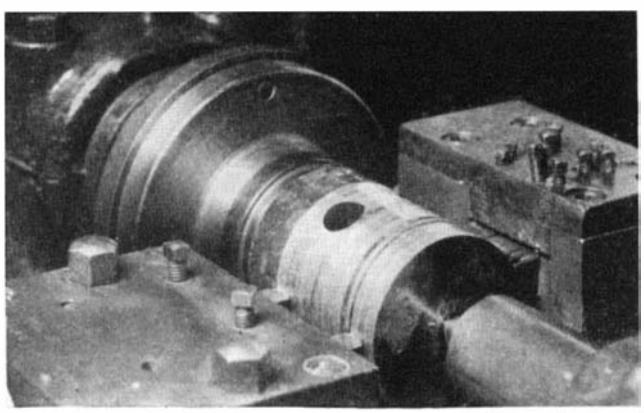


Brass shower heads in fast production

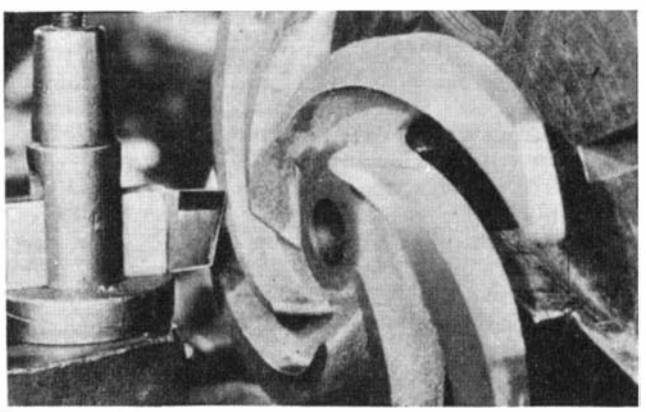


Spot-facing zinc casting at a saving

Machining "non-machinable" alloy pistons



Withstanding the jolts of "jump-cutting"



CEMENTED CARBIDES IN INDUSTRY

INCREASE PRODUCTION!

Cemented Carbides . . . Near Diamond Hard . . . Tantalum, Tungsten, Titanium . . . Face Tools and Dies . . . Reduce Rejects . . . Permit Fabrication of "Non-Machinable" Products

By PHILIP H. SMITH

SAVINGS of millions of dollars are accruing annually to industry through the use of cemented carbides for dies, tools, and wear-resistant parts. And this is only a beginning. These metallic substances of near-diamond hardness have virtually revolutionized the drawing, extruding, cutting, and machining of metals in mass production by making possible an extraordinary stepping up of operating speeds with marked improvement in quality.

The consumer is the gainer as well as industry. It may be seriously questioned whether the present-day, low-priced automobile could feature such excellent quality were it not for the cemented carbides. Certainly their use in machining operations has made possible the absolutely safe wire wheel and smoother operating engines. And among other contributions, for example, these carbides have enabled the placing of the so-called zipper fastener within the buying range of millions by decreasing the cost of drawing the wire of which these fasteners are made; and the drawing of enough molybdenum wire to satisfy America's insatiable demand for radios.

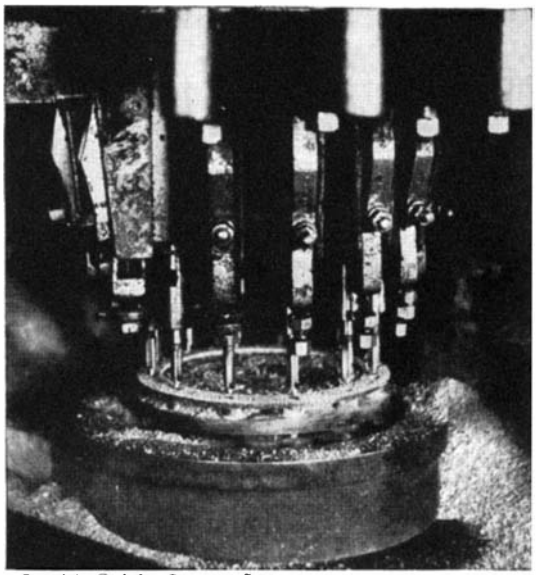
Cemented carbides, much as the name implies, are carbide particles cemented together, cobalt, and sometimes nickel, being used as the binder. The carbides used are those of tungsten, tantalum, titanium (and rarely molybdenum. As finished products, their applications in three main fields are as follows:

Dies—for drawing and extruding wire, rods, and tubes.

Tools—for machining and cutting ferrous, non-ferrous, and non-metallic materials.

Parts—for wear and corrosion resistance on machinery and equipment.

Tungsten carbide, father of them all, has a history running back 40 years. Henri Moissan was the first investigator; Schroeder of Osram Lamp Works (Germany) was the first to make it commercially important. Schroeder, seeking a substitute for the diamond to draw tungsten filaments, hit upon the



Counter-boring fiber clutch facings. Carboloy tools increased machine capacity 36 percent

fused carbide. This was not very practical because only small lumps were obtainable; and then, 13 years later, he succeeded in producing the present-day cemented type which came on the market following an alliance with Krupp. In 1928, tungsten carbide was introduced to the United States for dies and tools, and die application got away to a lightning start.

TUNGSTEN carbide alone is extremely brittle and, in order to apply it commercially, the particles are cemented with cobalt to form a tough bond. The process of manufacture begins with firing tungsten and carbon to make tungsten carbide, then ball-milling particles of it with cobalt until the whole resembles talc powder in fineness. This powder is fired in a hydrogen atmosphere, allowing for a uniform shrinkage of about 16 percent, to produce a material like chalk which can be shaped, allowing for a further shrinkage of some 15 percent in the hardening process. This formed piece is fired at a much higher temperature to emerge in its final form, harder than anything but the diamond with the exceptions of silicon carbide and boron carbide, neither of which has the strength of tungsten carbide.

It is for dies that the cemented carbides have been most extensively exploited. In six years since their introduction they have replaced steel dies for 80 percent of the nation's wire-drawing operations. Cemented carbides have swept through this field because they make die costs per ton of wire more nearly a constant, because they impart a better surface finish and greatly reduce rejections of wire due to off-size, and because they raise productivity per man. The story of achievements with these dies is fantastic; we can do little more than hint at it with random examples.

The drawing of steel wire is now a continuous process. Lengths of wire in the various stages of reduction can be welded to each other and run through the dies for weeks and even months without stopping. With the old steel dies the process was intermittent because dies wore out quickly and had to be replaced, else the gage at the beginning and end of a run would vary, with consequent rejections for being off-size. Speed of drawing varies, of course, with the size and analysis of the steel drawn, but in several instances speed has been tripled.

Cemented carbide dies have been saving an average of 20 percent in time and labor in drawing copper and brass, while with bronze the gains are even greater. Steel dies wore out quickly when handling bronze; hence only relatively short lengths could be drawn and that meant higher production costs.

These dies are being used for drawing welded and seamless tubing, rods, rounds, shafting, and shapes such as squares, hexagons, keystock and keystone, as well as wire. It is now possible, for example, to take a round stock and draw it into a hexagon or square in one operation. Savings from this simplification have been known to amount to as much as four dollars per ton. This single drawing means that a maker of bolts can buy rounds and draw hexagons through a die without the preliminary rough-shaping to a hexagon before drawing.

Trolley wire affords another striking example of what cemented carbide dies have accomplished. This wire must be drawn in lengths of not less than a mile. Steel dies tore the surface before the mile drawing was completed and heavy rejections had to be made because of the poor surface finish. Today, trolley wire can be drawn continuously, using four dies; and while not usual, it is not uncommon for as much as 1000 miles to be drawn to size with one drawing.

Automobile manufacture has benefited in a number of ways. Valve springs, formerly drawn with heavy rejections due to failure to produce a spring with proper vibration frequency, can now be turned out as simply as fence wire for the mechanical properties can be controlled throughout the drawing process. Valve stems, another item demanding accuracy if engines are to give fine service, are now drawn to the number of 500,000 with a single die, whereas 1000 was about the limit with a steel die.

SUCH a little thing as a screw base for an electric lamp doesn't seem like a problem of drawing, but it is. It must be absolutely to size. Steel dies could draw about 200 per minute, last about five hours, and then 20 minutes had to be spent making a new die setup. This meant about 60,000 bases per die. Now a cemented carbide die draws millions. There is one tungsten die that has been drawing for three years and when last heard from had produced 47,000,000 bases.

If there is any question left as to why tungsten carbide has penetrated the wire-drawing field so thoroughly, the reader has only to glance at Table 1. There he will find more data telling the fantastic story. In every case, cemented carbides have brought closer tolerances, reduced scrap losses, improved the product, and lowered the over-all die cost despite the higher original cost.

Examination of what the cemented carbides have done for machining and cutting tools reveals a wholly different picture, but still one of reducing production cost drastically. When carbide dies were introduced they were adaptable to existing wire-drawing machinery. Carbide tools were not quickly

Table 1

Cemented Carbide vs. Steel Dies* Performance Comparison

Material	Tolerance allowed (inches)	Pounds output per die, ratio steel to cemented carbide	Percentage decrease in rejections
Low carbon spoke wire (wheels) .243 in.	.001	1 : 1240	99
Bessemer screw stock (round) .4375 in.	.002	1 : 840	79.16
Bessemer screw stock (hexagon, sharp corners) .4375 in.	.002	1 : 660	97.5
Fine wire (steel screen cloth) .010 in.	.0003	1 : 130	96.6
Tire bead wire .017 in.	.0003	1 : 200	90

*Analysis by Union Wire Die Corp.

Table 2

Cemented Carbide Tools vs. Steel Tools*
Average Performance Comparison

	Steel	Cast iron	Aluminum alloys	Copper Brass Bronze	Non-metallic materials
Average percentage speed increase	115	153	238	297	175
Average ratio of tool life between grinds	12 : 1	29 : 1	32 : 1	36 : 1	30 : 1

*Analysis by Carboloy Company, Inc.

adaptable, however, because existing equipment lacked the rigidity needed for the higher permissible operating speeds. These conditions made for slower adoption, but results are quite as striking as those obtained with dies. In one sense, therefore, the tool application caused a greater revolution in practice.

The cemented carbides are used for the tips of tools and the introductory type were single point for simple truing, boring, and facing operations, mainly on cast iron. Since that time development has run two courses: creating new alloys (introduction of tantalum, for example, which was found to handle certain steel applications better than tungsten); and, secondly, perfecting the technique of use—as, for example, improving the quality of brazed joints and increasing the variety of steel shanks permissible. The stage has now been reached where the most intricate multi-point tools are practical for all types of machining operations on ferrous, non-ferrous, and non-metallic materials, and even for some operations hitherto un-machinable. Plastics which, oddly enough, tore old style tools to pieces, can now be machined with ease.

THERE are many reasons for adoption of cemented carbide tools. They will cut at terrific speeds and for a long time at red heat without dulling. This is of utmost importance because it means faster feeds and longer cutting life between grinds. Formerly, sufficient surplus material had to be included in castings to permit old-style tools to cut under the scale, but with these new tools light cuts can be taken through the tough scale, and this reduces the amount of scrap. A further saving is obtained frequently due to the ability of cemented carbide tools to combine roughing and finishing cuts in a single operation.

It is almost axiomatic that the mass production industries, where machining of thousands upon thousands of pieces is a major operation, should be the ones to make fullest use of cemented carbides. And that is the case. The automotive industry is the examplar; others are only runners-up, though coming fast. Savings to this industry or to any others cannot be totalled in exact figures, but the possibilities of savings inherent in the carbides are clearly indicated in Table 2, which covers the performance of 100 machining operations selected at random.

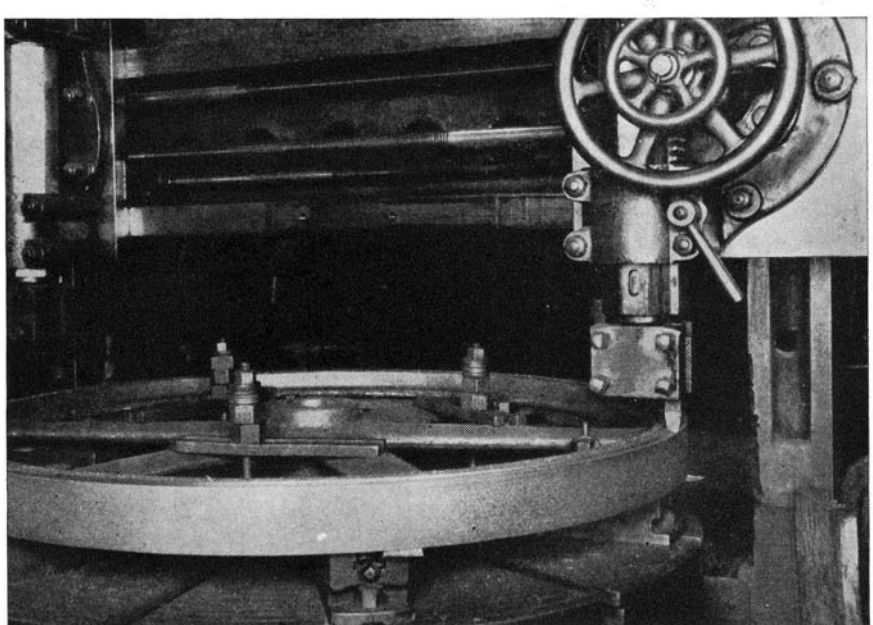
Wear-resistant applications of cemented carbides. Micrometer and other measuring instruments fitted with hard wearing surfaces

Turning to specific examples of performance, there are cases of operations hitherto un-machinable, such as: turning 50 chilled iron rolls (600-700 Brinnell hardness) at a saving of 761 dollars over former grinding costs; and the grooving, reaming, sawing, and turning of silicon-aluminum pistons. As examples of marked savings, there are: 1, the use of cemented carbide tools in the counter-boring of fiber clutch facings, thereby increasing machine capacity 36 percent and saving $51.75 between each tool grind; 2, a ninety-five-hour greater production per tool grind obtained in the forming of brass shower heads; and 3, the handling of 718 percent more pieces per tool grind in the facing and turning of semi-steel spur gears, with a 47 percent decrease in machining time, to give a net saving of 400 dollars per 100 pieces. Such performance records afford the best possible explanation for the rapid growth of carbide tool use.

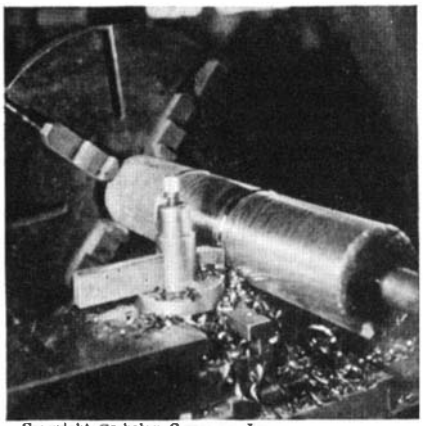
It is wholly logical that cemented carbides should be brought forward for wear and corrosion-resistant parts, following the performance they made in dies and tools. Not much has been done in this third and last field of exploitation as yet, but the following examples give a hint of application scope:

IT has long been a problem for the manufacturer of rayon to get a material for guiding the threads which will resist the abrasive action of the titanium dioxide in the acetate yarns. Glass cuts through within a very short time and so do semi-precious gems. Here, cemented carbides have been put into use with excellent results. Again, in mixing highly abrasive white lead in the manufacture of paint, producers have been greatly hampered. But now, capping the fingers of the rotor and stator in the mixing machines with cemented carbides reduces wearing to almost nothing, and the paint-bleaching operation formerly necessary when wear of metal discolored the lead, has been eliminated.

Cemented carbides have been used successfully for the coating dies used for coating rubber on automobile tire



Facing and turning semi-steel; 718 percent more pieces per tool grind



Turning steel rolls with cemented carbide tool; formerly these rolls could be machined only by grinding

bead wire, for coating flux on welding rod, for wire guides, coiling points, and pitch tools in the manufacture of spring wire, washers, etc., and for valve stems and seats on hydraulic presses where pressures range from 25 to 2000 tons.

Blast nozzles provide an excellent example of wear-resistant application. The slightest enlarging of the nozzle orifice through wear adds enormously to the amount of compressed air needed. Consequently wear necessitates use of more compressors and runs up costs. Cemented carbides have been responsible for immediate savings when applied in this manner and are now coming into wider use.

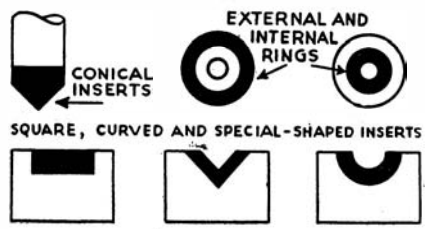
Just how widely cemented carbides have come into industrial use must be judged by the foregoing since statistical data cannot be had. The carbides stem from Schroeder's patents and being closely held, figures of tonnage or value are not published. It is known that approximately 80 percent of all wire made in this country is drawn with cemented carbide dies. It is also known that about 10 percent of possible tool applications have been made and that the use in wear-resistant parts is only just beginning. From this it can be concluded that cemented carbides have made a definite place for themselves in industry and that their greatest development lies in the future. They have revolutionized the handling of ordinary materials of production; they have made possible mass utilization of special alloys; and they challenge the research world to bring forward new, tougher materials.

Price, always a potent factor when it comes to replacements or to the adoption of something relatively new, must be reckoned with in any consideration of what lies ahead. In the case of dies, price is less a factor than it is with tools and wear-resistant parts, since wire drawing is a quantity production operation, whereas there are many tool operations or operations involving great wear where quantity is insufficient to warrant the higher cost of the cemented carbides. The introductory price of tungsten carbide was roughly 400 dollars per pound; today it is about half that. Tending further to broaden the possible market, better technique has led to substantial reduction in the amount of carbides needed for any given tool.

IT seems likely that tool cost will drop more as use increases. And use will increase unquestionably as merits become better known, as the technique of fabrication makes feasible a greater variety of tools, and as modernization of machine tool equipment permits getting the most out of their use. These are developments which quite logically progress together. But this reasoning does not apply quite as well to the future of wear-resistant parts. Their future is somewhat tied up with an uncemented carbide, boron carbide, introduced only a few months ago under the trade name, Norbide.

Norbide is not the first boron carbide ever made, but it is claimed to be the first graphite-free, commercially practical one to be introduced to industry.

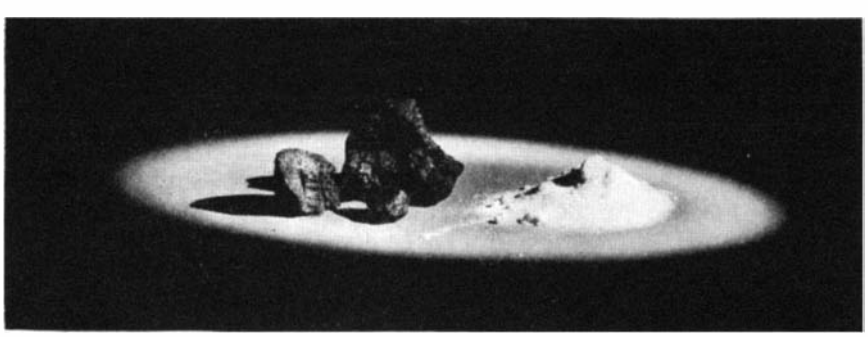
In powdered form, this hard substance serves as an abrasive, while in molded form it resists abrasion. It was offered to industry promptly in the form of sandblast nozzles, thread guides for rayon manufacture, and extrusion dies for graphite, porcelain, and other abrasive materials. So the cemented carbides have a competitor. But it is interesting to note that powdered Norbide is being used in place of diamond dust for grinding and lapping objects made with tungsten and tantalum carbide. Thus, the new product, while threatening competition with the cemented carbides for a share of the market, also facilitates their use.



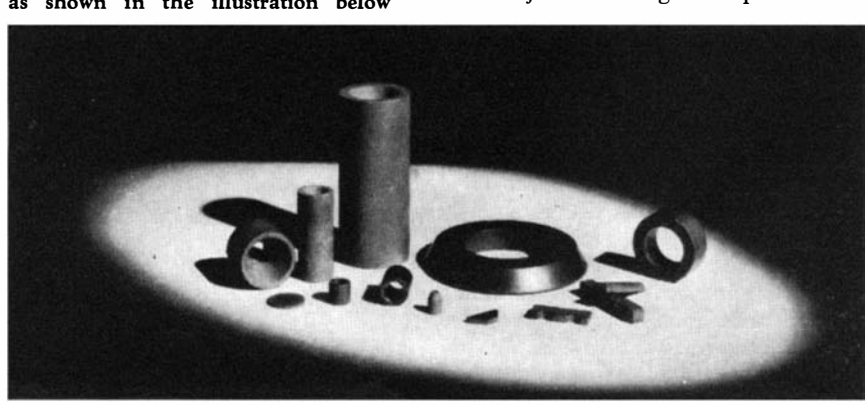
A few general types of cemented carbide inserts commonly used in tools

The part this new product will play in the wear-resistant field cannot as yet be forecast with any degree of certainty. Hardly out of the laboratory, it has yet to find its proper place in the scheme of hard materials where performance and cost must ultimately strike a balance. The cemented carbides have made a name in some two-score wear-resistant uses already, such as textile guides, swaging anvils, collets, sorting machine fingers, press trip dogs, and spinning tools, and Norbide may replace them in certain instances where the added life of a part justifies a higher cost—in every instance an individual problem of production economy.

Certainly the field of parts is big enough to hold both the cemented and this new uncemented non-metallic type of carbide. As fast as there is economic justification for using these products of research, just so fast will they be placed in use; and the performance of the carbides in all three fields noted proves them to be among those products for which justification grows apace.



Norbide, an uncemented carbide, is made from coke and boric acid (*above*), and may be molded into many shapes as shown in the illustration below



OUR POINT OF VIEW

Too Much Scotch?

SCIENCE at last has "diplomatically recognized" the Loch Ness monster. At a recent meeting of the Linnean Society of London this mystery of the Scottish loch was for the first time seriously discussed by scientists assembled, and data obtained by Sir Edward Mountain with the help of 20 watchers armed with field glasses, cameras and telephoto lenses, were presented to the naturalists of Great Britain.

Now that science has given the monster a hearing we may expect—what? A quick simple solution of the puzzle? One might be excused for jumping without thought to such a conclusion. But science is as badly baffled as the remainder of the world. Scientists thus far can only name with certainty some of the animals that it is not. For example, the paleontologist William K. Gregory of the American Museum of Natural History, who visited the scene of the animal's antics but did not see any of them, is able to dismiss from serious consideration numerous descriptions which combine the characteristics of a mammal's face and the hind feet of a reptile, and others which, more resourcefully than scientifically, combine in a single animal the features of several different reptiles, several different mammals and a fish.

The 20 watchers organized by Sir Edward Mountain actually saw the monster 21 times, so it is no mere myth. Photographs of it, taken by them and reduced to definite data (the angle subtended at the known distance) cause its mythological magnitude to dwindle to a mere eight feet—a sad come-down from the multiple-humped "sea serpent" of the newspaper reports. That it is a seal or an otter was the suggestion of some of the Linnean scientists who discussed the findings in London; also that it is not a killer whale, as has been supposed.

But it remained for Sir Arthur Smith Woodward, the anatomist, to deprive the monster of the most romantic touch of all. He points out that it cannot be a dinosaur, because if that were the case dinosaur fossils representing its ancestors during the 54,000,000 years since the end of the Age of Reptiles when dinosaurs are believed to have become extinct, would have been found in rocks of the ages since then. Even the case-hardened scientist will regret the exclusion of the dinosaur interpretation, for it would be such fun—a real thrill—to discover a real live dinosaur on earth today.

Anyway, why should a dinosaur choose, of all places, chill, raw Scotland as its domicile? But the verdict "not proved," rendered by the English naturalists, was a Scottish verdict, at any rate.

Speed and Mental Peace

IT has become a trite saying that we are living in an age of speed. Within the short space of a generation, the speed of transportation has increased many fold; the tempo of life in general has kept pace. Science has contributed largely to the development of speed but has it also contributed in like measure to mental peace and happiness?

No less a well-known personage than Owen D. Young recently sounded a pertinent note regarding the effect of speed on our daily lives when he warned American youth to slow down the tempo and to live a more sane, evenly balanced life. In the United States, the one predominant thought of youth—and all too frequently of middle age and old age as well—is "Where shall we go from here; what shall we do next?" This outlook, coupled with the readily available motor car and other forms of transportation, makes of life in general a mad merry-go-round of speed.

What effect can all this have on our mental peace and happiness? Surely happiness does not consist merely of excitement, of rushing hither and yon and eventually getting nowhere. Speed suffices for the moment; it furnishes an artificial stimulation which for the time being passes for a more or less satisfactory form of mental happiness. But what of the end product? What of the intellectual satisfaction that must be obtained if each individual's life is to be considered complete? Speed in its place has advantages. In transportation for business purposes it has added immeasurably to our creature comforts. Used sanely it is one of the most desirable developments which have been made possible by applied science. Used insanely, as it too often is, it is frequently a source of dissatisfaction, of mental unrest.

Mr. Young spoke wisely, sanely, instructively, when he ventured the opinion that we should slow down the pace, live more fully, enjoy the fruits of life which can be enjoyed only when savored slowly and to the full. Skimming rapidly along through this human existence, touching the high spots, missing the full flavor of life in all its ramifications is the shallow, superficial way of living. Slowing down, taking things easy, living life in what might be called the old-fashioned way, will enable people to enjoy the full benefits of this age of speed without burning themselves up prematurely and living in a state of continual unrest.

Scientific Architecture

SCIENCE today touches and influences practically every material object in our daily lives. It would not seem, however, that architecture, one of the oldest human arts, would show that influence very strongly. Building design and construction, if we disregard ornamentation, was essentially the same a very few years ago as it was when the ancient inhabitants of Ur discovered the principle of the arch and the dome. Recent advances, however, have made necessary studies that will without doubt radically change our building forms and structure.

It is not so long ago that metallurgical progress, making possible the fabrication of steel frames, and the invention of the elevator, started the trend toward skyscrapers. Scientific research in brick and other building materials has also contributed to the taller buildings. Welding may enable us to go a step further and eliminate riveting of structures. Other more important conditions will change both business structures and the homes of the future.

Much experiment has been carried on in the development of monolithic concrete houses. Steel houses and houses employing glass building blocks have also been widely discussed and both show great possibilities. Perhaps one of the greatest influences now pleading for close study as to its relation to building design is air conditioning. Use of this very new invention will make necessary much closer attention to questions of insulation against heat transfer than heretofore.

National interest is rapidly turning toward the question of our housing needs as discussed on page 58 of this issue. In our minds, it is a question now of whether the very large number of residences which must be built in the next few years will be built according to the findings of science or in the traditional haphazard fashion. Much can be done, at little increase in cost, in building for human comfort and health, and these are both vital.

THE MINIATURE CAMERA

The Advanced Amateur's Jack-of-all-Trades . . . High-Speed Lenses . . . Fast Films . . . "Gadgets" . . . Wide Range of Choice . . . Great Enlargement Possible

By JACOB DESCHIN

Miniature cameras are made in a wide variety of shapes and prices to fit all requirements

EQUIPPED to photograph anything from a bee to a ball game and capable of "shooting" from ambush, around corners and from myriad angles in myriad situations, the miniature camera is today luring new converts to photography and creating a veritable golden age of picture-making in this country.

A development of but a few years, the vogue of the small camera that can be slipped into the pocket or hung suspended from the neck while one strolls along, has grown so rapidly that the would-be amateur photographer in search of a suitable instrument is bewildered at the very start by the enormous variety of cameras, lenses, attachments, and what not, which vie for his favor.

To decide the approximate price one is willing to pay for a miniature camera is to limit the field at once and simplify matters to some extent. Other considerations are the type of work one wants to do; the preferred size of negative, although since the term miniature officially applies to negatives 2¼ by 3¼ inches and smaller, this should not offer much difficulty; the preference one may have for the reflecting type of camera or the "eye-level" type; the accessories available for the camera, and other points which gradually simmer the choice down to perhaps two or three similar cameras in the same price range, all equally good but one, eventually, standing above the rest because of some point which may seem to give it superiority in the eyes of the purchaser.

In the classification of miniature cameras will be found the small folding type using vest-pocket roll film and equipped with an *f*/4.5 lens and a direct vision finder and ranging in price up to about 35 dollars. The lenses supplied with the less expensive cameras are of course not as highly corrected as those of the expensive types, neither do the shutters give as complete a range of speeds, yet they permit making fair enlargements. The scope of these outfits is naturally small, but for the usual run of amateur pictures they will be found fairly suitable.

BETTER grades of cameras in this same class are distinguished from their less costly brethren by superior lens equipment. Better corrected and speedier, these lenses range from *f*/3.5 to as fast as *f*/2, making them useful under nearly all lighting conditions. These cameras are equipped with Compur shutters, and speeds range from as slow as one second to as fast as 1/300th of a second. View finders for these cameras are accurate, and in the Super Ikomat a built-in range finder permits automatic focusing. Provision is also made for the use of either 8 or 16 negatives on the same roll film. As in the cheaper models, only one speed or focal length lens may be used, though auxiliary lenses, called proxars, are available for shortening the focal length to a limited extent. Many a miniature camera worker has done exceptionally good work with this type of camera and would have none other. They are precision built and made of the best materials and with great attention to all details.

Those accustomed to the use of the reflex type of camera such as the Graflex, with the ground-glass focusing device showing the subject up to the moment of exposure and right side up, and offering better facility for composing the picture, generally adopt the miniature counterpart of the larger camera. These produce negatives 2¼ by 2½ inches and smaller and are equipped with high-speed shutters and semi-automatic film changing devices. One popular type has two lenses, one being used for focusing, the other for taking the picture. Lens speeds are *f*/3.5 and faster, and accessories add to the versatility of the outfits.

