YOUR 1937 MOTOR CAR

SCIENTIFIC AMERICAN

December · 1936

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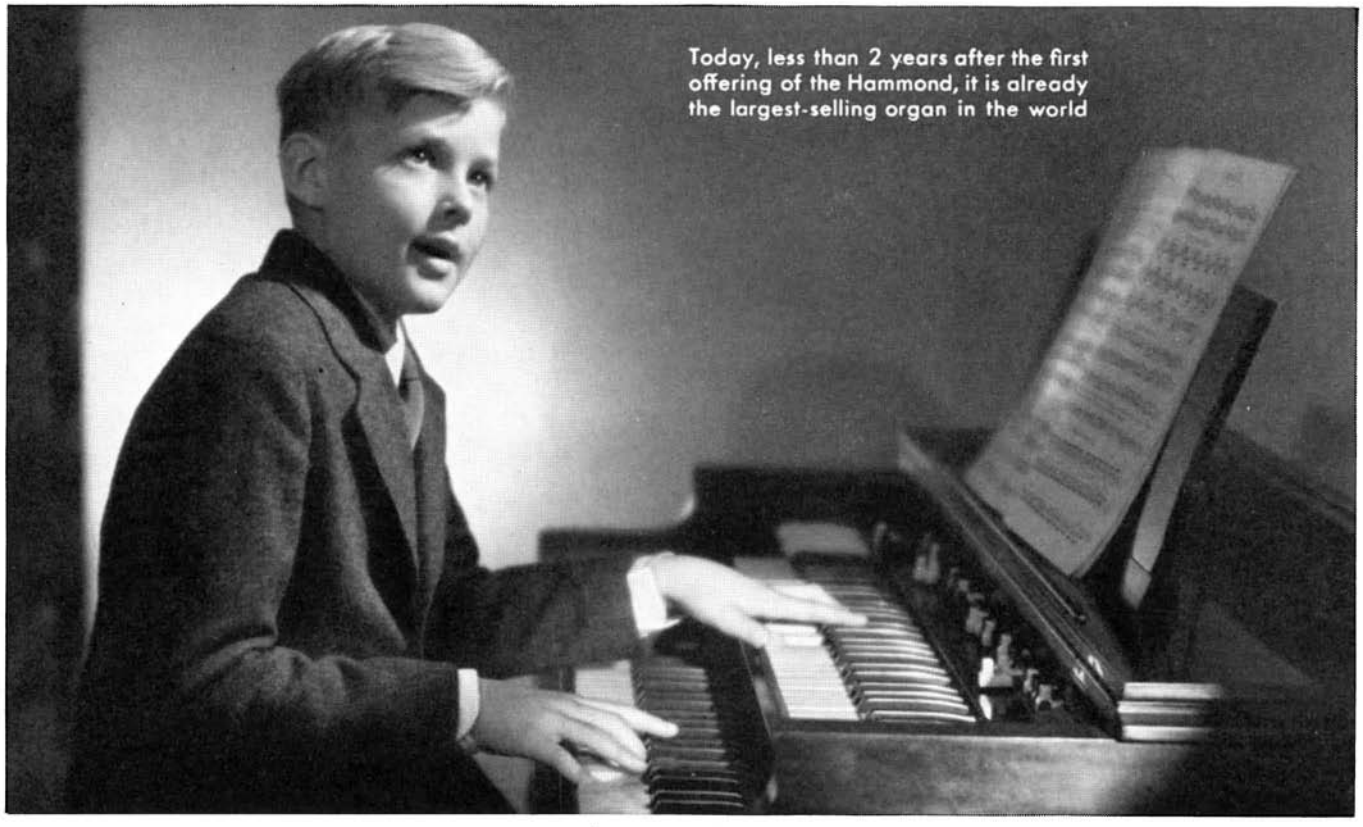


For your home—a new miracle of organ music!

The tone range of a great cathedral organ at the price of a fine piano

Already this wonderful organ has opened a whole new chapter of musical history. It produces the full range of rich, lovely tones heard in cathedrals. Yet it has no pipes, no reeds. Played like any organ, the Hammond originates tones by electrical impulses instead of by air-pressure.

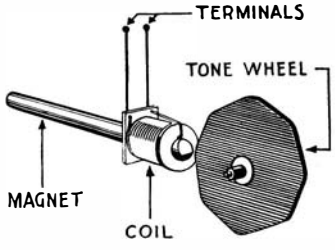
With the creation of the Hammond, the true, exquisite beauty of organ music has for the first time become a practical reality in private residences. This remarkable new organ occupies only a four-foot square. And it costs no more than a fine piano.

Modern quick-tempo music can be played on the Hammond with an ease and brilliance of effect never before possible on the organ. And in addition to the familiar organ voices—flute, diapason, strings, reeds—scores of interesting, lovely *new* tones are instantly available.

See and hear the Hammond at any of our dealers in principal cities. For a descriptive booklet giving full information, address The Hammond Organ, 2943 North Western Avenue, Chicago.

CREATES EXQUISITE ORGAN TONES BY ELECTRICAL IMPULSES

The heart of the Hammond Organ is a series of tone wheels—metallic disks revolved at constant speed by a synchronous motor. Each disk has a number of high spots spaced around its edge. As these high spots revolve past a magnet they vary its field and induce a tiny current in its coil. If 440 per second pass the magnet, an alternating current of frequency 440 is transmitted to the organ's tone cabinet, which in turn gives off a musical note of 440 vibrations per second—concert pitch "A".

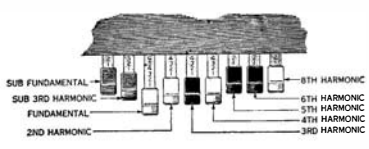


CANNOT GET OUT OF TUNE

The tone wheels are all driven by the same motor, thus cannot vary in relative speed. The motor itself is held to constant speed by the same principle that regulates an electric clock.

253 MILLION TONE COMBINATIONS

Any musical sound—trumpet, violin, or any other—consists of a fundamental tone plus a combination of harmonic overtones and subtones. Instruments derive their individual characters from different combinations of these harmonics.



In the Hammond Organ, fundamental tone and harmonics are all controlled by a simple system of drawbars shown in part at the left. By establishing the fundamental tone and adding a given combination of harmonics, the organist can create not only all the familiar organ tones, but also countless *new* tones never heard before by the human ear.

THE HAMMOND ORGAN

$1250
f.o.b Chicago—
slightly higher
for large installations

HAMMOND DEALERS ARE NOW HOLDING DAILY GIFT-SEASON DEMONSTRATIONS

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SECOND YEAR • ORSON D. MUNN, Editor

CONTENTS • DECEMBER • 1936

IN a constant effort to improve the quality of American-made motor cars, research engineers are continually investigating new materials and designs. An example of this work is shown in the photograph reproduced on our front cover, taken in the General Motors laboratories. Here a stroboscopic set-up is being used to study gear tooth contact in an automobile differential assembly. At the same time one of the engineers is using a sensitive stethoscope in order to detect sounds that might indicate approaching trouble.

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50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of December, 1886)

SPEED—"On Nov. 16 a Michigan Central train on the Canada Southern division, having on board a number of directors and officials, ran from St. Clair Junction to Windsor Dock, a distance of 107 miles, in ninety-five minutes, being at the rate of over sixty-seven and a quarter miles per hour."

TUNNEL—"The work on the new lake tunnel at Chicago is progressing rapidly. The men work in three shifts, of eight hours each. The first digs the hole about 10 ft. in diameter, through clay, at the rate of about 18 ft. per day, the second trims it up and walls with planks, and the third lays a circular wall of bricks in cement, 12 in. thick. The tunnel is left a shade over 7 ft. in diameter, the whole plastered with cement."

SUBMARINE—"A small vessel that has attracted much attention during the last few months is a submarine boat designed for use in placing torpedoes under the bottoms of war vessels. The *Peacemaker* is thirty feet long, seven and a half feet wide and six feet deep. The present craft is provided with a small sighting dome, nearly amidships, and projecting fourteen inches or more above its deck. A central fin extending the length of her deck, and rising about as high as the pilot's dome [is] designed to act as a fender. The great difficulty in submarine navigation has been to obtain an available source of power. In the *Peacemaker*, the Honigman soda boiler is used. A fourteen horse-power Westinghouse engine is used to drive the screw. . . . Her deck is to be provided with torpedo gear for discharging floating torpedoes . . . provided with cork floats, and electro-magnets, and electric detonators. . . . The instant they come in contact with the iron bottom of a war vessel, they will adhere with great tenacity."

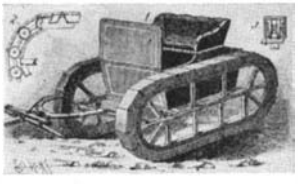
PARIS CEMENT—"A new cement, called 'cement de Paris,' has been introduced in France. The material is stated to be at least equal, if not superior, in quality to the English article. This material is said to possess durability and the cold appearance of marble, and a wall rendered, floated, and set with it becomes impermeable to moisture."

SHALLOW—"A steamboat has been built to navigate the Allegheny River between Pittsburgh and Kittaning, a distance of 45 miles. Although 142 ft. long and 25 ft. beam, she draws but 10 in. of water. There must be many streams navigable for steamers of light draught like the above. It only requires a little enterprise to make them available."

COLOSSAL—"The existence of the great statues of Bamian has been long known to Indian archaeologists, but reliable measurements have never been brought home till now. There are five statues at Bamian; three of them are in niches, which have been cut out, the figures being formed of the rock within the niche. The largest statue is 173 ft. high."

SLAG—"A new industry has been started in Middlesbrough, Eng., the object of which is to utilize blast furnace slag. . . . It has been found that if slag which has been annealed be pulverized, and mixed with cement in certain proportions, and pressed into moulds, and put aside for, say, three months, it sets into a peculiarly firm, hard, and solid mass. The value of these qualities was soon perceived, especially as applied to the manufacture of concrete flagstones."

TRACTOR—"The endless tracks are composed mainly of anti-friction rollers, united by links to form an endless chain. The side pieces of the body of the vehicle are oblong in form, are held parallel with each other by suitable framework, and are flanged to form guides for the wheels of the endless tracks, so that all danger of lateral displacement of the tracks is obviated. The guards surrounding the wheels are made up of links of sheet metal . . . hinged together to form a continuous chain to inclose the wheels. As the vehicle is drawn along the ground, the contact of the endless guards with the ground will cause the body to be drawn along the endless tracks."



AIR MAIL(?)—"Mr. Preece states that in some of the British post offices a great deal more air power than electrical power is used. In London, Manchester, Liverpool, and Glasgow, all the telegrams were transmitted by air power, and the use of air pressure for that purpose had been applied for thirty years."

STEAM TRICYCLE—"Mr. Louis Lallemand, a skillful mechanic of Vassy, has just constructed a steam tricycle, to be heated by petroleum. . . . The consumption is about three and a half pints of petroleum per hour. Upon a good road, a speed of from 7 to 9 miles per hour may be obtained."

NAVY—"The condition of the navy is attracting more attention than it has received at any previous time since the close of the war. Naval officers and a few legislators have long known—and the fact is now generally admitted by the press and the people—that we have not had during the last twenty years a single sea-going ship that would have had a hope of victory if pitted against any of the first class warships of other nations launched during that time."

WAGES—"Hon. Abram S. Hewitt, our new mayor-elect, says that 'for the first time in the history of this country, the day's wages of a mechanic can buy a barrel of flour.'"

STRIDE—"Dr. Gilles de la Tourette has found, from a comparison of a large number of cases, that the average length of a pace is, for men, 25 inches; for women, 20 inches. The step with the right foot is somewhat longer than that with the left."

PATENTS—"The question is sometimes asked why it is that the examiners of the Patent Office are so liberal in the allowance of patents, especially in simple things. The answer is obvious. It is clearly their duty, under the law, to exercise the greatest degree of liberality toward the inventor, and to do everything in their power to facilitate him in securing his invention by patent. The inventor is a man who supplies the country with new and valuable forms of industry; he supplies the people with all manner of comforts and conveniences. . . . Doubt should in every case be resolved in the inventor's favor."

AND NOW FOR THE FUTURE

¶Big Engineering by Hand Labor in China

¶Color in Movie Cartoons, by Andrew R. Boone

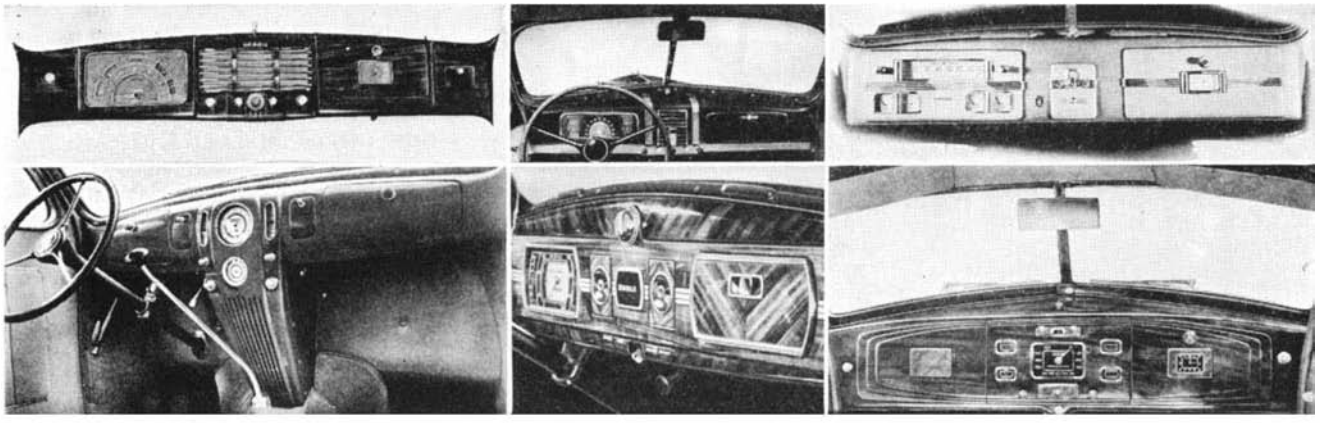
¶Fish and Physicians, by Henry Pelham Robbins

¶Broiler Factories (and Eggs, too), by Philip H. Smith

¶Ourselves and the Feeble-minded, by G. H. Estabrooks

KNOW THEM BY THEIR FRONT ENDS

TYPICAL of the 1937 automobiles are the representative cars illustrated above. *From left to right, top row:* Lincoln "Zephyr"; De Soto; Dodge; Studebaker. *Second row:* Buick; Pierce Arrow; La Salle; Cord. *Third row:* Cadillac; Chevrolet; Oldsmobile Six; Pontiac. *Bottom row:* Oldsmobile Eight; Terraplane; Chrysler "Royal"; Willys. Many of the new features incorporated in these and other American automobiles for the coming year are described and illustrated in detail in the article starting on the opposite page. An intensive survey of the entire motor-car field shows that, while there is only one wholly new car on the market for 1937, there have been numerous refinements and developments in previous models, all of which contribute toward safety, comfort, or economy for the automobile purchaser.