THE Contax or Leica type, using 35 millimeter motion-picture films cut into lengths containing 30 to 36 films 1 by 1½ inches, is the camera largely responsible for the wave of miniature photography enthusiasm sweeping the country. This type of camera not only has the great advantage of easy portability and accessibility but can accommodate a number of lenses of varying focal lengths interchangeably. Focal plane shutters, speeds of one second to

A fine character study, made unobserved by the subject; the camera equipped with an angle view finder

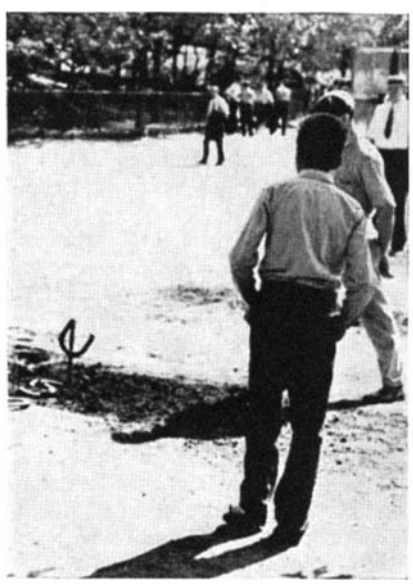
1/1000th of a second, film-winding device which makes double exposures impossible, extreme accuracy in focusing, automatic counting knob which indicates the number of exposures made, and other features make this type of camera one of the most perfect miniature photographic outfits on the market today. Enlargements, governed by the character of the film emulsion used, the slower or average speed films giving better results, can be made up to 35 to 40 times the original.

HAVING purchased his camera, the amateur has his hands full for the time being with the job of mastering its operation. "Fine grain" film specially manufactured for miniature cameras is available for almost all purposes. The camera fan can buy either orthochromatic film, which is sensitive to all colors except red, or he may wish to use the fastest film material available and take immediately to the super-sensitive panchromatic film, which is not only sensitive to all colors but works under the worst lighting conditions. Experts generally advise the use of average speed orthochromatic or panchromatic film because of the better grain and contrast results obtainable. There is a wide variety of these films and the problem of determining which particular brand to use is not a simple one to solve, but it is advisable to make a definite choice as soon as possible and to stick to the one type of film all the time. Only in this way will the photographer eventually know his camera's limitations and possibilities.

The person who buys the low priced miniature camera is generally content with what it will do by itself without any thought of adding accessories beyond, perhaps, the purchase of a filter to get cloud effects. For those in the upper brackets, and these include the type of devotees who take their hobby seriously and buy the best outfit they can afford, even if it means skimping on lunches for months to come and doing without other things, there exists a fascinating world of lenses and accessories to the possessor of which almost nothing is impossible.

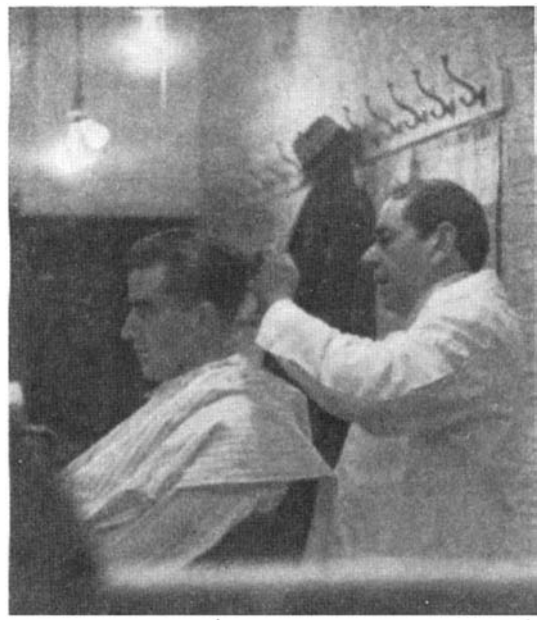
Short time exposure with a miniature camera. Light furnished by a candle 2½ feet from subject

Speed lenses of phenomenal capacity, used with highly sensitive films, make possible the taking of fast snapshots at night, indoors and out, and under difficult lighting conditions, "shooting" fast-moving sporting events, and similar subjects. So-called telephoto lenses permit the photographer to "bring" distant objects closer to his camera and in enlarged form, thus providing the equivalent of a closer vantage point. This facility of filling the entire area of the film with the object photographed, excluding everything else, is of the greatest importance in miniature photography, inasmuch as the small size of the negative material makes it imperative, if clear, sharp enlargements of 8 by 10 and 11 by 14 inches are to be had, that all or nearly all, of the film, be used as the basis for enlarging.



Caught in action. A 1/500th second exposure "stopped" the horseshoe as it was making a "ringer"

After he has gotten the "hang of the thing" and achieved some success with his hobby, the camera fan begins to be attracted to the innumerable "gadgets" being offered by the various manufacturers. There is the angle view finder, by means of which the photographer may take pictures unsuspected by the subject; the reflex attachment for converting the Leica or Contax type camera into a reflex camera, thus combining two types of camera in one; the panorama tripod head which permits the miniature camera to do the work of a regular panorama camera; apparatus for converting the cameras into a stereoscopic camera; attachments for photomicrography; flash lamps accommodating flash bulbs which may be attached to the camera and made to operate simultaneously with the release of the shutter so that flash and shutter act together; single-exposure attachment with focusing device for close-ups of 10 inches; copying attachments, and many other devices allowing the owner of the miniature camera unlimited scope in his camera adventures, including even color photography.



This barber-shop scene is a snapshot taken at night with only the illumination from the lights in the shop. Angle view finder was used

WITH miniature cameras and accessories at their present perfection it seems hard to believe that anything better could possibly be produced, but small hints that come seeping through to the outside world now and then from the laboratories of photographic engineers and chemists give rise to much speculation on the possibility of unrevealed wonders being hatched behind tightly closed doors.

●

A comprehensive listing of representative miniature cameras available in the United States has been prepared, giving lens speed, focal length of lens, type of shutter, range of shutter speeds, size of film used, and list price. This list will be mailed free to interested readers upon request. Enclose a stamp to cover mailing.—The Editor.

THE MOST INTERESTING

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

IF we look straight up into the sky on a clear February evening the brightest star above us will be Capella. It is at one corner of a very irregular but rather conspicuous pentagon of stars by which we may recognize the constellation Auriga (Figure 1).

Four of the five stars in this figure are objects of unusual interest. Capella (Alpha) itself was the first double star

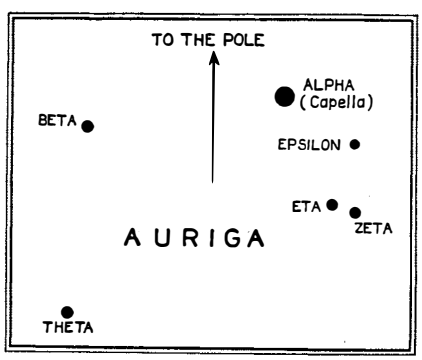


Figure 1: **Showing Zeta in Auriga**

to be separated by the interferometer, its two brilliant components revolving in a nearly circular orbit in a period of 104 days, just too close to be separated by direct vision with the greatest telescope. Beta Auriga, to the west, was one of the earliest stars whose duplicity was discovered with the spectroscope. Precise observations have revealed shallow eclipses at intervals of two days, which give us accurate knowledge of the real sizes of the stars. Passing across Capella, and to the next corner but one, beyond, we come to a pair of stars nearly equal in brightness and close enough to count together as the corner of the pentagon at first glance. The eastern of these two, Zeta Aurigae, has been shown by recent work to be perhaps the most interesting star in all the heavens.

Nearly 40 years ago Miss Maury, examining the Harvard photographs of spectra, noticed that this star was peculiar. In the green and blue it resembled an ordinary star like Aldebaran, but in the violet and ultra-violet, where an ordinary red star has but little light, the spectrum was still strong and showed the wide hydrogen lines characteristic of hot stars. The explanation was obvious. This star must be a close double, with components of very different temperatures and colors. Except in the violet the light of the red star predominates over that of the other.

Further evidence that the star was double came when Campbell at the Lick Observatory found changes in its velocity but it was not till 1924 that Harper of the Dominion Observatory at Victoria worked out the orbit. The red star, of spectral class K5, revolves with a period of 972.4 days, in an eccentric orbit a little bigger than that of Mars, about the center of gravity of the system. On the other side of the center, swinging opposite to keep the balance, must be the fainter white star. The Canadian's plates did not go far enough into the ultra-violet to show the lines of this component, but they have been detected recently by the French observer Tranblot, who finds that this star is about twice as far from the center as the other and must hence be only half as massive.

THOUGH the few-lined spectrum of the white star cannot be seen separately in the blue, it is strong enough to fill up the dark lines of the other spectrum and give it a "washed out" appearance. Harper noticed, however, that on one of his plates, taken on January 18, 1924, there was no such effect. Calculating the positions of the stars, he found that, at the time, the red star must have been almost in front of the white one, close to the place where an eclipse would happen if the orbit was turned nearly enough edgewise toward us.

For almost eight years—three revolutions of the pair—little more attention was paid to the star. But in 1932 the German observers Guthnick and Schneller found that the same change recurred in the spectrum, and that simultaneously the star's brightness dropped by nearly half a magnitude. An eclipse undoubtedly occurred, and a remarkably long one, for the light stayed down and the spectrum remained unblended for three weeks.

The next eclipse could now be predicted with some accuracy as due to begin in the latter part of August, 1934, and run till late in September. Many observers in different countries, with the best of spectroscopic and photometric apparatus, were on the watch for it. Their results are only beginning to be published but they tell a remarkable tale.

The last eclipse began on August 24th and ended on October 1st. During the 38-day interval only the spectrum of the red star was visible and the total light had diminished by a quarter of a magnitude by visual measures, and $0^{m}.6$ photographically. The day before the beginning, and the day after the close, the star was at full light and the spectra completely blended. It therefore took less than 24 hours for the white star to hide itself behind the edge of its huge red neighbor. Just how much less, the reports so far published do not settle, but it is clear that the larger star is at least 40 times the diameter of the other—perhaps 60 or even 80. Compared with its primary it is a mere speck, smaller in proportion than Jupiter's four prominent satellites or than Uranus or Neptune compared with the sun.

IT is no feeble satellite, though: it shines intensely. In visible light—that is, in the yellow and green—the larger star is about four times as bright as the other; in the violet only one and a half times; while in the ultra-violet the small star is actually the brighter. With 1/60 the diameter it must give out 900 times as much yellow light per square mile as its companion, and 4000 times as much ultra-violet. At first sight this difference seems incredibly great, but it is no more than might have been expected. The spectrum of the large star K6 (according to Mount Wilson plates) indicates a surface temperature of 3200

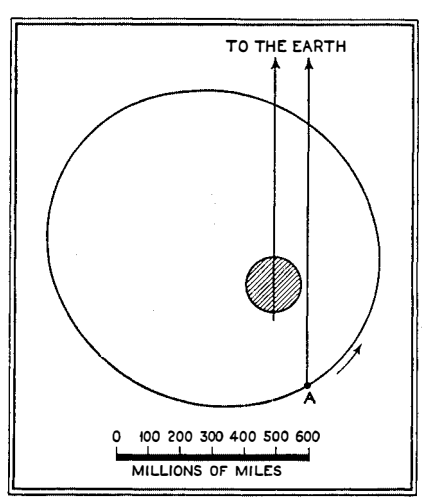


Figure 2: **System of Zeta Aurigae**

STAR IN THE SKY

Zeta Aurigae, a Close Double Star . . . Red and White . . . Giant and Dwarf . . . Now Visible . . . A Five Week Eclipse . . . Remarkable Tale

degrees or a little lower: the companion shows helium lines and is of a fairly early division of class B, which corresponds to a temperature of at least 15,000 degrees.

Surfaces of standard radiating power at these temperatures should differ in their light emission by a factor of about 600 in the yellow-green and 6000 in the ultra-violet—which agrees as well as could be expected with the rough estimates which can so far be derived from the published observations. With a red star as cool as Antares, and a white one as hot as its neighbor in Scorpio, the difference per square mile would be even greater. Strange as the results are, then, they make sense. The only trouble is how two such very different stars come to be such close companions—probably of a common origin. In our present absolute ignorance of the reason why some stars are large and cool and others small and hot we can attempt no answer.

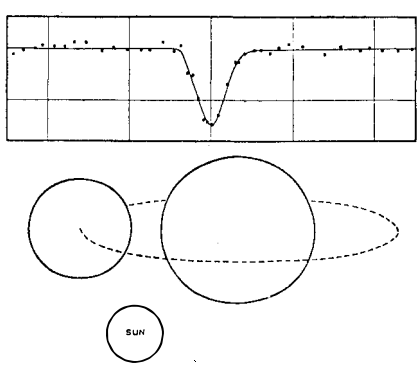
WITH the aid of Tranblot's measures we may now calculate the actual size of the system—assuming for the moment that the small star passes squarely behind the middle of the big one.

The average separation of the two stars is 530 million miles—ranging from 310 million 70 days after the middle of the eclipse to 750 million a year and four months later. The diameter of the large star is 175 million miles, or about 200 times that of the sun; of the small star, three or at most four million miles. The former is a typical "super-giant," like Betelgeuse or Antares, though not quite so big, while a number of stars similar to the latter are already known among eclipsing variables.

Figure 2 shows the stars and their relative orbits—except that it is hardly practicable to make a dot small enough for the little fellow.

Greatly as the stars differ in other respects they are still more unlike in density. The small star is eight times as massive as the sun which, with our rough estimates, makes its density one third to one eighth of the sun's—fairly normal for stars of its spectral class. But the large star has nearly 8,000,000 times the sun's bulk and only 16 times its mass, so that its mean density is only 1/500,000 that of the sun or about 1/500 that of air under familiar conditions.

Here again is an apparent paradox. How can so excessively thin a mass of gas be opaque enough to eclipse a brilliant star? In the first place it is very wide. If it was all of uniform density the 175,000,000 miles of gas along a diameter would be equivalent to 350 miles of ordinary air. The light of the



Typical eclipsing variables. *Above:* W. Volantis, showing drop of about one magnitude during the eclipse. *Below:* The ellipsoidal stars and orbit of V. Leporis, as determined by Martha B. Shapley at Harvard College Observatory. The sun is shown for size comparison

setting sun has traversed much less than this, and yet it is cut down to far less than one percent of its original amount. But, if this were all, the outer and thinner parts of the star would really be transparent. We know, however, both from theory and from observation of the sun, that a highly heated gas ionized and full of free electrons is naturally hazy and, even at a very low density, would be opaque in a thickness of a few thousand miles at the most.

So there is no real difficulty. We might expect, however, that the transition between dense haze, opaque to light from behind, and empty space above would be more gradual at the star's surface than on the far denser sun, and this conclusion is confirmed by a simple calculation which shows that the force of gravity on the star's surface is but 1/2500 of that on the sun. Direct evidence of such an atmosphere has been obtained at the present eclipse and in the preceding one of 1932. At that time Guthnick, photographing the spectrum just after the companion had come out of eclipse (as illustrated at *A* in Figure 2), found that the *K* line of calcium and some other metallic lines were stronger and sharper than when the companion was well at one side of the primary. These lines did not appear when it was obscured, and hence do not come from the principal star. They must be absorbed from the light of the companion when it merely grazes the surface of the other; that is, the great giant star has a thin transparent atmosphere, a gaseous envelope, rising many millions of miles above its surface. We know that the sun has a similar but shallower envelope, the chromosphere, thousands of miles deep, all over its surface and rising ten times as far here and there in the prominences. With the smaller force of gravity on the star a chromosphere millions of miles deep would not seem absurd. When the next eclipse happens in April and May 1937 we may be sure that these unique and interesting observations will be repeated.

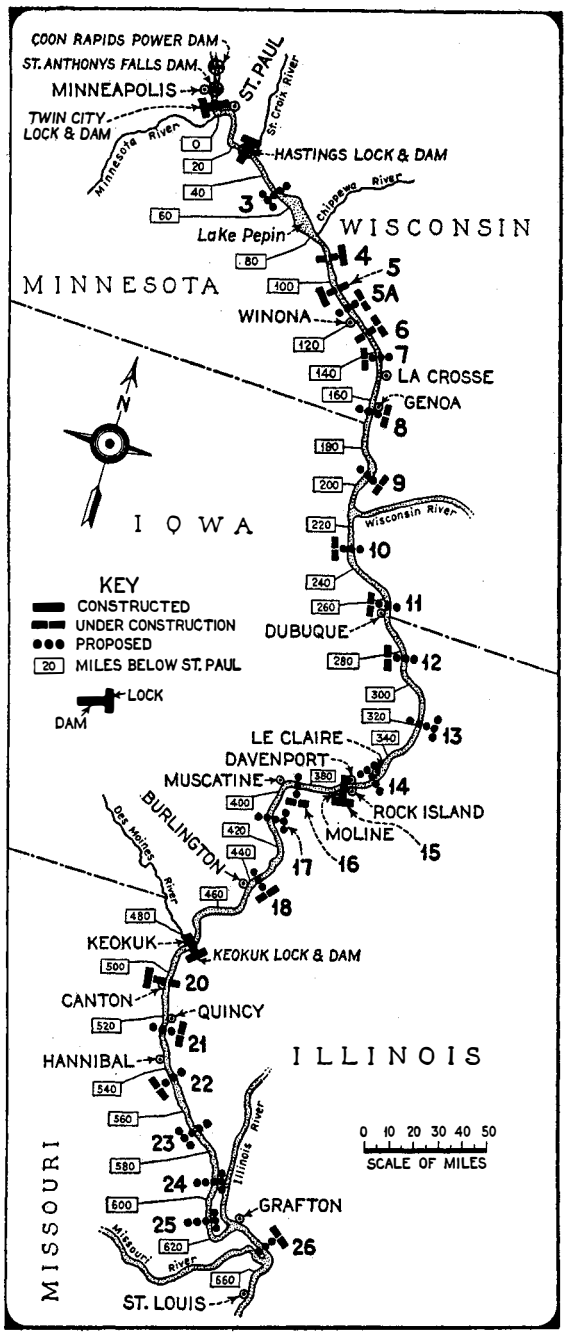
THE actual luminosity of Zeta Aurigae must be very high. The giant red component, judging by its temperature, is likely to be about 1/40 as bright visually as the sun for equal areas—which makes its estimated light 1000 times the sun's. The white star may be 15 or 20 times as bright per square inch as the sun and give out 200 or 300 times as much light. The combined light therefore may be estimated as 1200 times the sun's—pretty bright but by no means extraordinary. To the eye this appears as a star of magnitude 3.94. The corresponding distance is 750 light years—much farther than the majority of naked eye stars. When the components are farthest apart at right angles to our line of sight, as will happen in 1936, their angular separation will, on this reckoning, be 0".033—too close to separate with any telescope, but within the power of the interferometer. The inequality of visual brightness, however, will probably make it impracticable to "see" the star double, even with this aid.

Before we leave Auriga we may recall that Epsilon Aurigae, between Zeta and Capella, also shows apparent eclipses at a still longer interval, 27 years, and of more than a year's duration. The phenomena are more complicated, however, in this case and we shall have to wait a good while before we get another chance to observe them.—*Princeton University Observatory, December 14, 1934.*

CANALIZATION OF THE

VAST engineering undertakings, because of their number, have become somewhat commonplace of late in this country. Magnificent dimensions stimulate the popular imagination for a while and then cease to interest. But among this procession of major construction projects there is one of which the public generally knows but little; yet it is likely to be of outstanding and enduring benefit to the nation as a whole. This is the really monumental and truly momentous work now in hand for the improvement of the upper Mississippi River.

The upper Mississippi embraces so much of that stream as lies northward of the point where the Missouri meets the "Father of Waters," a few miles above St. Louis. Between the city of Minneapolis and the Missouri, the upper Mississippi is in process of being turned into a great 650-mile canal, which, even at low water, will have a channel that nowhere will be less than nine feet in depth. No matter what may be the volume of the water flowing seaward at any season, a score or more of dams will convert that part of the river into a succession of slack-water pools that will facilitate the movement of flotillas of craft capable of transporting, as unit groups, thousands of tons of cargo at freight rates that will make the business worthwhile and be at the same time a boon to the farmer, to the manufacturer, to the miner, and to the ultimate consumer of commodities of innumerable kinds.



Built, building, and proposed dams and locks on upper Mississippi—Minneapolis to St. Louis

THIS subject is of present moment not because of its newness in principle but by reason of the engineering procedure that is now being followed out to achieve an end long desired but heretofore not attained. More than a quarter of a century ago, Congress authorized taking such steps on the upper Mississippi River as might be necessary to provide at low water a channel not less than six feet in depth. After study, the Corps of Engineers of the Army decided that such a channel could be assured by dredging in some sections and by constructing contraction works in other sections—the latter tending to increase the speed of flow and thus automatically prevent the accumulation of silt and the formation of obstructing bars. This program has never been finished; there are today considerable stretches of the river where boats drawing more than four feet cannot navigate during low-water stages. The completion of a nine-foot channel on the upper Mississippi will make possible trunk-line, common-carrier service from Minneapolis to New Orleans. At the present time, up-bound and down-bound freight is usually transhipped at St. Louis; and this entails loss of time and increased costs.

The prolonged periods of exceptionally low water in the upper Mississippi during the last five years have made it plain to the experts that the nine-foot channel sanctioned by Congress in 1927 could not be realized by recourse to dredging and contraction works. Therefore, after a very careful survey, the Army engineers recommended, near the close of 1931, that the only feasible solution of the problem was to canalize the river throughout the section in question by creating 27 pools upstream of that many dams, the dams to have, with two exceptions, locks 110 feet wide and 600 feet long. The purpose of such large locks is to permit a towboat and its group of barges to pass through a lock without altering its formation—that is, without losing time in splitting up. But the upper Mississippi presents physical difficulties to the execution of such a plan.

THE valley through which the river flows is generally broad and flat. When the river is at flood stage, the surface of the water varies in breadth from half a mile to two miles; and along the banks on each side of the stream and just above flood level, are numerous villages and small cities. At the larger river cities, industrial developments lie along the shores just out of the reach of high water. The tracks of some paralleling railroads are similarly but little above flood levels. Moreover, there are rich farmlands lower down on the upper river that are protected from inundation by dikes or levees that actually have their bases always submerged so that seepage on to cultivated areas makes well-nigh continual pumping necessary. The government engineers had, accordingly, to fix upon types of dams that would raise the natural flood level of the river at no point more than 12 inches, lest property damage be prohibitively great. Low dams were therefore adopted—of just

Upper Mississippi River

Trunk-line Water Route From "Twin Cities" to New Orleans . . . 27 Dams With Locks Required . . . Cost 124,000,000 Dollars . . . Economic Gains

By S. G. ROBERTS

sufficient height to impound enough water to provide a minimum channel depth of nine feet. The work has been going forward rapidly during parts of the last three years. When finished, the estimated total outlay will be 124,000,000 dollars.

The changes in water level on the upper Mississippi, in the wet season, may be as much as 18 to 21 feet. It is self-evident that such tremendous volumes of flood water should be given the fullest possible avenues of escape lest they back up and overrun wide areas above obstructing dams. All new dams on the upper Mississippi are designed with spillways and spillway gates that will permit the normal regulation of the river for navigational purposes and yet at flood stages will allow nearly unrestricted escape for flood water. Vessels bound upstream or downstream will pass the dams through locks of the most modern design with electrically operated gates.

It is not enough that the dams be equipped with spillway gates to deal with flood waters, but the same gates must work positively when exposed to either fields or floes of ice which, in the upper Mississippi, attain thicknesses of from 12 to 24 inches. The spillway gates are patterned to free themselves from ice in contact with them; will be able to withstand the pressure of large bodies of ice; and when necessary will be able to open promptly and allow the ice to escape instead of forming disastrous jams. Dam No. 15, popularly known as the Rock Island Dam and now in service, typifies what the Corps of Engineers of the Army is doing in canalizing the upper Mississippi. The dam crosses the river between Davenport, Iowa, and Rock Island, Illinois, and has a length of a little more than 1203 feet from one terminal structure to the other. The dam is equipped with 11 great roller gates that are patterned after a type that has been widely adopted in Scandinavian countries where heavy ice on the waterways has to be contended with in the wintertime. The roller gate is peculiarly suited for such service; besides freeing itself from clinging ice, it incidentally breaks the ice so that the blocks can be swept downstream over the spillway.

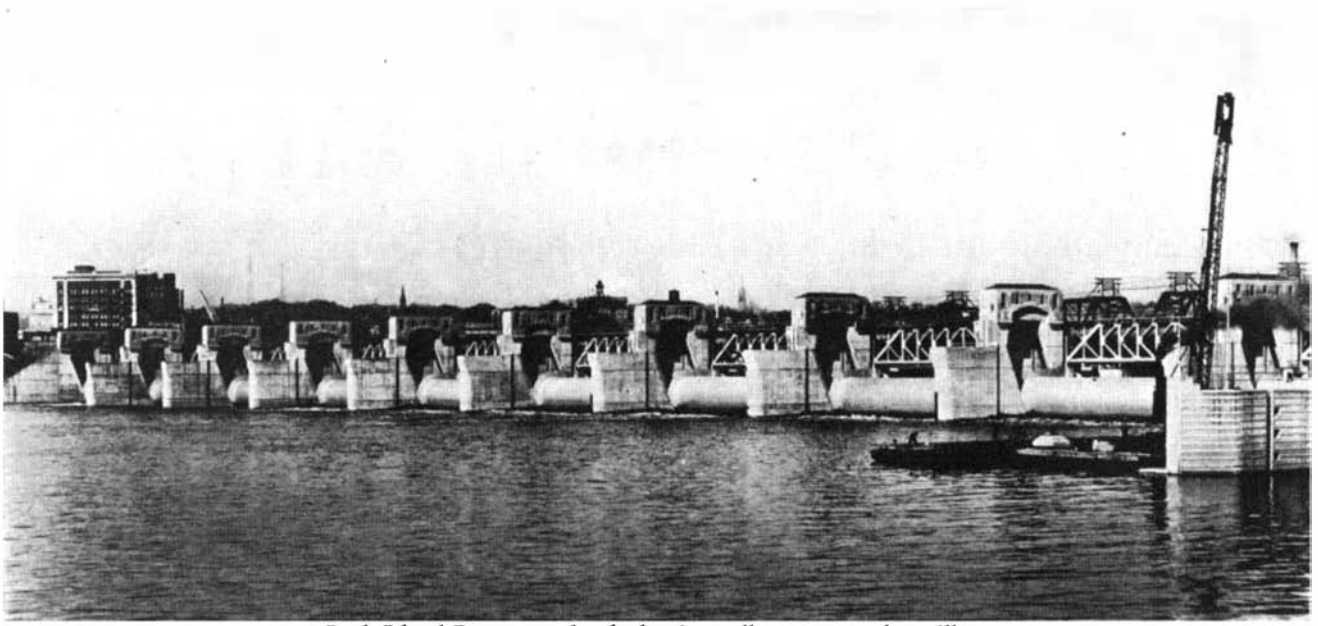
Early construction stages of Lock Number 15 (right) at Rock Island, Illinois. Rock-filled cofferdam may be seen at the left

We cannot, at this time, go into the engineering details of the roller gate other than to say that each one on the Rock Island Dam is a sturdy cylinder of steel having an over-all length of fully 109 feet; most of the gates on that dam have a diameter of 19 feet 4 inches. Each gate has a projecting longitudinal lip that rests against a timber seal on the gate sill when closed. This lip swings clear and rises as the roller gate is partially rotated in moving upward on inclined toothed tracks. A powerful electric motor controls the raising and lowering of a gate; and when at its maximum height, a gate is six feet or more above flood water at the estimated highest level. Electrical heating units at the ends of a roller gate will melt any ice that would otherwise grip the gate and prevent its opening or closing.

The main structures of the Rock Island Dam are anchored on bed rock, but at Dam No. 5, now building about 265 miles farther upstream, the river bed is composed of sand and gravel to a depth of several hundred feet. In that case the reinforced concrete structures rest upon numerous timber and steel piles driven into the underlying formation. Many of the other dams will be underpinned with piling, and only a few of them will be at locations where bed rock can be reached. Because the erection of a dam will block the course of the river, the Government is first constructing a lock or locks at each dam site so that shipping may not be hindered at any stage of the work. At this writing, work is underway on 12 locks; two were recently finished; and four others were built a year ago. Three dams are under construction, and additional activities will soon be started. At the present rate of progress, the magnificent scheme should be an accomplished fact by 1938.

MINNEAPOLIS and St. Paul — familiarly known as the Twin Cities —occupy a strategic position in relation to the contiguous and neighboring states, which to a large extent are essentially agricultural in their productive activities. When not hampered by drought or other unseasonable conditions, Montana, North Dakota, South Dakota, and Minnesota grow annually a billion and more bushels of grain. Save for the outlet at Duluth, this immense region—which has the combined expanse of Germany, France, Italy, and the British Isles—is, for all practical purposes, landlocked.

Through Minneapolis each year is handled between 100,000,000 and 150,000,000 bushels of grain, of which a considerable percentage is bound out of the country. The farmer and the middleman thrive or lose according to the export price, which is determined by the cost of getting the grain to our sea coast. Grain from the northwest traveling by rail to either Duluth or Minneapolis pays the same freight. Should any of that grain, however, after reaching Minneapolis, be forwarded to Duluth to take



Rock Island Dam, completed, showing roller gates on the spillway

advantage of the lower cost transportation on the Great Lakes, then every 100 pounds of grain making the rail journey to the lake port must bear an added charge of five cents. This is a severe handicap to the grain merchants of the Twin Cities which must use Duluth as a port of outlet and cannot seek a competing market.

In the grain trade, a difference of so little as a quarter of a cent a bushel for carriage decides the route by which grain can be shipped profitably to a market abroad. With the Mississippi River available for trunk-line service, the Twin Cities and other communities on the upper Mississippi will be able to ship bulk cargoes through to New Orleans and will thus be placed directly in touch with ocean-going craft without breaking cargo between the shipping point and the Louisiana seaport. On their upward-bound run, the river craft can haul commodities reaching New Orleans from either of our seaboards or arriving there from foreign sources. In short, the canalization of the upper Mississippi, in conjunction with the remainder of that river, will offer a channel for trade that eventually will transform the industrial and the economic life of a great part of the Mississippi Valley that now lags measurably because of the means of transportation today available.

SEVEN years ago the Federal Barge Line, subsidiary of the Inland Waterways Corporation, a government organization, began its pioneer service on the upper Mississippi to demonstrate what would be possible in moving large volumes of water-borne freight with modern equipment run on schedule. Interested people along the water-way raised the funds necessary for the purpose of constructing towboats, barges, and terminals. While the barges were of light draft and could carry only 500 tons each, they demonstrated what could be done with better facilities. It was largely because of the work of the Federal Barge Line that Congress finally authorized the work that is now in hand.

On the nine-foot canalized channel, towboats will be able to maneuver unit flotillas laden with cargoes of from 8000 to 14,000 tons on the down-river trip, and on the upstream run to move groups of barges carrying from 6000 to 8000 tons. These flotillas will be able to make the whole run, if so desired, up or down the river without breaking bulk or changing the flotilla formation the while. There are coal companies and steel companies that even now operate fleets of barges between the Pittsburgh district and the coal mines adjacent to the Ohio River. These concerns transport their commodities to the Twin Cities and to other points on the upper Mississippi. With a nine-foot channelway, this traffic will be much stimulated and everyone concerned will be benefited. But the private flotillas are for the performance of their owners' immediate service; it is essential that common carriers be available to any shipper seeking the advantage of low-cost water transportation in getting his products to profitable markets. With such common carriers, the western half of the Mississippi Valley, instead of being well-nigh exclusively devoted to agriculture, will be transformed into a region engaged in many forms of industry, and enjoy what it cannot boast now—a balanced economic life.

THERE is every reason to believe that the work now under way will give to the Mississippi Valley a trunk-line water route that will mean to the vast region served by it what the Rhine has long been to central Europe. From Minneapolis to the sea, the Mississippi has a length of 1950 miles; and the run from Minneapolis to New Orleans is 1840 miles. From the head of navigation on the Rhine to the sea, the distance is 445 miles. Therefore, the Mississippi offers a water outlet to a far more extensive region than does the Rhine; and the potential wealth of the American domain is infinitely greater and in some respects more varied. The Rhine carries a tremendous tonnage of up-bound and down-bound freight; and upon both banks of that waterway are operated prospering railroads that handle more rapidly goods that can afford to pay for the speedier transportation, while the barges move at a lesser pace and at lower cost goods that do not call for expeditious haulage. Both systems are reaping substantial rewards for their respective services.

Improvements now going forward on the Illinois River, the Ohio River, and the Missouri River will contribute to the importance of the Mississippi River system as a whole. Over some of these associate routes it will become a commonplace to see single towboats of 2000 horsepower propelling flotillas of barges laden with 20,000 tons of coal, ore, crushed rock, grain, and so on. A locomotive of the same horsepower can pull on favorable gradients possibly a maximum of 7000 tons. This, in part, indicates why water transportation offers opportunities to make savings in distribution of products; efficient and more economical distribution is vitally necessary to our complex national life. The canalization of the upper Mississippi River is just one more outstanding effort to this end, and also evidence of our awakened consciousness of what our inland waterways can be made to do.

From the Archeologist's Note Book

Two-storied Pompeiian Houses

TWO centuries of almost incessant excavation work have helped to make Pompeii one of the most magnificent undertakings by which man has essayed to reconstruct both history and a bygone civilization. Pompeii has been found to have some two-storied houses, and even remains of tenements have been uncovered. Two-storied houses have also been found at Herculaneum, not a great distance away. The new excavations at Pompeii have been much easier to conduct, as mostly only ashes have to be removed for a distance of 19 to 26 feet while the consolidated mud at Herculaneum varies from 39 to 82 feet in depth. Of course, progress is much slower on the latter city but the net results of the two areas are fully justified.

"The Human Adventure"

IT is rarely that a man of the eminence of Dr. James H. Breasted breaks into the movies but archeology has lured him to this medium. An eight reel talking picture has been produced in the centers where the expeditions of the Oriental Institute have been located. Three years were required for the completion of the film, "The Human Adventure," which grew directly out of the researches and explorations of the Oriental Institute and visualizes the rise of man from savagery to civilization. The picture carries the audience by airplane through the lands where civilization first arose—Egypt, Palestine, Syria, Anatolia, Iraq, and Persia. In all, some 14 expeditions are represented. The film ends with beautiful views taken at Persepolis.

An Early Egyptian Toy

THE first elaborate mechanical toy was discovered at Lisht, Egypt, by the Egyptian Expedition of the Metropolitan Museum of Art during the last season. There were four ivory figures on an ivory base. Only one of the figures is in New York; the rest are in Cairo. So far as we know, these are the first representations of central African pygmies. One of the curators of the Museum, succeeding in making paper models of the originals, rigged strings to the spools in the base and made the figures turn in one direction and then in the other and finally make a full pirouette. At first sight the originals seem to have been of Chinese origin, but they were found in undisturbed Egyptian clays. Mechanical toys have been found before in Egypt but always crudely made.

Ivory dwarfs in a toy, found in Egypt

Sea fight scenes decorate this vase

A Colossal Funerary Vase

AN early Athenian grave monument of considerable interest, particularly by reason of its size, has recently been acquired by the Metropolitan Museum of Art. It dates from the 9th to the 18th Century, B.C. Its height is 39 inches and its diameter at the lip is 37 inches. This is a monument from the "dark ages" of Greece, a period of unrest and colonization, perhaps synchronous with the time when Homer wrote.

Pompeii's Terraced Houses

IF the catastrophe of Vesuvius had taken place 50 years later, Pompeii would probably have become a factory town. As it happens, new excavations show a great many varieties of dwellings which indicate residences of people of comfortable means. Several houses have been discovered which are elevated on beautiful terraces as well as set back from the street by gardens.

Lion attacking bull: from Persepolis, Persia

A set-back Pompeiian home resting on terraces

THE AMATEUR AND HIS MICROSCOPE—XIV

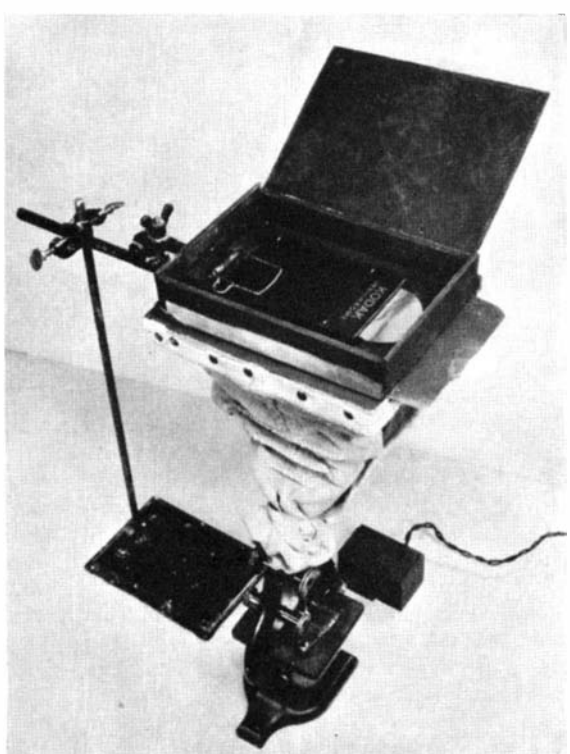
Making Your Own PHOTOMICROGRAPHIC CAMERA

By JOHN KENNEDY

THE optics of a photomicrographic camera are extremely simple—such a camera does not even require a lens, since the ocular lens of the microscope functions in this capacity. To prove this for yourself, observe some specimen under the microscope in the usual manner; then, with the object in focus, darken the room and hold a piece of white paper horizontally eight or ten inches above the eyepiece of the microscope. An exact (real) image of the specimen will fall on the paper. If this paper were photo-sensitive a photomicrographic impression would have resulted. You will notice, on raising and lowering the paper, that the image becomes enlarged and diminished, respectively, in size. By varying the projection distance in this way any desired size of picture can be obtained.

The author has developed a simple, very efficient, and durable photomicrographic camera which can easily be built by anyone, with the total expenditure involved for materials not exceeding one dollar. The camera is of the ground glass focusing type and uses a film pack in an adapter. It consists essentially of an adjustable bellows, with a frame of sufficient rigidity to support the adapter. The latter is a light-proof box which holds the film pack, and is provided with a sliding metal shutter. The adapter is easily lifted off the frame and a ground glass plate substituted. The image of the object on the microscope stage is projected on this plate and the microscope adjusted till this image is focused sharply on the plate. This plate occupies exactly the same position on the frame as the film itself, hence an image in focus on the ground glass plate will obviously be in focus on the photographic film also, when the plate is replaced by the adapter.

THE frame should be made of light but strong wood (white pine is good), one inch square. The size of frame is determined by the size of film pack to be used. However, it is a simple matter to make the frame large enough to accommodate the largest size of film pack manufactured, namely five by seven inches, in the event that on some special occasion it might be necessary to work with such a size. A frame whose inner dimensions are five by seven inches will be ample for this purpose. The long and short side pieces should therefore by nine inches and seven inches in length, respectively. The ends should be given a corner half lap joint (Figure 1) and glued together. Before the glue has dried, the ends should be further secured by fastening them with metal corner supports or braces on the under side (Figure 2).



The completed home-made unit, ready for use

To this frame is attached the extension bellows. The bellows is made up of a chamois skin which is attached at intervals to rectangular wire frames of gradually decreasing size. The chamois may be attached to the frame with carpet tacks or preferably thumb tacks. The chamois skin is merely sewed around the wire frames with heavy thread (Figure 3). The wire frames are made from wire of about ⅛ inch diameter and bent into the shape desired, the ends being fastened by winding or braiding one over the other, as an electrician would splice house wire. Several inches of chamois should extend below the smallest wire ring. A strong elastic band is slipped over the outside of this portion so that it can be snugly fitted over the eyepiece of the microscope.

The bellows itself is now complete and is best supported by an ordinary laboratory ring stand with jaw clamp. It is necessary now to provide the bellows with an adapter for holding the photographic film. An adapter of the type to be described is built to accommodate but a single size of film pack. Hence, for every size of film to be used there must be a corresponding adapter. Since the most popular size of film pack used in photomicrography is 3¼ by 4¼ inches, dimensions for making an adapter for this size alone will be given. A shallow cigar box fills this rôle very satisfactorily. The box should be ½ inch shorter in length than the longer side of the bellows frame. This allows just room enough for the jaws of the ring stand clamp to grasp the frame.

THE optical center of light passing from the eyepiece of the microscope theoretically should pass through the center of the boot, or narrow end of the bellows up through the center of the frame. With this in mind, set up the bellows over the microscope with the use of the ring stand and clamp, and adjust the apparatus until the cone of light passes through the center of the bellows. If a piece of thin tracing paper be placed on top of the frame it will greatly facilitate in making this adjustment, since the image of the circular field will fall on the paper and will show clearly when it lies in the center of the frame. Now place the adapter box in its proper position on the frame, making allowance for necessary room for the jaw clamp on the left, and find where this optical center intersects the bottom of the box. With this point as a center draw a rectangle 3 by 4 inches on the bottom of the box. Then, with a

Simple, Efficient, Durable . . . Materials Cost One Dollar . . . Wooden Frame . . . Chamois Skin Bellows . . . A Few Other Gadgets and an Evening or Two of Time

sharp knife, cut this rectangle out, leaving the box with a rectangular opening.

Place a 3¼ by 4¼-inch film pack inside the box over the opening, in such a way that only the metal frame of the pack rests on the bottom of the box, thus allowing the entire surface of the safety cover paper and subsequent films to be exposed to light passing through the opening from below. With a pencil, trace the outline of the film pack as it rests now on the box bottom. Cut several strips of felt or similar material ½ inch in width and of the necessary length,

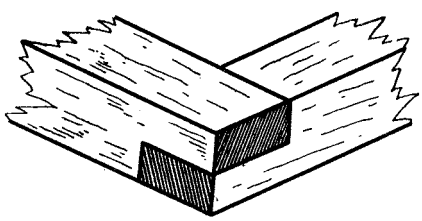


Figure 1: **The wooden framework**

and glue them on to the box around the trace lines (Figure 4). This will help to keep the film in the desired position, and will also keep extraneous light from the films. To keep the film pack rigidly in place when films are being changed, it is advisable to glue a foreshortened mouse trap to the bottom of the box so that the jaw of the trap presses down firmly on the top of the film pack (Figure 5).

The adapter must have a shutter. This is made very easily from a smooth sheet of tin or similar metal. The shutter slide should be slightly smaller in size than the bottom of the adapter box, except that on the right side a small portion should project for use as a tab for grasping, when the shutter slide is to be pulled out. The slide supports or guides are more difficult to contrive. Two pieces of tin, about 2½ to 3 inches wide, and of the same length as the box, are required. These are bent crosswise into a V shape of about 90 degrees. They are then lined on the inside with felt or very heavy cloth, using glue as a binder, and then glued to the side of the box (Figure 6). In this final gluing operation the slider should be in position and moved back and forth from time to time in order to ascertain whether or not it is free to move. One should strive to fasten the guides in such a way as to hold the slider snugly in place against the under side of the box without impairing its requisite ease of motion. It is not at all difficult to do this in a neat manner.

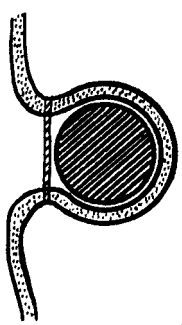


Figure 3: **Cross-section of bellows**

The adapter is now complete, and should be coated on the inside (at least) with a coat of flat black paint. [One kind is known as "coach black".—*Ed.*] The slider should also be painted black. The bellows should be blackened around the frame, while the chamois portion may be dyed black or painted black on the inside with India ink. Place the adapter back on the bellows frame in its proper position. To establish this position and to obviate any difficulties which might arise later in finding this exact position, two corner guides may be attached to the frame at one end, as shown.

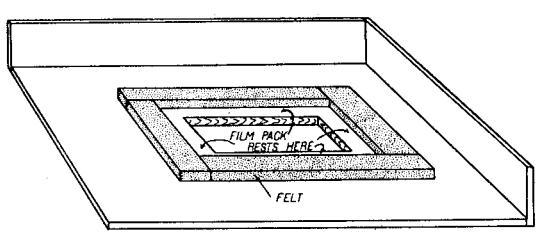


Figure 4: **Showing the film pack compartment**

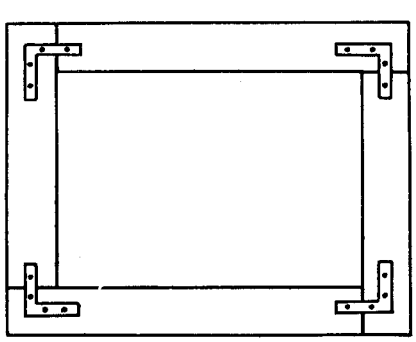


Figure 2: **Angle plates at corners**

It can be seen, now, on critical examination, that there are two openings through which light might enter: namely, at the two ends of the bellows frame, between the slider plate and the frame itself, because of the slider guides. To close these openings it is necessary only to glue to the frame at these places one or two thicknesses of chamois or cloth strips, depending on the magnitude of the openings.

The next piece of necessary equipment is the ground glass plate. This plate should be of the same size as the bottom of the adapter and should fit in precisely the same position on the frame as that occupied by the adapter. A piece of glass of the ordinary window pane variety is cut to the proper size and one side is ground with a fine grade of automobile valve grinding compound. This may best be accomplished by taking a little of the compound on a flat hard surface, such as a metal spatula or a broad flexible knife, and then rubbing it into the surface of the glass, using a circular motion. One should strive to obtain a uniform frosted appearance over the entire surface of the glass. The plate should now be finished off with a border of adhesive tape (see Figure 7), which will prevent the edges of the glass from

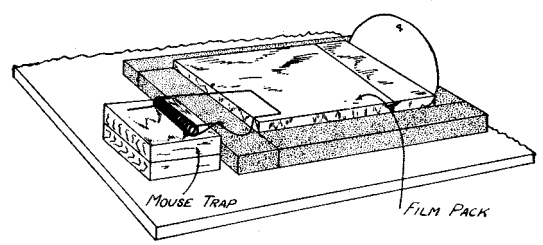


Figure 5: **The film pack held by a mouse trap**

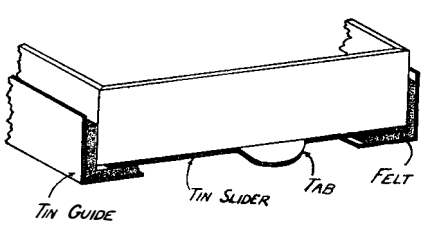


Figure 6: **End view of the adapter**

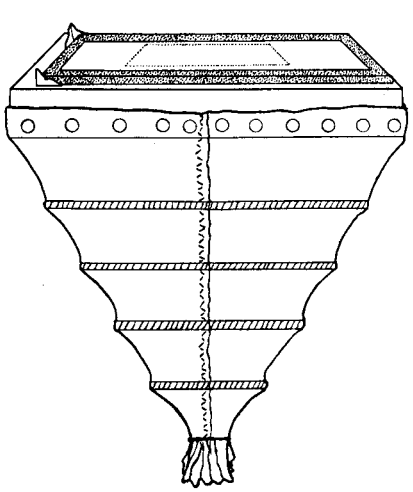
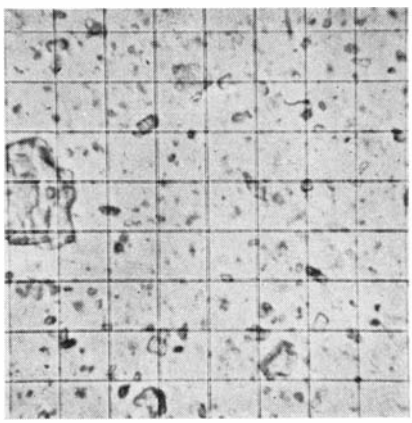


Figure 7: **Bellows with ground glass**

chipping when the plate is moved about, and will make the plate easier to handle. Theoretically the plate should lie in the same plane as the photographic film. To satisfy this condition small lifts may be glued to the corners of the plate. Small corks are ideal for this purpose; they should be cut to such a size that they raise the plate up evenly to the desired height. However if the plate is laid



on the frame without any lifts it will cause no appreciable error between the size of image observed on the ground glass and that photographed.

Place the ground glass plate on the frame, ground side up. Then, after removing the slider from the adapter, place the latter on top of the plate. Trace the outline of the opening in the bottom of the adapter on the ground glass plate with a lead pencil. The resulting trace lines facilitate greatly in focusing and centering the image on the glass, since they show just what area will be included on the film.

The camera now lacks but one minor accessory, an eye shade of some kind to facilitate viewing images on the ground glass plate. A shade of this kind need not be elaborate and may be made from heavy cardboard. An empty cylindrical container (similar to those in which salt is packed) from which the top and bottom have been removed is satisfactory. It may be necessary to glue a strip of chamois or other fabric around the bottom rim in order to assure a snug fit between carton and glass. The shade is laid on top of the ground glass plate, with the result that the image stands out more sharply in relief against the dark background.

WHEN the camera is to be used, the bottom boot of the bellows is fitted tightly over the microscope eyepiece, using an elastic band around the outside of the boot. The bellows is supported rigidly by the ring stand clamp, care being taken to adjust the bellows so that the beam of light from the microscope passes up through the center of the bellows. Now place the ground glass plate in its proper position on the frame, ground side downward. Then lay the eye shade on top of the plate and adjust the microscope until the image falls sharply on the plate. Then raise or lower the bellows on the ring stand until the image assumes the size desired. For photomicrographic work a 300-watt or a carbon arc lamp is recommended, although lamps of weaker intensity can be made to work quite satisfactorily as a source of illumination.

With everything in focus, replace the glass plate with the adapter, which should contain a film pack ready for exposure (directions for using film pack accompany each pack). Place a piece of black paper between the source of light and the substage mirror. Now open the adapter sliding shutter full length, withdraw the piece of black paper from the front of the mirror and time the exposure. This will be discussed below.

Photomicrographs made by the author with the unit described in this article. *Left:* Chalk, magnified 150 ×. *Center:* Crystal growth of anthranilic acid, × 175. *Right:* Sublimed crystals and stalactite growths of pure hexachloroethane, × 150

At the end of the exposure replace the piece of black paper and immediately push back the slider shutter into its normal position. To complete the operation pull out and tear off the film tab or flap for the exposed film, thus bringing the next film into position ready for exposure.

The exposure times vary with the intensity of illumination, with the microscope, and with the nature of the specimen under observation, hence it would be impossible to suggest any limit. The optimum time for any one exposure can be learned only from experience. Using a 200-watt bulb as a source of illumination, the average time for exposures would probably be from 10 to 20 seconds. It is obvious that this exposure time will also depend on the distance the bellows is extended and upon the type of film used.

The magnification of a photomicrograph can be calculated after measuring with a centimeter scale the distance from eyepiece lens to the plane of the film pack in the adapter. This distance is called the projection distance. Substitute this distance, and the magnification of the optical system used in the microscope itself, in the formula: Image magnification=magnification of microscope × projection distance ÷ 25 cm.

OFTEN one would rather make a hurried sketch of a specimen under observation in the microscope rather than go to the trouble of taking a photomicrograph. One can do this very easily with the help of the camera described above. Set up the bellows in the usual manner but replace the ground glass plate with an ordinary clear glass plate of the same size. If a piece of fairly translucent white paper, such as tracing paper, is now placed on top of the glass the image of the specimen will fall on the paper in natural colors. It is a very simple matter to trace the outline of the image on the paper in a surprisingly short time, with the result that an accurate drawing with details all in true proportion is produced. Since the specimen is projected on the paper in natural colors it is feasible to produce a colored drawing, using wax crayons. Obviously one should attempt to draw pictures of this sort only in a room with subdued light, since the darker the surroundings the easier it is to see the

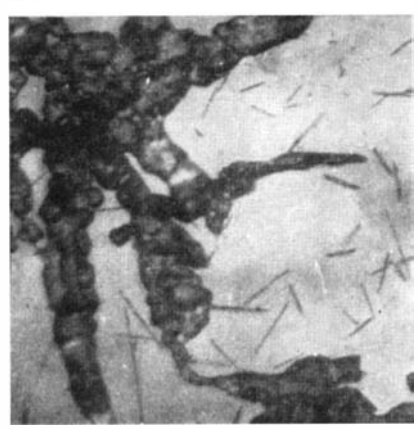


image on the paper. If this is not convenient it will be necessary to erect suitable shades around the apparatus.

MANY a research worker in chemistry, biology, and natural science has wished that he could photograph his interesting specimens. A photomicrograph is of great value, since it is the only definite proof of an observation; it is a permanent record.

During the last year or so microscopy has attracted a great deal of attention on the part of both the old and young, many of whom have adopted and fostered it as their chief hobby. To aid this group, numerous interesting articles have appeared from time to time, giving hints on microscope technique and suggestions regarding sources of interesting specimens. Perhaps the present article will add its mite.

RUBBER

Plant Experiments By Federal Scientists

IF the price of raw rubber should ever be forced as high again as in 1923-27 under the Stevenson Plan, the United States will be in a fair position to produce a good share of its rubber requirements. Experiments by the United States Department of Agriculture—covering practically every important plant used for commercial production of rubber throughout the world—have singled out as the most promising sources for domestic rubber goldenrod, guayule, a shrub which grows well in the southwest, and *Hevea*, the rubber tree of the tropics. Of these, goldenrod is regarded as the most likely to develop commercially. The recent transfer to the Department of the Edison collection of goldenrod selections has given new impetus to the research program.

Rubber of good quality has been made from goldenrod, but the details of extraction and manufacture have not been developed sufficiently to produce rubber on a commercial scale. With present knowledge it would not be possible to make rubber from goldenrod at prevailing prices of about 15 cents a pound. However, experiments now in progress in the Department lay the foundation for domestic rubber production in case of an emergency.

Guayule is a shrub native to Mexico and southern Texas, which resembles sage brush and which can be harvested with machinery. Several thousand acres have been planted to guayule in California.

An experiment with guayule shrubs in California. These are perennials

Other sources of rubber which could be developed in this country if the price were high enough to warrant it include the *Hevea*, the famous rubber tree of the tropics. The Department now has 30,000 of these trees growing in Florida, some of them from seed produced there. There is every reason to believe that they will yield as well as those in the East Indies.

Another rubber tree which grows well in Florida is the *Castilla*, from Central America. It is not so resistant to frost as *Hevea*, but it has a big advantage in that it yields a large percentage of its rubber at one tapping, a factor that would help to cut labor costs.

Two varieties—short and tall—of goldenrod plants in South Carolina

RUBBER made from guayule and goldenrod in this country so far has not been as good as the imported product. With continued improvement in methods of extraction, however, it is entirely possible that domestic rubber from these plants might be made to approximate that from the East Indies, in the opinion of L. G. Polhamus, who for several years has been engaged in a study of rubber plants for the Department of Agriculture.

So far, *Solidago leavenworthii*, one of the Edison selections, has the highest rubber content of any of the goldenrods analyzed. Specimens have produced more than 12 percent rubber. Another species, *S. fistulosa*, a selection by the Department, has analyzed as high as 9 percent rubber. A third species which yields from 4 to 6 percent rubber is considered promising because of its greater leaf production.

In spite of the popular interest in goldenrod as a source of domestic rubber there are many problems which must be worked out before we can look to this plant for commercial production of rubber, Polhamus believes. In the last few years he has laid the groundwork for genetic studies of the kind which are the basis of any intelligent breeding program. The Edison collection represents only a careful selection of outstanding individual plants. With the same scientific effort that is applied to the crossing of such plants as wheat and corn it seems reasonable to expect results with goldenrod far more promising than anything yet achieved.

Goldenrods are native to all parts of the country. Most of the plants studied for rubber production have been grown in the south, either in Florida or South Carolina, but it is entirely possible that plants from other sections would do equally well for making rubber. Cost of land and labor would be important items in selecting a locality for growing goldenrod commercially. The goldenrod experiments have not progressed far enough to warrant anyone going into the business of growing or collecting goldenrod to sell for making rubber.

To show something of the task facing him, Polhamus tells of planting a seed in 1932, from which a nice clump of plants grew in 1933. These plants he knew were genetically identical—which meant that they should behave alike. He harvested all the same day because he had learned that the time of harvest often influenced the percentage of rubber. They ranged from 1.07 to 3.55 percent rubber, in spite of the fact that they were genetically identical.

THE FIRST TENNESSEE

Excavations by CWA Workers Under the Tennessee Valley Authority Have Brought to Light on a Wholesale Scale the Contents of 40 Indian Mounds and Village Sites Soon to be Submerged by Reservoirs

THE archeological survey carried on by the Tennessee Valley Authority in the Norris and Wheeler Dam reservoir areas during the past year constituted an attempt to bring to light before those areas were submerged any data which the region might offer which would be valuable in solving some of the many problems facing the students of prehistoric records of southeastern United States. The areas subjected to examination were Anderson, Campbell, Union, Claiborne, and Grainger Counties, comprising the Norris area in northeastern Tennessee, and Lauderdale, Limestone, Morgan, Lawrence, Madison, and Colbert Counties, making up the Wheeler area in northern Alabama. The survey was conducted by Major W. S. Webb, formerly head of the Department of Archeology at the University of Kentucky.

At the outset, the survey was handled as a CWA unemployment relief project and financed by Federal CWA funds. Later, when Federal aid was withdrawn, it was carried forward and financed by state relief organizations. Sometimes as many as 800 men were employed in the work.

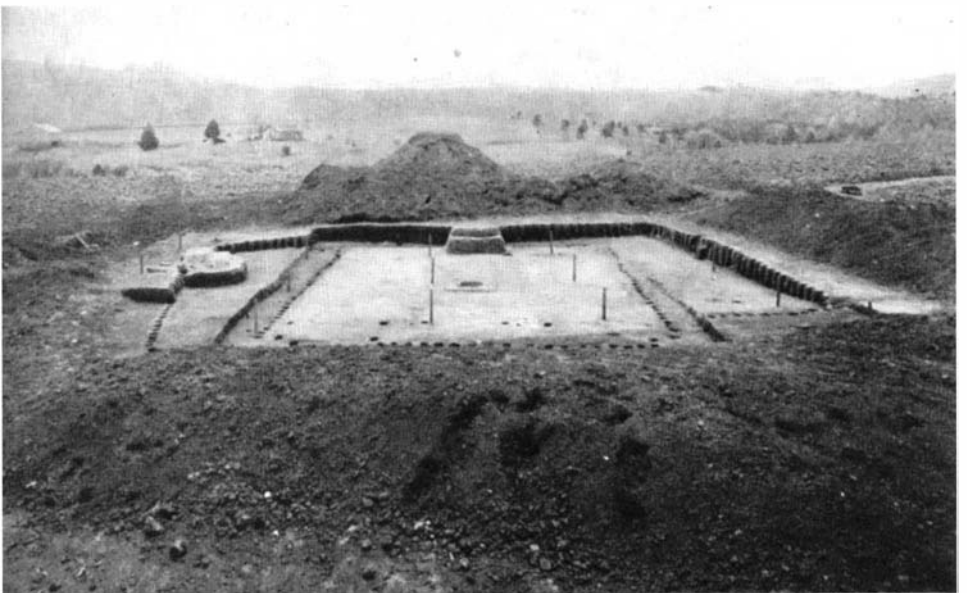
One hundred TVA-CWA workers began investigating the Norris reservoir area early last year. Two miles above Catham Bend on the Powell River in Campbell County, a series of open front caves were discovered. In one of these caves a number of primitive artifacts were found and eight skeletons exhumed. The human remains were discovered in completely flexed positions; that is, their knees were drawn up and both arms and legs bound tightly to the torso before interment. The remains were found lying in ash-filled hollows lined with bark. About the bones hung the remnants of a roughly-woven twine fabric in which the bodies had been wrapped.

None of the artifacts found in these caves indicate that these primitive peoples had ever had contact with the white race. Major Webb believes that these early inhabitants of the region were prehistoric Algonquin Indians.

As the examination of the region progressed, entirely different findings were reported. Mounds and village sites were discovered and excavated. The method of location is simple. The early inhabitants drew heavily upon the large supplies of shellfish along the rivers. The shells and the bones and refuse from game that had been killed were either buried in pits or scattered carelessly in the neighborhood of the settlements. In this unwitting manner, phosphorus was returned to the soil in considerable quantities, and this accounts for some of the unusually rich alfalfa crops in the bends along the rivers. Whenever Major Webb located an unusually fine field of alfalfa, he generally found underneath it the record of prehistoric occupancy.

Some 40 mounds were uncovered, enough to give a representative picture of the entire Norris reservoir region. Each mound marked the site of a village, and in the center of each a town house or "temple," ranging anywhere from 40 to 60 feet long by 30 to 35 feet wide, was in evidence. Extreme care in removing the overburden of earth was necessary in bringing the foundations of these buildings to light. Usually from four to eight feet down, a stratum of hard-packed clay was struck. Then the search for post holes would begin. When the buildings had burned down centuries before, they burned completely to the ground, leaving the stubs of the wall posts in the ground. The protruding ends of these stubs were carbonized and proof against decay, but the points under the surface soon disintegrated. When a ceremonial building burned down, the site was heaped with a layer of fresh earth and a new building constructed. (This reconstruction may not have been done by the same tribe; years may have elapsed in the interim.) With the disintegration of the stubs of the old wall posts, the fresh earth, whether laid on immediately or years afterward, forced its way down into the rows of holes. And when the archeologists lay bare the old temple floor, they look immediately for the long straight lines of round spots of earth colored differently from that of the main floor. These are carefully dug out with a trowel, and frequently the charred remains of the stub are found in the bottom.