What you see as you drive them: Instrument panels on *(upper row, left to right)* Buick, Chevrolet, Studebaker, *(lower row, left to right)* Lincoln "Zephyr," Dodge (note recessed controls and ignition switch mentioned in article), and Hudson

Your 1937 Motor Car

Engineered for Safety . . . Improvements in Minor but Important Details . . . Lowered Center of Gravity . . . "More Car" for Your Money

By A. P. PECK

RESEARCH in a hospital may seem to be a queer approach to solving motor-car problems, but it is exactly what has been done in designing some of the motor cars that will be available by the time this article is in print. Realizing that many of the injuries suffered in motor car accidents are caused by drivers or passengers being forcefully thrown against projections on automobile dashboards, Chrysler engineers took up the matter with hospitals and doctors throughout the country in an endeavor to determine just how serious this phase of the accident problem really is. The result is that the instruments of the entire line developed by them are set flush with the dashboard; there are no projections—not even light control switches—against which the driver or passengers can be injured. Even the ignition key is inserted in its lock in a miniature tunnel at the lower edge of the dash, so that it does not project at all. Light switches, hand throttle, and other manual controls are also at the lower edge, from which position they are operated by a finger tip hooked into a notch.

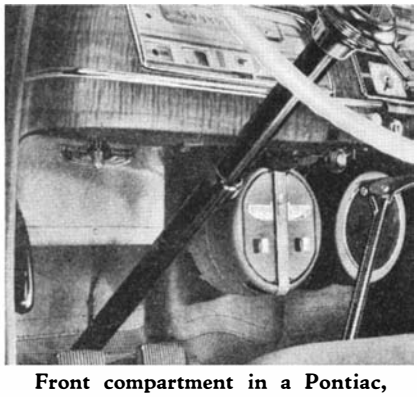
Curved door handles on most 1937 cars are an added safety feature

IN order to present to our readers the latest possible information on the new motor cars, the writer of the accompanying article, one of the editors of Scientific American, spent several days visiting the factories in and around Detroit. He has purposely avoided dwelling on those phases of motor car design which are ordinarily heralded widely through advertisements; rather his aim has been to uncover those minor but important developments which are not usually well known, but which contribute largely to the comfort and satisfaction of motoring. —*The Editor.*

Door handles, inside and out, are so curved that they cannot catch clothing or pierce flesh.

The foregoing is typical of the attention which is being given in increasing degree to the safety of motorists. Minor in scope as it may seem to be, it indicates that manufacturers are acutely aware of the necessity of inbuilt safety in cars, and are striving to do everything possible to decrease motor driving accidents.

Presenting an impartial analysis of the new features of the 1937 motor cars involves peculiar difficulties. The



Front compartment in a Pontiac, showing radio, heater, and speaker

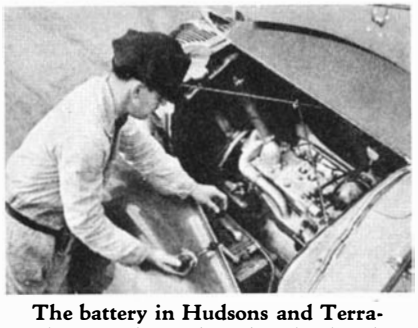
greatest progress lies in development and improvement of existing parts and mechanisms, with little that can definitely be labeled as "new" in the strictest sense of the word. If, therefore, the present article seems to dwell on the smaller details, it must be realized that these are just as important to the motorist as radical changes in design or construction—more so, in fact, since such progress is indicative of the lessons that are being learned by experience and of the application of this knowledge to the construction of better cars for the public. The accompanying photographs and explanatory notes tell much of the story of the 1937 cars; the following paragraphs supplement the photographs and describe some of the details that

Capacious trunks are the rule on the cars for 1937. At the left is Chrysler "Royal" touring sedan, at the right the Pontiac touring sedan, and below, the Lincoln "Zephyr." Note how the spare tire in this model is mounted on a rack that swings down out of the way, giving complete access to the large luggage compartment

do not lend themselves to photography.

In order to simplify the servicing of cars when the driver pulls up for gas, oil, and water, some of the designs—Chevrolet for example—place all the intakes for these essential fluids on the right side of the car. No longer need the attendant hop from one side of the car to the other in fulfilling his duties. Up comes the hood; there are the water and oil filler caps. This part taken care of, the attendant fills the gasoline tank without walking around the car. This is a small factor, perhaps, but one that adds to convenience.

A feature that practically all manufacturers have considered this year is prevention of fog and frost formation on the windshield. The recent development of hot-water heaters for car interiors has been in their favor. Most of the new cars are provided with means for taking off a stream of hot air from the heater and directing it upward



The battery in Hudsons and Terraplanes is located under the hood. It is kept cool by a flow of air

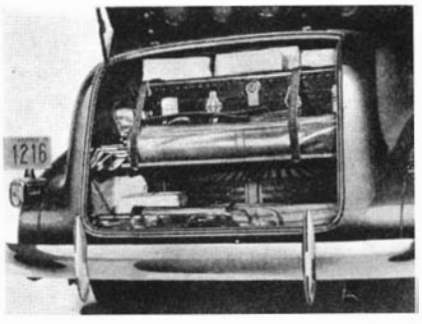
against the inside of the windshield. This evaporates interior mist, and in cold weather warms the glass so that frost cannot form on the exterior and the windshield wiper can do its job regardless of outside temperatures.

In the matter of wheel construction, it is evident that wire wheels are definitely out of the picture, as far as mass production is concerned. Pressed steel artillery and disk wheels are far in the majority. Although disks seemed to have been eliminated years ago, the increased use of "doughnut" and "air wheel" tires, with the decreased wheel

size accordingly necessary, has brought the disks back to some prominence, sharing the field with pressed steel artillery wheels with very short spokes.

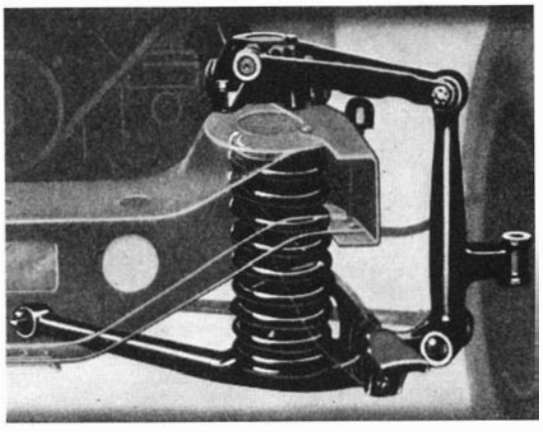
Probably the most interesting development for 1937 is the advent of the new Willys. Whether this entirely new car will stand the gaff of usage is not for us to say; only time and hundreds of thousands of miles of driving can answer the question. Nevertheless, a newcomer to the field, even though it has an old and well-known name, is always welcome and provides material for speculation as to performance and durability. The new Willys is announced as the lowest priced car in the standard size field. Its body is a fine piece of design—modernistic to a large degree, but pleasing even to those eyes which usually belittle the modern trend. At the time of writing no mechanical details are available except that the engine will develop 48 horsepower at 3200 revolutions per minute, and the valves seat on ring inserts that resist pitting and reduce the necessity for frequent valve grindings—a type of construction now widely used.

With increased use of all-steel bodies it has been necessary to devote not a little attention to the problems of noise. All new General Motors cars have bodies that contain a minimum of wood, and clever design has been applied to reduce road and body noises to a low value by means of proper placement of insulating materials. Chrysler engineers, who were among the first to pioneer in the use of all-steel bodies, have produced a rubber mounting for bodies that eliminates all metal-to-metal contact and results in the body literally floating on rubber. This is accomplished by the use



of a number of brackets rigidly riveted to the chassis frame, each carrying three-piece rubber inserts on which the body rests. Body bolts go through these rubber inserts and are drawn up to a predetermined tension that is limited by a metal tube running through the rubber insert. Thus the rubber is under a constant but comparatively light pressure at all times and effectively insulates the body from road noises.

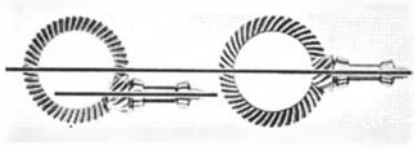
Road noise is not the only noise bug-a-boo of all-steel bodies. Vibration of metal panels, regardless of how well braced they may be, contributes its share. This has been kept under control by the liberal use of insulating and sound deadening materials. For example, the metal floor panels of the De Soto and other cars made by the same company are covered with a half-inch thick coat of asphaltic compound that is bonded securely by heat treatment. This, together with the conventional floor rugs, effectively eliminates vibration. The interior surfaces of the metal roof and side panels are treated by spraying with a similar material, inserting sheets of



Torque arms, mounted in rubber on all new Packards, hold the independently sprung front wheels in rigid alinement against road shock

sound-damping fabrics, and covering all with the usual upholstery. Speaking of upholstery; an added safety feature is found in the rolled back of the front seat in certain body styles of Dodge cars. The soft cushion thus formed serves to lessen the effect if a back-seat passenger be forcefully thrown against the front seat in the event of a sudden stop or collision.

New shock absorbers are adding their part to riding comfort. Many of the 1937 cars are using shock-absorbers of the so-called airplane type. These require no linkage as did older models; they are long and comparatively thin telescoping tubes that are fastened directly to axles and body, thus providing less chance for squeaks and rattles to creep



in as the parts wear with use. These shock absorbers are all hydraulic in action.

In the power plants of many of the new cars, aluminum pistons are found, but they are by no means the aluminum pistons of a few years ago. By an electrolytic process they are "anodized" to produce a file-hard surface that resists wear. Some of them are skirted and some have new shapes designed to give better service and faster acceleration. Full-length water jackets serve to cool motors more efficiently and also to keep the oil in the crankcase at a lower temperature.

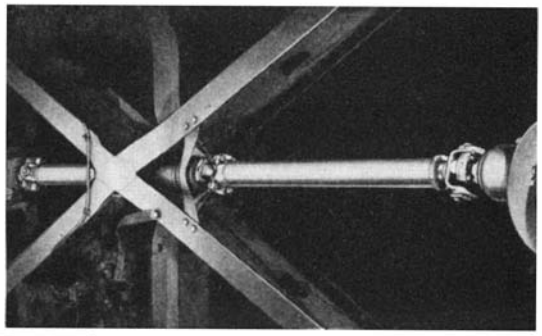
The Buick oil pump operates in conjunction with a floating screen and inlet, so that the oil forced through the engine is always drawn from the top of the oil supply in the crankcase, and therefore cannot carry with it any sludge or dirt that may have accumulated.

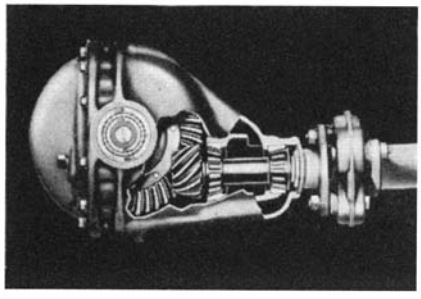
VENTILATED clutches in Plymouth and other Chrysler-made cars give promise of longer life and better action. While the car is in operation, air is constantly circulated around the clutch members, keeping them cool and hence increasing their efficiency.

Although free-wheeling, so widely acclaimed only a few years ago, has been abandoned by many manufacturers, Hudson and Terraplane still retain it in the form of a modified automatic clutch for use with their "Electric Hand" gear-shifting mechanism. Since, however, it is usually undesirable to use free-wheeling over 20 miles an hour, a governing device has been installed to limit the free-wheeling action to speeds of 15 miles an hour and less. Studebaker, one of the first advocates of free-wheeling, also has a modified form for use in connection with their overdrive. The over-running clutch operates only temporarily when the overdrive is coming into or going out of use. The car coasts against engine compression in all speeds.

A "hydraulic hill hold" is available on Hudsons and Terraplanes, by means of which the car is prevented from backing up when stopped on a hill. This device is actuated by the same fluid used in the braking system, and operates in conjunction with the clutch so that the car is held by the brakes until the driver operates the clutch to start the car forward.

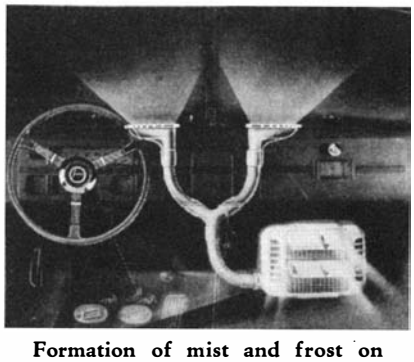
Two methods are in general use for lowering the height of the drive shaft and permitting lower body mounting. One is the hypoid rear end, below and at left. In the drawing are shown the relative heights of the drive shaft with hypoid and pinion gears. The other method, as in Oldsmobile, is shown at the right, where a two-piece propeller shaft is employed



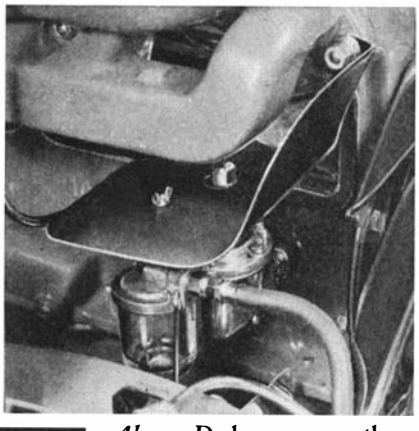


Lowering the center of gravity of a motor car—highly desirable for safety, better roadability, and more comfortable riding—is largely limited by the matter of transmitting power from the engine via a drive shaft to the differential. Common practice in the past has been to lower the body around the drive shaft by providing a tunnel in the flooring. This, however, is an undesirable make-shift and has given way to two general types of improved methods of power transmission. Most widely used in 1937 cars is the hypoid gearing in the differential. By means of a design that is half-way between a worm gear and the conventional pinion, the hypoid on the end of the drive or propeller shaft is located lower on the ring gear than would be possible with an ordinary pinion. This permits a lower position of the drive shaft and hence a lower body without a tunnel. The other method of achieving the same end is to use a two-piece propeller shaft as is done by Pontiac. In this design the forward half of the shaft is integral with and supported by the transmission. Connecting this shaft with the differential is a second shaft with universal joints at each end.