Site of Indian ceremonial building, Harris farm, Powell River, Norris Dam area—one of few instances in which the "seat of authority" was not on east side of building



THE site of an early fortified village was unearthed near Caryville, Tennessee. (SCIENTIFIC AMERICAN, November 1934, page 248.) Foundations of the tribal temple, council room, and a portion of the stockade were brought to light. The temple foundation measured about 30 by 40 feet. In the center was located a raised baked clay altar with a fire pit in the center. The findings indicate that the walls of this building were thatched and about 10 feet high. The roof had been made by bending the tops of the young trees that formed the wall inward toward each other and then binding them together, thus forming an

VALLEY AUTHORITIES

By HERBERT F. GOUGH

arched roof. This too was thatched. Supporting posts for the roof were located at intervals within the building. Though this particular ceremonial building did not possess one, the floor of the one discovered directly underneath, and all the other temple foundations discovered in the region with but one exception, had a raised seat or dais with its back to what would be the center of the east wall. Thus, dais and ceremonial altar were always in a direct line facing the setting sun.

The semi-public building which stood near the temple was of the same construction, but had a flat fire pit rather than a raised altar. Adjacent was the site of a private building, typical of the dozens that must have formed the village. This covered a space of approximately 18 by 15 feet and was constructed of much smaller poles. Along one wall was a raised clay bench which evidently served as a seat for the head of the house. In the center was a small fire pit.

THE post holes marking the location of the stockade indicated that tree trunks at least 10 inches in diameter had been used in the fortifications. Occasionally this huge fence took abrupt right-angled turns, so that the face of the stockade could be protected by a cross-fire of arrows. The gateway had a protecting wall of poles in front, in order that no person entering or leaving would be in a direct line of fire from an enemy. It is thought that this Caryville village site, since it was the top and therefore most recent of several layers of superposed remains indicating several periods of occupation, may have been the Cherokee fortress that Colonel Montgomery saw and thought too strong to attack during his Colonial campaign.

Besides the temple site found at practically every mound, other representative findings were made. Large and small pieces of pottery were unearthed, some quite small, others at least 12 inches across at the mouth and equipped with handles. This pottery, typical of all American Indian pottery, is of the hand-coiled type. The pieces found were quite unadorned, except an occasional serrated edge or lip, and were unglazed. They were apparently made watertight, however, by the simple process of holding them upturned over a smudge and then rubbing into the rough-textured interior the accumulated lampblack.

Ceremonial objects, round stone disks or markers for some kind of game, and the customary run-of-the-mine artifacts were disclosed as well. At one mound a square, rather than round, raised ceremonial altar was discovered. This altar had a fire pit in the center, flanked on four sides by round shallow depressions —depositories no doubt for offerings to the four winds of heaven. None of the artifacts or findings indicate contact with white men.

Though as many as four levels of occupancy were discovered at some of the village sites, representing earlier and still earlier inhabitants of the region, no skeletal remains had been found in the mounds. A few dolichocephalic or long skulls were discovered in a crevice, which were identified immediately as being Iroquois. A final investigation at a site located along the Clinch River in Anderson County was decided upon.

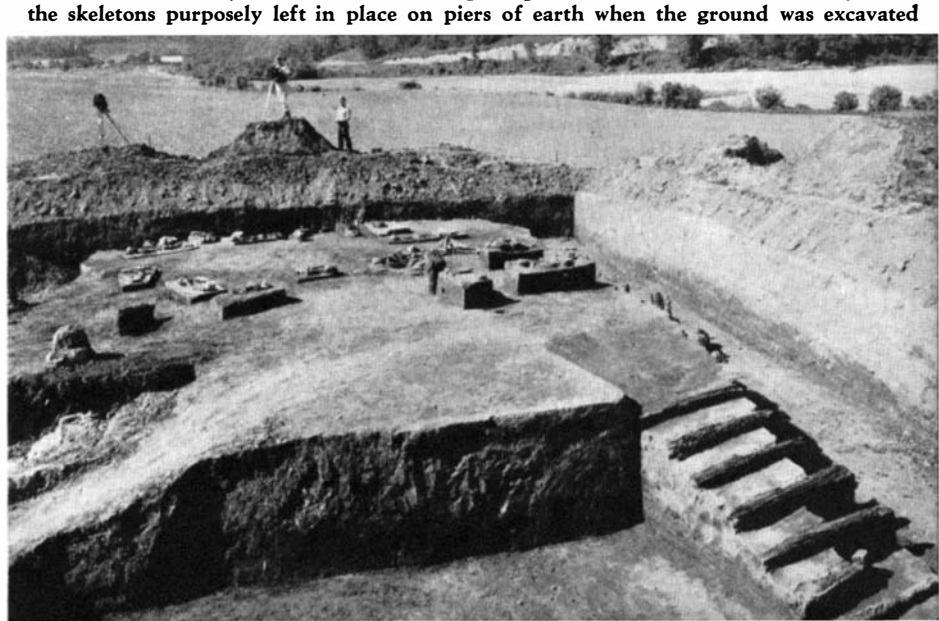
The site turned out to be a burial mound, and 49 skeletons were found. Underneath the burial area were found indications that the spot had been occupied by a large public building. At one end of the burial area were found the charred remains of cedar logs that had formed a stairway. "It was the custom," said Major Webb, "to cover buildings with three or four feet of earth and use this roof for ceremonials. The cedar logs forming the ramp to the roof are the originals laid down by the Indians. When, in time, the building collapsed, the earth on the roof covered it, and later the same spot was used for burials." The bodies had been buried in the extended position rather than flexed.

The exact age of the prehistoric buildings uncovered in the Norris area, and the precise identity of their inhabitants, will not be known until later. These Indian remains are different from any hitherto found in America. "The men who built the round altars may have been early Cherokees and lived into historic times—until about 150 years ago. The presence of the square altar indicates Catawba influence," said Major Webb.

THE Cherokee nation built many towns throughout Tennessee similar to the walled villages of the Iroquois in the north. At one time a member of the Iroquois union of tribes, the Cherokees seceded from the Great League and migrated southward. In the southland they remained, a group of settled agricultural people surrounded by less civilized tribes. Their structures, intricate religious ceremonies, and compact political organizations bear out the traditions of their Iroquois forebears, whom the archeologists have termed "the Romans of the North American Indians."

Though a guess may be hazarded at the identity of the recent or topmost layers of remains, Major Webb refuses to make a definitive statement on the obviously earlier ones. For example, the old temple site found below the burial mound alongside the Clinch River in Anderson County is believed to date back long before the arrival of Columbus in 1492.

Site on Clinch River, near Clinton. Cedar log ramp mentioned in text shows clearly. Note the skeletons purposely left in place on piers of earth when the ground was excavated



"The exact age of prehistoric buildings uncovered in the Norris area will be known within another year," said Major Webb. This will be accomplished with the aid of a dendrochronologist, one who reads the ages of trees from the rings shown in a cross-section of the tree. Samples of 23 logs from the ancient buildings have been taken, and of these the rings in nine can be read. Dendrochronological comparisons will be made with logs furnished by the Tennessee Valley Authority's Forestry Division from the oldest living trees of the same species in the region and from logs taken from old houses in the neighborhood. A present rough estimate is that many of the buildings had been erected around 1000 A.D.

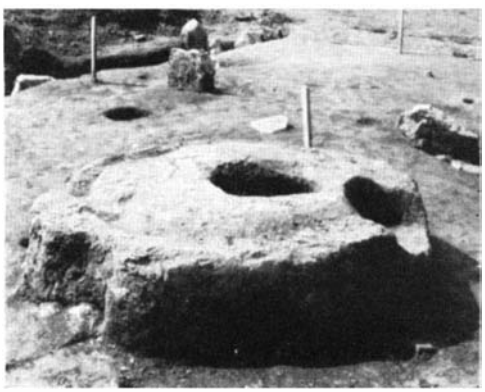
"At least three vanished civilizations will soon be flooded in this area," said Major Webb. "One was very low in the human development scale; two were well up in barbarism, one extending into the history of our own country."

THE exploration of the Wheeler Dam reservoir area presented quite different archeological data. In this area alone there are 300 Indian mounds and village sites ranging in age from late historic to prehistoric times. In January, 1934, two parties of 60 men each began work in Lauderdale and Colbert Counties, and as the project progressed, the work gradually spread out to include all the counties falling within the reservoir territory.

One shell mound near Lock No. 1 along the Tennessee River in Lauderdale County yielded a very considerable body of information concerning the stratification of occupancy on this site, and also a considerable amount of skeletal material and artifacts, study of which should enable differentiation of the various levels of culture in the creation of this huge mound.

Numerous other sites were uncovered, the most important being two sand mounds on Tick Island in the Tennessee River, a village site on the Tennessee near the mouth of Cane Creek, and another on Hobbs Island in the Tennessee.

Some unusual finds were made in the burial mounds. The heads of several of the skeletons of children were found to be encased in huge conch shells, which had been split and then fitted back together around the heads. In these burials, the lower half of the shell was skilfully cut away to accommodate the deceased's head and neck, after which the upper portion was placed over the face and firmly cemented to the bottom part. That portion placed over the face was sometimes rudely fashioned into a face-mask, with tiny holes for the eyes and a crudely carved representation of the nose. The conch shells used in this burial practice are native only to the Gulf of Mexico. From this it might be inferred that much of the cultural influence on these tribes came from the south.



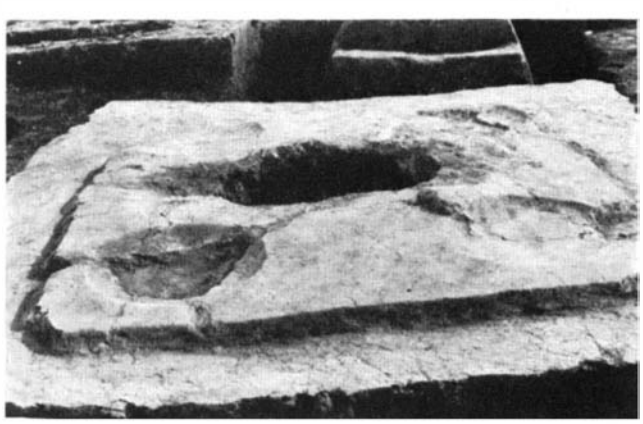
From the Caryville site mentioned in the text. A raised ceremonial fire pit

This inference is further substantiated by the finely fashioned stone pipes discovered in some of these graves. The stone pipes manufactured by the Indians at the spot now occupied by the town of Pipestone, Minnesota, were highly prized by all the tribes and have since been found in the remotest corners of the United States. These particular pipes, however, are finely fashioned, but are of entirely different stone.

Two peculiarly shaped copper ceremonial objects were found in a depression immediately beneath one grave. They are flat and four armed, roughly shaped like the wooden creels upon which we wind string today. Only about six of these have ever been found in the United States, and all of them in the Tennessee area. It is believed that the native copper from the country up the river was used for these objects, rather than copper relayed by trade from the Lake Superior region, as is the case in some instances.

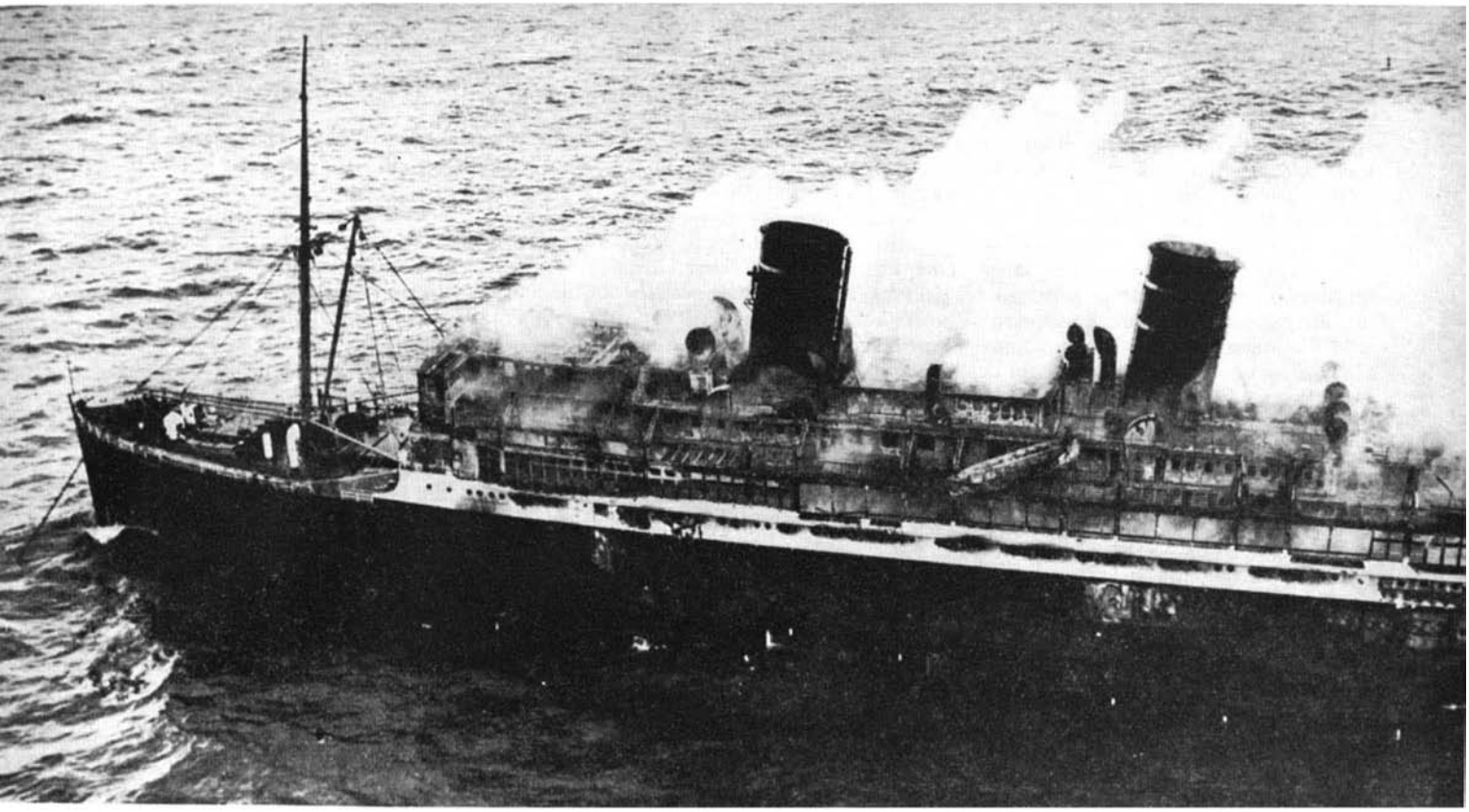
TO all appearances these races that occupied the Muscle Shoals area in prehistoric times were for the most part nomadic, being attracted to the neighborhood mainly by the presence of the large supplies of shellfish. There is little or no evidence of sedentary life, such as the walled towns in the Norris area. Two main groups of ancient peoples once lived in this area, archeologists believe. The oldest known lived long before historic times, were the most skilful carvers of stone pipes and other objects among all the American Indians, traded with shells, and buried their dead in stone-lined graves. The later inhabitants were the predecessors of the more modern Indian tribes. Some of the older village sites are believed to date back to the time when the bow and arrow had not been invented and the chief weapon was a dart given strong momentum by an *atl-atl* or throwing-stick.

With the close of the actual exploratory activity the findings were sent to various institutions for final accurate examination. The artifacts found in the Wheeler Dam region were sent to the University of Alabama, with the exception of the skeletal and pottery finds, which were sent to the University of Kentucky and the University of Michigan respectively. Relics from the Norris Dam area were sent to the University of Tennessee; the skeletons were sent to the University of Kentucky. Major Webb, himself, will offer an accurate and scientific monograph on the entire project as soon as final data from these institutions are available.



A square, raised ceremonial pit in one of the temple sites. Note four depressions mentioned in the article

The site of a structure in the Norris Dam reservoir area. This is where the "water tight pottery" was discovered



The tragedy of the *Morro Castle* might have been avoided by adoption of available safeguards

FIRE AT SEA!

By R. G. SKERRETT

Many Ships Are Firetraps... Personnel Inadequately Trained and Disciplined... Yet Fireproofing and Full Protection Possible... Aroused Public Opinion Needed

WILL the horrifying loss of the S.S. *Morro Castle* lead to corrective measures that will make for greater safety at sea? Or will the virtual destruction by fire of that comparatively new ship and the sacrifice of 137 lives remain just one more appalling blot on the record of our Merchant Marine? Are we to understand that such tragedies are inseparable from ocean-going travel, and that naval architects and other technicists have not made possible greater security of life and property afloat? We can answer these questions only by analyzing the contributive causes of that disaster and show what can be done to make a recurrence more or less unlikely.

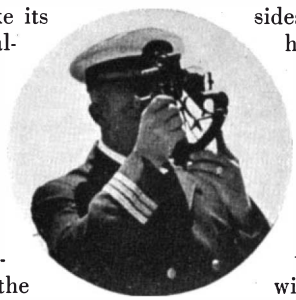
The files of SCIENTIFIC AMERICAN will disclose how, over its many years of service to the public, it has earnestly and repeatedly urged the adoption of practicable measures that would promote safety at sea. Its position now is that the catastrophe that befell the S.S. *Morro Castle* and the people aboard her could have been avoided, and that human fallability was, in the main, responsible for the conflagration reaching an uncontrollable stage. Harsh and deserved criticism will do no good now—there are constituted authorities that should place blame wherever accountability lies: our function is to point out how the menace of fire can be very much lessened on vessels designed primarily for the carriage of passengers in considerable numbers. To this end, we must first examine the ship and her equipment; and then we must weigh the part that must always be played by her personnel in her proper administration or operation either when things are running smoothly or when the presence of fire aboard creates an emergency calling for prompt and trained collaboration.

THE fire hazard in modern merchant ships, and especially aboard the de luxe liner, has led to extensive investigation, to the devising of numerous protective features and instrumentalities, and to a somewhat voluminous literature that is revealing of how much study has been given to the prob m. Furthermore, various branches of ur engineering and industrial life have ntributed dependable apparatus fo the early detection of fire, and have rovided effective means for smothering or extinguishing flames, as well as structural materials that can be relied upon to resist the spread of fire long enough to give an alert personnel a very fair chance to bring the fire-fighting equipment into action effectually and decisively. No experienced naval architect or seafaring man believes it economically feasible to build and to operate profitably a craft that is 100 percent fireproof. On the other hand, there are those of experience that are convinced that a passenger ship, for example, can be made so far fire-resistant that flames can be held in check and the vessel safeguarded from extensive damage.

The modern express steamship which, for our purpose, also means the motor ship, earns money for her owners by transporting both freight and passengers. The freight or cargo, no matter what its character, is commonly stowed in steel-walled compartments that are kept sealed between ports. Should fire develop within any of these closed spaces, it is a comparatively simple matter to fill the endangered space with steam, inert gas, or, in some cases, to

admit water to extinguish the fire, or at least to confine it to that single subdivision of the craft.

The up-to-date liner is equipped with some kind of automatic fire-detecting system that indicates at one or more continually attended stations just where the danger has developed in a cargo hold, a storeroom, a fuel bunker or any kindred space, and within a minute or two a volume of inert gas, for example, can be turned into the area to smother the fire or to make its spread extremely slow—really progressive smoldering rather than flaming. Again, in the well-equipped liner there is an automatic fire-detecting system that stands guard continually over the quarters of the ship's personnel and the cabins of the passengers; and should fire develop in any of these spaces, men assigned for the purpose in each division of the craft can hasten at once to the endangered area and deal with it with means provided for that purpose.



THE *Morro Castle* had fire-detecting systems extending to all the structural subdivisions enumerated in the foregoing paragraph, but, by the irony of fate, no such automatic detectors were placed in the public or recreational spaces designed for the convenience of the passengers. It was in one of those spaces that the fatal fire was first located and, according to reports, inefficiently attacked. Possibly, had the ship had automatic detectors in all those spaces the fire might have been discovered sooner; but, even then, it is an open question whether or not the flames had originated somewhere else within the structure and spread there insidiously—acquiring the while a headway that made their onward progress irresistible.

Safety regulations for the arrangement of present-day passenger liners require the interposition of athwart-ship steel bulkheads, with suitable doors, that divide the passenger accommodations into unit areas intended to check the advance of fire from one division to another forward or aft of the zone on fire. But this is, at best, only a partway safeguard and would hardly do more than slow up disaster if the entire affected area became inflamed. The safety of a ship exposed to fire in her passenger accommodations can be reasonably assured or minimized only by the adoption of structural changes that will reduce to a marked extent the quantities of inflammable materials in those sections of a vessel that will make each stateroom or each public space a self-contained unit having walls, ceiling, and floor that are in themselves fire-resistant. Furthermore, ways and means must be provided that will restrict or choke drafts that contribute to the propagation and the spread of flames.

Because of its inherent lightness, comparative ease of working or shaping, and because it lends itself readily to painting or some other surface finish, wood is usually employed to form the partitions, paneling, and cabinet work found in staterooms and the public spaces of a liner. The structural steel framework overhead and along the sides of a ship are generally hidden behind carpentry work. To support that finish, furring or grounds of wood are interposed between the steel and the paneling, ceiling, and so on. It is within the intra-mural spaces so formed that piping and electric wires for a diversity of services are run. We have a counterpart in our own homes. On shipboard, these intra-mural channels contain fuel and induce insidious drafts that feed and encourage the spread of a fire. Thus a conflagration may attain dangerous proportions even before it comes out in the open and is discovered. Inflammable furniture in a passenger stateroom may be the means of propagating fire started by a cigarette, a cigar, or a match disposed of carelessly.

For these reasons, all wood backing should be chemically treated to make it fire-resistant or be supplanted by light metal that will serve the same purpose; and the walls of a stateroom should be of fire-resistant materials extending from the floor or deck up to the deck or beams overhead to isolate the cubicle and thus prevent drafts along the ceiling.

IN an effort to win patronage, the public spaces of some de luxe liners of today have many of the characteristics of accommodations found in overly elaborate hotels. The architectural embellishments are usually fashioned of wood and, of course, are highly inflammable; while the interior decorator provides appointments that are just that much more fuel for flames. As has been well said, probably most travelers do not feel at home in that setting, and the lavishness of those places is unnecessary and an invitation to calamity. In the case of a hotel, similarly appointed, such a hostelry would be found in a city boasting a fire department manned by a thoroughly trained personnel. On none of our merchant ships, up to date, is such a force at hand to battle with a fire.

It has been argued by naval architects of acknowledged standing that the cost would be high, if not prohibitive, to rearrange the passenger accommodations and the public spaces aboard any of our well-known liners so as to reduce materially the fire risk on them. To some extent, this may be true even though extremely regrettable; nevertheless, steps can be taken and the means are at hand to lessen the peril on those very vessels. On the other hand, it is a heartening fact that there are in service today modern express steamers that have been so designed, built, and equipped in their passenger accommodations that fire originating in a stateroom or in one of the public spaces would have little to feed on and only a slight chance to attain dangerous proportions before the fire-fighting apparatus could be brought into action.

THE conservative naval architect—one who would still cling to a wide use of untreated wood—justifies his stand on the basis that the employment of metal or fire-resistant materials would add excessive deadweight to the above-water body of a ship and make vexatious the problem of giving to the craft comfortable motion and the desired measure of stability in a seaway. According to other experts, a large liner can be immensely improved in the matter of her structural defenses against the spread of fire without adding to her deadweight more than 1 percent; and there are still others who are convinced that even this allowance for the sake of added security is an excessive estimate. Of course, best success in this direction can be realized only when the ship is designed from the very beginning with a full knowledge of the materials that can now be had for use in place of inflammable lumber; and the increased cost, if any, would be rela-

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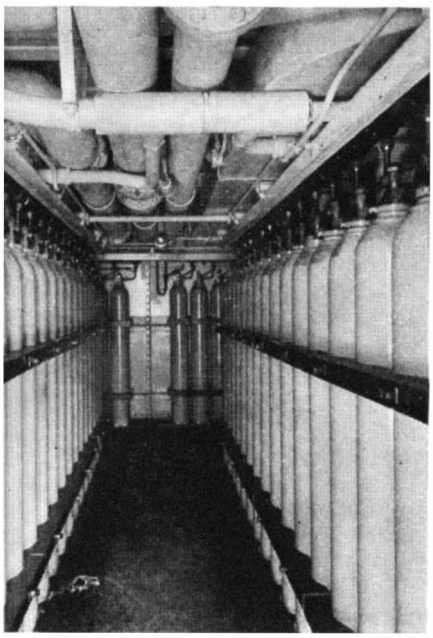
Metal furniture (aluminum) and fireproof paneling aboard ships, as are used in this cheerful, modern dining salon, greatly reduce fire ha

ke pouring from one tube of this fire de-
r (right) indicates compartment in which
is located. Below are shown containers
ire-smothering inert gas on the *Europa*



tively small and well worth the while for the protection thus afforded.

Rear Admiral George H. Rock, formerly chief constructor of the United States Navy, is an outspoken advocate of steel partitions in place of wooden panels, walls, etc. It is his opinion that lightweight stainless steel, fabricated for the purpose, can be employed, where lumber is now used, and afford all essential strength and resistance to fire. He has pointed out that steel so fashioned would cost less to maintain in proper condition than any combustible material today utilized.

It is not possible in the space now available for the general presentation of our subject to enter into details such as has been done by technicists in this country and abroad. Let us, however, touch briefly upon certain conclusions arrived at by George G. Sharp, naval architect of New York City, who, besides designing a number of ocean-going liners especially constructed to resist the spread of fire, has also carried out a series of tests on a sizable scale for the purpose of definitely evaluating a number of materials developed commercially to minimize the fire hazard within the passenger spaces of vessels. These also included the testing of metal furniture to replace furniture of wood, commonly found on shipboard. The investigations established the relative adaptability of steel, fireproofed wood, aluminum, asbestos, combinations of asbestos and aluminum, felt-bonded metals, and the non-inflammable panel-

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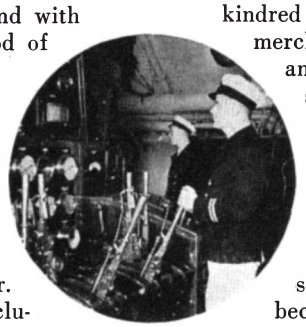
ings of phenolic resin and Micarta plastics. (See "Plastics Come of Age," January, 1935, SCIENTIFIC AMERICAN.—*The Editor.*)

THE purpose was to ascertain how far these different materials could be employed in constructing three different classes of bulkheads, each capable of affording a prescribed measure of fire-resistance at given maximum temperatures and for fixed periods of time. The assumed temperature of a briskly burning fire is 1700 degrees Fahrenheit; and in the tests conducted by Mr. Sharp and his associates, the so-called A-1 bulkhead resisted a temperature of 1500 degrees for 60 minutes; the A class bulkhead withstood a fire for 30 minutes when exposed to a temperature of 1500 degrees; and the B type bulkhead survived a temperature of 1000 degrees for 30 minutes. In every case, the resistance to combustion was such that fire could be held at bay long enough to bring fire-fighting facilities into action with measurable promptness and with every reasonable likelihood of extinguishing the flames.

The objective in developing the foregoing bulkheads was to produce those that would make for simpler construction while increasing the defenses against the spread of fire on shipboard. Mr. Sharp reached this conclusion: "In the matter of simplification of the methods of construction, it may be assumed with reasonable confidence that by making a fresh start in the consideration of this problem, economies can be effected that will wipe out any adverse balance which might, in the light of existing practices, seem to be inescapable. Of course, such economies as might be effected would in some measure also apply to construction using untreated panels, but it seems fair to credit the economies effected by the advancement in the art to the production of a means for controlling an outbreak of fire." In short, this designer, as a result of what he has already accomplished on certain modern ships, is convinced that any added cost involved in increasing resistance to fire in the ways he proposes will be more than offset by resulting benefits.



The point to be emphasized is that there are today available sensitive apparatus that will give instant warning of the presence of smoke or an alarming rise in temperature in any compartment or subdivision of a ship and indicate in some manner where the danger lies. Again, measures have been devised by which flame-promoting drafts can be localized or choked; and by the use of structural materials of approved efficiencies the spread of fire can be checked for considerable periods. Furthermore, fire-fighting mediums in the form of automatic sprinklers, inert gases, steam, and the like, are at the disposal of the naval architect when planning for the security of a vessel.

IT must, however, be recognized that carelessness, a short circuit, and various other causes may lead to a fire in the passenger accommodations of a liner regardless of regulations, education, or other precautions relied upon to promote safety at sea. In any case, ultimate security rests upon the personnel of the craft concerned and the promptness and skill displayed by the officers and crew in combating a fire. The flames must be fought in their very earliest stage, and the attack must be an understanding one that shows preparatory training. This state of readiness and efficiency is reported to have been woefully absent aboard the S. S. *Morro Castle.* We wonder how much better are discipline and fitness for a kindred emergency on other of our merchant fleet. In the last analysis, responsibility rests squarely upon the Government and its statutory agency, the United States Steamboat Inspection Service.

The so-called short cruises offered by passenger steamship lines have become popular with our people. Of these relaxing trips, Rear Admiral Bradley A. Fisk has written to *The New York Herald Tribune*: "American men and women have been going to sea on the most shocking and irresponsible 'joy rides' on board vessels about whose seaworthiness, fire prevention methods, and other matters they knew nothing whatever. They had . . . some vague notion that there were some kinds of laws which made it perfectly safe to go to sea in American

(*Please turn to page* 110)

THE VERSATILE PAPAYA

A papaya plantation in Florida, showing the "bunches" of nearly ripened fruit hanging just under the lower branches

Used as Breakfast Food . . . In the Manufacture of Rope . . . For Medicines and Cosmetics . . . 'A Melon in a Tree'

By FRANK A. MONTGOMERY, JR.