Typical of advances in driver and passenger comfort are the changes in seat design that are so noticeable in the new models. In every case the seats

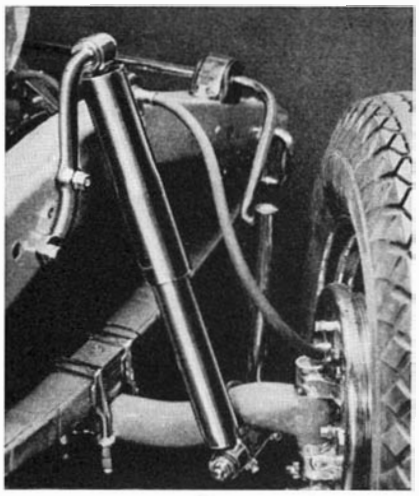


Formation of mist and frost on windshields is prevented by blowing air from the heater against the glass

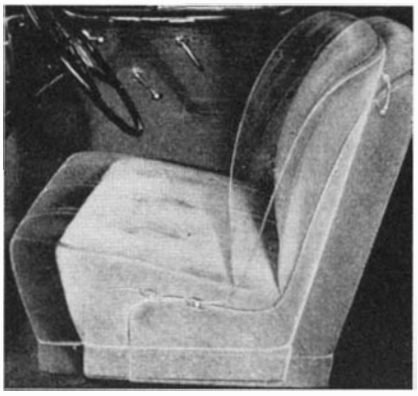


Above: **Dodge, among others, cools the fuel pump and filter by a current of air directed by a curved metal deflecting plate**

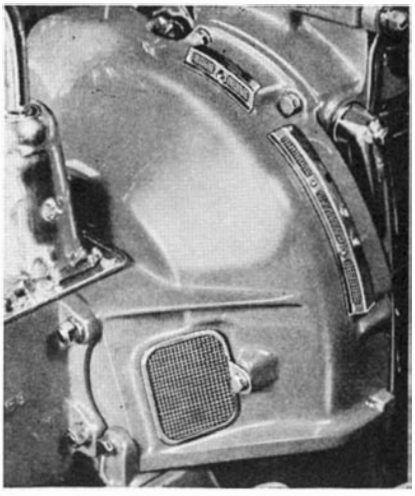
Left: **The new Willys, with standard tread, appears in 1937 as a wholly new car with modernized yet pleasing lines**



Typical of new telescoping shock absorbers is that used by Dodge



Adjustable seat in which angle of back changes, as in the Chevrolet

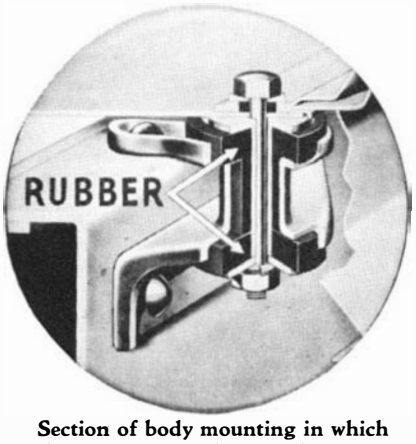


Ventilated clutches are used in all of the Chrysler Motors cars

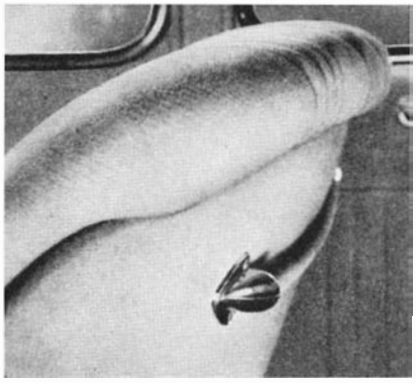
and backs have been so constructed that they hold the body in a natural position—not reclining with legs thrust forward nor sitting bolt upright as in a hard straight chair, but much the same as when sitting in a well-upholstered easy chair. Driver's seats are universally adjustable, and most of them incorporate a new feature of tilting slightly forward as they are moved nearer to the steering wheel. Thus a short-legged driver is given as comfortable a position as one of more normal stature; the same is true for long-legged ones.

A FEATURE that the buying public cannot see on many of the new 1937 cars, but one that is of great importance to lengthened car life, is that all sheet metal is rust-proofed before it is enameled or lacquered. All bolts, nuts, washers, and so on are cadmium plated to prevent rusting.

A trend that has been evident in motor-car design during the past few years, and which is even more noticeable for 1937, is the redistribution of weight and the relocation of passenger position. Hand-in-hand has gone a development of better braking systems. In



Section of body mounting in which there is no metal-to-metal contact

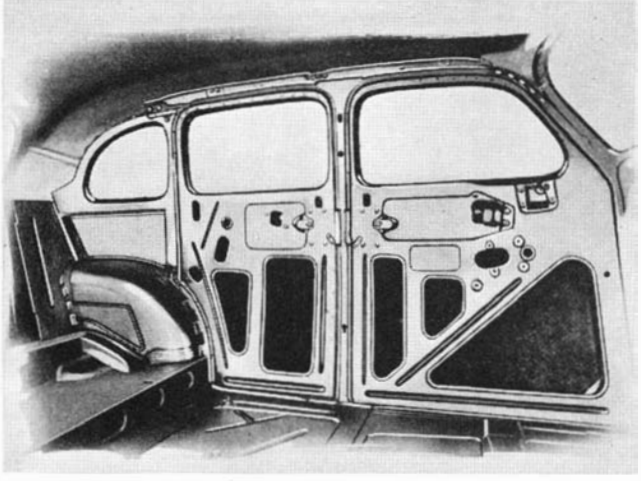


Rolled back of the front seat forms a cushion—safety for passengers

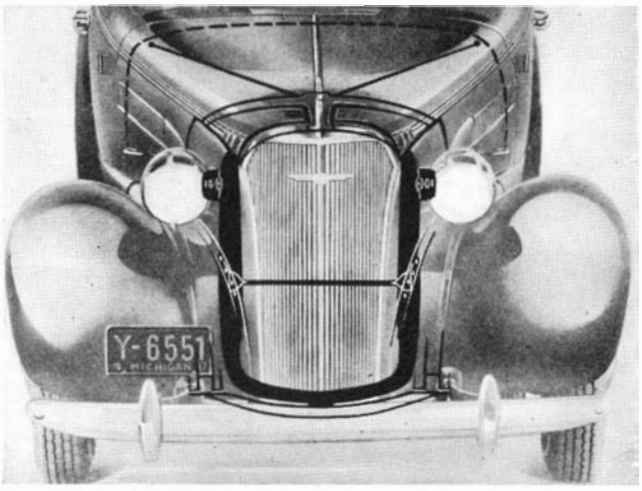
many of the new cars, 50 percent of the total weight of the car, exclusive of wheels and axles, is carried by the front wheels, and 50 percent by the rear wheels. Also, rear-seat passengers are placed farther forward. These two developments have definite implications for safety and riding comfort. It is now possible to apply more braking power to the front wheels and thus achieve easier stopping in an emergency by taking advantage of the forward shift of the center of gravity as the brakes are applied and the car slows down.

Up to the day of going to press, the Ford organization was unable to supply the writer with details of the changes and improvements being made in their new cars.

TAKEN as a whole, the outlook for the purchaser of a 1937 car is bright. He will get more for his money than ever before in safety, comfort, quality, fine appearance, service, and economy. That the ultimate in motor cars has not been reached is obvious; there is still a long way to go, but what the motor car of the future will be even the best informed engineers hesitate to predict.



The new General Motors bodies are all-steel, as shown by this photograph of the interior of a partly assembled body



In the front-end mounting of Chevrolet, radiator, headlights, and sheet metal are formed into a single structure

OUR POINT OF VIEW

Future Motor Cars

AS stated in the article ending on the opposite page, even the best-informed engineers in the motor-car industry hesitate to say what the future holds for the automobile. One such engineer, recently interviewed, ventured the prediction that the next big change will be in power plants. Pressed for details, he stated definitely that it would not be in the direction of the Diesel, but would go no further than to venture that it would involve a complete redesign of the automobile engine and body as we know them today. One of the truths with which the motor-car designer is faced is that the power plant in the modern car takes up too great a percentage of the space in the car. Roughly one third of the wheel-base is occupied by the engine, the rest by the passenger and baggage compartments. What to do about this state of affairs is a problem that is receiving considerable but unpublicized attention in the research laboratories of many of the motor-car manufacturers.

Thus the way is left open for a little stimulating theorizing. If the power plant can be made smaller, more compact, and still with the required horsepower for present-day traffic demands, cars can be made shorter, more compact, easier to handle and park. More cars can be driven on a given stretch of highway with no increase in congestion, and if they can be more easily maneuvered, the chances of accidents will be reduced. With this in mind, two thoughts emerge: radial engines such as used in aircraft, and engines in the rear. Why not combine the two? A radial air-cooled engine, placed in the rear and cooled by air conducted through ducts from the front of the car offers a starting point for solving the problem. "Bugs" will be present aplenty, but surely not formidable enough to halt progress, if this be a feasible way of gaining a desirable end.

Such theorizing is a pleasant recreation and harmless, but it is brought to an abrupt end by a realization of one factor that is neither mechanical nor technical. This factor is the human resistance to radical change. Courageous indeed must be the motor-car manufacturer who will attempt to give the public something in motor cars that is radically different from the cars which that convention-bound public is used to seeing. Courageous—and, even more important, backed by unlimited finances to take the losses that will inevitably result.

The never-ceasing efforts of the research engineers give assurance that changes will be made in motor cars, changes that will react to the benefit of the public as well as to the manufacturers. When research uncovers ways and means of making radical changes in automobile power plants, past experience with a fickle public will undoubtedly serve as a guide post which will point the way toward introducing the change with the least possible resistance. Through a process of evolution extending over a period of years, subtle changes in body design will undoubtedly be made, paving the way for an entirely new concept in motor-car construction. Then, just as the clothes of the last decade appear ridiculous today, today's motor-car design will be seen in its true light as being only a step removed from the horse and buggy.

Unclean!

THE recent escape of 235 lepers from an institution in Manila points directly at the folly of premature announcements of "cures" for serious diseases. Incited by legislative action that would have ended segregation of lepers if Governor General Frank Murphy had not vetoed it, these unfortunate victims of the disease gained the idea that they need no longer be kept from contact with the outside world. Despite a growing belief among medical men that leprosy can be cured and that it is not contagious, there is not as yet basis enough in fact to warrant discontinuance of segregation. Such beliefs should be kept within the profession until satisfactory proof has been reached.

Ship Personnel

THE problem of advancing safety at sea has been more vigorously attacked in this country in the last decade than during any previous ten-year period. Progress has been made, but much still remains to be done. There is, for example, the question of qualifications of personnel. Discussing this phase recently, Captain J. H. Tomb, U. S. N. (retired), said that minimum requirements for men qualifying as able-bodied seamen are "a travesty on safety at sea."

An American seaman, according to Captain Tomb, superintendent of the New York State Merchant Marine Academy, becomes in three years by Act of Congress, an A. B. even though he has "damned little training in the fundamentals of his trade. . . ." Yet the graduate of a state marine school is prevented by Act of Congress from getting his A. B. ticket until one year after graduation, although he is qualified to hold a licence as a third mate. The result of this peculiar situation has been that many people have criticized American seamen as inefficient; we have come to depend more and more on alien seamen to man our ships, and safety at sea has suffered.

Captain Tomb urges establishment of a national merchant marine academy; or as an alternative, that nautical training be extended to high schools, apparently as an elective vocational course. He estimates that this subject is of interest to "at least one third of all American boys."

For a different reason but to the same end, Joseph B. Weaver, Director of the Bureau of Steamboat Inspection Service of the Department of Commerce, had previously urged the establishment of a series of training schools for seamen. It is his belief that the *Leviathan*, now retired and tied up to a pier, should be converted into a training ship for seamen who desire advancement. "These men should be encouraged to study," he says, "and we should provide facilities for their training." The *Leviathan*, moored at New York, could accommodate 1000 seamen as could also the old *America* if she were stationed at San Francisco and the old *George Washington* if at New Orleans. The courses could last three or four months and the cost would be low. His plan, Mr. Weaver explained, would save three discarded ships from ruin, provide employment during their remodelling, and improve the quality of man power in the merchant marine.

Here are two really constructive ideas. One seems to envision preliminary nautical education while the other concerns advanced training. Both may be unsound in certain aspects but both do possess the merit of approaching boldly the problem of safety at sea as it pertains to personnel. And this, we believe, is vital. It is vital because lives and property are at stake; the men that man our ships are the "human factor." In view of the steadily mounting number of criticisms against that human factor that have been heard recently, isn't it time something were done about it? We are sure of it. And Congress should get busy.

BRITISH "MOSQUITO BOATS"

New Type Warship . . . 60 Feet Long . . . 40 Knots . . . Habitable, Seaworthy, Efficient . . . Long Distance Raiders . . . Torpedoes, Guns, Depth Bombs

By OSCAR PARKES

WHEN King Edward took the helm of *M.T.B. No. 1* and ran her out of Portsmouth harbor and around Spithead on June 30, the occasion was one which is likely to rank as a naval event in years to come, as it signifies the advent of a new type of warship into the British Navy—the motor torpedo boat.

At first sight there may not seem to be much difference between a motor torpedo boat and the coastal motor boats and submarine chasers such as are found in most navies; actually there is every difference.

The C.M.B., as originated by Thornycrofts, was a war-time production designed for fast, short-distance raiding, a surface-skimming, frail little craft which bounced along the sea when weather permitted, and was a hard-riding, uncomfortable craft at 40 knots which had a human fatigue time of about two to two and one half hours. The 55 footers weighed 10 tons and naturally were very lightly built. Their progress was such that control was difficult; no compass could give a course to a boat which bucked like an unsprung car at high speed on a rough road. Lewis guns were carried but it was impossible to use them effectively. A couple of 18-inch torpedoes were carried in troughs and discharged, nose forward, over the stern when the boat was in a line with her target. To avoid being hit herself, she was instantly slewed round and steered clear, so that torpedo attack was a somewhat tricky business demanding a clear brain and quick judgment.

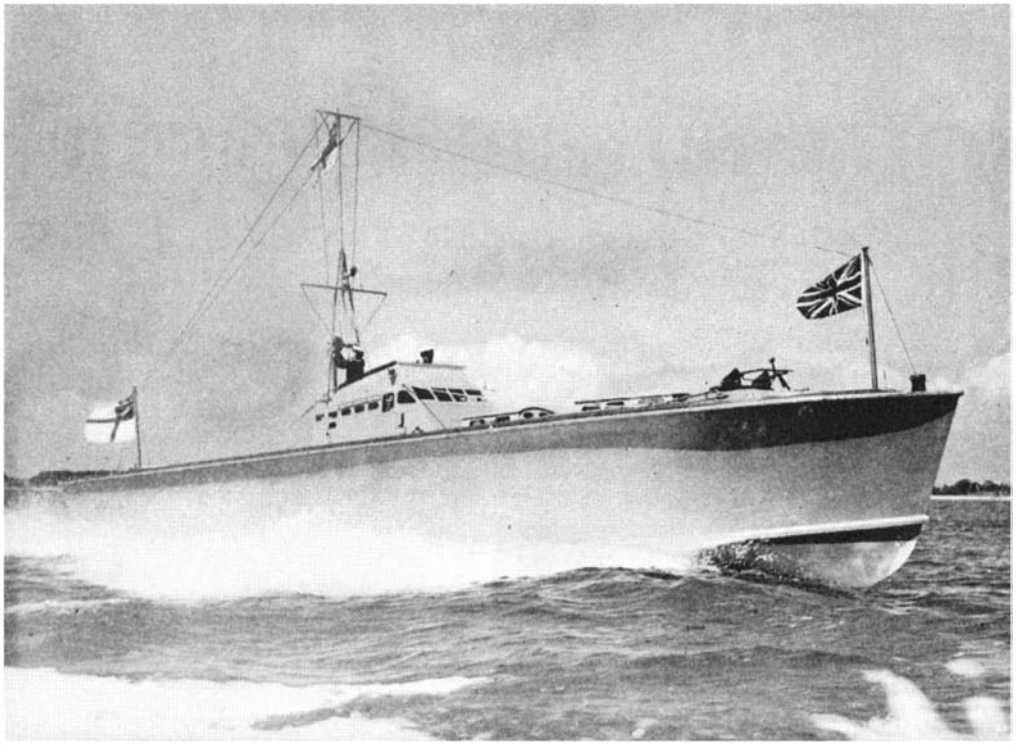
WITH the exception of the latest German boats, all the fast motor boats now built are based on the C.M.B's. with very shallow draught, light displacement, and no attempt at habitability. Some of the French craft can do their 50 knots, but such speed has little war value because the boats themselves have such limited possibilities. The other type of heavier motor boat, like the British M.L's. and the United States S.C. boats with a speed of below 20 knots, belong to a different category and are quite unsuitable for torpedo operations requiring high speed, although they are quite efficient as patrol boats and chasers. The M.T.B's. are a completely new proposition, at least so far as the British Navy is concerned. To some extent the Germans may have anticipated them in their *S.1—S.15* types, but without full data no definite opinion can be expressed on this point. Designed by H. Scott-Payne of the Motor Boat Trophy fame, and built by his firm, the British Power Boat Company, the M.T.B's. are intended for long distance, deep-sea work as independent units, and it is anticipated that they will commence a new phase in torpedo warfare.

We have seen the torpedo boat, starting off with the little steam launches fitted with a spar torpedo which Yarrows built in 1873, and the first boats built to carry the Whitehead torpedo which the firm supplied to the Argentine Government a year or so later, grow up in size and power from the first destroyers of 250 tons designed by Yarrows in 1892 to the super-destroyers like the French *Fantasque* class of 2500 tons which have entered the cruiser category both in tonnage and gun-power. Cost and size limit the numbers of such craft which have completely outgrown economical standards and, when a cycle of evolution has been made, it is only natural that the reversion should be made to the smallest size consistent with functional ability. Hence, with the advent of the M.T.B., we are back again to the sea-going torpedo boat, a boat cheap enough to be built in large numbers, fast enough to make her objective and avoid destruction, and armed with torpedoes which can menace a modern battleship.

In the old days, we had first- and second-class boats, the latter being small enough to be transported in depot ships and to form part of the equipment of the battleships. Thus, when Lord Fisher was captain of the *Inflexible* in the

Courtesy The British Power Boat Company

H. M. *Motor Torpedo Boat No. 1* passing the *Hood* and *Effingham*. A fleet of these boats could be built within the cost of the *Hood*, and at times might do more effective work



A close-up of the first *M.T.B.* at speed showing about as much as can be learned of hull design. Her clean lines and absence of parasite structures favor attainment of high speed

'Eighties he used to say that he would deal with opposing battleships by closing them at nightfall and lowering his second-class torpedo boats for a mass attack. Nowadays, we want modern editions of the old first-class boats, which we have found in the M.T.B.—able to stand up to bad weather, habitable, and efficient.

A GLANCE at the illustrations will show that a special feature of the boats is their high freeboard, upon which so much of the success of the design depends. The dimensions are still confidential and so are the under-water hull lines, so that the essential data cannot be discussed. The only figures available show their length to be 60 feet, which is a mean between the medium (55 feet) and large (70 feet) C.M.B's. But, although the hull is a light shell, it is divided into many watertight compartments which give positive buoyancy even when to all intents and purposes the boat has been "totally destroyed."

To say that they are magnificent in bad weather is the simple truth, and their maneuvering abilities are such as have never been achieved in boat design before. Their directional stability is such that once put upon a course they can be left there in either a beam, ahead, or following sea; and the controls, operated from the wheelhouse, are finger-light. To appreciate what this means to the navigator and the bearing it may have when hazardous and nerve-wracking operations have to be performed, I may say that Mr. Scott-Payne drove one of these boats up the English Channel and North Sea from Southampton to Grimsby for 14 hours and from Grimsby back again for 10 hours at 36 knots—both non-stop runs in bad weather. And, in his own words: "I was at the helm the whole time without, I may assure you, any physical fatigue of any sort."

For armament, each M.T.B. carries two 18-inch torpedo tubes which can discharge their weapons by a novel method at present confidential, the gear being fool-proof in operation and the lightest as yet designed. In addition, there are several machine guns and depth charges so that the boats can be employed either as torpedo boats against fleet units when, with their close approach and exact torpedo aim, they should be very efficient, or as submarine chasers.

Considering the size of the boats, their general equipment is wonderfully complete, comprising everything requisite from a heavy ground anchor, sea anchor, and towing gear to an ice chest, electric fans, spacious wardroom six-feet high, lavatory compartments, radio telegraph and telephone, fireproof petrol stowage, and ventilation system. The chart house has full electrical equipment, chart tables, and navigating gear; the whole design, arrangement, and construction bristles with novelties of every description. The M.T.B's. carry three quarters of a ton of fresh water and provisions and gear for eight men and two officers for 14 days.

Their triple screws, driven by three, 500 b.h.p., Power Sea Lion, 12-cylinder, petrol engines, are capable of providing a speed of over 40 knots, with a thousand-mile radius at 25 knots.

At present, six boats are under construction or completed and six more are included in the current estimates for which the sum of 700,000 dollars has been provided, but this batch is considered to be purely experimental. They can be built quickly and cheaply, so are essentially suitable for emergency construction, while the design lends itself to further development if the present boats are not large enough or fast enough for other conceptions of their war-time uses.

The German boats which can be compared with them date from 1929 to 1936 and are numbered *S.1* to *S.15*. They are 92 feet long and displace from 45 to 50 tons, their profile being that of an exaggerated C.M.B. with a low freeboard aft, sheering up to the bows. There are three engines of the airplane type, petrol driven, each developing 1000 horsepower for speed work, and a single 100 horsepower engine for cruising. About 40 knots is reported to be the best figure so far achieved for the petrol boats; whether those which are Diesel-driven have done so well is not known. The torpedo armament is heavier than in the M.T.B's. as the two tubes discharge 20-inch weapons. Photographs show these to be on the forecastle, which suggests that the trim may be slightly altered when they have the tubes loaded. Twelve officers and men can be accommodated, but their habitability cannot be equal to that of the British boats.

●

Dr. Parkes, who is best known for his long editorship of the annual "Jane's Fighting Ships," has, with the limited facts at his command, removed much of the mystery surrounding the new British fighting boats. From newspaper accounts, the impression had been gained that these were to be of defensive use primarily in restricted waters adjacent to the British Isles. On this basis, authoritative American naval opinion holds that, having used "mosquito boats," we want no more of them. The British M.T.B's., however, are offensive boats, powerful, speedy, long-distance raiders and, as such, may point the way to a recapitulation of naval needs the world over. Large fleets of them can be built at low cost, and destruction of one or a score of them in wartime would not compare in loss of men and materials with the loss of one battleship.—The Editor.

CHEMISTRY AND THE FARMER

Scientific Research to Aid the Farmer . . . New Jobs for Idle Men and Idle Acres . . . Co-ordination of Agencies into One Chemurgic Enterprise

By FRANCIS P. GARVAN
President, The Chemical Foundation, Inc., and the Farm Chemurgic Council

DURING the last few years, we have all been more or less painfully aware that many millions of our people have been deprived of things that they should reasonably have, and certainly not the least of these things is *work*.

It is often said now that times are getting better. Nevertheless, there are still many millions of idle hands. Even though every mouth is fed, and everybody clothed and housed, we shall still be a very sick nation if so many of our people are deprived of *work* which they are eager to do. It is obvious, therefore, that the re-employment of idle men and of idle acres is still the basic problem confronting America today. Solve this problem and the economic ills of the nation will subside.

Unemployment has been the arch villain of all depressions in the past and will so continue in the future. It is well, therefore, that we determine what past experience might contribute toward the solution of this problem of unemployed men and acres.

History discloses that relatively recent depressions finally terminated and were followed by the return of men and acres to prosperous employment because of two things, namely: 1, Expanding markets for old industries; 2, Creation of new industries. It further discloses that unemployed acres and men, including subsequent growth in population, have been absorbed in our national economy in approximately the following ratio: About one third due to expanding markets for old industries, and about two thirds due to the creation of new industries and the development of new products and new methods.

IT is confidently predicted that with the return of confidence in business; stability of exchange; balanced budgets; and through reliance on sound economics, the expansion of markets for old industries will occur in the natural order of things. This should absorb about one third of our unemployed. But what we are concerned with today is the two thirds dependent upon new industries for their return to productive enterprise.

Statistics in support of our dependence upon new industrial enterprises are not available in precise form as they relate to any particular depression. However, by taking a term of years, which is the safer method, there are ample figures in support of this contention. For example, let us take

The Author

the record of the four decades from 1890 to 1930. We had several depressions during those years including one major depression; namely, in 1893. We escaped another major depression in 1914 only because of the outbreak of the World War.

In those four decades our population was increased by 60,000,000 persons, of whom 40,000,000 gained their subsistence from new industries. What were these new industries? They were the product of modern science and invention developed by American initiative and applied to every-day usage by private enterprise. They fall into two general classifications: the mechanical arts and industrial chemistry.

Specifically, these new industries which have contributed so much to the public welfare include the agricultural implements, air-conditioning, automotive, aircraft, cement, central heating, electrical, food preservation, iceless refrigeration, internal combustion power, modern sanitation, motion pictures, nonferrous alloys, petroleum by-products, radio, steel alloys, synthetic chemistry, telephone, utilities, machinery which lessens the burden of human labor, and many others. Payrolls of these enterprises rightfully are credited with the vast army of men engaged in transportation, distribution, servicing, and maintenance of their respective products. Some of these industries will continue to enjoy a slow but steady growth. Others are still in their infancy and have a brilliant future.

IN 1890, the genius of Edison and his contemporaries had hardly begun to touch American life. Kerosene lamps and horse-cars predominated, and telephones were the exclusive luxury of the banker, the judge, the sheriff, the doctor, and the apothecary. Today who would surrender the comforts, the well-being, the necessities, and the luxuries of life that flow from these very industries—all created through the genius of men like Edison and firmly established through the courage and vision of American industrial leaders?

With few exceptions, these men were of gigantic mental stature. They were business statesmen. Their initiative normally provided employment for 10,000,000 men and women (based on the 1930 census). On the basis of four persons to a family, they furnish material security for 40,000,000 citizens—almost one third of our present population. Without these new enterprises, the United States could not have supported the tremendous increase of 60,000,000 citizens, who were actually added to our population in this short span of 40 years.

All of these industries owe their expansion to labor-saving machinery which has reduced selling costs, broadened markets, and pyramided consumption to a gross volume impossible with hand-labor methods, thereby increasing—not decreasing—the demand for labor. Scientific research and inventive genius furnished the brains. Thus a great variety of articles now within reach of the great mass of our people would have remained luxuries of the wealthy but for the savings in cost that accompany modern mechanical production.

Critics of the machine, afflicted with the spirit of defeatism, might well take

notice of one concrete illustration of how the American system of quantity production through labor-saving machinery in reality creates more jobs than it ever destroys.

The first commercial radio broadcasting station in the world (WWJ) was established by the Detroit News on August 20, 1920. At that time the station had one man on its payroll. A few citizens had cheap crystal receiving sets. A short time ago, this station celebrated its sixteenth birthday, at which time Dr. Lee DeForest announced that there are over 600 commercial broadcasting stations in the United States giving continuous full time employment to over 50,000 technicians, operators, and miscellaneous employees. This does not include the artistic talent engaged in actual broadcasts. Likewise, instead of a few crystal sets, there are now over 25,000,000 vacuum tube receiving sets in use throughout the country.

THE tremendous opportunity for employment afforded by the expansion of this one new industry within a short span of 16 years is sufficient evidence to prove that never in the history of the world has any industrial system been developed that contributes more to the general welfare than the American system. Free competitive enterprise made it possible.

We are now on the threshold of a chemical revolution which, within the next generation, will accomplish as much for the well-being of society and for the broadening of opportunity for employment as did the mechanical and electrical revolution in the two score years referred to previously. As stated before, the creation of new industries is dependent upon scientific research and American inventive genius plus the courage of industry.

This is the task—the creation of new industries—which has been recently undertaken by the Farm Chemurgic Council, the new recruit which has joined in the battle against enforced idleness of men and of acres.

One should explain the meaning of this new word, "Chemurgic," for a great deal will be heard about it in the future. It comes partly from the ancient Egyptian word "chemi," the origin of our modern word "chemistry"; and partly from the Greek word "ergon," meaning "work." Thus, "Chemurgic" literally means "putting chemistry to work." And of course "Farm Chemurgic" therefore means putting chemistry to work in industry for the farmer.

If any one of us has been enjoying the privilege of doing something and loses his job, his natural tendency is to try to find something else to do. What the Farm Chemurgic Council is doing is to react the same way as a powerful social group. In other words, it seeks to find, on a national scale, *something else to do* for those millions of our citizens who are now cursed with enforced idleness, and something else to do for those millions of acres producing more of certain commodities than the market can profitably absorb under present conditions.

Courtesy *Dallas Morning News*

One may reasonably ask why emphasis is placed on the farm problem in this movement. The answer is brief and to the point. The economic illness of the nation cannot be cured until the buying power of the large rural fraction of our population has been greatly increased. This rural group *must* buy, if the industrial group is to be continuously employed in manufacturing.

But agriculture, in turn, cannot buy unless it can farm enough of its acres profitably. And since now the task of producing food alone does not require a sufficient acreage of our land, it is plain that we must turn to non-food uses for products of the farm, and develop industrial processes and new outlets for these products. Thus we see that industry and agriculture are concerned, *together*, in seeking a common economic cure.

Then, you may ask, why does science come into the picture? The answer to that question is also clear. On a national or social scale, the attempt to find new things to do simply means research—scientific research. And by that term, scientific research, we do not mean chemical investigations alone. All the sciences must do their best to help discover *new regions of human activity*. Chemistry happens to be a major unit in the scientific army seeking the advancement of human welfare; hence its name has been chosen as a part of the name of the Farm Chemurgic Council.

Modern men of science, particularly in the field of chemistry, are teaching progressive men of industry how to separate the ingredients contained in the organic products of the soil and re-combine them in different forms for industrial use. Here we have the basis for a host of new industries, all pointing the way toward the return of enduring prosperity. The movement to accelerate these new industries began a year ago last May (1935) when Mr. Henry Ford was host to several hundred public-spirited citizens at Dearborn, Michigan, representing agriculture, industry, and science. Their avowed purpose was and is "to advance the industrial use of American farm products through applied science."

OUT of this original conference has been organized what is now known as the Farm Chemurgic Council. It is not a governmental agency, nor is it political. It certainly has something better to do, and more important to all of us, than to concern itself with the advancement of anyone's personal political fortunes. It is simply a group of far-sighted and public-spirited men who realize the magnitude of the economic problems confronting this nation, and who are unselfishly giving time and effort toward their solution.

The members of this council are men who carry large responsibilities in their respective enterprises. They recognize that prosperity cannot be sectional, that no one can be truly prosperous unless everyone is prosperous. In admirable contrast to the demagogue who would *lower* the standard of living of all by dividing the wealth of the few, these men have set themselves to the task of *raising* the standard of living of all by creating new sources of wealth within the nation.

The purpose of the Farm Chemurgic Council is: To survey the variety of farm products which, through applied science, can be transformed into raw materials usable to industry; to define the scientific research problems essential thereto; to stimulate appropriate research both in public and in private institutions; to activate American indus-

IF we accept the principle that good is bound to come from adoption of the "scientific attitude"—and who does not!—then we can know that splendid results are inevitable from the work of the Farm Chemurgic Council. Here at last is something over which we, long past our days of wide-eyed wonder at the marvels of progress, can sincerely enthuse. Here at last is genuine help for the farmer, and we predict that it will bring to a clear focus a problem that hitherto has been attacked in hit or miss fashion. Even so, the projects sponsored by the Farm Chemurgic Council must often be experimental. Trial and error or—as the scientist calls it—fact-finding, will be the rule. For example, one of the first major projects it is sponsoring—power alcohol from farm products—is at present a highly controversial subject, one which many level-headed experts claim is economically unsound. The Council expects to get the facts. It will get the facts on this and other important subjects and in the end the farmer and the nation will benefit—*The Editor*.

try to apply the fruits of research; to encourage the joint co-operation of agriculture, industry, and science in promoting this significant development nationally.