IF you are somewhat tired of the constant procession of oranges and grapefruit and similar products of the fruit grower's art that march endlessly across your breakfast table, and have an adventuresome spirit that calls for something "different," you might, quite possibly, do worse than vary your fare with a papaya. Your fruit dealer or neighborhood groceryman might look puzzled and inform you that there is no such product. But don't you let him fool you. For he should know better, and recognize in the papaya, or tree-melon, that delicious product of tropic lands that is rapidly coming to the fore as not only a delicious breakfast food, but also as a source of many useful products to mankind.

In fact, the varied products of this unusual member of the plant world are fully as striking as the strange appearance of this tree in fruit. The papayas are borne upon long stems that issue directly from the trunk near the topmost leaves. For example, the bark of the papaya is used in the manufacture of rope, while the roots yield a juice that is said to be an excellent nerve tonic. The seeds are eaten as a delicacy and the natives of the tropics quite often chew them to quench their thirst. The ripe fruit finds a place as a most pleasant substitute for the prosaic cantaloupe, while, in a green state, it may be cooked and eaten as a vegetable. Then, too, when a tree has become unproductive at the end of approximately three years, and is cut down, the soft, pithy heart of the tree is carefully removed and grated and served in just about the same manner as a cocoanut. The flavor is somewhat different from that of the cocoanut, but in appearance and general characteristics the heart of the papaya tree might easily be mistaken by the unsuspecting for grated cocoanut.

Sliced and served with whipped cream, papayas make a delicious dessert; in combination with lettuce and sliced cucumber, a wholesome and nourishing salad. Marmalades and jellies made from the fruit are greatly relished, and for pies, shortcakes, sherberts and pickles, those familiar with the fruit want nothing better. On the other hand, crystalized papaya cubes, if prepared carefully, make some of the best candies that can be prepared from tropical fruits.

But more interesting than the fruit of the papaya (and it is for this product that so many of the commercial plantings are being made in the tropical sections of the United States) is the milky juice that is obtained principally from the fruit while it is still green. This juice, in its natural state, is used by the natives of the tropics in the treatment of eczema, warts, intestinal worms, ulcers, and many kinds of sores, in diphtheria, and for numerous other ailments.

The ripe fruit is used as a cosmetic, a slice of it being rubbed upon the skin to remove freckles and other blemishes. Face powder and many lotions for care and treatment of the skin are produced from the papaya. The green fruit and the leaves are employed as soap to remove stains from clothing.

EXCEPT for food, and the production of papain for the drug trade from the fruit, no single use of this plant is so common in the tropics as that of the milky juice in rendering tough meats tender. For this purpose a slice of the green fruit, rich in juice, is rubbed over the tough meat, or the latter is dipped for a few minutes in a solution of the juice itself. Sometimes a piece of the fruit is placed in the water in which meat is boiled. Another way to utilize this long-used property of the papaya is to wrap the meat in the leaves. Some stock raisers, it is claimed, even feed the fruit to their hogs to make the pork more tender!

The reasons for this unusual quality of the papaya for rendering tough meats tender lies in the fact that the juices of the tree are rich in papain, which is a product possessing the power of digesting protein materials such as meat, egg white, the curd of milk, and so on. The action is similar to the two well-known body-ferments in the human stomach, pepsin and trypsin. On account of the efficiency of papain, it is largely replacing pepsin in the drug field.

The method followed in obtaining this valuable papain is to dry the milk that exudes from the rind of the green papaya fruit. The milk containing the papain is best obtained from the nearly full-grown, well-developed green papayas by scratching or making shallow cuts in the rind with an ivory, wooden, or bone knife. Very young fruits give a milk that is rather weak in digestive power, while the ripe fruit gives very little, if any, milky juice.

The juice that flows from the cut on the fruit is collected in a glass or china vessel, which must be scrupulously clean. After a short while the bled fruit will cease to flow, due to coagulation of the milk in the cut. In a few days, however, the cut heals over, and, apparently, the process has little effect upon the quality of the fruit produced. Additional cuts may be made in the fruit every four or five days, or until the fruit shows signs of ripening. Under no conditions are steel knives used for making the incisions, as the resulting papain will be of a dark color, and of little value. The tapping is done in the early hours of the morning, and is always finished before 10 o'clock, which gives plenty of time for drying the same day.

SHORTLY after collection, the whole mass of juice coagulates, forming a pure, white curd. This must be rapidly dried lest decomposition should set in, completely spoiling the material. Drying is accomplished by many producers in the tropics by simply spreading the curd upon glass sheets and drying in the sun, and while it should be done without delay, too rapid drying results in an inferior product. In Ceylon, especially, where, on the southwest side of the island, weather conditions are usually rather uncertain, drying the juice cannot be done outdoors. In this locality, and on many of the larger plantations in other parts of the world, special drying apparatus is in use. A good average yield of papain from an acre of papayas is 175 pounds of powder yearly.

A noted health expert has this to say about the papaya: "I have been especially interested in investigating the vitamin content of the papaya. Work done in Honolulu and the Dutch East Indies indicates that the papaya is rich in vitamin C, which makes the orange so valuable, and is very rich in vitamin A. This last vitamin is rare in fruits, and is generally associated with vitamin D wherever found. Vitamin D prevents rickets, so for this one reason alone the papaya should be of inestimable benefit to the people of the world. Also, because of its powers to aid digestion of foods, it should prove a boon to sufferers from the various forms of indigestion.

"The study of the papaya from a health standpoint has only just begun, in spite of the fact that its medicinal virtues have long been known to dwellers in the tropics, where the fruit grows wild. But the facts already known indicate that the papaya possesses qualities which make it capable of rendering a priceless service to the people of the United States."

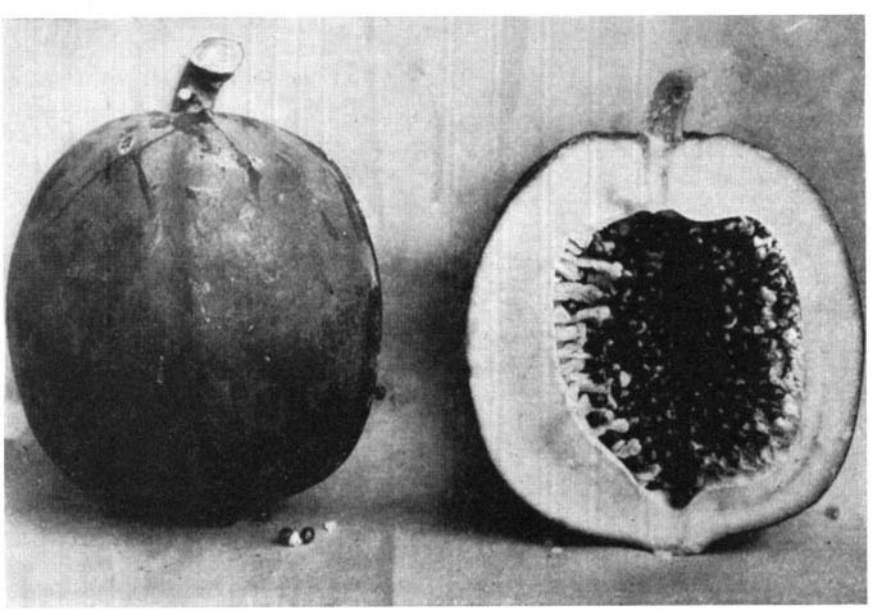
THE papaya belongs to a genus of about 20 species which are native to tropical and sub-tropical America, with the common species (*Carica papaya*) occurring naturalized through the keys and hammocks of south Florida. The plant has been carried around the world, however, until it is known throughout almost all tropical regions. All the species are of rapid growth, making unbranched trees up to 30 feet in height, which are of striking appearance, with large leaves and abundant melon-like fruit, giving the plant a singular and characteristic aspect. The fruiting is comparatively continuous over a period of three or four years. The fruit ranges in size from the size of a quart measure to that of a large water bucket, and weighing from three pounds to as much as fifteen. Many species are round in shape, while others are elongated, and these, incidentally, are the best type for shipping.

The problems of the cultivator are several. The first one, and that which has caused the greatest difficulty in selling the fruit for food purposes, is the problem of establishing a strain of papayas that are of high and uniform quality. The papaya produces three types of plants bearing, respectively, staminate, pistillate, and perfect flowers. The first are useless for fruiting, and the second must be pollinated by male or perfect flowers.

A small papaya tree flourishing in the yard of a Florida fruit grower

It seems rather unfortunate that a plant with so many possibilities for culture in the tropical portions of the United States, especially southern Florida, should be surrounded by so many perils. Being strictly tropical, the papaya must be grown out of reach of freezes. It can not stand flooding or a high water level, yet requires a constant supply of moisture. On sandy lands it is subject to root knot, but it can be managed in such places as an annual crop. Its leaves may be attacked by a leaf fungus, but this is controlled by means of regular spraying. The greatest danger to the grower, however, lies in the activities of the papaya fruit fly, an insect that deposits its eggs beneath the skin of the papaya, where they later hatch and prey upon the pulp within.

For a fruit which has so many qualities to recommend it, it is but natural to run to superlatives in describing it. But fortunately the papaya, not being human, cannot be injured by so much praise, for which we should be grateful. One lover of the fruit will praise its delicious taste as a food; another will rave endlessly about its marvelous digestive properties; while still another will run wild upon the subject of its many odd, and, seemingly, unrelated uses. But after all the papaya is nothing but a melon, and the fellow who said that it struck him as being a "glorified melon which has climbed into a tree to display its superior qualities," certainly hit the nail upon the head.



Ripe papayas. In the sectioned fruit at the right may be seen the location and arrangement of the numerous seeds, uses for which are mentioned in the text

Let Us Die Fashionably

By T. SWANN HARDING

SOMETHING a doctor friend said to me recently gave me the idea expressed in that rather curious title. I was bemoaning our increasing death rates from heart disease and cancer. I said I hoped I should not die of cancer. It was then that the physician remarked:

"You will probably die fashionably."

"Fashionably?" I gasped.

"Certainly. What is so extraordinary about dying fashionably? Who ever died of appendicitis in 1875? Look how many people die of it now. I tell you certain diseases become fashionable. I mean by that, that they are recognized as diseases, doctors grow somewhat enthusiastic over them and then patients begin to die of them."

"But statistics do show that our death rates from heart disease and cancer are becoming most alarming."

"FIGURES don't lie," said the doctor, "but statistics are figures that have grown up and learned how. In the first place, who is it that says anybody dies of anything? The physician who signs the death certificate. Why does he say, for example, myocarditis, a form of heart disease, or cancer? Often, I tell you, because it is the thing uppermost in his mind, the fashionable thing. I just came from the autopsy of a man who died of diabetes, according to his death certificate. But he had an infected leg. His heart gave out. Worse still he had an inoperable cancer in his abdomen. What did he die of? If he had not gone to autopsy the attending physician might have written any of three or four things and been right, to some extent. Suppose he was interested in heart disease and it looked like endocarditis to him. Would this man have died of diabetes? Look it up some time. You will find out I'm right. And, as for you, you are almost certain to die fashionably, whatever else you do. Cheerio."

"What are diseases?" Our bodies are invaded by organisms and they produce symptoms as their reply. These replies have various names—measles, scarlet fever, whooping cough, and so on. These are called diseases and they are classified in various ways. No scheme of classification can possibly be perfect, and diseased conditions constantly arise which will not fit into existing schemes under existing labels.

The doctor confronts a living patient. He observes certain symptoms. He classifies and concludes that the disease is such and such. Why? Assume that there are ten symptoms to be expected as evidence of a certain disease, say influenza. Of these, seven are invariably found in influenza, but the other three are found also in pneumonia. There are overlapping symptoms. You can see easily that there is a margin for free judgment here.

WHAT would you call a classic picture of influenza? A case with seven of the symptoms, a case with but six, or a case with eight? A point is soon reached where one physician would say influenza, another influenza-pneumonia, another la grippe and still another coryza, perhaps. Suppose the patient dies. What shall be assigned as the cause of death in the certificate? Suppose now that the patient had a weak heart and that he died suddenly of heart failure?

I began to see how it would be possible for a person to die fashionably.

Indeed, Dr. B. Henry Mason told the American College of Surgeons in November, 1930, that, upon reviewing the cases in New England hospitals, he found errors in diagnosis in from 20 to 75 percent of all that had resulted in death. He said that gross errors were made in 20 percent of the cases and he urged that autopsies be performed on every dead body, because only thus could we begin to get an accurate idea about causes of death.

So a disease is, after all, not so much what a person dies of as what his doctor thinks he died of, or what he certifies as the cause of death. Therefore mortality statistics based on death certificates may mean little.

Because we hear so much about it, let us take heart disease as an example. In early 1932 Dr. Robert H. Halsey published an article that caught my eye. For one thing I discovered that there is such a thing as "The International List of Causes of Death." You practically have to die of something listed in this list or else lose caste as a corpse. But in 1919 you could have died of only four kinds of heart disease:—Pericarditis, endocarditis, acute myocarditis, or angina pectoris. If the death could not be shoved into one of those classifications—well, you simply died of "Other diseases of the heart."

But in 1929 the same list was much expanded. The four causes remained, but one could also die of "acute" or of "unspecified" endocarditis, not to mention "chronic unspecified" and "chronic specified." It was also possible in 1929 to die of conditions such as "chronic myocardial degeneration," or "disease of the coronary arteries." Finally, under the old classification, "Other diseases of the heart," were to be found, "*a:* Functional," and "*b:* Other and unspecified." So I saw that a person might die of what might be called one type of heart disease one year, which might be quite another disease ten years later.

I ALSO found that in the years 1804 to 1808 no deaths from heart disease were recorded as occurring in New York City. Only in 1868 did attention come to be directed to the matter of classifying causes of death for statistical study. A list was then adopted. It was revised every 10 years. Now in 1924 when the 1919 list mentioned above was still effective, only 10.6 percent of all deaths from heart disease were classified specifically; the other 89.4 percent were thrown into the omnibus drawer called "Other diseases of the heart." Things were just about the same in 1927, meaning that specific diagnosis was uncommon.

But the list expanded, as we observed. Yet, while in 1929 figures collected under the old listing classified 91.8 percent of all deaths from heart disease among "Other diseases of the heart" (which means essentially nothing), the figures for 1930, reported under the new listing, so classified only 4.3 percent of the deaths! Why? Had heart disease changed? No, but the classifications had. Physicians had become aware of new labels for varieties of heart disease. These new classifications became fashionable. People at once began to die of them.

Am I drawing a long bow? I think not.

Take myocarditis, for example. The myocardium is the muscular part of the heart wall; myocarditis is a very acute inflammation of that wall. In 1914 Dr. R. C. Cabot asserted that his studies of 3000 necropsies had demonstrated that myocarditis was "recognized" in living patients six times as often as it could be found in dead ones. That seems to do quite well for recognition of something that is not there.

In 1908, however, the famous heart specialist, Sir James Mackenzie, had very emphatically called attention to the importance of the myocardium. He at the same time deprecated the great weight then given by physicians to valvular damage. What happened? Almost immediately the registered deaths from myocarditis increased rapidly and significantly, and those ascribed to valvular disease dropped off.

AS Dr. Halsey writes, "It was apparent that physicians of the State could become 'myocardial minded'. . . . It was almost certain that there was no such change in the actual incidence of myocarditis or valvular disease. . . . These tabular changes evidently result from the demands of 'style,' 'vogue,' or 'fashion' in medical thought. . . ." Names and classifications change. Then people die of newer and more fashionable diseases. Shall we soon read in the advertisements: "Die of endocarditis! It is the latest thing in the smart set of business men. To die of endocarditis is to die fashionably."

Nevertheless in 1930 the deaths from heart disease in New York State were 23.6 percent of all deaths. Deaths ascribed to this cause were only 1667 less than the sum of all deaths ascribed to cancer, tuberculosis, and pneumonia put together. What about that? Or we read an article about cancer. It says that the death rate from cancer in 18— was —— per 100,000 but that today it is —— per 100,000. That looks nice and impressive, especially if illuminated with charts and graphs. What about that?

Well, what is heart disease? "Is the 'appalling increase' in heart disease real?" That, by the way, is the title of an article by Drs. Charles F. and Nils W. Bolduan of the New York City Department of Health. I read this and immediately discovered that what had increased was the number of deaths from heart, kidney, and arterial ailments. But while a great deal has been said and written regarding "the rising tide of heart disease," it appears that no one has so far taken the trouble to determine whether the tide is really rising or not. The *basic data* are death certificates filed by physicians who classify deaths "fashionably" under the causes of death listed in the international classification list.

Statisticians in health offices really

Growing Death Rate From Cancer and Heart Disease . . . Is It Real or Only Apparent? . . . Why Our Alarm May Be False . . . Inaccurate Reporting of Cases by Earlier Physicians . . . Better Reporting Today Reveals More of the True Cases

use this list more conscientiously than do doctors. What happens is this: A death occurs. The physician certifies the cause of death. Here are five specific cases as they left the physician—

1. Chronic organic heart disease; chronic Bright's disease; arteriosclerosis; cerebral hemorrhage.

2. Diabetes; pneumonia; myocarditis; coma.

3. Chronic Bright's disease; diabetes; pulmonary tuberculosis; anemia.

4. Acute endocarditis; subacute nephritis; acute articular rheumatism; uremia.

5. Chronic heart disease; pneumonia; fall down stairs; fracture of leg.

The health office statistician reads something like that and then has to classify the death under one cause in the international list. Which of the causes should take precedence? Having decided upon heart disease, which kind thereof shall it be? Perhaps the one that is most fashionable, most talked of at the time.

WHEN the heart, kidneys, and arteries are all involved it is almost impossible to say what, specifically, a patient died of. But this is true: While there has been a registered increase in the death rate from heart disease, there has been, in recent years, a corresponding reduction in registered deaths from other causes that might easily be mistaken for heart trouble. I mean that, hand in hand with a registered increase in the death rate from heart diseases, there has gone a corresponding decrease in registered deaths ascribed to apoplexy, kidney disease, and old age. That is very significant.

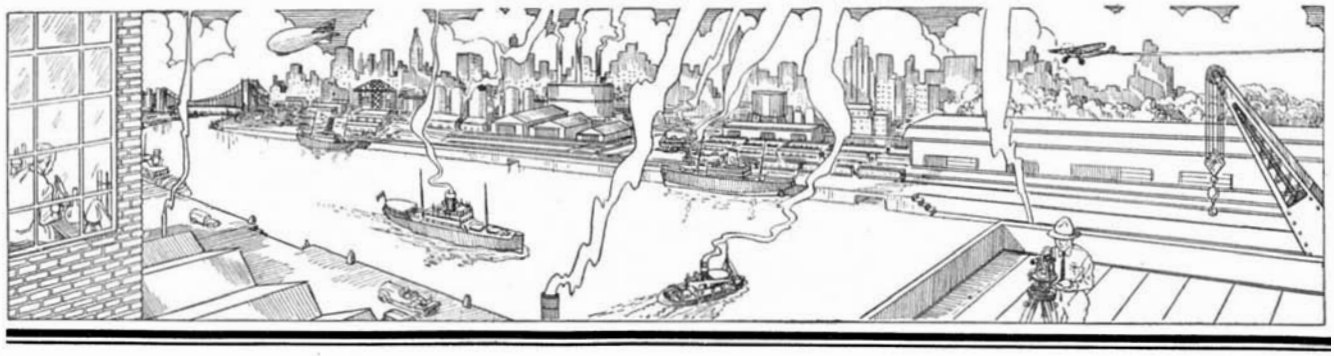
The registered death rate from heart disease has risen, but that rise is largely if not wholly fictitious—so write authorities. This is because statistics based on the registered deaths from heart disease alone are necessarily fictitious. This means that apoplexy, arterial disease, kidney ailments, and senility must be regarded along with heart disease as causes of death, and there is great prevalence of the first three in the United States. But the mere fact that specific death rates in the higher age groups have declined in this country since 1900 alone proves that there can not have been any considerable increase in mortality from heart disease.

So it became apparent that one could not trust mere printed statistical statements of alarming increases in deaths from this or that disease. Fashion had a hand in the classifications. Heart disease is too often accompanied by kidney and arterial involvements to be a real disease entity. Many deaths attributed to the heart are undoubtedly caused by pathological conditions elsewhere.

SOMEWHAT the same condition exists with regard to cancer. Cancer is difficult to diagnose. Even physicians often mistake it when they themselves are their own victims, while 50 percent correct diagnoses of cancer on living patients, with every modern clinical device available, is about as well as can be done. Surely the conditions diagnosed as cancerous, and from which our nearer and more distant ancestors died, may or may not have been cancers at all. What does this mean?

It means, for one thing, that we do not today know the true mortality from cancer. Our best statistics are adulterated with faulty diagnoses. It means also that we cannot compare our present with our past cancer death rate in this country because older statistics are even faultier than those of the present. We actually do not know whether the prevalence and the morbidity of cancer are increasing or decreasing, and this despite what well intentioned fanatics would have us believe.

Dr. Francis Carter Wood, Director of the Institute of Cancer Research at Columbia University, says our available cancer statistics are based upon the same old death certificates and that they therefore contain uncorrectable errors carried over from the primary documents—the certificates. These, as we have seen, are of little value. Hence the reports of the Bureau of the Census can rise no higher in accuracy than the faulty death certificates from which they are derived. The mere summation of data and their dramatic presentation in the form of graphs or tables do not impart to the basic sources the character of infallibility. It may astonish those who bow down and worship statistics to know that the records err by from 30 to 40 percent. The only sound method of obtaining accurate statistics is to base them not upon fashion and vogue, but upon autopsy findings.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

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Research on Twins

IN a study of the influence of heredity and environment, Prof O. von Verschuer of the Kaiser Wilhelm Institut für Anthropologie at Berlin has divided twins into three groups: (1) those with the same heredity and environment, (2) those with the same heredity but with different environment and (3) those with different heredity and the same environment. A comparison of groups 1 and 2 shows the degree of environmental influence, that of groups 1 and 3, the degree of hereditary influence.

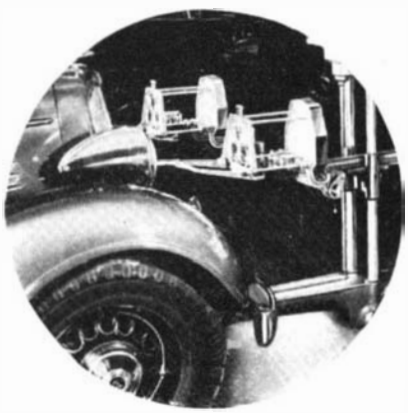
Influence of Environment and of Heredity

	Environment	Heredity
In body weight	85 percent	169 percent
In chest circumference	70 percent	165 percent
In height	18.5 percent	192 percent

—Journal of the American Medical Association.

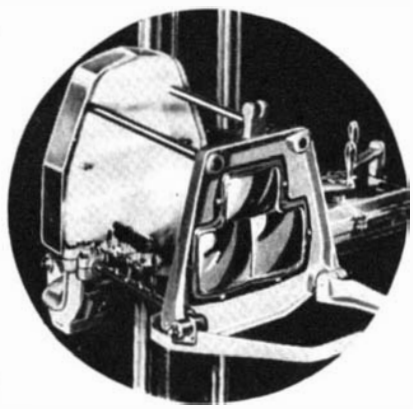
Checking Up on Headlights

A NEW device for testing and adjusting automobile lamps with scientific accuracy and at a range of only 18 inches, is attracting interest in the automotive service field. The new machine, developed by R. N. Falge, research engineer for the Guide Lamp Corporation, checks both the patterns of the light beams and their intensity, the latter being measured by means of a specially developed photronic output meter and registered in lumens on a micro-ammeter.



Motor-car headlights ready to be checked for pattern and intensity

With the car standing on four special flat steel plates to assure proper position and correct level, the lamp beams strike twin "aiming heads" 18 inches distant. Each "aiming head" carries three specially-ground meniscus lenses which collect the light from a given area of the headlamp and focus it in various patterns on a target card. The latter is provided with cross lines indicating the desired shape and locations of the beam patterns. The "aiming heads" may be raised or lowered by means of adjusting screws calibrated to change the level of the lamp beam in steps of one inch at 25 feet. With the head adjusted at the required level, the car headlamps then are aimed to bring their beams into proper relation with the target cross lines behind the lenses. Differences in battery voltages and candlepower rating are compensated for by a calibrated variable resistance control. All information revealed by the testing device is recorded on a special analysis chart for the convenience of the customer.



These three lenses are the heart of the headlight checking device

Hydro-Electric Steam Generator in Dairy Work

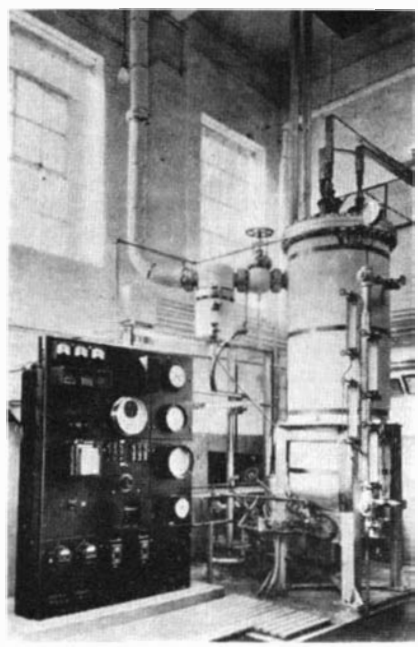
ELECTRICITY is used to make steam, instead of the customary process of steam being used to make electricity, in a new hydro-electric steam generator recently put into service in the Montreal milk and ice cream plant of J. J. Joubert, Limited. This is believed to be the first installation of its kind for large scale dairy work in Canada or the United States.

Four coal-fired steam boilers of 150 horsepower each are replaced by the new steam generator which is of the water resistance type. In such an installation, electrodes are submerged in water and heat is generated by the passage of current through the water between the electrodes, the water itself forming the resistance.

It is estimated that, at the present price of coal in Montreal, steam made in coal-fired boilers would cost about 46 cents per thousand pounds. During the first month of the new generator's operation, the steam made by electricity cost 32 cents per thousand pounds.

One of the unusual features of the installation is its ease of control. The flow of steam can be regulated by a control system which injects a small amount of salt into the boiler feed water to increase its conductivity. Various other control mechanisms are on the panel such as safety switches and low water alarm, as well as duplicate safety valves.

Three cast-iron electrodes about 10 inches in diameter are arranged in a triangular form within the boiler which is about 30 inches in diameter and 10 feet in height.



Vertical hydro-electric steam generator and its control instruments

The space occupied by the boiler is about 10 feet square and requires for dismantling a total height of 25 feet in order to raise the electrodes clear of the top of the boiler for any possible repairs or cleaning.

Without any water in the boiler no current flows but as soon as water is pumped into it and the bottom of the electrodes are covered, current starts to flow. The more the electrodes are submerged, the more steam is obtained from the boiler. In other words, the amount of steam is increased by pumping additional water into the boiler.

INSANITY'S INCREASE

COMPARED with 1910, the proportion of patients with diseased minds has risen from 173 to 225 per 100,000 population. This is a sad commentary on our rapid pace of living.

Real Cream Made at Home

HOME made cream, compounded from butter and milk, is available to every home now that a hand homogenizer, marketed by Club Aluminum Products Company, has been placed on sale through the nation's department stores. Heretofore, cream has been like Humpty-Dumpty—once it was separated into butter and milk it couldn't be "put together again." But the home homogenizer does just that. An ounce of unsalted butter and a half pint of milk are placed in the bowl of the gadget, the handle is jerked up and down a few times and presto!—fine, thick cream spurts from the nozzle, and at about half the price that the milk-man charges. Whipping cream, fully equal in whipping properties to the best grade of natural cream, can be compounded at one third the cost from the dairy.

Technically, the 12-ounce machine is well made. The parts are of bronze and aluminum, and no rubber gaskets or washers are needed. Inside the bowl is a small pump, with the piston attached to the lever. The mixture to be emulsified leaves the lower end of the pump through a small hole and is distributed along narrow, radial, horizontal grooves. In operation, the jets of liquid strike the vertical walls of the emulsifying chamber with sufficient force to disrupt fat globules, forming a permanent emulsion. The pump handle also operates a beater which agitates the untreated liquid in the reservoir.

Making cream from butter and milk, with the utensil described here

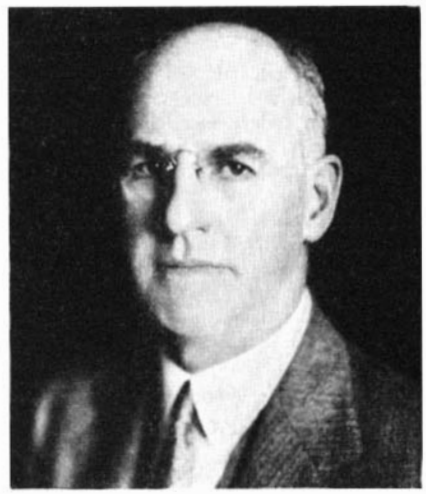
An early handicap for the machines was the need for using only salt-free butter, since cream from salt butter tastes definitely salty. The cream-maker is now sold with desalting equipment, however, obviating the need for special butter, and involving an extraction of the salt content with water. In domestic use, the butter is boiled with water, and then the mixture is poured into the bowl of the machine to settle for a minute or two. A valve permits removal of the lower layer of saline, leaving the butter sufficiently salt-free to furnish perfect cream.—*A. E. B.*

PROGRESS In This Age Of Science

As Told to SCIENTIFIC AMERICAN

By ALVAN MACAULEY

President, Packard Motor Car Company



THE field of research and invention and the high perfection that has been reached in mechanical processes have brought all manufactured products, automobiles as well as practically everything else, to a state of development today that goes far beyond that which would have been thought possible only a few years ago.

Among motor cars this is particularly true. Development and improvement of automobiles in just the last year or two exceeds that which had been accomplished in the previous five or six years, perhaps even the last ten years. Buyers of today are certainly obtaining new and almost undreamed of values for their dollars.

These values extend back all the way from the ultimate consumer to the raw materials. The manufacturer's dollar is buying more also, making it possible to pass further values along to the consumer.

We came to the realization of this when we started out to build a completely new plant for the manufacture of our new car. We were fortunate indeed in being able to do it at this time. The machinery manufacturing industry has gone far in development of new machinery. Otherwise perhaps such a car as our new one could not have been built to sell at anywhere near its price. If it were possible or economically feasible to scrap all the machinery in the automobile industry and replace it with completely new equipment all automobiles would be still further improved and could be manufactured at considerably less cost.

Of course this could not be done, any more than it would be possible to scrap all railroad passenger cars of today and replace them at once with light weight, air conditioned, high speed units representing the latest development in railroad travel. The savings in the country's railroad freight bill alone if ponderous freight cars could be advantageously replaced with those of light alloy steel construction would be almost incalculable.