The commendable hope is entertained that such co-operation will: 1, Result in the gradual absorption of much of the domestic farm surplus by domestic industry; 2, Put idle acres to work profitably; 3, Increase the purchasing power of the American farmer on a stable and more permanent basis, and, thereby—4, Increase the demand for manufactured products, and, thus—5, Create new work for idle hands to do; revive American industry; restore American labor to productive enterprise; and help relieve the economic distress of the nation.

Every dollar used in support of the Farm Chemurgic Council has been supplied by the Chemical Foundation, Inc. and by no other source, directly or indirectly. In its work, the Council invites the co-operation of all related agencies engaged in agricultural, industrial, and scientific pursuits. The co-ordination of the talent thus made available is the Council's task.

THE members of the Council are positive in their convictions that, through orderly and persistent development, American industry will be able to absorb a major portion of the normal surplus of the American farm and thus gradually obviate the necessity of processing taxes, benefit payments, farm subsidies, and other temporary remedies.

That this is not a fairyland prophecy is indicated by the agencies already cooperating. A few of them may be named as follows:

Certain scientific agencies of the Federal Government; majority of the Land Grant colleges; many of the leading universities; Ford Motor Company; E. I. du Pont de Nemours & Company; The Chemical Foundation; Mellon Institute for Industrial Research; The National Grange; American Farm Bureau Federation; leading paint and varnish manufacturers; large processors of food products; manufacturers of farm machinery; the large chemical industries; and many other institutions.

One basic idea favored by the Farm Chemurgic Council is that of promoting the production, in this country, of crops and crop products which are now being supplied to us by foreign countries. Equally important are the Council's effective efforts to encourage and to induce financial support for greatly increased activity in the scientific research laboratories of the country. The result of such research will be *new* uses for many of our farm products, and along with this, the creation of much greater demand for them.

Dominant among the developments of this kind, already begun, is the project of power alcohol. There is some conflict of opinion, but not of enlightened interest, between the advocates of power alcohol and the petroleum industry; nevertheless, authentic tests have shown that the use of alcohol in a motor fuel blend is efficient from an engineering standpoint. Certainly its use nationally would be of tremendous benefit through bringing many millions of idle acres back into profitable production. You are going to hear a great deal more about this power alcohol question as the development makes further progress.

The Chemical Foundation is aiding in the construction and demonstration of the first power alcohol plant in the United States at Atchison, Kansas. The Farm Chemurgic Council is aiding in the technical phases of the work. The plant has a capacity of 10,000 gallons a day.

Orders fourfold in excess of plant capacity have been received. The alcohol will be used for blending with gasoline for motor fuel in middle western states. The plant is so constructed that a wide variety of farm products such as grains, sugar beets, cull potatoes, and Jerusalem artichokes may be used in alcohol distillation in order to arrive at dependable cost and yield data.

A SURVEY of new Chemurgic enterprises launched within the last year since the First Dearborn Conference justifies the estimate that no less than 50,000,000 dollars are being invested in new industries which will use factory crops raised on American farms for raw materials. These new industries include American paper mills, power alcohol for motor fuel, vegetable fiber plants, expansion of the plastic industry, new uses for cotton, tung oil development, soybean plastic and oil extraction plants, starch from southern sweet potatoes, furfural from oat hulls, and other miscellaneous new products.

This splendid progress is the constructive answer of American inventive genius and enterprise to the unemployment and farm surplus problems.

It is particularly gratifying to report that the fruits of the research conducted by Dr. Charles H. Herty in the utilization of southern pine in the manufacture of both kraft and newsprint paper are now receiving attention. (See "Southern

An experiment discussed fully in this journal in 1931 in which the entire cotton plant is harvested and baled. Increases in yield of alpha cellulose are indicated

Pine for White Paper"—Scientific American, May, 1934.) Dr. Herty's work has been financed principally by the Chemical Foundation and is a part of the Council's program.

The seven new paper plants now under construction in the South represent an investment of over 40,000,000 dollars and will have a combined capacity of about 1500 tons a day. It is estimated these seven new mills will give full time employment to 5000 persons working in the mills, and in addition will furnish profitable work throughout the year for 15,000 others working in the timberlands.

Those familiar with the possibilities of this new development—the perpetual supply of rapidly growing pine available, and the economy in operation—forecast that this is but the beginning of a new half billion dollar paper industry that will be established in the South within the present generation. Millions of acres of worn out cotton lands will be reseeded in pine; permanent progress will be made toward solving the surplus cotton problem; and profitable employment will be furnished several hundred thousand men.

Next to the South where 39 percent of our forest lands are located, come the western and northwestern states, the forested areas of which comprise 26 percent of our timber resources. There the hitherto much despised hemlock has been re-discovered as a valuable source of pulp for paper making and of alpha cellulose for the manufacture of rayon.

NOTABLE among recent western developments is the new 200-ton a day pulp mill being erected at Everett, Washington, by the Weyerhauser lumber interests, which will provide profitable use for hemlock formerly neglected in the forest. Modern chemical discoveries have made this development possible.

Marked progress has been made in the use of cotton membrane mesh for reinforcing bituminous roads in secondary highway construction. The Department of Agriculture has recently allotted 1,300,000 dollars to purchase and furnish free, sufficient cotton membrane to build experimental sections under varied climatic and soil conditions in every state of the Union.

When you realize that competent highway engineers estimate that of the 900,000 miles of now unimproved dirt roads in the country where traffic requirements justify surfacing, 600,000 miles will ultimately be given a bituminous paving, you can begin to visualize the potentialities spread out before us. On the basis of from eight to ten bales of cotton per mile of cotton road built, those 600,000 miles of new unimproved roads represent a potential market for from 5,000,000 to 6,000,000 bales of cotton. This is aside from additional requirements for annual maintenance.

The plastic industry is making splendid progress in new developments involving the use of both inorganic minerals and organic products from the farm in the manufacture of a wide variety of useful products.

New tung tree plantings have been made in southern states, notably in Texas, Mississippi, Alabama, Georgia, and Florida. It is believed that the output of 1,000,000 acres of southern tung trees

Irénée du Pont, Henry Ford discuss industrial uses for farm products

can be consumed in this country as rapidly as they reach commercial maturity, which is about six years after planting.

Substantial progress has been made in the utilization of soy-bean proteins and soy-bean oil in industry. Soy-bean production in 1935 (39,000,000 bushels) was almost double that of 1934, yet the demand was so great that importations were made from Manchuria equivalent to the output of 1,000,000 acres. Many automobile parts are now made from soy-bean plastics. The use of soy-bean oil in place of other imported vegetable oils in the manufacture of certain paints and lacquers is now an accepted standard practice in the paint and varnish industry.

I. C. Bradley, President of the National Soybean Processers Association, points out that the saturation point in the use of the soy bean and its by-products is far in the distance: "So many new uses are being found that it is easy to believe claims of chemists and of economists that the soy bean will take its place as one of our major crops."

Everything that grows in the vegetable kingdom is being analyzed by scientists, investigated by industrialists, and contemplated by agriculturists with the end in view of creating new industries, new products, and new methods, all of which means new jobs for the unemployed. It is a better future than has ever yet beckoned our people onward. The co-operative effort of these men is the answer to those "alarmists" who prophesy falsely that eventually the American farmer must retrograde to the status of the European peasant.

THE opportunities are legion: non-poisonous insecticides made from the painted daisy or pyrethrum; cork from domestic oak trees; wines and beverages from surplus fruits; perilla oil for paints; building material from bagasse or waste sugar cane; alpha-cellulose from the whole cotton plant (See "Cotton Stalks, a New Source of Rayon," Scientific American, October, 1931); increased domestic production of sugar; tanning materials from the Sourdock weed; domestic fiber from hemp and flax; domestic raw materials for rubber; rayon and Cellophane from a wide variety of plant life; and so on.

Summarizing, the Farm Chemurgists envision displacing eventually some 250 million tons of raw materials now drawn annually from the mineral kingdom by a like amount of organic (farm) products from the vegetable kingdom, all for industrial use in the United States.

A century ago the mineral output in this country was one half the farm output, measured in tons, and we had no serious unemployment problems. Today, the mineral output is about one billion tons, the farm output is one half billion tons, and unemployment threatens our social order. The switch suggested would make the output of each kingdom about 750 million tons. It would give us a farm population of close to 40 percent of the total population and would provide gainful employment for every man and woman qualified and willing to work.

This change would mean increasing agricultural production, instead of decreasing it. It would give us a better balanced distribution of population and would bring about a gradual decentralization of industry. Congestion of population in large cities, which is the real threat to modern civilization, would be retarded. Man, once again, if he so chooses, would be able to live a wholesome existence.

In the words of Mr. Louis J. Taber of the National Grange, the co-operation of agriculture, industry, and science to this end is "Our Greatest Economic Trinity."

And to quote Mr. Henry Ford's words at the First Dearborn Conference: "I believe that industry and agriculture are natural partners. Agriculture suffers from lack of a market for its products. Industry suffers from a lack of employment for its surplus men. Bringing them together heals the ailments of both. I see the time coming when the farmer not only will raise raw materials for industry, but will do the initial processing on his farm. He will stand on both his feet—one foot on the soil for his livelihood, the other in industry for the cash he needs. Thus he will have a double security. That is what I am working for."

REFLECTION NEBULAE

Large Opaque Clouds of Dark Particles in the Galaxy are Lit Up Whenever Stars are Near . . . New Type of Telescope Confirms an Older Theory

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. President of the American Astronomical Society.

ANYONE who looks carefully at the Milky Way must be impressed by its irregular and patchy appearance. Even the fainter stretches of the Galaxy in Auriga, Gemini, and Orion, which are seen in the winter skies, are far from uniform, and the brighter part which we observe in summer is full of brilliant areas and darker regions. Our eyes are handicapped in detecting this, for much of the most remarkable structure is too faint to be easily detected by direct observation—especially if the air is even slightly hazy or lit up by artificial lights. Long-exposure photographs reveal an extraordinary wealth of detail, some of it remarkably sharp in outline.

A generation ago it was supposed that the darker parts were gaps between the visible star-clouds through which the blackness of outer space was revealed through a foreground of scattered stars. Then Barnard, by a masterly analysis of his own superb photographs, convinced a skeptical world that the dark lanes and patches were caused by enormous opaque clouds—dark nebulae—lying between us and the bulk of the galactic stars, and blotting them out, or at least greatly diminishing their light. Even the great rift which splits the Milky Way in two from Cygnus to the Southern Cross and extends for one third of the circumference of the heavens, comes from a vast cloud, or belt of overlapping clouds, which conceals from us a great part of what would otherwise be the most brilliant region in the sky. When a bright star happens to be close to such a cloud, the neighboring part of the latter is lit up by the starlight and appears faintly luminous. The first evidence that this happened was given in 1912 by Slipher, who showed that the spectra of several of these nebulae were true copies of those of nearby stars, and the proof was completed in the following year by Hertzsprung, who found that the brightness of the wisps of nebulosity in the Pleiades was just what might be expected from a whitish cloud illuminated by the stars of the cluster.

Ten years later Hubble showed that this explanation applied to all the diffuse and irregular nebulae within the Galaxy. When the star whose light excites the nebula is exceptionally hot, the light of the latter comes mainly from atoms of gas, but if the star's temperature is less than 20,000 degrees, the nebula shows a continuous spectrum such as would be expected from reflected starlight (if observed with a spectroscope not powerful enough to show the dark lines). The brightness of the star-lit nebula naturally fades away at a distance from the star, and Hubble's measures show that the distance at which it ceases to be perceptible, on photographs taken with the same telescope under similar conditions, increases with the apparent brightness of the star in just the way which might be expected on simple geometrical principles.

The evidence that these nebulae shine by reflected light was thus made conclusive, but one further test might be imagined. Nebulae lit up by stars of different colors, and reflecting their light, should themselves be colored correspondingly. Are they so in actual fact?

IT is much easier to ask this question than to answer it, for it is one thing to show that a faint object exists and a very different one to find out what color it is. Direct visual observation, which is the first thing one would think of, is hopeless; the human eye, exposed to fainter and fainter light, loses its sense of color long before it ceases to appreciate the existence of a luminous form. One may see this for himself without laboratory apparatus. It suffices to take an electric stove into a dark room and switch it off after the wires and their supports are red hot. The fading light, at first a good cherry red, loses color as it weakens and the last faint glimmer looks almost gray—though, as a matter of fact, the radiation emitted from the cooling mass contains an ever increasing proportion of the deep red and infra-red rays.

Color in objects as faint as these nebulae can be detected only by photography, comparing images on an ordinary plate sensitive mainly to the violet, with those on an isochromatic plate with a yellow or red filter in front of it. The latter gives pictures on which the relative brightness of red and white stars is very much as it appears to the naked eye: on the former the red stars are much fainter—the plate is insensitive.

One of the best examples in the sky is the constellation Scorpio. Antares, its brightest star, is very red, of spectral class M, but has on each side a pair of blue-white stars (Class B) which, to the eye, look only one fifth as bright. On an ordinary photograph Antares is the faintest of the three, so that the whole appearance of the constellation is changed. In this familiar group nature has supplied us with the desired test under conditions as definite as could be provided by a pre-arranged experiment. Antares and its neighbors—including a number of bright stars to the north and west—belong to a moving cluster and are undoubtedly physically connected. The neighboring region of the heavens is noteworthy for some of the blackest and most opaque dark nebulae which are known, and these in the vicinity of several stars of the cluster are lit up in the characteristic way which has just been described. Ordinary photographs show this illumination strongly around a number of the white stars but only a faint glow near Antares.

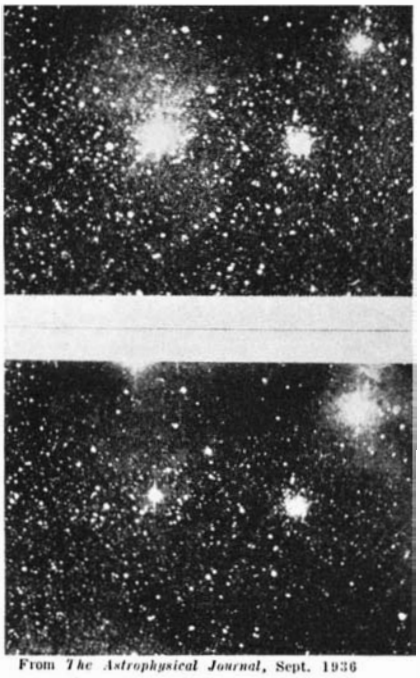
The critical test with yellow light has been made by Struve, Elvey, and Roach, of the Yerkes Observatory. These photographs were taken at the new McDonald Observatory in the mountains of western Texas—not with the great 82-inch telescope, which is not yet completed, but with a small but very efficient Schmidt camera—of the type described a few months ago in these pages. This has a mirror with four-inch aperture and seven-inch focal length and gives small but very sharp images. For revealing faint, extended luminous surfaces it far surpasses the great reflector itself.

Photographs taken with this camera, using yellow and red light only, show Antares as the brightest star in the constellation and reveal a large diamond-shaped nebula more than a degree in length, which is barely visible on the plates taken with violet light with the same camera, while the nebulae sur-

rounding the blue-white stars behave in just the opposite way. The plates were carefully standardized so that they show not only that the colors of the nebulae differ but just what they are. After correction for the general foreground light of the sky (originating largely in the Earth's atmosphere) which even in the clear Texas sky is greater than that of the nebulae, it is found that the nebula near Antares is strongly red (color index +1.9) and that near the other stars blue (–0.4) and that in both instances the color of the nebula matches closely that of the star which lights it up. No more convincing proof of the reflection theory could be desired.