However, benefits from all of these great developments and improvements which have come from an inventive people hard at work trying to pull themselves out of a record breaking depression will accrue to the country. Eventually these new things will replace the old. Machinery that can finish a cylinder block in half the time at half the cost and do the job far better will force out the old equipment, just as an old freight car cannot long stand against a new one which carries twice the load at one half the cost to move it. America of tomorrow is going to find good reason to be extremely grateful for American inventive genius of today.

While no one believes implicitly in the age-worn theory that a better mouse trap built in the woods will sell itself, there is a place always, even in the most crowded markets, for a new and superior product. That was our thought in building the new lower priced Packard car.

This Year's Motor Car

HERE, in summary, is what will be offered to the motor car buyer in 1935 and 1936. Cars will be even more streamlined than those of 1934, not merely because they offer advantages of fuel economy but because the buying public wants a "fast-looking" car.

Cars will develop still more power, partly because of improved engine design and mainly because gasoline is improving rapidly. The standard "gas" of today is the premium gas of five years ago and better than any gasoline sold 15 years ago.

Wider use will be made of the "overdrive," the use of a fourth speed shifting over either automatically or manually at about 50 miles an hour which slows down the engine speed to about three fourths of its maximum number of revolutions per second. With driving speeds on open intercity highways reaching speeds of 60 miles an hour the overdrive will have economy angles from the standpoint of fuel consumption.

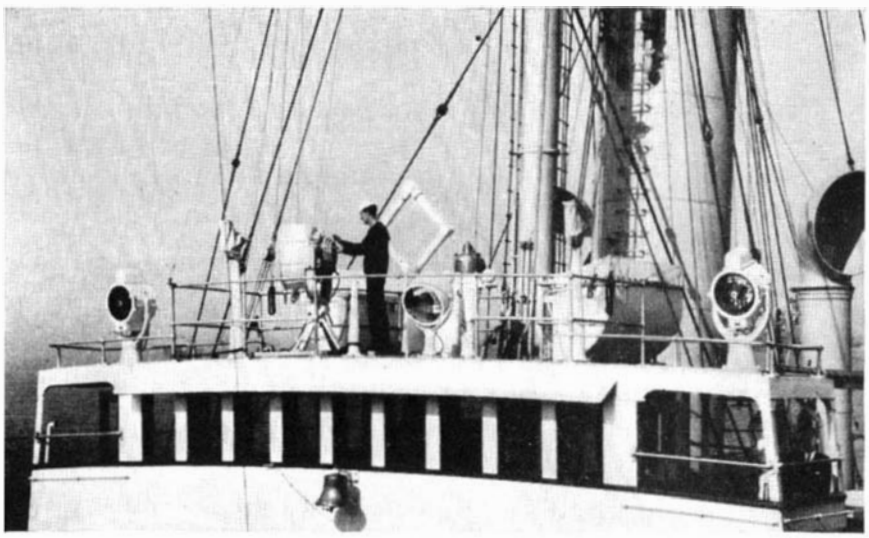
Independent spring suspension on the front wheels is now installed on about half the cars now being sold. Its principal value comes at speeds over 35 miles an hour and

as average car speeds go up it may gain in use.

Cars of the future will have larger generators to maintain the proper voltage in the battery. The growing use of automobile radios is, in part, responsible. There is also the demand that sufficient electricity be supplied at the higher driving speeds—when the charging rate is automatically decreased—to make the headlights shine as brightly at 50 and 60 miles an hour speeds as they do at 30 miles an hour now.

Finally brakes will be improved, not alone in plain stopping ability but in uniformity of action on all four wheels in all kinds of weather—hot or cold, wet or dry.

Such is the forecast of the future in automobiles made in the official journal of the Society of Automotive Engineers by Henry M. Crane, technical assistant to the President, General Motors Corporation.



The high-power loud speaker mounted on the bridge of the *Tampa*

Stentor Outdone

WHEN the American yacht *Rainbow* defeated the English yacht *Endeavour* in the International Yacht Races off Newport, last September, a newly developed loud speaker, so powerful that it can magnify the human voice a million times, was in operation for the first time. It was used aboard the U. S. Coast Guard cutter *Tampa* to warn shipping off the course and to issue instructions to spectator craft.

While the *Tampa* used the new sound projecting device at less than its full power, it has been so designed that it can be made 500 times more powerful than the ordinary loud speaker. At full power it hurls sound into the air with the force of a 50-pound hammer blow. Over flat terrain, in still air, it can project intelligible speech at a distance of several miles.

The volume produced exceeds the classically loud sounds of nature. The voice can be made louder than a clap of thunder. Measured at the horn's mouth, the sound is about 1000 times louder than the roar at the foot of Niagara Falls. The new loud speaker not only carries over distances beyond reach of existing speakers but will penetrate a din which would drown out the most powerful equipment heretofore available.

Clarity is obtained in spite of the tremendous power because the design intentionally emphasizes those voice tones which contribute most to making speech intelligible, while filtering out the other frequencies. This enables the output of the new speaker to pierce through a tumult of other noise and reach ears which already may be receiving a virtually deafening burden of sound.

The 500-watt loud speaker or "bullhorn" to replace the megaphone

Use is foreseen for the new speaker in directing throngs of people either too vast, or in the presence of too much noise, for the ordinary loud speaker to be heard. Fire fighters within burning buildings, deafened by the crackle of flames, could be directed by the giant voice. A rescuing vessel at sea could bellow instructions to a distressed crew or to persons in life-boats. In place of the fog horn's simple warning, the loud speaker could give spoken directions.

The new loud speaker is a recent development of scientists and engineers of the Bell Telephone Laboratories, in connection with their researches in the transmission and projection of sound. The horn is made of cast aluminum, and aboard the cutter *Tampa* is mounted on a swivel mast and can be pointed in any direction. Despite its tremendous power, the system is compact in design and simple to operate, being entirely controlled by a single push button.

Forecasting a Pilot's Ability

A VALUABLE aid in predicting whether or not a candidate for flight training is likely to qualify as a pilot has been designed by Dr. L. J. O'Rourke, Director of Research and Personnel of the United States Civil Service Commission. The apparatus, which is shown in the accompanying photograph, bears the imposing title of "complex co-ordinator."

The device has been given extensive trials at the Army Air School at Brooks Field, Texas, and shows a marked relation between those men who make low scores in the tests and those who fail in flight training.

In the test of the candidate the co-ordinator presents the candidate with conditions which are very similar to those confronting him in actual flight. The apparatus consists of an adjustable seat and a set of airplane controls mounted on a frame in correct relationship to the seat. In front of the controls is an upright panel upon which is mounted a buzzer and a series of red and green lights. The flashing of one light means that the flyer is meeting a certain kind of simulated flight condition, to which he must react instantly in his operation of the controls. Another light indicates another condition to which the pilot must react in a different way. If the buzzer sounds in the midst of constantly flashing lights, the pilot has to do a certain thing very quickly or else meet with a simulated disaster. The promptness of action time is recorded automatically in hundredths of a second by a six-pen chronoscope. Besides recording time, the chronoscope records the correctness of control operation. The problems which can be presented to the pilot are of a very wide variety; thus we may have rudder and stick co-ordination; the correction of a violent stall, and so on.

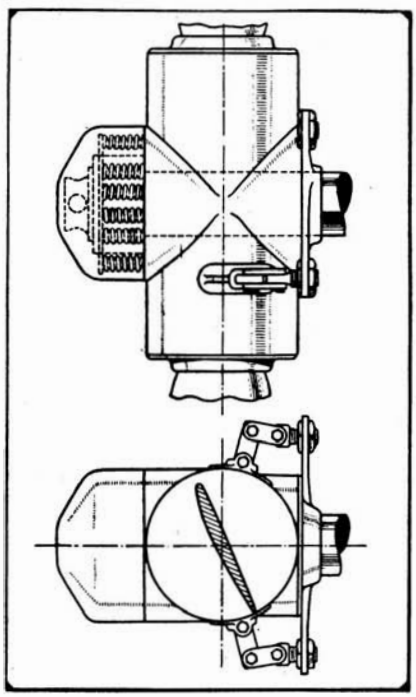
A pilot's flying ability is checked by the use of this co-ordinator

This instrument has now reached a high stage of development and will undoubtedly be useful for Army and Navy work. Of course, a man who does badly in the test may still make a good flyer, but the Army Air Corps which spends so much on training cadets will at least be able to minimize the risk of failure when taking on new students.—*A. K.*

An Automatic Variable Pitch Propeller

THERE is scarcely an important transport airplane in the world today which is not equipped with some form of variable

pitch propeller, either mechanically, hydraulically, or electrically operated. The improvement of performance to be gained by varying the pitch have long been beyond dispute. The sole disadvantage of a manually operated controllable pitch propeller is that it gives the pilot still another device to think of. Therefore, development work has been going on, particularly in the United States and in France, on automatic pitch control methods. The automatic variable pitch propeller produced by the Eclipse Aviation Corporation has gone through its



Drawings of the automatically variable pitch propeller described

tests successfully and has attracted much attention. To understand an automatic propeller of this type it is necessary to delve a little into aerodynamic principles.

The thrust of the propeller with the motor at full throttle is greatest when the airplane is stationary on the ground, held by chocks or a parking brake. It is then known as the "static thrust." To start off quickly on the get-away run it is advisable to have as large a "static thrust" as possible. Now, if the blade angle of the propeller is large, it resists the torque powerfully and the engine on the ground never turns up to its full revolutions per minute. On the ground, therefore, we want a device which will decrease the pitch, allowing the motor to speed up, and thus increase the static thrust.

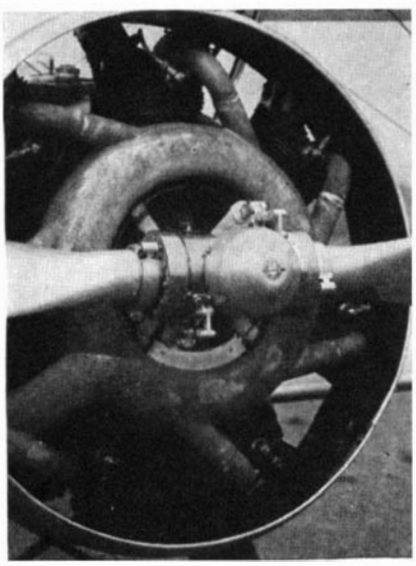
On the climb following the take-off, the thrust diminishes but is improved if the blade angle is now made greater, because a larger blade angle or pitch coordinates better with a higher forward speed.

At cruising speed the thrust diminishes still further because the motor is now throttled down. But the air speed is greater than on the climb, and therefore the blade angle should be still further increased.

Summarizing: We need low pitch or blade angle with very high thrust on the ground; more pitch and somewhat less thrust in the climb; more pitch and again somewhat less thrust at cruising speed.

The problem for the inventor or designer of the automatic variable airscrew is, therefore, to make the thrust the controlling element. Thrust high, low pitch; thrust low, higher pitch or blade angle. The engineers of the Eclipse Aviation Corporation have realized this principle in a simple fashion. The design of the propeller is simple and requires only a few moving parts.

A linkage system which is anchored to the back plate acts as a fixed fulcrum. When



Variable pitch propeller installed on a standard radial plane engine

the thrust is very high the springs at the front of the propeller are compressed and the blades accordingly move forward. As the blade moves forward, the linkage straightens out, as can be seen from the sketch, and the blade setting diminishes accordingly. A typical arrangement is that shown in the diagram. At take-off and 1900 revolutions per minute, the blade angle is at 13 degrees to the plane of rotation. At cruising and 1600 revolutions per minute, the blade angle is at 23 degrees.

A little reflection over the diagram will make the working of the propeller perfectly clear to the reader who is interested in such simple mechanical devices. The advantage of the device in giving the propeller the right blade angle to suit every condition of flight without action by the pilot is obvious.—*A. K.*

War Weapons for Exploring the Air

THE Big Berthas of World War fame hold promise as valuable peacetime weapons for scientists interested in upper air exploration. These enormous guns, which nearly 20 years ago bombarded Paris with death-dealing projectiles, might just as readily bombard the mysterious upper regions of the atmosphere with devices for bringing back to earth samples of air and indications of how the winds blow.

Recording instruments carried aloft in kites, balloons, or airplanes have cleared up much of the mystery of the lower air—the so-called "troposphere"—and of the lower levels of the stratosphere, just above the troposphere. But no balloon scouting for meteorological material has yet risen higher than 22 miles. In the Paris bombardment, however, the Big Berthas hurled projectiles 24 miles in the air.

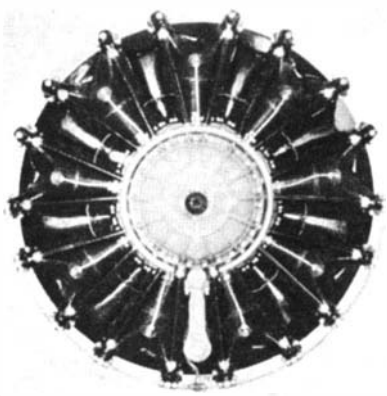
Observations in the troposphere show that air here moves in many ascending and descending currents, causing the formation and dissipation of clouds. Air movements in the stratosphere, on the other hand, are believed to be generally horizontal. As air mass movements are responsible for our weather and as the movements in the lower levels are affected by those at upper levels, definite information on what is happening at these heights would be of great value in weather forecasting.

A Radio Compass for Itinerant Pilots

A LONG-RANGE radio compass which enables itinerant pilots flying over oceans and unknown land to find their way

directly to any radio broadcasting station has been developed by the Westport Manufacturing Company. The first Westport automatic radio compass for civil use was built for a Lockheed Vega.

The radio compass consists of an indicating dial mounted in the cockpit, a conventional aircraft radio receiver, a compass converter unit located in any convenient place, a dynamotor, and a loop antenna mounted in the fuselage. The complete assembly including cables weighs less than 45 pounds, while the receiver and converter

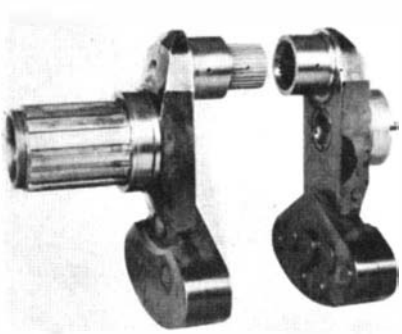


Front view of the new Wasp airplane engine described. *Right:* Back, showing some of the accessories

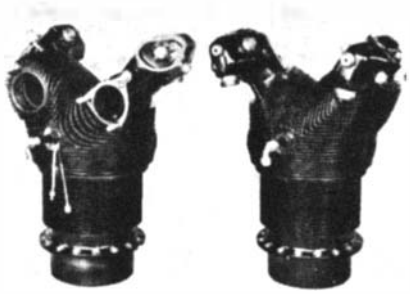
units measure only 12 by 7¾ by 11½ inches over-all. When within range, a pilot may tune in on a broadcast station by listening through the earphones in the customary manner. If the plane is headed directly toward a station, the indicator needle on the dial points to "zero." If the plane is off course ever so slightly, the needle points "right" or "left" as the case may be. In addition to enabling a pilot to fly directly to a radio station, the radio compass gives a navigator all the information he needs to locate his exact position over land or sea. To do this, he tunes in several different stations, determines their direction, and by a system of triangulation determines the location of the plane.—*A. K.*

A Wasp with Automatic Lubrication

A NEW Wasp airplane engine has been announced by the Pratt and Whitney Aircraft Company. The new engine is more rugged, develops greater power, and requires less servicing than any of its predecessors, which have made so enviable a reputation for themselves in military, naval, and transport aviation. Though it develops 550 horse-

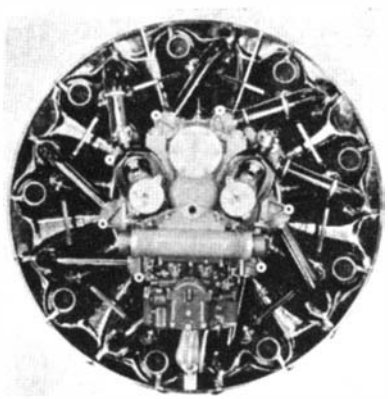


The two-piece crankshaft of the Wasp, showing splined connection



Back and front of Wasp cylinders

power in its geared down drive embodiment, it is basically and fundamentally the same engine as that which made its first appearance eight years ago. Just as the first Wasp engine, the new model H has a displacement of 1344 cubic inches, a bore of 5¾ inches, and a stroke of the same amount. The increase in power has come step by step—by higher compression ratios, greater refinement in design, and systematic improvement. The power is developed at the moderate speed of 2200 revolutions per minute. The specific output per cubic inch of displacement is now four tenths of a horsepower, while a quarter of a horsepower per cubic inch was considered fine practice only a few years ago.



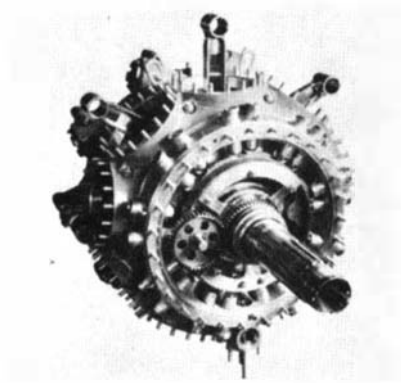
The Wasp H embodies many striking improvements, but the outstanding feature of the new engine lies in the automatic lubrication of the valves and valve actuating mechanisms by means of the standard engine oil supply system. This will eliminate the manual labor, grease guns, and the stocks of grease now essential. The cost of engine maintenance and transport operation will be reduced thereby, and the reliability of operation will be increased. American airline operators will bless this one new development many times.

Valve tappets, ball ends of push rods, rocker bearings, balls of adjustment screws and valves are now all lubricated by pressure, eliminating the use of rocker box grease and periodic manual servicing. Scavenged oil in the upper cylinders drains down through the pushrod covers into the sump, while from the lower cylinders it passes through an outside oil manifold attached to the cylinder heads and is scavenged by an additional suction stage on the oil pump. Rocker boxes have improved covers which are made oil tight by the use of gaskets and which are secured by means of studs and nuts.

Two of the photographs show the front and rear view of the engine, and give a splendid idea of its "cleanness" and mechanical finish.

With increased power, there must go increased strength. Thus the single-throw two-piece crankshaft, split in the center of the pin, has been suitably reinforced and its diameter has been increased. The rear section of the shaft telescopes into the front section and is held in position by splines. Formerly only 16 splines were used but there are now 31, adding materially to the ruggedness of a part which has to take up great torsional stress.

The more power developed by an engine,



Power section of the Wasp engine

the more cooling is required. Therefore, more and deeper cooling fins are provided. The exhaust ports now have shrunk-in stainless steel liners (stainless steel to resist corrosion) for a slip joint with the exhaust pipe, thus eliminating the flange used in previous models.

Another very interesting feature of the engine lies in the baffles. It is easy enough to cool the front of the cylinder on which the air impinges directly, but not so easy to cool the rear. The baffles, which are sheet aluminum surfaces, carefully formed, guide the air tightly around the cylinders and to the back, so that no part of the cylinder is left uncooled. These baffles are so constructed and affixed on the model H that any cylinder or group of cylinders may be re-

The heads of the pistons in the new Wasp engine are flat, but recesses have to be provided for the valves

moved without removing the carefully placed baffles. This is a feature which will appeal immediately to a practical mechanic.

A noteworthy point in the design of the power section of the engine is the cam system. The H Wasp cam revolves on a bronze bearing of large surface which is mounted on a shelf housed by the front section of the main crankcase. It is driven by a reduc-

tion gear with a bearing on each side assuring correct alignment. Valve tappets are mounted in guides located in the front section of the main crankcase directly over the cam track. Through such an arrangement a more direct load on the rockers is provided because of the decreased angle of the push rods in respect to the rockers. Thus greater rigidity is secured.

The pistons are machined from aluminum alloy, provide a compression ratio of 6 to 1, and have flat heads with recesses for both intake and exhaust valves. Piston pin bosses have been considerably strengthened and the under side of the piston head is ribbed for strength. Each piston has four compression and one scraper ring.

Space will not permit us to detail with many other interesting features such as supercharger clutch, reduction gear, temperature control, and so on.—*A. K.*

PAPER DOTS

PAPER perforations, dropping from the holes in U. S. stamps, totaled 35 tons during the last fiscal year, during which 12,000,000,000 United States stamps were made.

A Two-In-One Plane

THE great difficulty in transatlantic flying is in the building of a seaplane which will have not only the required range, but also carry sufficient mail or payload beyond the huge amount of gasoline which is required for a non-stop flight.

Short Brothers are now constructing in England, under the auspices of the Air Ministry, a two-in-one plane which may meet the difficulty.

The seaplane, which is to be used for the non-stop transatlantic operation, will be a comparatively small machine, with a tremendously heavy loading in pounds per square foot of wing area. The heavy loading will not decrease the high speed so very much, and it will enable both sufficient fuel and payload to be carried. But with this heavy loading the craft may be unable to get off the water at all, or to climb to a reasonable altitude!

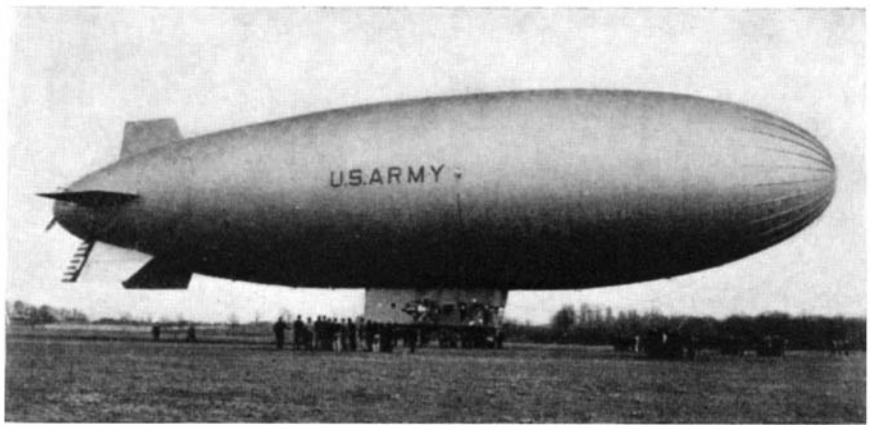
Major R. H. Mayo has suggested that the difficulty be met by using a large "carrier" flying boat which will take up the smaller machine to the necessary altitude where it can operate on its own.

The heavily loaded small machine, and the lightly loaded big machine will be locked together by a patented device, and will take off as a unit, using their combined horsepower. As the big machine will be lightly loaded, as for a short flight only, there will be sufficient excess power for rapid take-off and climb.

When the appropriate altitude is reached, the pilot of the smaller craft will release a locking lever, the mail plane will sail away and the "carrier" will return to its base.

No details are available as to the mechanism, but this is of an obvious character and offers no particular difficulties.

The reader may ask why this device is considered superior to the catapult with which a heavily overloaded plane can be quickly launched into the air. The reasons are twofold. With a very heavily loaded craft, the speed of launching has to be



The *TC-13*, with its ground crew

high; the accelerating process will have to be very violent, putting heavy stresses on the machine and not making the flier any too comfortable. Another difficulty is that while the plane may come off the catapult it will still be flying with but very little excess power and a dangerous forced landing might be feared at times. In the new system the "catapult" will really launch the machine very gently and at a reasonable height above the water. So if the release is not successful, or any other difficulty arises, the pilot will have plenty of time to dump the fuel and make a subsequent forced landing without undue hazard.

British authorities are also agreed that this process will be preferable to refueling in the air, or to alighting at a mid-ocean base of an artificial character.—*A. K.*

Army Airship "TC-13"

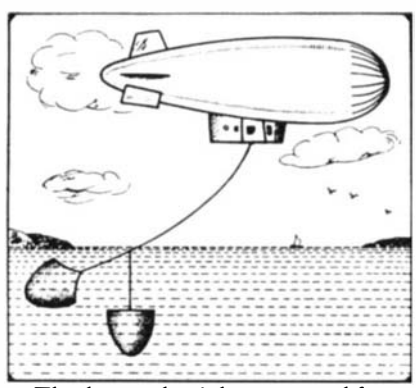
WHILE no rigid airships are at present under construction in the United States, the Army Air Corps is actively developing the smaller non-rigid type formerly termed the "blimp." The latest example is the *TC-13*, which is perhaps the largest non-rigid ever built in the United States. The *TC-13* has an over-all length of 243 feet, a diameter of 54 feet, and a height, including the airship car carried underneath, of 69 feet. The helium gas capacity is 360,000 cubic feet. The gross lift is 22,300 pounds and the fuel capacity, 900 to 1300 gallons. The *TC-13* has a cruising range of 1000 miles at 65 miles per hour and can remain in the air about 100 hours when maintaining a slow speed of only 25 miles per hour. It can pick up fuel while in flight and is equipped with a radio set of 3000 miles' range. The tanks for fuel, water, and storage are overhead. Instead of the four usual control surfaces, it has five. The equipment includes a sub-cloud car for observation purposes, which can be lowered by a single cable to about 1000 feet below the ship.

A very interesting feature of the new design is a sea anchorage (illustrated in the sketch), principal features of which have been definitely established during 75 hours of experimentation.

A winch is provided in the car, which carries six to eight hundred feet of anchor cable, on the extreme end of which is fastened a drag cone of large diameter. Approximately 80 feet from the drag cone is fastened a weight cone which holds 1000 pounds of water. The weight cone stabilizes the variation in lift resulting from aerodynamic disturbances or changes in gas temperature and also serves the useful purpose of keeping the drag cone submerged at all times, so that the drag load is constant and wave shock is eliminated.

Adjustable rigging at the ship permits the point of application of the anchor cable to be varied fore and aft so that the kiting or dynamic lift effect on the ship may be varied to suit the wind speed.

Weighing—pulling up—the anchor is normally accomplished by releasing a trip weight which runs down the anchor cable



The drag and weight cones used for anchoring the *TC-13* when at sea

and inverts the weight cone, spilling its load. The drag cone is then pulled out of the water under power, its water being spilled through a hole in its bottom. Emergency release is accomplished by tripping all cables and cones free of the ship.

While riding at anchor the ship may be "flown" or piloted as when under power and its drift is cut down to approximately 25 percent of the wind speed. This feature is believed to be a decided advantage in case of power plant trouble or fuel shortage during a high wind period. Otherwise the airship might be driven by the wind for long and dangerous distances.

This new method of sea anchorage is certain to be of great utility in airship operation.—*A. K.*

Aerial Study of Pollen in Atmosphere

ONE of the most curious projects of analytical chemistry has been inaugurated in Philadelphia, where a fleet of airplanes is sampling the atmosphere for miles above and around the city in order to determine the exact amount of pollen in the air. The survey is being made by scientists of the Philadelphia College of Pharmacy and Science, as an attack on the problem of relieving victims of hay fever, a malady caused, or at least aggravated, by the presence of pollen in the atmosphere.

The survey is intended to measure accurately the density, nature, and distribution of air-borne pollen in the upper atmosphere and will be carried on over the Philadelphia metropolitan area, extending in many directions as far as 40 miles from the city center and also along the New Jersey coast in and around Atlantic City and seaward for 20 miles. Daily flights are scheduled throughout the hay fever season for the next four years.

The apparatus for carrying on the work was developed in the engineering laboratories of the college under the direction of Frank N. Moerk, assistant professor of manufacturing chemistry. The airplanes with which the survey is being made were made available by Richard Mark, a hay fever sufferer.—*A. E. B.*

Keeping Engines at the Same Speed

TACHOMETERS for aircraft engines have undergone considerable modification since early days. At first the tachometers were mounted directly at the back of the engine and were gear driven. Then, as the pilot's cockpit moved further from the engine, flexible shafting was employed for the same purpose. Now, when two or more engines may be disposed along the wing at distances of 20 feet or more from the dashboard, it is clear that flexible shafting or mechanical gearing tends to become impracticable.

Since the practical medium for speed measurement and transmission appears to be electrical in character, the Pioneer Instrument Company has announced a new and simple electrical tachometer. A generator, driven by the engine, is a simple two-phase, three-wire machine, based on well-known principles. This is mounted in the nacelle, or wherever the engine may be, and the current which it generates is led to an

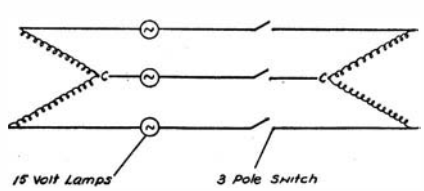
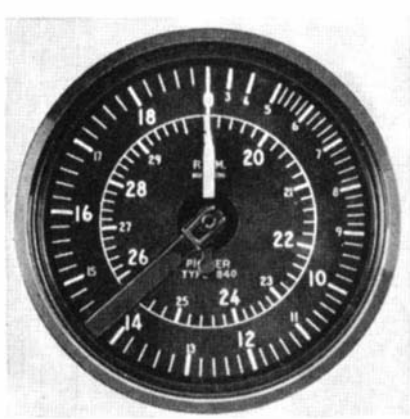


Diagram of tachometer generators (above), and the indicator (below)



induction type indicating instrument. The advantage of the induction type indicator is that the alternating current is led around stationary magnets, and that the sole moving element is a thin metal disk (restrained by a spring), the displacement of which is exactly proportional to the revolutions per minute of the engine.

With the use of tachometers of the electric type, there is another advantage which is illustrated by the simple diagram. The tachometer generators of the engines on each side are connected, as shown in the diagram, to three lamps. When the pilot has succeeded in bringing the engines as nearly as possible to the same speed, he closes the three-pole switch. If the generators of both engines are running at exactly the same speed their voltages meet and nullify one another, and none of the lights will burn. Should the generator speeds vary by as much as one revolution per minute, the lamps start flickering, and the rate of flickering will increase with the difference in speed between the engines.

The advantages of such an electrical check-up to the pilot of a multi-engine airplane are obvious.—*A. K.*

SINO-JAPANESE

IT would appear that the Japanese are great admirers of Chinese culture. Compulsory study of Chinese by the Japanese Empire, with a population of 94,000,000, totals half a billion years, since each individual must study Chinese for at least six years.

Aluminum and Cancer

IN view of articles in the daily press, ascribing to aluminum, lead, and other substances a cancer-producing action, a recently published experimental study denying such harmful effects is of much interest.