Struve and his colleagues state that the new red nebula is "fairly easily visible" visually with a good binocular, provided that Antares is hidden behind some convenient obstruction. It is far too faint, of course, to show any trace of color, and attempts to see it, except in very clear mountain skies, are likely to be futile.

THESE investigations confirm the conclusion that these great interstellar clouds—dark and light alike—lie at substantially the same distance as the stars of Scorpio or a little behind them. From the motions of these stars Kapteyn showed that their distances from the sun range from 350 to about 450 light-years. The distance and size of the nebular clouds follows at once, and the results are astounding. Some of the heavy dark clouds are as much as 50 light-years long, from five to ten light-years wide, and probably equally thick. To compute their bulk is easy enough to anyone used to reckoning in powers of ten, but the results are hardly comprehensible.



From *The Astrophysical Journal*, Sept. 1936

Above: **Nebula near Antares (center) revealed with Schmidt telescope camera and yellow filter.** ***Below:*** **Same, ordinary photograph**

A cloud 50 light-years long and 5 light-years square contains 1250 cubic light-years, or 10^{42} cubic kilometers. The "few octillions of cubic leagues of space"—of which Walt Whitman spoke in one of his grander flights—amount to only 10^{30} cubic kilometers. The nebula is bulkier in the ratio of the whole national debt of the United States to the postage on a single letter!

Vast as it is, the nebula must be of excessively low density. A simple calculation shows that if its density were as great as a thousand-billionth part (15^{-12}) that of ordinary air, it would contain matter enough to make 650,000,000 stars similar to the sun. A mass a thousandth part as great would attract the stars even 50 light-years away so strongly that a large proportion of them would move around it in closed orbits. The observed motions show not a trace of this, and we may conclude that the average density of the nebula is less than 10^{-18} grams per cubic centimeter; that is, less than one ounce in 7000 cubic miles.

The wonder now is how anything so excessively tenuous can be opaque. But another simple calculation shows that if we took our 7000 cubic miles and stretched it out into a column long enough to extend through the whole five light-years' thickness of the nebula, it would shrink laterally till it was only 2¼ inches square. Now our question looks different. Can we put an ounce of stuff into a tube 2¼ inches square in such a way as to stop light from passing through it? Assume that our "stuff" is as dense as rock. A single piece weighing an ounce would be about an inch in diameter and could not cut off the light; but if we broke it up into sand-grains averaging 1/100 of an inch in diameter, there would be a million of them. Each one would have a cross-section but 1/10,000 that of the lump, but the combined cross-sections of the lot would be several times greater than that of the tube. If they were rammed down along it into one place, they would unquestionably block it, and even if scattered here and there along its vast length, their total obscuring effect would be very heavy, though not quite complete. By grinding our stones to finer and finer powder, the resulting cloud of dust would have more and more obscuring power, so that a completely opaque cloud could be made even with a much smaller density.

There is a limit to this process. So long as the dust grains are larger than the wavelength of the light they will act simply as obstacles and behave as has been described. But when they get considerably smaller than the wavelength, they no longer get much grip (so to speak) upon the light waves; further pulverization makes the cloud less opaque. Even at the unit when the material is broken up into separate molecules—that is, transformed into a gas—it has still some power of scattering and so weakening the light which passes through it, but relatively very little. For a homely illustration of this, one may recall that a few inches' thickness of "steam" emitted from a pipe (that is, of one containing a very small percentage by weight of small drops of condensed water) will obscure the sun, whose rays pass with but little weakening through all the miles of atmosphere above our heads.

Courtesy Dr. Otto Struve

Another photograph, showing the red nebula near Antares photovisually, Antares at the bottom

It is probable, of course, that the dark nebulae contain particles of all sizes, from loose gas molecules to large chunks, if not bodies of planetary size. But of all these, the fine dust, pound for pound, has enormously the greatest light-stopping and light-reflecting power, so that we will *see* the dusty parts of the clouds, whatever else may be there as well.

PARTICLES larger than the wavelength act very much the same upon light of all colors. A cloud composed of them will look white by reflected light (if the incident light is not colored) or, at least, grey, if the particles themselves are dark colored; and light, which has come through it, though weakened, will not change color (like the sun shining through a fog). But particles smaller than the light waves behave quite differently. They react more strongly with the shorter waves, so that a cloud of them will reflect blue light much more than red. The molecules of clear air behave thus: hence the sky is blue, while the light of the setting sun, which has escaped the scattering, has lost most of its blue and looks red.

The clouds in Scorpio and Ophiuchus, which scatter light of nearly the color of the stars which illuminate them, must be composed mainly of particles of the larger sort. Another nebula near the yellowish star Gamma Cygni, and eventually illuminated by it, shows, however, a decided bluish color and must be formed mainly of small particles.—*Princeton, October 3, 1936.*

SPEED WITH EASE

Motor-Car Speed a By-Product of Efficiency . . . Can Kill or Save . . . What the Manufacturers Are Doing About Safety . . . The Penalty of Speed

By JOHN HENSHAW CRIDER

YOU'RE passing a car on the long straight-away of a two-lane highway, and you've misjudged the speed of an approaching vehicle. It's coming faster than you thought. You're already doing 50. You step down on the accelerator and pray that there is enough reserve power to get you through that rapidly closing hole. The car leaps forward, spurting gracefully to safety. It's got power, all right; it's got speed to spare; only that reserve power prevented tragedy. The engine compensated for a miscalculation of speed and distance. None of us always judges such puzzling elements of safe driving without an error. And when mistakes occur, as they occasionally will, it's a comfortable feeling to have that extra power and speed under foot.

As you look back on that experience, you realize your old gasoline buggy would never have been equal to that sudden extra burst of speed without a remarkably powerful motor. It would not have had that capacity for spurting ahead if the engineer hadn't put that smooth, 80 horsepower engine under the hood. You're mighty glad he did.

In spite of this and similar experiences with which every driver is familiar, the biggest argument in the realm of automobile safety today is over the question of speed. The majority of car buyers seem to want it, the manufacturers declare it is essential, and yet enforcement and safety officials insist that it's dangerous. As the 1937 models roll off assembly lines into showrooms around the country, it is interesting to consider some aspects of this matter of speed and what is being done about it. It has a great deal to do with the future of automobile manufacturing, and, needless to say, it has a strong bearing on the popular question of highway safety.

No one in his right mind says that speed is the only cause of automobile accidents, but, as you will see, there are some who believe it is a leading cause of fatal crashes. Accidents are caused by (1) the car, (2) the driver, (3) the highway, or (4) the other fellow who, incidentally, is just another driver like you and me. Most accidents occur while cars operate at slow or moderate speeds, but the greatest percentage of *fatal* accidents happen when cars are going too fast.* Over 30 percent of all fatal accidents in 1935 occurred when cars were driven too fast. Now what are people saying about this question of speed? Who are the objectors, and who the defenders?

A spokesman for the automobile industry pointed out that in several European countries, where cars are not capable of speeds as great as ours, the rate of automobile deaths runs two to four times as high as ours. To illustrate a British manufacturer's idea of speed, here is a quotation from an Austin advertisement which appeared in *The Geographical Magazine* (London) of April:

"About time I got a new car—a car that is thoroughly up-to-date. . . . Let's think what I really want it to be like and what I want it to do. Ninety miles an hour? No. It might be a bit of a thrill when one gets the chance but sixty-five is all I'll ever want. . . ."

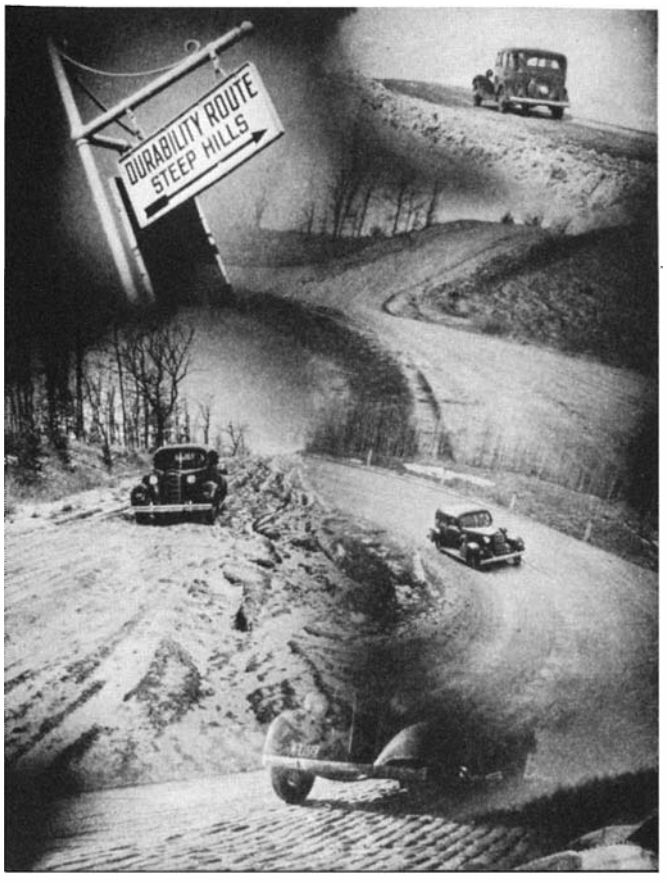
Compare that with some of the American auto advertisements of a few years ago which gave you the idea that an 80-mile-an-hour car could be driven through a brick wall without so much as spoiling the driver's hair comb. Speed and strength were the main themes in those days. Note, for example, the following newspaper advertising copy of an American accessory manufacturer which appeared during March of this year:

"WANT MORE SPEED? If you were a racing driver, preparing for a great race, you would test your car with various types of equipment and you would find that you could reach your highest speed only when your engine was equipped with——Spark Plugs."

THERE is little question that the American people like speed and use it. Speed surveys show conclusively that we do travel fast—that is, most of us do. One of the latest surveys, one made by E. L. Springer under Professor Ben H. Petty of Purdue University in which 2023 cars were observed on Indiana highways, showed that 19 percent of the total cars observed traveled between 50 and 55 miles an hour. Sixteen percent traveled at 45 to 50, and another 16 percent at from 40 to 45. Ten percent traveled at 35 to 40, another 10 percent from 55 to 60, and still a third 10 percent from 60 to 65. Six percent drove at 30 to 35, and another 6 percent at from 65 to 70. About 2 percent drove at from 70 to 75, and less than 2 percent at from 25 to 30. About 1 percent drove at 75 to 80, less than 1 percent at 20 to 25, and less than ½ of 1 percent at from 80 to 85. A study of these speeds, published with the observer's report in the March *Better Roads Magazine*, makes it readily apparent that driving under 40 miles an hour is not very popular on Indiana state highways.

Maybe it isn't that people want to drive fast, but simply that the new cars

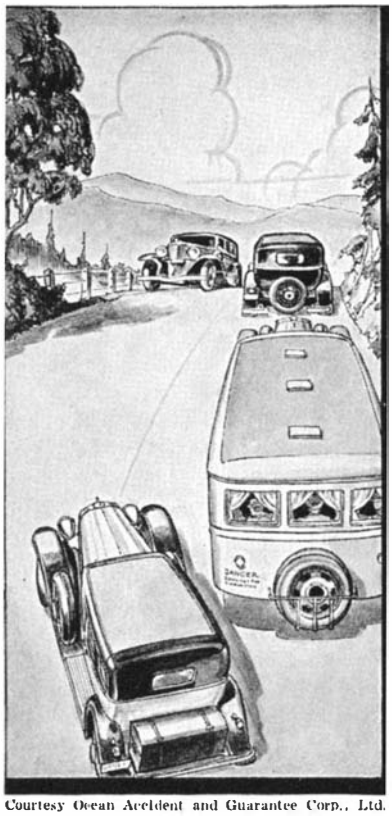
Safety factors at all speeds of which new cars are capable are checked by grueling tests on proving grounds



*See table, page 61, August 1936, Scientific American.

with their smooth acceleration reach high speeds before the drivers realize how fast they're going. For such absent-minded folk, Dr. George H. Stacy of the *Peoria (Ill.) Star* has designed a speedometer which shows the area upwards of 50 miles an hour in red. The zone from 30 to 50 is colored in yellow for caution, and below 30 the background is green.

A similar speedometer design, which tells the driver not only the speed he is traveling, but how many feet per second, the average braking distance for each



Courtesy Ocean Accident and Guarantee Corp., Ltd.

A perfect setting for an accident that speed and power may prevent

speed, the reaction distance, and the average stopping distance, was prepared by Emanuel Gorfine, speaker of the Maryland House of Delegates, and appeared on the cover of the July issue of *Keystone Motorist*. Many persons who drive habitually at speeds over 40 miles an hour would probably slow down if they had at hand the figures supplied by Speaker Gorfine's speedometer.

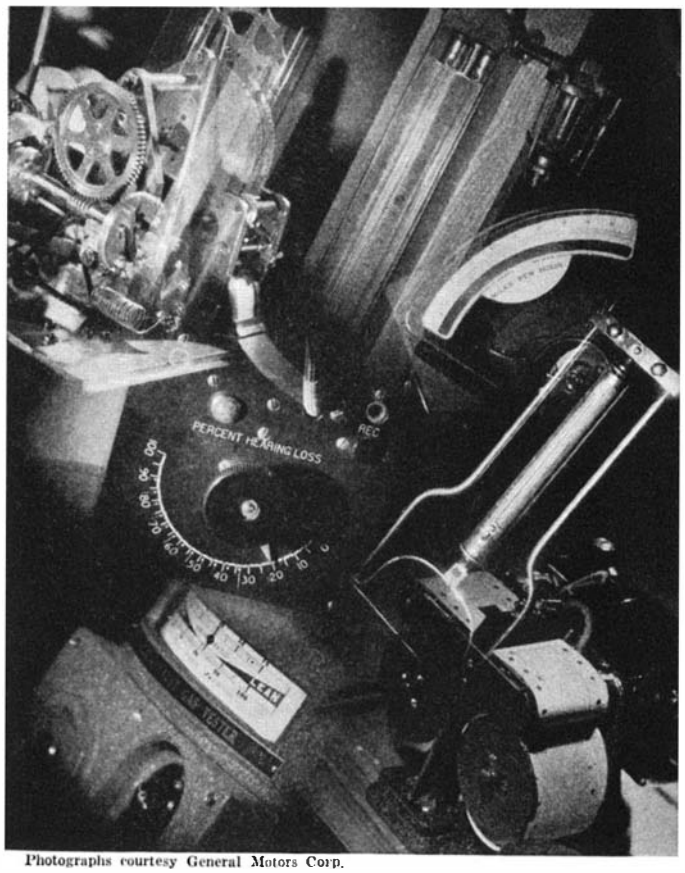
"There is a very definite line of demarcation between the speed at which a car can be controlled, and the next higher bracket of speed at which the driver is practically helpless when a crisis arises," said John W. Wheeler, member of the Indiana State Highway Commission, writing in *Civil Engineering*. "The speed of an automobile can only be regulated in its design on the drafting board. Until a maximum speed is set, and the automobile is designed and the highway built for that speed, American accidents will increase in spite of all that highway engineers can do to prevent it."