In a recent issue of the *Annales de l'Institut Pasteur*, Bertrand and Serbescu report two series of experiments on rabbits. In both series, coal tar was applied at regular intervals to the ears of rabbits in order to produce a cancer. In series A a visible cancer resulted in 78.3 percent of rabbits living more than 40 days. No aluminum was given in this series. In series B an artificial ear cancer resulted in 50 percent of the animals living over 40 days. In this series a solution of aluminum sulfate was placed directly in the stomach.

In neither series did the necropsies reveal any visible lesion of the stomach or intestine. The authors conclude that the rôle of aluminum or its salts in the production of cancer has been greatly exaggerated. Fear of the ingestion of the minute amounts of aluminum from the use of utensils made from this metal as well as from foods or baking powders in which alum salts are used is not justified by laboratory research.
—*Journal of the American Medical Association.*

Dry-Ice as Rain-Maker

ACCORDING to Consul Sydney B. Redecker, Frankfort-on-Main, Germany, in a report made public by the Chemical Division of the Department of Commerce, experiments are soon to be conducted in

Wurttemberg designed to produce rain artificially. The experiments will be under the auspices of the Society for Dry Ice Research, recently established in southern Germany, and the plan is to scatter pulverized dry ice from airplanes above the clouds. It is alleged that copious rainfall was produced over the Zuyder Zee by this method a year ago, when two tons of dry ice were discharged over clouds.—*A. E. B.*

"Age" and Whiskey

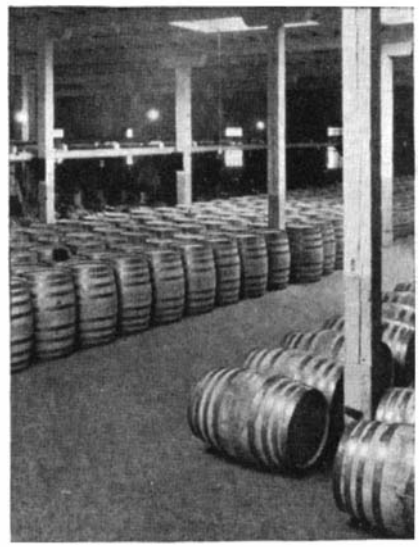
THE repeal of the 18th Amendment descended upon a country in which credulity with respect to liquor consumed was unbounded. If "Joe" said it was good, it must be good, for Joe bought enough whiskey to know. Besides, Joe had said it was "Old Stuff," and the word "old" carried a great significance during a period that supposedly saw no manufacture of whiskey. Age came to mean more than the mere passing of time. It was a symbol of genuineness. Although aging certainly plays an important part in the production of fine whiskey, it is not so all-important as

Weighing-in barrels of whiskey for federal tax determination purposes

many would make it seem when measured only in terms of days, weeks, months, and years.

Whiskey may be of several different varieties, depending upon the mixture of grains used in its manufacture. Each of these varieties has its own individual flavor, the excellence of which hinges upon the quality of grain used and the manner of its conversion into alcohol.

All of the preliminary treatment of the grain leading up to the actual fermentation is in preparation for fermentation, the result of which is alcohol and acid. Naturally, these ingredients alone do not compose the Beer, or fermented mash. There are higher alcohols, such as fusel oils, aldehydes, and water. [See also "What is Whiskey?" page 70, August, 1934, SCIENTIFIC AMERICAN.] There is also a certain mineral content. The Beer is now distilled, but this process is not carried to the extreme, for if all of the impurities were lost, the result would be pure alcohol. Certain impurities, modified during the aging period, are necessary to give whiskey its color, flavor, and aroma. The higher alcohols, acids, and aldehydes (called congeners) have a very strong, and at this



In the background is the equipment for the heat treatment of whiskey

stage disagreeable, odor and taste. It is with these elements we have now to deal, for at this point the "aging" of the whiskey begins.

It was found in the early days of distilled beverages that the presence of char in storage barrels not only reduced the loss due to excessive absorption but also contributed a mineral content and certain resinous nature to the whiskey which highly improved both its color and flavor. The degree to which this color and flavor existed seemed to depend upon the length of time the whiskey had been permitted to stand in the barrel.

The next discovery was that whiskey made in warm climates aged better and faster than whiskey made in cold climates. It was found that the summer months were better than the winter months in results obtained from stored whiskies. Whiskey came to be spoken of as so many "summers old." The next natural step was the introduction of perpetual summer into the distiller's rack-warehouse. The heated rack-warehouse produced a finer aged product in a shorter time. Thus the distiller could sooner recover his investment in taxes made at the time of manufacture.

It was not long before a distiller decided to experiment with chemical changes in whiskey by the application of heat. A steam coil was introduced into the barrel and live steam passed through it, heating the whiskey. Under such favorable heat conditions the acids combined rapidly with the higher alcohols, and the char imparted its benefits freely, absorbing harmful ingredients and contributing desirable minerals and oils. "Aged" whiskey was made in a short period of time, and contained less heavy oil and aldehydes.

But, like any other innovation, the heating process was fraught with dangers and difficulties. No one seemed to be able to control the steam coil and obtain an even temperature so that whiskies of consistent quality could be manufactured. There was burning and scorching. There was leakage and reduction in proof of the contents. The 18th Amendment found things in this state —and legal experimentation stopped.

The Dry Era was coincident with great developments in modern science. Heat engineering had progressed equally with its fellows. With the advent of repeal, it became possible for the distiller to adopt a controlled heating method for aging his whiskies. Modern distillers have spent great effort, time, and money on the further development of these processes. Controlled heat has become a major factor in the aging of whiskey, giving a product which compares favorably in palatability and congeneric content with whiskey aged for four years or more in the barrel.—*By James D. Webb.*

JUST A WORD

YES, sodiumditolyldisazobetanaphthylaminesixsulphonicbetanaphthylaminethreesixdisulphonate is the chemical name for a Congo red dye.

Tires Made Puncture Proof

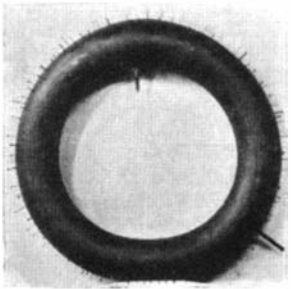
THE modern motorcar is to a large extent safeguarded against accidents by the perfection of its design and manufacture. There are two exceptions. Punctures and blowouts, despite many attempts to produce a blowout-proof tire or tube, are still the cause of a large percentage of fatal accidents each year. Such accidents may be prevented, according to reliable information reaching us from Germany, by the use of a new product patented in that country.

Blowouts may be due to expansion of air

Chemical analysis and control of ingredients are important in whiskey

in the tube caused by excessive speeding over heated roads or by traveling over stones or bumps with insufficient air in the tires. Skidding contributes its share to fatal accidents resulting from blowouts.

Oddly enough this new invention does not pertain to tires or tubes but to a substance which the car owner inserts in the tube through the valve aperture. This compound is composed exclusively of natural products which, according to the sworn



Nails in a puncture-proof tube fail to let out the air

statements of commercial chemists, are by no means deleterious to the rubber. Floating freely within the tube it is thrown by centrifugal force against the periphery so that should the tire and tube be punctured or ripped, this material is immediately thrown by pressure of the air into the opening. The result is that the puncture is immediately sealed by the substance. In case of a blowout, the substance prevents the rapid escape of the air and the car can be brought to a stop safely.

It is stated that this substance is not a conductor of heat and will not therefore transmit to the air the road heat absorbed by the tire tread. The weight and bulk of this substance are small. It cannot choke up valves, undergoes no changes during the whole life of the tire, and is perfectly harmless to clothes and hands. Its advantages, as can readily be seen, are numerous, one of the most important being that it gives a sense of security that enhances the pleasure of safe, carefree driving regardless of speed. The purchase price of this compound, incidentally, adds only 25 to 35 percent to the average price of a tube. It is at present being distributed widely in Germany and other countries.

Short Wireless Waves in the Treatment of Disease

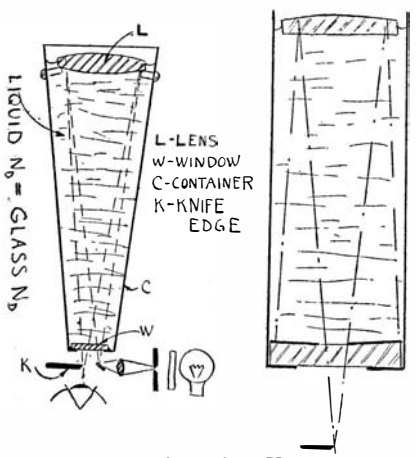
THE treatment of chronic inflammation, especially of deep-seated structures, by short waves, similar to those used in broadcasting, is already popular on the continent of Europe. These waves are usually only from 6 to 30 meters long and are generated by thermionic valves or by a spark gap machine. They can be passed into a patient without any contact between him and the source of the current. While the surface of the body remains comparatively cool, heat is generated in the tissues within. Dr. W. J. Turrell, medical officer to the electrotherapy department at the Radcliffe Infirmary, Oxford, tested the effects of these short waves on white of egg and on pieces of bullock's liver. He found that they differ from those used in diathermy, in which the electrodes are in contact with the patient's body, in the more violent oscillations of an

(*Please turn to page* 102)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

MANY of the advances in practical optics and telescope making have been made by amateurs. Such an advance is a very much needed test for convex optical surfaces, devised by J. H. King of Amityville, New York. At our request, Mr. King has prepared a description of his test,



Apparatus for the King Test.
***Left:* Figure 1. *Right:* Figure 2**

which is reproduced below, and a world of refractor and Cassegrain reflector makers will doubtless vote him sincere thanks for discovering it. Mr. King writes:

"CONCERNING the polishing of convex spherical surfaces, Ellison states in 'Amateur Telescope Making,' second and third editions, page 118, second paragraph, 'No question of their figure can arise at this stage of the proceedings, as it is impossible to test it.' Professional makers sometimes test convex spherical surfaces by interference methods, referring the convex to a standard concave. This method is hardly practical unless a number of similar convex lenses are to be made.

"Judging from the number of times the desire has been expressed for a test for convex lenses which would be as simple as that for concave mirrors, it would seem that such a test, if available, would be very useful. Therefore, the writer proposes a test for convex spherical surfaces requiring no auxiliary optical surface, and one which is simple and as rigorous as the mirror test at center of curvature.

"If, for the sake of illustration, we imagine a spherical surface consisting of only a skin of silver of practically no thickness, which would at the same time remain optically true without support on either side, one side would be a convex mirror and the other a concave of the same radius. Then, in order to test the convex mirror, one would merely have to go around to the other side and test the concave at the center of curvature.

"However, practical optical surfaces are generally formed on glass but if, as in the case of convex spherical surfaces on lenses, we could eliminate the lens optically and leave the surface to be tested, we could again go around back of the convex and test it as a concave mirror at the center of curvature and that test would be the equivalent of a test of the convex surface.

"To do this, we make use of a simple principle employed for many years in inspecting optical glass, but to the writer's knowledge never applied in this manner. In examining optical glass for striae and general uniformity of index, when it is in crude broken chunks, it is placed in a large container having glass windows at either end. Liquid is introduced having the same refractive index as the glass and then, if the glass is homogeneous, one is able to look clear through the liquid and the chunk of optical glass, and the rays will suffer no deviation. In other words, we have optically eliminated the glass. Bell's 'The Telescope', page 61, gives an account of this method of inspecting optical glass.

"Figure 1 shows a sectional view of the set-up which allows us to test a convex as a concave by introducing a fluid equal in refractive index to that of the glass. The fluid optically eliminates the lens. Since the upper convex surface faces air, the light proceeding from the pinhole suffers a partial reflection and some of it returns to focus again adjacent to the pinhole and the test becomes merely that for a spherical mirror at center of curvature. The test is rigorous because it is conducted to all practical purposes entirely within the liquid medium, and the small amount of air between the eye and the window is too close to focus to be detrimental. Several solutions have come to the writer's attention as having about the refractive index of crown glass when near room temperature. Toluene [obtainable from dealers in chemicals; for example, Eimer and Amend, Third Avenue and 18 Street, New York City.—*Ed.*] seems to be the best commercially obtainable liquid, since it is homogeneous, and though inflammable does not have a low vaporization temperature. A very strong word of caution should be urged against the use of benzene or any other inflammable liquid which vaporizes at room temperature. The worst explosion due to chemical silvering would be very mild indeed compared with that due to a gallon of benzene properly vaporized and ignited in a closed cellar.

"Below is given a list of various liquids and their refractive indices for the sodium line at given temperatures. However, the refractive index usually does not vary widely with a slight change in temperature.

Aqueous Solutions (Sugar and Water)

Sugar—Refractive Index at 20° C.
1.5001 at 16 percent water
1.5033 at 15 percent "
1.4951 at 18 percent "

Non-Aqueous Solutions

Carbon tetrachloride 1.460 at 25° C.
Benzene 1.501 at 30° C. (Dangerous)
Aniline 1.586 at 20° C.
Glycerine (Glycerole) 1.474 at 25° C.
Toluene 1.495 at 20° C.
Carbon tet. 40 percent, Ethylene bromide 60 percent, 1.4989 at 25° C.

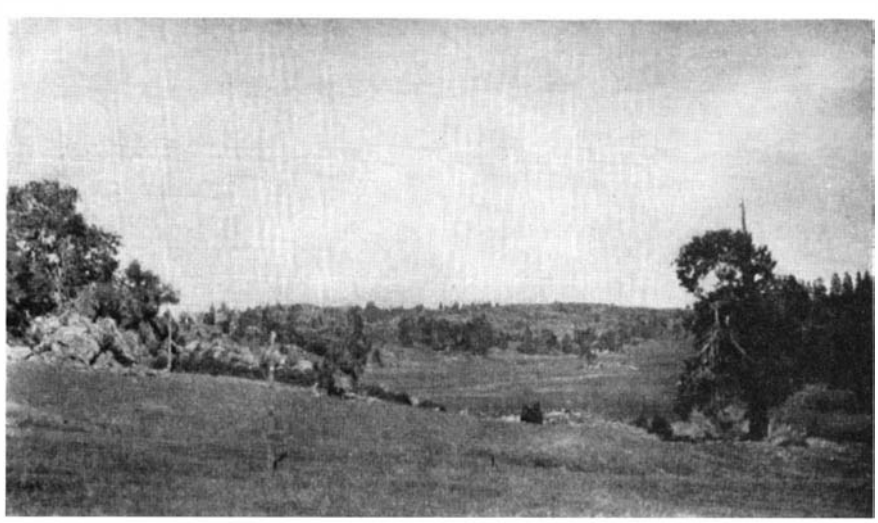
Aqueous Salts

Pyradine 85 percent, H_2O 15 percent, 1.4960 at 15° C.
NaCl 20, KCl at 80 percent, 1.500, 18° C.

"Some may raise the objection that the dispersion of the liquids may not be equal to that of the crown glass. Of course, testing in sodium light would remove this objection completely, but the writer believes that testing with white light is about all that is necessary and the refractive index does not have to be exactly that of the crown. This has also been borne out by experiment.

"As a matter of convenience, a small prism may be used in place of the window, and the testing funnel mounted on a wall. This allows the observer to assume a comfortable posture looking horizontally instead of lying on his back as in Figure 1.

"This principle is also applicable to testing a convex hyperboloidal surface by using a small spherical mirror of scarcely larger dimensions than the convex hyperboloid. Figure 2 shows the set-up. The spherical



Site for the 200-inch telescope (on skyline) on top of Palomar Mountain, at 6126 feet elevation. Distance from Los Angeles 90 miles, San Diego 48

mirror should be silvered and lacquered and the silver removed in the center, leaving a small transparent hole. Using this method, it is not necessary to construct a large optical flat or a large spherical mirror when building a compound telescope of the Cassegrain type. However, it would be well to construct the small secondary hyperboloid of optical crown in order to insure freedom from striae."

THE test which Mr. King describes above has also been tried, previous to this publication, by J. H. White of Cranford, New Jersey, in making a 3-inch objective lens and later a 4½-inch. Mr. White states that he finds it thoroughly practical. Besides the test described above (should it be called the King Test?), Mr. King has contributed another important advance to the telescope making art, having found a relatively simple way to render the Ronchi test quantitative without the use of mathematics, that is, by direct reading with apparatus. A description of this method will be found in the *Journal of the Optical Society of America* (Prince and Lemon Streets, Lancaster, Pennsylvania) for September, 1934, pages 250-252, and will be extracted here, provided the amount of response appears to justify doing so.

AT our suggestion Leo J. Scanlon of Pittsburgh has kindly written down some of the hints he has accumulated while learning to work glass with metal tools, and here they are:

"Glass or Pyrex mirrors can be ground on iron tools if the tools are first machined to proper radius of curvature. The tools should be cast, either in iron or brass, and machined to curve. Do not use steel plate. Lead is not so desirable as iron or brass.

"Iron tools may be rotated at a fairly high rate of speed—somewhere under 300 r.p.m., and the mirror may be rotated at the same speed on top, but I would not advise rotating anything larger than a 6-inch at this speed, while 50 or 60 r.p.m. is enough for a 10-inch. There is otherwise too much danger of breakage, if the mirror should stick to the lap and be whirled off.

"It is impossible to polish a lap on pitch at any of the above speeds, but flattened *H.C.F.* directly attached to the iron tool polishes very rapidly and very well. [Some professionals are now using this method.—*Ed.*] The mirror may be finished by hand, on pitch.

"The mirror may be whirled at the same speed as the iron tool; it may be held in the hands and slowly rotated first on one side of center and then the other while the tool revolved; or it may be ground as usual, but on an iron tool. Any of these methods will produce good results and they have all been tried here, some of them on mirrors up to 12½ inches in diameter."

Mr. Scanlon did not mention that, while it is easy to make the concave metal tool on the lathe, the convex tool is not nearly so easy, as it cannot be made on a radius basis; also that *H.C.F.* may be attached to metal by warming the metal.

THE Amateur Telescope Makers of New York City, Lew Lojas, acting secretary, 1510 White Plains Road, Bronx, New York City, is the latest organization of amateurs. Poor old tail-ender New York has a telescope makers' club at last!

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 99)

electromagnetic nature set up in the treated tissues. He obtained the best results in the treatment of parts connected with or closely underlying bony structures and in inflammatory conditions closely beneath the surface. Pain unrelieved by other methods yielded to this method. A great difficulty is the cost of the apparatus, as the power required to produce these short waves is much greater than for longer ones.—*Journal of the American Medical Association.*

Unique Multi-Unit Heating Plant

THE unique multi-unit central heating plant, consisting of 120 of the now familiar General Electric domestic oil furnaces all arranged to operate automatically in a single battery, which has been installed at Mount Holyoke College, South Hadley, Massachusetts, is now in regular service.

The new central plant comprises the major portion of a total of 172 of these furnaces installed at Mount Holyoke in providing a complete new heating equipment for the college. Fifty-three buildings now have the benefit of fully automatic heating. Of these 53 buildings, 24 of the largest and most centrally located structures on the campus are heated from the central plant. The rest of the buildings are at more remote locations around the edge of the campus and are equipped with single furnaces or with furnaces in small groups, the largest of which numbers 10 units.

When the problem arose of replacing the heating plant which had served the college for nearly 40 years, college authorities found themselves faced by an additional and corollary problem—the problem presented by far-reaching plans which had been drawn up for progressive landscaping of the campus. The old boiler plant, with its tall ugly smokestack, occupied a prominent location in one of the prettiest places on the campus. Obviously, a new heating plant of conventional design could offer no particular solution to the landscaping problem unless it could be located out of sight beyond the campus limits—an expedient which would have involved the construction of extensive additions to the existing underground steam distribution system.

The proposal which resulted in the construction of the plant just put into service offered an immediate and economical solution to the landscaping problem. Furthermore, although somewhat radical and perhaps startling at first glance, this new plant is based on sound engineering principles and embodies many unique advantages other than esthetic adaptability.

Although about 70 percent of the total college heating load is on the central system, this system is relatively so compact that transmission losses are gratifyingly small. Functionally, the entire system can be considered as consisting of two separate and distinct parts—steam generation and steam distribution. Each has its own physical equipment and automatic control, interrelated only by steam demand.

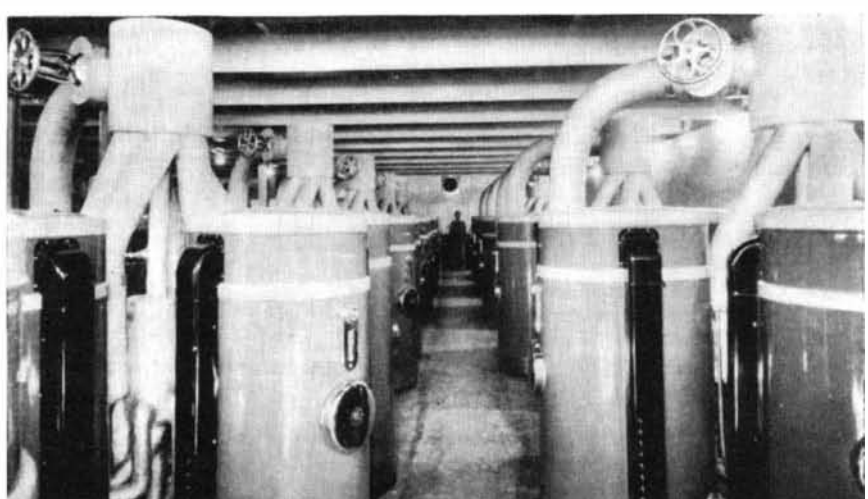
THEY STING AND LIVE

BEES, contrary to the general impression, do not always die after having used their stinger. This statement is made by Dr. J. G. Myers of the Imperial College of Tropical Agriculture, Trinidad, who has made tests to prove it.

Discovery of Heavy Hydrogen Wins Nobel Prize

FOR his discovery of the hydrogen isotope, deuterium, the basis of "heavy water" previously described in these columns, Dr. Harold C. Urey, Professor of Chemistry at Columbia University, has received the highest honor that can come to an American chemist—the 1934 Nobel Prize in Chemistry. The discovery of deuterium is regarded as one of the most important discoveries of modern science.

Dr. Urey, through mathematical consideration of the several theories involved, made the prediction that the hydrogen isotope H^2 must exist. Then began an intensive search which confirmed his prediction. While the significance of the discovery was scarcely realized at the time, it was soon recognized that the importance of the isotope might be greater than that of many of the elements. It became the starting point for research of



A battery of oil burners in a central heating plant

New type of transportation unit, using electric drive

a new kind in many laboratories. Indeed, there is hardly a chemical or physical problem which may not be affected eventually in some way by this isotope of hydrogen. The biologists are hopeful that heavy water may have great significance in many of their own problems, as, for example, the study of cancer. They have found that yeast cells and cancer cells share the property of multiplying or growing much more rapidly in ordinary water than in heavy water, and this fact may prove significant in future research.

Dr. Urey was born in Walkerton, Indiana, April 29, 1893. In 1917 he was graduated from the University of Montana with the degree of bachelor of science in zoology, and was an instructor there from 1919 to 1921. Two years later he received the Ph.D. degree in chemistry from the University of California. He was the American-Scandinavian fellow in Denmark during 1923-24, studying under Niels Bohr at Copenhagen. Dr. Urey was an associate in chemistry at Johns Hopkins from 1924 to 1929 and has been connected with Columbia University since 1929, being promoted to a full professorship in the spring of 1934. Now, having scarcely entered the forties, Dr. Urey becomes one of the three American chemists to whom the Nobel Prize has been awarded. The prize includes 40,000 dollars cash, which Dr. Urey says he will devote to further research.—*A. E. B.*

New Transportation Unit

AN unusual body design and independently driven wheels are features of a new type of transportation unit in which electric transmission is used. The engine is mounted longitudinally back of the rear axle and is connected direct to the electric generator by means of a rubber disk coupling. While primarily designed for rail coach, bus, truck, and highway maintenance use, with slight changes it can be furnished for any kind of service desired including portable electric power use and operation of machines constructed for special types of service.

Every wheel being independently driven eliminates all drive shafts and permits a very low center of gravity. This creates a stable unit which benefits acceleration and deceleration, permits higher speed on curves with a greater factor of safety, and eliminates skidding or slipping. Therefore, the driver is given perfect control of the coach at all times and safety is assured.

Gear ratios range from 4.3-1 to 12.1-1, dependent upon the type of service for which the machine is furnished. Speeds up to 150 miles per hour for rail service are claimed.

The body construction is of modified "air slip" design with a row of windows extending all the way around the machine. All wheel pockets are enclosed with removable cover plates. The entrance and driver's seat are located in the extreme front portion, ahead of the front wheels, which location, together with the abundance of windows, permits the driver unlimited visibility, not only to the front, side, and rear, but also to those portions of the road heretofore obscured from view by hood and fenders of conventional construction.

The machine was designed by Wm. Henry Baker and Henry G. Baker of the Perfect Traction Corporation, and for the present will be custom built.

Too Much Radium

JUST how much radium is reasonable and allowable as a constituent of a bath salt to be used medicinally? The Federal Food and Drug Administration has not ruled on that question yet, but the quantity would not be large. In one case recently it ruled that a shipment of bath salt from France had too large a proportion of radium and was therefore dangerous and might not enter the United States. And how much was that? The proportion of radium was almost inconceivably minute—eight-billionths of an ounce in a pound of bath salts. But that was too much!

It would be extremely difficult to detect and measure such a minute quantity of most chemical substances. But with radium it is not difficult to estimate accurately even smaller quantities than this "dangerously large proportion." It is principally a matter of having the right instrument in the laboratory—in this instance what is known as a gamma-ray electroscope. The Beverage Section of the Food and Drug Administration is completely equipped for analytical work of this character.

Airplane Engineers May Design Next Automobiles

WHEN better automobiles are built airplane engineers will design them, claims William B. Stout, well-known aero-

nautic expert and head of the Stout Engineering Laboratories. And the same applies to other forms of transportation, he says.

"There are definite and good reasons for this," says Mr. Stout. "I can illustrate my point with a story. Not long ago a prominent yachtsman of Detroit wanted a transmission built for his cruiser. He went to a marine engineering firm, told them the horsepower and torque requirements and they designed one for him. It weighed 9000 pounds. The yachtsman put the same problem up to an airplane engineering firm and to meet the same requirements the transmission weighed 1700 pounds! Both were good transmissions. The 7000 pounds was in the difference in the point of view.

"These new streamlined trains which weigh half as much as previous types are good examples of what the airplane engineer can do with our notions on old-fashioned transportation units. If you don't think the present type of road transportation unit is old-fashioned, wait until you see what happens to it in the next few years!

"No airplane engineer would design a Pullman car that weighs 90 tons to transport eight passengers. Neither would he design a motor car that weighs 1500 pounds to a passenger; and when two people ride in a 3000 pound car, that is what it amounts to. It is not hard to see why the principles of airplane engineering will soon be applied to automobiles and other forms of transportation units just as well as to streamlined railroad trains. It is only a question of 'materials and engineering knowledge and we have both,' as Charles B. Bohn recently expressed it."

Intoxicating Candy

ONE of the most insidious results of Prohibition is the growth of the intoxicating candy racket. This particular sweetmeat, consisting of a shell usually coated with chocolate and filled with perhaps half a teaspoonful of alcoholic liquor, was developed into a sizable industry during Prohibition, at which time it was sold particularly from pushcarts in the larger cities. It was and is still being made by only two or three companies which operate somewhat in the manner of the bootlegger. The candy is sold in many cases near schools where children, using their few pennies to purchase it, are later discovered to be half stupefied from consuming several pieces.

The sale of this candy is a direct violation of the Food and Drugs Act and repeal of the liquor laws did not change this regulation. Many seizures of this product have been made and criminal prosecutions are in course of development against manufacturers and distributors.

Governmental suppression of this illicit traffic can never be fully successful. It is, therefore, strongly urged that parents use their influence to see that children do not purchase this drugged candy.

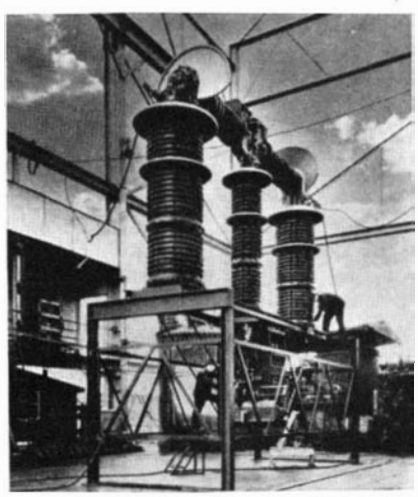
Chemical Brakes Reduce Wear and Tear

"CHEMICAL brakes," as Dr. Arthur D. Little of Cambridge, Massachusetts, calls them in his *Industrial Bulletin*, are substances which slow up natural deterioration from wear or weathering. Thus, "the use of chemical antioxidants is adding thousands of miles of wear to automobile tires, and greatly extending the life of other rubber goods. Lubricating oils exposed to air and either light or heat are now kept from gumming by the same means. A surprising recent development for automobile engine oils is a crystallization controller, which, even when used in less than 1 percent amounts, prevents thickening of the oil, although the temperature goes down to zero or lower.

"A chemical has just been developed which virtually fixes the calcium and magnesium of hard waters, but without removal or precipitation, so that the water may be used for boilers without scale formation, or for laundering with good economy. Deliberate searches are finding practical controls over many long-standing difficulties, and some of the solutions surprise even the investigators."

Big Circuit Breaker

THE impulse oil breaker shown in the accompanying illustration is a single pole of the eight triple-pole breakers being tested for the Department of Water and Power of the City of Los Angeles. Built by General Electric and rated at 2,500,000 kva, 287,500 volts, 60 cycles, it is to be used in the line between Boulder Dam and Los



A 287,500 volt circuit breaker pole

Angeles. It is the highest voltage breaker ever manufactured for commercial use, and has a rated operating time of not more than three cycles on a 60-cycle basis.

In this type of breaker the oil is driven across the arc path under pressure from a piston actuated by the operating mechanism. This results in extremely rapid and positive interruption. It contains about 20,000 gallons less oil than conventional tank-type breakers, and in the interrupting elements there is only 10 percent of the oil content, which means an appreciable saving in oil maintenance costs.

Chemical Exports Grow for 1934

UNITED STATES imports and exports of chemicals and allied products have increased substantially since the beginning of 1934, largely because of increased activity in chemical-consuming industries at home and improved conditions in many foreign markets, according to the Department of Commerce.