Mr. Wheeler was thinking principally about the highway as a cause of accidents. Narrow roads, bad pavements, needlessly sharp curves, narrow or worn out bridges, and lack of proper marking are certainly among the important contributors to highway disaster, but these things would not be so important if automotive science had not given us high speeds. Mr. Wheeler feels that the top speed of cars should be decided upon and fixed once and for all. Then, he says, engineers could build highways to accommodate the established speed with safety for the motorist.

Barney Oldfield, veteran automobile racer, told an Associated Press reporter in Los Angeles that speed should be left to the race tracks.

"I've driven over a million miles in automobiles," he said, "and I've only struck one pedestrian. At the time of the accident I was eating popcorn and my mind was not on my driving."

The silly part of motor-car speed is that when we drive too fast we don't get the maximum economy out of our motors. B. H. Anibal, chief engineer of the Pontiac Motor Company, reported that tests on the General Motors Proving Grounds showed that while the best mileage delivered by one of the test cars was 24 to the gallon of gas, the same car could do only 13.9 miles to the gallon at 70 miles an hour. At 50 you get from 25 to 30 percent more mileage than at 70.



Photographs courtesy General Motors Corp.

The automobile industry uses many delicate scientific instruments to measure safety factors in the laboratory

A SEVERE critic of high-speed automobiles is Dean A. Fales, associate professor of Automotive Engineering at Massachusetts Institute of Technology, who says: "Many of the new cars are so much faster and smoother than the older cars that the driver is deceived as to his speed, and when he meets an emergency, both he and the vehicle are unable to cope with it. Excessive speed is one of the real dangers on the highway today."

The New York Times took a leading place, editorially, in denouncing fast driving. After reviewing an analysis of last year's accident figures, the following statements were made: "These figures should dispose once and for all of the argument that it is 'old fashioned' to emphasize speed as the most important factor in the alarming rise in the automobile death rate. . . . In collisions, no matter what the cause, it is generally speed that kills. . . . Even among those who refuse to concede that higher speeds increase the number of accidents, no one can deny that they increase the destructiveness of the accidents that do occur. . . . It is little wonder that two thirds of all fatalities to occupants of automobiles occur at speeds in excess of 45 miles per hour."

Professor Amos E. Neyhart of Pennsylvania State College, pioneer exponent of public school instruction in safe driving, declared that an analysis of 2571 highway deaths in Pennsylvania during 1934 showed that 56 percent were due to "exceeding speed limit or driving too fast for conditions."

It was perfectly natural, in view of the public clamor, that Secretary Daniel C. Roper, in announcing some of the objectives of President Roosevelt's national safety survey, should have asked: "Why is it necessary to manufacture cars with speeds from 80 to 100 miles an hour?" And again: "What steps are being taken by dealers to insure the public against the selling of high-speed cars to reckless, disabled, or incompetent drivers?"

The automobile industry couldn't afford to sit back without saying or doing something. After all, the manufacturers have a right to a hearing on matters so vital to their well being. One of the strongest blasts against them was a front-page editorial in the *Detroit News* which brought an immediate answer from the industry. The editorial said in part:

"Let the industry which has given us the cars—so necessary in American life today—establish the rules by which those same useful cars will cease to be weapons of death and injury.

"THE AUTOMOBILE INDUSTRY MUST NOT LET THE AUTOMO-

BILE COME TO BE KNOWN AS A KILLER!"

Alvan Macauley, president of the Automobile Manufacturers' Association, answered the challenge in part as follows:

"A long continued investigation of traffic accidents shows that they are due to a great diversity of causes, chief of which is the fact that our cities were laid out for horse drawn traffic at a time when the automobile was not dreamed of, and when the present congestion of street traffic was beyond the imagination of anyone. But there are many other existing causes, some of them more readily curable than by the rearrangement and widening of the streets of a great city."

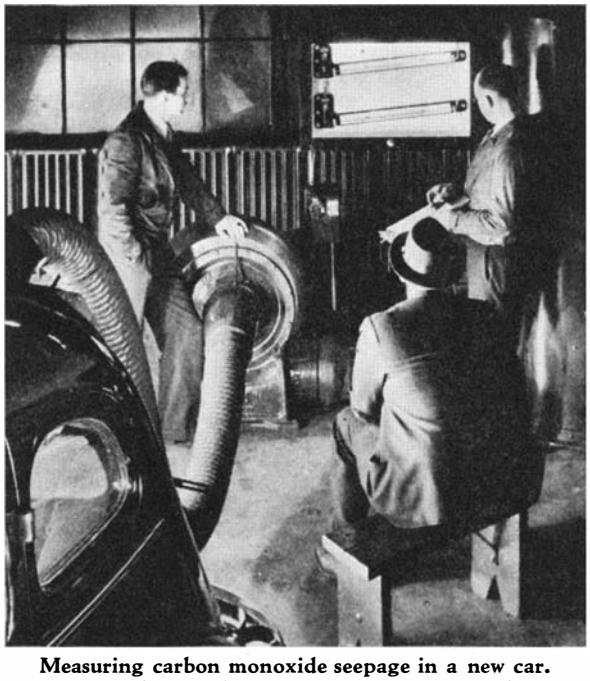
MR. MACAULEY called attention to the industry's establishment of the Bureau for Street Traffic Research at Harvard University, which is generally regarded as the most competent organization in the country for solving street traffic problems. The bureau has provided fellowships to deserving students. Dr. Miller McClintock, director of the bureau, has said that "speed as a function of the motor car, just as sharpness as a function of a knife, must be recognized on its face value, and instead of destroying it, we must surround it with those controls which assure reasonable protection."

Said Ray W. Sherman in his book, "If You're Going to Drive Fast": "It is not logical to expect our evolution to be toward slowness when the major inherent quality of the automobile is speed, and its road is made smoother. No matter what is or what isn't logical, I don't believe we are going to do much slowing down. But we must have more safety!"

William S. Knudsen, executive vice president of General Motors, had the following to say about the speed controversy: "We spend a great deal of money every year finding out what our customers want. So it is with considerable confidence that we tell you that they want cars which will accelerate quickly, negotiate the majority of hills without gear shifting, and transport them at a fairly rapid rate of speed. We are confident that the public will not buy cars which do not have these performance characteristics, no matter what we as individuals may think about it."

You probably recall that in the August issue of Scientific American Professor Alexander Klemin of New York University gave other important reasons why speed and power are built into the modern motor car: "(1) Everyone likes to get going just as quickly as possible; (2) if the bare minimum of power just sufficient for good speed on a level road were provided, hills would become an intolerable nuisance; (3) engines or other machinery operating at the highest pressure will never work with the same perfection and reliability as when working well within maximum capacity."

Robert S. Mann predicted last fall in *Editor and Publisher* that any advertising copy "which places undue stress on speed—even though it may sell cars—will be found to build public resentment not only toward the individual manufacturer, but toward the whole industry."



Measuring carbon monoxide seepage in a new car. Drivers, drowsy from CO, may cause accidents

The industry took heed. The handwriting on the wall was conspicuously clear. All you have to do is look at the new 1937 models, read their safety specifications, and you'll be convinced that the manufacturers are co-operating 100 percent with safety demands. They still have speed and reserve power for the reasons stated by the industry's spokesmen. Without these qualities, as you can appreciate, the automobile would be a sorry piece of merchandise. Nobody would want it. This very need for reserve power and emergency speed is the reason that governors are not popular either with the public or the manufacturers. They seriously cripple a car in its performance characteristics and thereby reduce safety margins.

The 1937 manufacturing and advertising credo of the Automobile Manufacturers' Association, which is the industry's answer to the alarming cries of the past twelve months, pledges that every safety factor proved by research and engineering will continue to be built in American automobiles. The most radical decision of the manufacturers was to eliminate from their advertising and publicity "all references to vehicle top speeds."

This pronouncement is of historic importance because it marks the end of the industry's efforts to sell speed to the public. Having spent millions of dollars to sustain and satisfy a demand for speedy motor transportation, the manufacturers now agree to drop the emphasis on speed and sell safety. After all, it is security that the public wants most of all, and the industry is answering that demand.

BUT safety is something which the industry alone cannot supply. In the final analysis it is up to the driver. Given a fast car which is safe under reasonable conditions, it is the responsibility of the driver to adhere to those conditions. Unless the driving public proves itself worthy of being intrusted with fast motor cars—and that means you and me—government may intercede and take the privilege away. The National Bureau of Casualty and Surety Underwriters, in the booklet, "Man and the Motor Car," presents this warning: "In a frantic attempt to reduce death and injury on the highway, any one of dozens of drastic measures may be put in effect that will kill the pleasure and curb the natural liberty of citizens who want to move in motor cars. Under such conditions, the use of automobiles will manifestly decline."

If you think this is idle talk, hearken to the 1935 annual report of Charles A. Harnett, New York State Commissioner of Motor Vehicles, in which he said: "We urge that a maximum speed limit of 50 miles an hour be established by law in the State of New York, and if enforcement of such a statute and program does not bring about the desired results, it may be necessary to resort to mechanical devices as a means of restriction."

It is plainly evident that the public has little choice in this matter of speed. Either we must use it with discretion, or it will be taken away. The privilege of operating smooth-running, powerful motor cars is one worth keeping. But that has become a matter for drivers to decide for themselves. You will drive at reasonable speeds or be compelled to do so.

●

Simplicity has always characterized motion-picture animated cartoons, and perhaps this very simplicity accounts in large measure for their wide-spread popularity. With the advent of color to these cartoons, they take on an added interest. An article to be published soon tells in detail of the method for producing these colored films.—The Editor.

Checking up on Hurricanes

Instrument Records Temperature, Pressure, Humidity . . . Microscopic Record . . . Carried Aloft By Sounding Balloon . . . Importance of Data

A TINY instrument, weighing about 1¼ ounces and suspended beneath a small balloon, is science's latest device for finding the whys and wherefores of South Atlantic and Gulf Coast hurricanes. According to W. R. Gregg, chief of the United States Weather Bureau conducting tests of the equipment, the data obtained will add immeasurably to what is already known about hurricanes. The instruments are sent out from three stations—located near Montgomery, Alabama; Jackson, Mississippi; and Augusta, Georgia—operated by the Massachusetts Institute of Technology, co-operating with the government in this study.

Signals for release of the instrument-carrying balloons are given by the Weather Bureau's Eastern District Forecaster at Washington, D.C., who also sets their schedules. From his daily charts of weather conditions all over the world, the forecaster follows every tropical disturbance from the time it appears far out on southern seas, until it has blown a path across the land or has veered to spend its fury over the water.

If the "eye" of the storm—the calm area sometimes ten miles in diameter in the center of winds that blow at velocities up to 200 miles per hour—passes over one of the special observation stations, the instruments will be sent up at fifteen minute intervals. Otherwise they will be released every one and a half to three hours, the interval depending upon the path and speed of the hurricane. This will also decide whether one or all three of the stations will take part in the program.

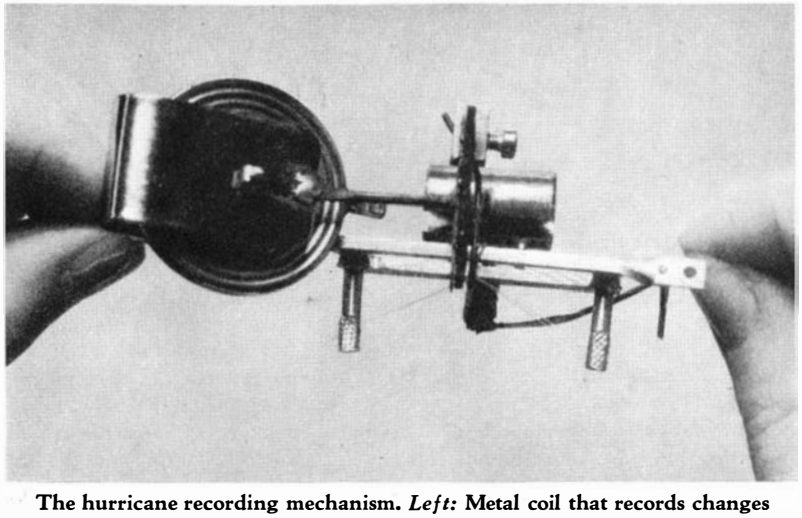
Ready for the upper air: The hurricane data recorder and balloon

The instrument consists essentially of three recording elements, three small penpoints, and a piece of smoked glass about the size of a postage stamp. Fitted into a small aluminum or doped fabric gondola, it is carried by a hydrogen-inflated balloon to a height 10 to 20 miles above the earth at a rate of climb of 650 to 800 feet per minute.

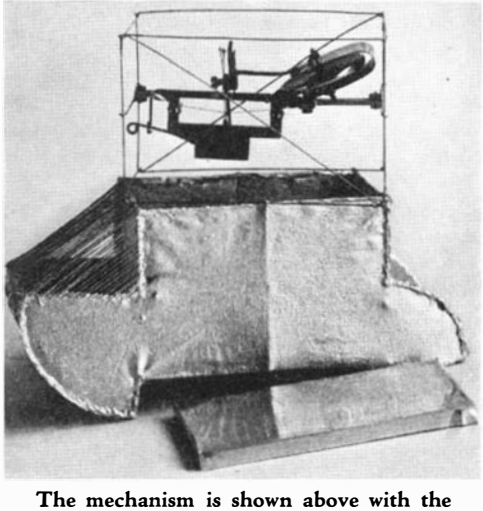
The three elements of the instrument record pressure, temperature, and moisture. The pressure-recording element consists of a small metal capsule from which the air has been exhausted and which contracts or expands with changing pressure. This is attached to the smoked glass plate which rises or falls vertically with the expansion or contraction of the capsule, tracing a record of the pressure changes with a stationary penpoint. The temperature recorder consists of a little cylindrical shell made of two thin layers of metal which coil or uncoil as the temperature rises or falls. This is connected to a penpoint moving crossways over the surface of the glass plate. A third penpoint is attached to a strand of human hair that becomes longer or shorter as the air about it becomes damper or drier.

THE gondola is attached to the intersection of three bamboo sticks which in turn are coupled to the balloon. As soon as the balloon reaches its ceiling and bursts, a mechanism removes the penpoints from contact with the plate so that no records are made during the descent. The instrument is mounted on rubber bands to reduce shock on landing.

Five pieces of red cloth are attached to the bamboo framework to attract attention of passersby to the fallen instrument. A tag offering a reward for return of the device to the United States Weather Bureau station at Boston, Massachusetts, is also attached. There the glass plate will be examined and read under a microscope and tabulations from the recordings will tell an interesting story of what goes on in the heart of a hurricane.



The hurricane recording mechanism. *Left:* Metal coil that records changes in temperature. *Center:* Pressure capsule. *Below:* Hair for humidity changes



The mechanism is shown above with the gondola that protects it during its flight

The New in Heating

Heating Industry Progresses . . . New Systems, New Controls . . . Co-ordination with Air Conditioning . . . Radiant Heating . . . The Future

By PHILIP H. SMITH

IMAGINE a house heating system which functions at its maximum only when the house is occupied, and only in the particular room in which the householder chooses to be at the moment. A push of a button would bring on comfort heat while at all other times the temperature would be no more than necessary to prevent injury to the house contents.