Exports of leading chemicals and allied products from the United States during the

first eight months of the year 1934 were valued at 75,000,000 dollars, an increase of almost 25 percent over the corresponding period of 1933, according to preliminary figures. Industrial chemicals led the list with a 40 percent increase to 14,000,000 dollars; naval stores, gums, and resins increased 5 percent to 10,000,000 dollars; paint products increased 32 percent to 9,200,000 dollars; and coal-tar products, including dyes, which advanced 20 percent to 9,150,000 dollars. Exports of fertilizer and fertilizer materials advanced from 4,400,000 to 7,600,000 dollars, an increase of 71 percent, largely on account of increased foreign demand for American phosphate rock. Other important items on the chemical export list which registered gains included sulfur, 8 percent; medicinal and pharmaceutical products, 12 percent; chemical specialties, 16.5 percent; and soaps and toilet preparations, 24 percent.—*A. E. B.*

Grease Packed in Cartridges

CARTRIDGING of grease is a distinct innovation. The old type of grease gun was filled laboriously and messily from cans and drums. The formation of air pockets and the inclusion of dirt were almost unavoidable. To fill the new type the operator merely slips in a factory-loaded cartridge of the desired lubricant. After using the required amount from any cartridge he can remove it from the gun and substitute another. Each cartridge can be used again later, and repeatedly until it is empty. In this way a single gun serves for a full greasing operation involving use of the several different lubricants which are required for proper lubrication of the modern auto-

Grease gun and cartridges

mobile, and a minimum of time and trouble will be devoted to loading and unloading.

This new equipment has been developed and perfected by Lubrication Corporation, a concern owned jointly by Standard Oil Company of Indiana and the Bendix Aviation Corporation.

Nitrogen Used in Radio Condensers

A REVOLUTIONARY change in the design of radio power amplifiers has been worked out by Westinghouse engineers in the design of the new KYW station in Philadelphia through the use of the inert gas, nitrogen.

Tuning condensers for radio transmitters generally consist of large metallic plates insulated from each other. The spacing between the plates depends upon the voltage which is to be applied to the condenser in service. In high power transmitters, this voltage is extremely high and the spacing between the plates must be rather great. In order to obtain enough tuning capacity in the condenser, it has been necessary to use large plates or many small plates. Engineers have known for many years that the voltage that condensers will withstand depends upon the pressure of the gas between the plates. By placing the plates in a tank and applying pressure, the plates can be brought closer together and made smaller in physical size, yet they retain the electrical characteristics of the original condensers. In sealing the condenser plates into a tank, nitrogen gas is used because of its inertness.—*A. E. B.*

PINE PAPER

TWO thirds of the annual newsprint needs of the United States are said to lie in the pine forests of one section of Georgia, if and when Dr. Herty's process for making white paper from southern pine is put into operation. Dr. Herty's work, described fully in our May, 1934, issue, has now been carried one step further; he has now shown that rayon can be made from cheap pine.

Instruments Aid Senses of Taste and Smell

MEASURING devices which prevent fatigue of the senses of taste and smell, and establish with scientific precision the chemical and physico-chemical properties of water too small in magnitude to be detected by ordinary analytical procedures, are being employed in researches by the Hackensack Water Company in connection with its study of the effect of stray electric currents upon the quality of water supplies.

In determining tastes and odors, the nose and tongue, under the older practice, functioned unaided. When exerted for prolonged periods these organs were overtaken by fatigue and lost their sensitivity. Hence conclusions were incomplete and often untrustworthy, impeding advances in waterworks science.

To assist the nostrils in identifying the quality of odors in water Gordon M. Fair, associate professor of sanitary engineering in Harvard University, has invented the "osmoscope." In this device is imprisoned the full strength of an odor as it flows from a test flask to the nostrils, preventing any leakage which might destroy the accuracy of the determination. A new process of dilution, performed with mathematical precision, protects the sensory organs and assures exact measurements of the degree of odor intensity and concentration.

The same principle of dilution, employing taste-free water as the diluting agent, is being utilized to determine taste. The new methods provide water analysts throughout the country with a uniform basis for obtaining data of vital importance to public health.

The aim of the New Jersey tests is to ascertain under laboratory conditions the influence of electricity on the quality of water. Evidence that fugitive current is one of the surreptitious forces which sporad-

ically imparts tastes and odors to water supplies has already been discovered in field investigations in northern New Jersey.

"MANY A MICKLE"

COPPER cents totaling 242,503,500 were coined in one day at the Philadelphia Mint recently, when a coining record for any Governmental mint of 3,506,547 dollars in coins was achieved.

New Aluminum Process

A PROCESS for the manufacture of aluminum from alunite ore, with potash as a by-product, has been developed by the Bohn Aluminum & Brass Corporation. Lower cost and higher purity in the metal are claimed for the Bohn process, which is the result of five years of research. A pilot plant to cost roughly 50,000 dollars is to be built to iron out wrinkles in the process. The entire project will require a year for completion. Plans involve a sheet and wire mill in the Detroit area and an aluminum manufacturing plant in some western state where extensive deposits of alunite are available.

Until a few years ago, practically all aluminum, everywhere, was made by the electrolysis of fused bauxite. Aluminum is the most common metal in the earth's crust, but although plentiful in many ores and clays it has not heretofore been commercially practical to extract the metal from any ore save the rich bauxite. Alunite, the ore used in the new process, is not as rich in aluminum as bauxite, but the new process and the fact that potash will be produced as a by-product is expected to bring production costs down to a competitive level.—*A. E. B.*

Streamlining Spreads to Air-flow Trailer

THE streamline motif in automotive equipment is carried out cleverly in a new type of trailer for one of the modern air-flow types of motor-car. When the folk with the air-flow cars want to go places and take things with them, they need only fasten one of the new streamline trailers to the rear of the car, pack it to the gunwales and step on the gas. Even the small tire on the single wheel on the trailer is streamlined, being the General Jumbo, Jr. modification of the streamline airplane-tail wheel tire. It is mounted on a caster-like device which permits the trailer wheel to revolve freely.

Cure for Prussic Acid Poisoning

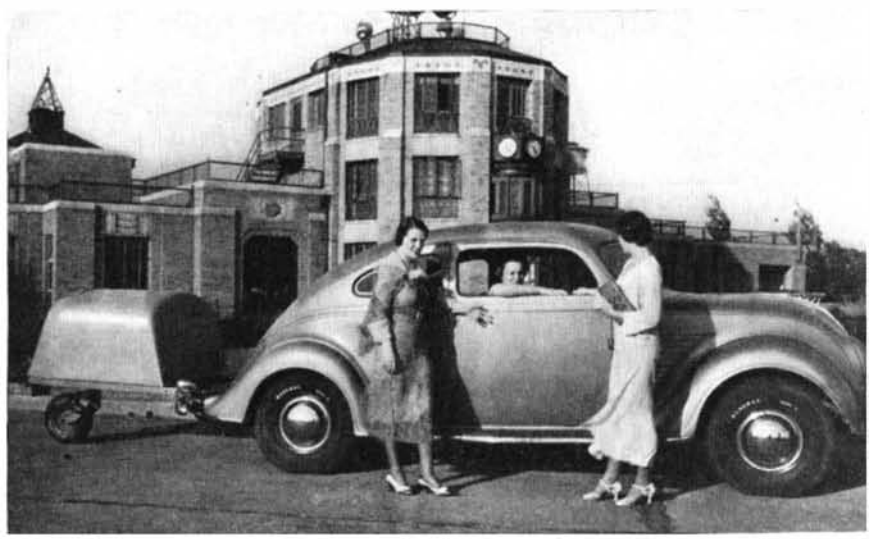
AN effective cure for prussic acid poisoning of livestock has been discovered by veterinary scientists of the United States Department of Agriculture. Sodium thiosulphate alone or, better yet, in combination with sodium nitrate, if administered in time, will save the lives of animals poisoned by eating plants which for one reason or another have developed prussic acid or hydrocyanic acid. Treatment should be by a skilled veterinarian, and the Bureau of Animal Industry is informing the profession as to the technique of administration and essential results of the experimental work.

Hydrocyanic acid does not develop in dangerous quantities in healthy growing plants but does develop in many valuable forage plants when normal growth has been retarded or stopped by drought, frost, bruising, trampling, wilting, mowing, or other cause. Many plants develop some hydrocyanic acid but, under practical conditions, only a few are actually dangerous. Among the more widely distributed of these are the sorghums, Johnson grass, flax, arrow grass, Sudan grass, wild black cherry, and wild chokeberry (not the chokecherry, which is a different species).

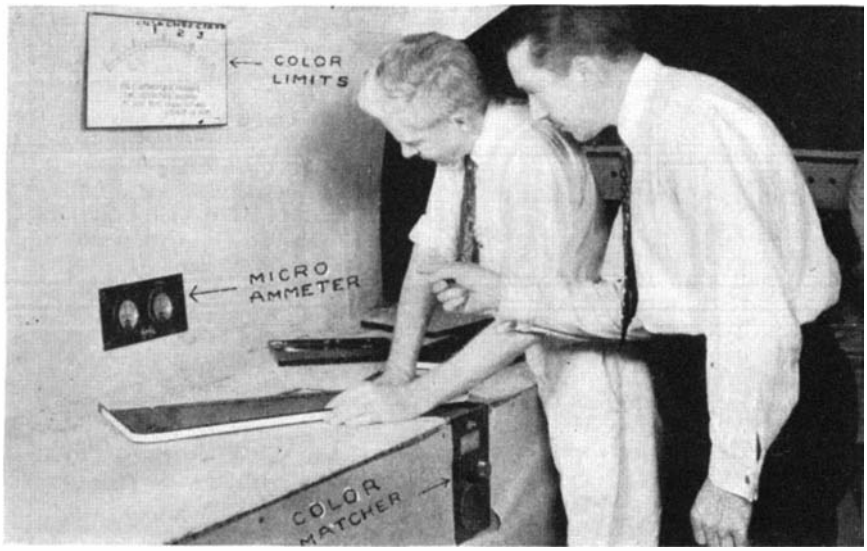
Refrigerator Finish Matched by Electric Eye

TO match porcelain panels for refrigerators the Mansfield Works of the Westinghouse Electric and Manufacturing Company employ a fool-proof electric-eye color matcher. Because of its sensitivity to every color variation, it quickly and accurately chooses panels which match for a cabinet. When producing thousands of units a day, the matcher has proved invaluable in speedy, dependable service. Formerly, all matching was done by eye with the resultant errors due to visual inspection. With the electric eye, no panels have been mismatched in its five months of operation.

In the color matcher, colored light is sent to a sample. The amount of light diffusely



The streamlined trailer has a single small wheel



Instrument set-up for matching colors with photo cells

reflected is sent to a phototube controlling an amplifying tube and an indicating microammeter. The colored light is provided by three color filters—red, green and blue. Rays of light pass through the color filter, lenses, 45 degree mirror, and through the window to the sample. A sample having a gloss surface reflects the ray back to the mirror and through the system back to the lamp. The true color of the sample diffuses the light, reaching the phototube by multiple reflection in the integrating chamber. In this way relative readings are obtained which may be compared with those of a standard sample.

Wool Grease Protects Steel Against Rust

THE most satisfactory and economical method of preserving the bright steel parts of stored steel machinery from rust is to coat the metal with partially refined lanolin. The mixtures recommended are 7.8 pounds of lanolin dissolved in one gallon of white spirit, or 8.3 pounds of lanolin in one gallon of solvent naphtha. This quantity applied with a soft brush will cover approximately 1200 square feet of surface.

This information is contained in Engineering Research Special Report No. 12, published by His Majesty's Stationery Office, Adastral House, Kingsway, London, W. C. 2, England. The recommendations are based on the results of tests made, not only in the laboratory, but at sea on vessels passing through the tropics, and also in stores. Even in a badly corroding atmosphere, as in an ammonium nitrate shed, satisfactory protection is reported for a period of three years.—*A. E. B.*

Light-O-Graphs Test Illumination

THERE has been developed a simple device for determining lighting intensities. It is known as the Westinghouse Light-O-Graph and consists of a piece of sensitive photographic paper enclosed in a light-proof envelope. The envelope is colored to a very definite shade and has 10 round apertures through which the sensitive paper is exposed to the light. The sensitive paper, before exposed, is of a light yellow color. As it is exposed to light, it turns darker. In 2½ minutes, under the proper lighting intensity, the sensitive paper will turn a shade as dark, or darker, than the color printed on the protecting envelope. If, however, in 2½ minutes the sensitive paper is lighter than the protecting envelope, then the lighting is not of sufficient intensity.

With this new lighting indicator, anyone can determine in 2½ minutes the illumination conditions at any given spot. The housewife, for example, may determine what the lighting conditions are at her favorite reading chair, at her writing desk, or at her work table in the kitchen.

STEAK BY BREED

THE housewife may soon order an Aberdeen-Angus beefsteak or Guernsey milk or White Leghorn eggs, according to the prediction of the chief of the United States Bureau of Animal Industry. Breed names, in other words, may be used to convey the idea of quality.

Radium Imports Unaffected by Depression

RADIUM, which in recent years has become so important in medicine and chemical research, is one of the few commodities imported into the United States which has not been affected by economic conditions, according to the Chemical Division of the Department of Commerce. On the contrary, importations of this product into the United States have been heaviest since 1929. The Belgian Congo has been the world's chief source of radium, although some has been produced in Czechoslovakia and in 1930 radium ore was discovered in northern Canada.

While the United States is the world's largest consumer, it has imported less than one third of a pound of the substance during the last decade and for this small amount has paid more than 6,000,000 dollars. During this period imports remained fairly steady at around 125 to 170 grains valued at from 400,000 to 575,000 dollars per annum, until 1930 when they advanced to 260 grains valued at 925,000 dollars, the largest amount ever imported during one

year. In 1933, 179 grains, valued at 576,000 dollars, were imported at an average invoice price of 3217 dollars per grain, and during the first seven months of 1934 400,000 dollars' worth was purchased abroad. —*A. E. B.*

Diesel Engines for Submarines

ANNOUNCEMENT has been made in Washington that the United States Navy has placed orders for 30 large Diesel engines to be installed in five new submarines. The total cost of these engines and the electrical equipment they drive is 3,948,145 dollars. Twenty of these engines are large units for propulsion service; ten smaller units are for auxiliary service, generating electricity for operating all equipment aboard the vessels.

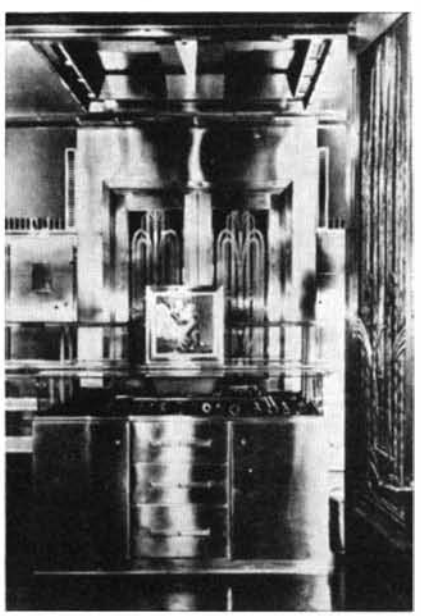
While Diesel engines have been used in submarine service for many years, acceptance by the Navy of light-weight, high-speed Diesel engines now being widely used in transportation and marine service is significant. Submarine service places the greatest importance upon absolute reliability of operation.

Eight of the large engines and four auxiliary units are opposed-piston Diesel engines. This type has two pistons in each cylinder, each connected to its own crankshaft, one above and one below. Advantages of this type of engine are improved combustion efficiency and extreme compactness and light weight for the power developed.

A Unique Office

AN office, decorated and fitted throughout in stainless steel, has been added to New York's list of novelties. The display room pictured here is an exhibit of products produced from Nirosta steel ranging from a coil of wire having a diameter of less than half that of a human hair, to a huge chemical tank capable of handling boiling acids without material deterioration.

The room itself is paneled with Nirosta sheets that have been ground to a satin finish around the borders with a raised polished center. The decorative design has been etched into the metal and the furniture and exhibits include examples of this alloy in cast, rolled, drawn, spun, welded, wire, etched, and riveted form. There are 48 American steel manufacturers of prominence now licensed to produce this material.—*A. E. B.*



Office decorations of steel

Preserving Proof of Invention

EVERY inventor who is working on a device which he contemplates patenting should first prepare sketches and a description of his invention, which should be dated and witnessed by at least two persons. The inventor has thus established the date of his disclosure, and such evidence should be deposited in a safe place from which it may be produced when needed.

When an invention has been completed, it is advisable to file an application for patent without delay. However, we realize that many inventors today do not have sufficient funds to meet this expense, nor have they safe places in which to keep their disclosures. Therefore *Scientific American* will undertake to act as a depository for such documents. These will be held in safekeeping for two years (unless withdrawn by the depositors) and then destroyed without opening.

To take advantage of this offer, place your papers in a sealed envelope endorsed with your name and address and marked "Not to be opened." Then enclose this in another envelope addressed to A. P. Peck, Associate Editor, Scientific American, 24 West 40th St., New York, N. Y., and mail.

—*The Editor.*

Can You Taste Salt?

SALT is now said not to be a taste. Scientists claim this because of the fact that salt can be noticed on lips and gums where there are no taste organs. Thus the four traditional primary tastes (sweet, salt, sour, and bitter) are probably now narrowed to three.

Varnish Spreader

THE time necessary for varnishing a linoleum-covered floor has been reduced from the two or more hours required when a brush is used to but 15 or 20 minutes by the use of a newly invented varnish spreader and the development of a free-flowing varnish which goes on smoothly and shows no "brush" marks. The varnish is durable and lustrous, and will not water spot, being waterproof.

In doing the work, the housewife merely pours a little varnish on the floor and "mops" it with the spreader. The device has a removable pad of fabric which is high-piled and has long fibers which act the same as the bristles in a varnish brush.

Varnishing at ease

These fibers, however, are finer than bristles and there are many more of them.

Since the spreader has a long handle, it is unnecessary to get down on hands and knees, as when using a brush, or even to bend over when varnishing a floor.

Cadmium Compounds Kill Insect Pests

CADMIUM, a chemical element related to zinc but less commonly known, has been found to be an effective poison for use against chewing insects such as caterpillars, by Dr. Joseph M. Ginsburg of the New Jersey Agricultural Experiment Station. Reporting his experiments, Dr. Ginsburg states that the compounds cadmium oxide and cadmium hydroxide compared well with lead arsenate, a standard insecticide, when used against tent caterpillars.—*Science Service.*

Bamboos in Established Groves

BECAUSE bamboos in an established grove can grow to a height of 50 or more feet in 4 to 6 weeks, many persons have the idea that they can make money growing this magic plant. They overlook the fact that the grove must be from 10 to 15 years old before the creeping underground stems or rhizomes are strong enough to produce these giant upright grass stems.

Letters constantly are requesting information from foreign plant specialists in the United States Department of Agriculture on growing bamboos for the market. At present American-grown bamboos are of practical value in this country only when grown for ornamental purposes or for local use on farms in the south. Bamboos usually will thrive wherever cotton is grown and also do well in the moist valleys of the Pacific Coast states.

"Although bamboos have a great variety of commercial uses in this country, these uses are so limited in quantity that we cannot advise anyone to grow them for the market in competition with the Orient," say officials of the Division of Plant Exploration and Introduction.

Bamboos are grasses, distant relatives of corn, wheat, oats, rye, and barley. There are only two bamboos native to the United States. The larger of these constitutes the so-called "canebrakes" of the South. While the idea prevails that bamboos like wet land, most species thrive best in fertile, well-drained soil. For about 15 years the Bureau of Plant Industry has experimented in a limited way with approximately 100 varieties of bamboos at a station near Savannah, Georgia, and more recently at Chico, California.

Bamboo shoots served in butter sauce are among the favorite dishes of the Orient and are popular here. But since a bamboo grove must be well established before the shoots can be spared for food, they are an expensive dish and their use so limited that any attempt to grow them in the United States for profit, without a market also for the canes, undoubtedly would fail.

CURRENT BULLETIN BRIEFS

ACID-PROOF EQUIPMENT describes a new improvement in the field of acid-proof chemical stoneware. This is a close grained product of uniform texture, with thin walls, called "deairated" ware. The pamphlet gives full specifications. *Maurice A. Knight, Kelly Avenue, Akron, Ohio.—Gratis.*

RESEARCH—AN EYE TO THE FUTURE is an instructive pamphlet showing how some of the problems of the automobile have been solved by intensive research. *General Motors Research Division, Detroit, Mich.—Gratis.*

CONDENSERS—ELECTROLYTIC, PAPER, MICA, is a pamphlet giving characteristics of a complete line of condensers. *Solar Manufacturing Corp., 599-601 Broadway, New York City.—Gratis.*

SEWAGE CLARIFICATION BY VACUUM FILTERS describes an installation for sewage clarification together with sludge dewatering facilities. *Municipal Sanitary Service Corporation, 155 East 44th St., New York. —Gratis.*

SERVICE CHARACTERISTICS OF THE LIGHT METALS AND THEIR ALLOYS is a report prepared for the purpose of presenting to the engineer, in a brief and concise form, essential data for aluminum and magnesium and their alloys. *American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa.—50 cents.*

THE SHIELDED ARC. An arc may be shielded by enveloping it with an inert gas, which will not enter into chemical combination with the molten metal and at the same time prevents its contact with the air. The pamphlet describes the process fully. *Bulletin 235A, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

RAYMOND ROLLER MILLS AND KILN MILLS deals with a system of drying and pulverizing which is now applied to a wide variety of non-metallic minerals and manu-

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA FOR THE YEAR ENDED DECEMBER 31, 1933. Prepared by Slason Thompson, Bureau of Railway News and Statistics. This is the 31st year of publication and the statistics are compared with the official reports for 1932. *Bureau of Railway News and Statistics, Daily News Building, Chicago, Illinois.—Gratis.*

DOWMETAL DATA BOOK describes the properties, shop practice, specifications and availability of magnesium alloys which are now competitive in price with other light metals and alloys. *Bulletin 235B, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

MORRIS DOUBLE SUCTION HORIZONTALLY SPLIT CENTRIFUGAL PUMPS (Bulletin 152) gives examples of designs based on 70 years of experience. *Morris Machine Works, Baldwinsville, N. Y.—Gratis.*

HANDBOOK OF SUPER DE LAVAUD CAST-IRON PIPE CENTRIFUGALLY CAST tells of the characteristics of this pipe which is given a much finer and closer grain than is found in cast-iron pipe produced by other processes. *Bulletin 235C, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

INSULATION TESTING EQUIPMENT (Bulletin No. 934) discusses such subjects as insulation, dielectric strength, resistivity, and dielectric constant and power factor. *Sound Engineering Corporation, 416 North Leavitt St., Chicago, Ill.—Gratis.*

A "DIFFERENT" WI-R-OPE HANDBOOK describes the construction of wire rope as well as splicing and the miscellaneous operations in using such rope in the oil industry, elevators, and for marine as well as for other purposes. There are numerous tables and illustrations. *Bulletin 235D, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

CHEMISTRY AND WHEELS tells that the automobile is a chemical factory on wheels and shows by graphic diagrams how this is the case. *General Motors Corporation, Research Division, Technical Data Section, Detroit, Michigan.—Gratis.*

SARCO TEMPERATURE REGULATOR FOR HEAT CONTROL IN INDUSTRY describes a system of temperature regulators operating by liquid expansion, the thermostat, connecting tubing, and plunger being filled completely with a special hydrocarbon oil. *Bulletin 235E, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

SELF-CALCULATING RESISTANCE CHARTS. Values and associated data may now be determined without mathematics (or headaches) by means of this collection of self-calculating resistance charts. The charts provide a simple method for determining the relation between resistance, voltage, current, and power of any resistor or rheostat. *Hardwick, Hindle, Inc., 40 Hermon St., Newark, New Jersey.—Gratis.*

THE STORY OF LEARNING is a well illustrated booklet describing a new enterprise. *Rose-Croix University, Rosicrucian Park, San Jose, California.—Gratis.*

FIRE AT SEA!

(*Continued from page* 85)

ships. To American navy officers trained in the exact methods of all navies, the knowledge which we have always had of the American Merchant Marine, and of the loose laws which govern it, the dangerous conditions in the American Merchant Marine have stood before us always as a ghastly prophecy."

Admiral Fisk's attitude is bred of his realization that the national Merchant Marine is counted upon to play an indispensable part as an adjunct of the battle fleet in time of a foreign menace. His denunciation is really directed against those weaknesses that do exist in some of our merchant fleet and its personnel, and is not intended to discredit those fine men who have rightly won acclaim because of their splendid and even spectacular actions at sea. Even so, it must be remembered that the nation's money has been spent in sums of many millions in later years to promote our Merchant Marine by building craft like the *Morro Castle*, and behind this substantial help has lain the purpose of thus providing ourselves with vessels and well-trained men that could collaborate with the Navy in time of need. Manifestly, steps must be taken to see that the personnel of these ships shall be wholly qualified and so disciplined that they can at least battle intelligently with fire aboard or meet resourcefully and courageously any other situation at sea touching first the safety of the ship and then the well-being and security of the passengers entrusted to their keeping.

The heartening aspect of this subject is that we are positively assured that ships can be built, without inviting excessive cost, that will be far better safeguarded against the hazard of fire than many of the liners afloat and in active service today. This much the naval architect and groups of contributive specialists and industries have shown to be attainable. Nevertheless, a grave weakness remains in the human equation of the problem; and only an aroused public opinion and popular insistence will bring about the necessary corrective measures and their enforcement. The carefree attitude of the traveler should not be reflected in the conduct of the operating force of our passenger liners. Discipline, efficiency, and continual alertness must be assured. Our Merchant Marine, like the Navy, should be able to live up to any prescribed standards. The nation has proved time and again that it has all the men it needs to maintain its prestige upon the sea. Let us see to it that we recruit from them such personnel as will make our merchant service a source of pride.

Books SELECTED BY THE EDITORS

(*Continued from page* 61)

fied by individual variations among healthy people; and finally, as to the justifiable anticipations of advances to be gained through the newer knowledge of nutrition and food values." This is the publisher's statement and we find it amply justified in the 277 pages of this book. The author is a professor of chemistry at Columbia University and a widely known scientific authority on food and nutrition.—$2.70 postpaid.—*A. G. I.*

RAILWAY ENGINES OF THE WORLD

By Brian Reed

IN time the steam locomotive will probably be as dead as the dodo. The reciprocating engine will probably be in use in the time of all of us now living, but steam propulsion was recently given a serious blow by the use of Diesel engines by the Union Pacific System and other lines. The present book illustrates many unusual types of locomotives in use in Great Britain and in Europe as well as those in South America, Asia, Africa, and Australia. The author tells enough about each type illustrated to show that locomotive designers all over the world are alive to the opportunities for improvements.—$1.90 postpaid.—*A. A. H.*

THE BRITISH AIR ANNUAL

THE Air Annual of the British Empire, 1934-35, is an interesting volume in three languages (English, French and Spanish), containing some 840 pages and a large number of illustrations. It covers civil, military, and naval aviation in the British Empire, airplane engines, accessories, the latest wrinkles in construction, and in general constitutes an up-to-date encyclopedia of the art. It is of as much interest to serious American readers as it is to British readers.—$6.30 postpaid.—*A. K.*

HALF MILE DOWN

By William Beebe, Sc.D.

IN this most readable volume the widely known Director of the Department of Tropical Research of the New York Zoological Society, better known to millions of fascinated readers simply as "Beebe," brings together the whole story of his work with the bathysphere. The main text is non-technical but in a 213 page appendix he assembles the more technical data about the bathysphere and the forms of life seen from it. The book is well illustrated and produced, and is sure to be a scientific best-seller. It is essentially a narrative.—$5.20 postpaid.—*A. G. I.*

NORTHERN LIGHTS

By F. Spencer Chapman

THIS account of the British Arctic Air-route Expedition to Greenland is a dramatic narrative of a large scale arctic expedition, with plenty of thrills. It concerns mainly the east coast of Greenland, but sledge journeys were made to and across the high interior ice plateau, including one man's winter sojourn in solitude there for five months. The adventure is prefaced by a foreword by Admiral Byrd.—$2.70 postpaid.—*A. G. I.*

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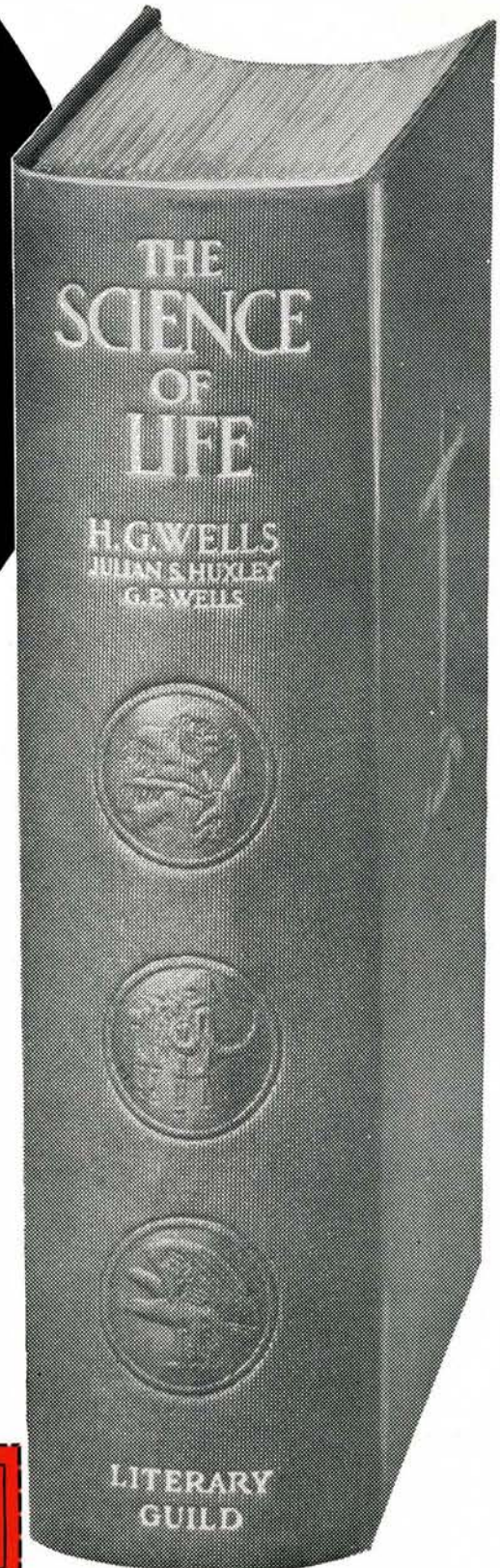

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