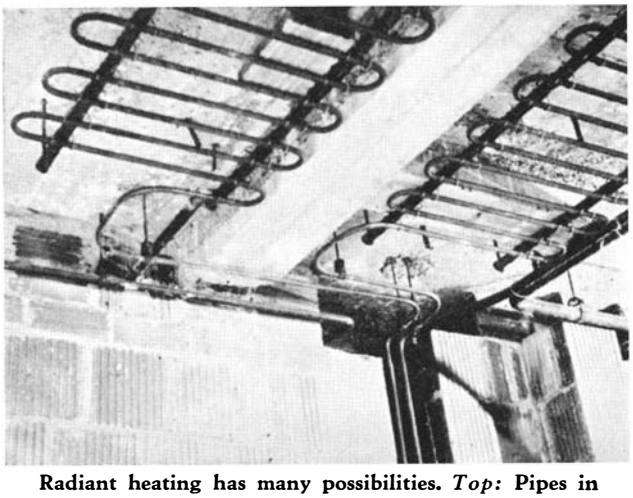
This sounds like a very impractical dream, but it isn't. The lines of approach to such a convenient system have been laid down and it may come to pass in another decade. It will involve a sharp departure in heating practice, but the hurdles to be taken are economic rather than technical.

The heating industry has been making steady progress. Innumerable refinements have been incorporated in existing systems, all aiming to overcome well recognized defects to the end that the user will get greater satisfaction in the form of bodily comfort, and mental comfort as it applies to his pocketbook. More uniform distribution of heat, automatic control of temperatures, reduction of heat losses, elimination of dirt, and improvement in appearance are some of the accomplishments of recent effort.

COINCIDENTALLY with these improvements there has come about a growing appreciation that insulation and air conditioning are inseparably linked with heating. Whether the best in each of these factors in comfort is to be obtained jointly or individually is a moot question not yet decided. The pros and cons have been related already in these pages and need not be covered again to make current gains in heating clear.[1]

The improvements which have the greatest appeal to the home owner are those which are to be classed as control. Controls are now exercised in many ways, but they all contribute to achieve a regulation of room temperatures. It doesn't matter whether the system is steam, hot water, or warm air; nor does it matter what the fuel—better regulation has been given to all. The development of oil burning systems has stimulated similar improvements in the positive control of coal burning, and the choice of systems today depends more upon the local cost of fuels than individual merit.

Distribution of heat throughout a building is now being equalized in a number of ways. If the system is run by steam, vent valves are provided for adjustment so that the radiators nearest the source of heat generation vent air slowly, while those most distant from the boiler vent quickly. When hot water is used, a similar effect is obtained by valves which strangle the flow nearest the heat source. In effect, the heat is metered to the radiators, and thermostats provide automatic control for the entire system.



Radiant heating has many possibilities. *Top:* Pipes in wall before covering with plaster; and *below:* On ceiling

The control of heat losses—in other words, the attainment of greater operating efficiencies—is quite as important from the technical viewpoint as the regulation of heat distribution, although it is not so apparent to the home owner who easily loses sight of costs. In the main, the efficiency of heating systems has been improved in three ways—by better combustion of fuel, improved insulation of heat generators, and more complete utilization of the heat of combustion gases. Economies of this type begin by the exercise of positive control over air and fuel mixtures; are accentuated by jacketing the generators with the water or air used as the medium for transmitting heat; and end by providing an opportunity for combustion to be completed and heat absorbed before escape up the stack. In one type of coal-fired boiler, the hot gases are made to travel four times the length of the boiler before they are permitted to escape; in a new warm-air heating system which employs oil as the fuel, the gases are conducted 36 feet past heat-absorbing walls and fins before they enter the chimney.

Illustrative of the advance made to reduce heat losses and unique among the newer heating systems is a plant which uses gas as its fuel and does away with the need for a chimney. The equipment comprises a combustion chamber, jacketed with water, and an all-copper piping system with radiators. In operation, the hot gases are made to enter a mixing chamber where they pick up water as vapor from the jacket and pass directly to the radiators. Then the cooled gases and condensate pass to the return piping, the condensate going back to the water jacket and the non-combustible gases being discharged through an exhaust pipe. Water made from the hydrogen in the gas overflows to a drain.

The unique feature of running the gases directly to the radiators is made possible by using an exhaust fan which produces about three quarters of an inch of vacuum on the condenser outlet. This provides, in effect, a controlled draft. An additional advantage lies in

[1] *Scientific American*, August, 1936.

the fact that once the intake of gas and air is regulated to insure proper combustion, the ratio remains constant regardless of variations of weather or chimney. Instead of a chimney, a two-inch copper pipe is employed for exhausting the non-condensible gases, and so great is the efficiency that the outlet temperature is as low as 80 degrees, Fahrenheit.

All heating systems on the market today have been vastly improved in appearance and for the most part the enhanced appearance represents a corresponding gain in insulation and reduction in dirt. This applies both to the heat generator and to the distributing system. Concealed radiators have enhanced appearances but not without some loss in heating effect, and the next swing will be in the direction of design which will give considerably more radiant heat.

Quite apart from progress in refinement of existing heating systems a new method has been developed known as radiant heating. It is not widely known in the United States because installations are few and far between, but in Europe where it originated it has become quite common. It is found in many of the British Government buildings, in theaters, stores, auditoriums, and other public and semi-public structures, as well as in many thousands of private homes.

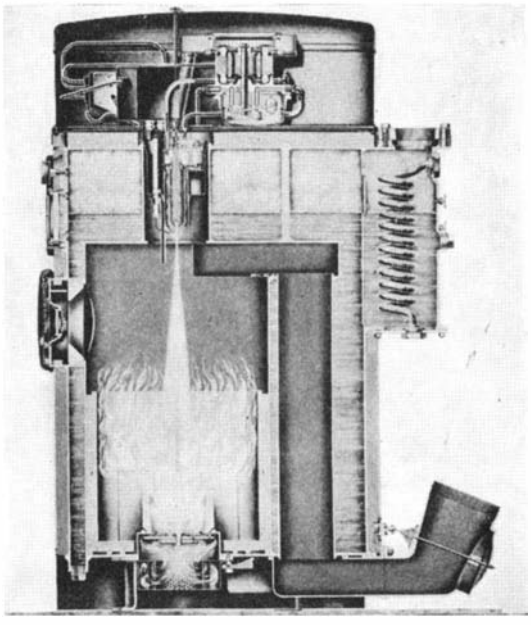
Radiant heating is based upon a very old principle of thermodynamics. As indicated by its name, it employs radiant heat which is a wave or beam of pure energy, rather than the commonly used "convected" heat, the "sensible" heat which is the vibration of the material particles of the body of matter. The old-fashioned fireplace provided more radiant than convected heat. The sun demonstrates this type of heat most impressively as anyone can testify who has experienced comfort in its direct rays during a cool fall day.

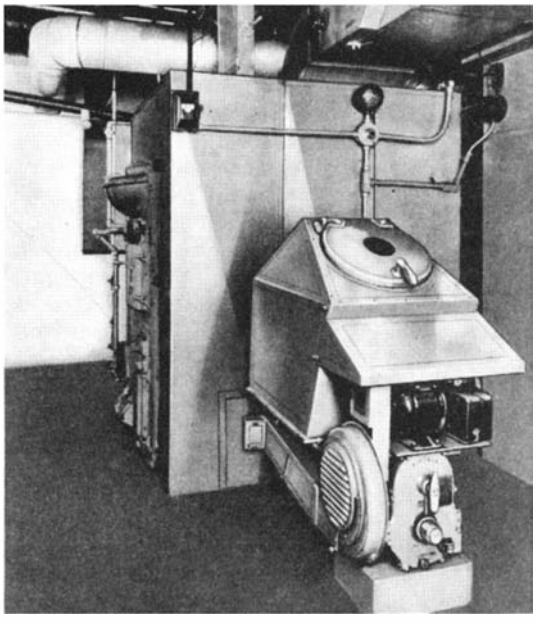
It is a phenomenon of radiant heat that it warms objects without heating the intervening air; therefore the occupants of a room can be made comfortable by radiant heat although room temperatures may be low. Under actual conditions this is just what happens, and an experiment conducted in one of the country's large electrical laboratories is worth relating as dramatizing this peculiarity of radiant heat.

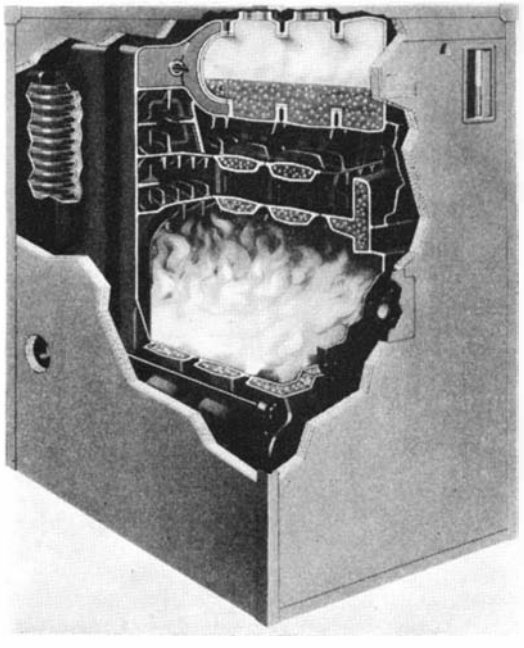
To demonstrate the difference between convected heat and radiant heat, people were seated in a room in which the temperature was 104 degrees, Fahrenheit, and the wall temperature 57 degrees, Fahrenheit. They were asked how they felt and they replied that they were far from comfortable in such a chill surrounding. Then conditions were altered to give a room temperature of 25 degrees, Fahrenheit (below freezing), and a wall temperature of 81 degrees, Fahrenheit. This time the occupants found themselves very comfortable.

Such an experiment makes us more conscious of the law that heat energy can travel only from a hotter to a cooler body and it also drives home the fact that no heating system ever put heat into a person. It shifts attention from consideration of room temperatures to consideration of walls and forces a re-statement of the purpose of heating which is nothing more nor less than the prevention of dissipation of bodily heat at a faster rate than it can be generated. The ideal heating system, therefore, is one which will give the greatest degree of comfort when taking into consideration the loss of heat from the human body by radiation, convection, and evaporation.

Proponents of radiant heating claim that their system is superior because it permits comfort with low room temperatures. They say, further, that radiant heating simplifies the problem of maintaining normal conditions of humidity. Certain examples of European installations forcefully confirm these contentions. There are schools where the classrooms lack one exterior wall and the pupils sit comfortably in outdoor air; there are also hospitals where the patients lie in bed exposed from the side







Top: **The fore-runner, still quite new, of a type of domestic oil furnace which has brought many changes in house heating recently**

Center: **An automatic coal burner installed in a home furnace and air conditioner**

Bottom: **Cut-away section of a new oil-burning boiler showing insulation of jacket, water chamber, flue, and the hot water supply coil**

Radiator vent valves with adjustable vent for controlling the amount of steam to each radiator in a system

to the open air yet thoroughly warmed by radiant heat. In neither instance is there any attempt made to warm the *air* surrounding the occupants.

There are several methods of heating with radiation in use today. There is one which employs pipes, imbedded in the ceiling, through which warm water is circulated. There is another which uses plates heated with steam, affixed to or recessed in the wall surfaces. A third method utilizes electrical resistance coils, but its application is limited to regions where electrical current is cheap.

IN the system which employs coils, the pipes are looped back and forth over the ceiling area. Above the pipes is placed heavy insulation, usually cork, while the pipes themselves are placed in intimate contact with the concealing plaster surface. This plaster surface serves as the radiating panel. Ceiling installation is advocated because the rays envelop the occupants of a room. When side walls are used as the radiating surface, all four walls must be radiant; otherwise suitable reflecting surfaces must be had if the occupants are to receive the rays from all directions. Obviously, whether pipes or steam-heated panels are used, care must be exercised to afford direct rays or reflected rays. Radiant heating does not require any supplementary system to warm the air because the air picks up enough warmth from the heated objects to safeguard water pipes, food, and so forth.

There is much to be said for the lower room temperatures which are a feature of radiant heating. We have all experienced the unpleasant sensation of a dry, overheated atmosphere and we also know how much better we feel in a cool and relatively moist surrounding. Temperatures as low as 60 degrees, Fahrenheit, are compatible with comfort in a room heated with a radiant system, and the shock experienced by going outdoors is materially lessened.

While there is much controversy raging over radiant heating, the disagreements are mainly over what constitutes a satisfactory system. Architects, engineers, and builders are in general accord as to the soundness of the principle, but they are by no means one in believing that the ultimate system of radiant heating has been perfected. The panel system, which employs ceiling pipes, is wholly satisfactory to some designers, while others hold that it is only a step on the way. Presumably the principal drawback to its adoption is one of cost, installations running anywhere from 10 to 40 percent higher in outlay than orthodox systems. But since operating costs are claimed to be lower with radiant heating, the disadvantage is not as great as first cost indicates.

On this side of the Atlantic a good deal of experimental work is being carried on covering many phases. At one of the large universities, scientists are trying to determine the physiological effect upon the human body, believing that radiant heating may reduce respiratory troubles. Another experiment seeks to prove the practicability of heating hollow walls with hot air, while some electrical equipment concerns are working with resistance coils imbedded in panels to serve as radiant wall surfaces. Still in the realm of fantasy is the idea of using the sun's rays and supplementing with artificial rays on cloudy days, while even more remote is the conception of heating with induction coils which would *induce* heat in the occupant of a room.

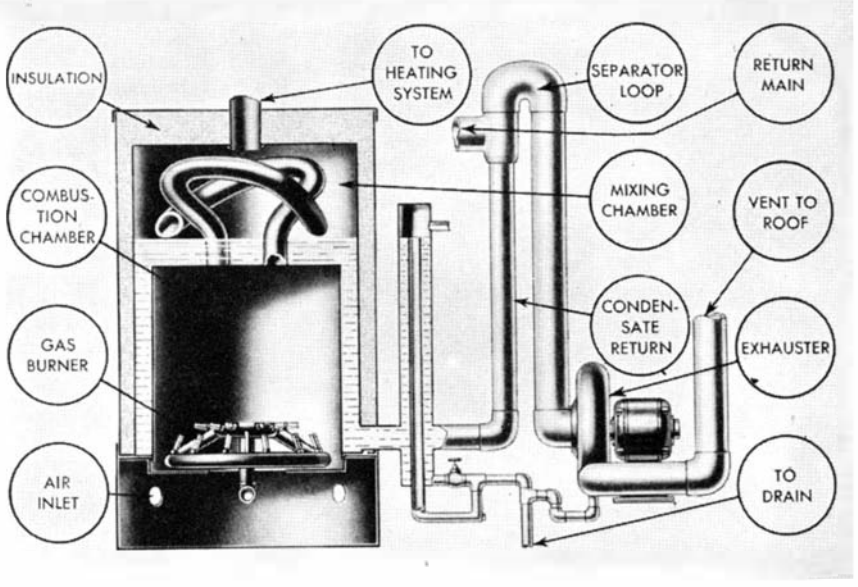
There is no question but that radiant heating is here to stay, but adoption is hindered by costs, whatever the method employed. Some of its proponents believe that it will be used in commercial structures before it comes into general home use. They reason that operating costs, more than offsetting higher installation costs, will make it a sound venture. For the most part electricity is favored as the source of heat, but this is now impractical because of rates for current.

Adoption of radiant heating would have a profound effect upon present concepts of insulation and air conditioning. It would void much that has been done during recent years. With lower room temperatures the diffusion of heat through wall surfaces is much less rapid and construction might be lightened substantially. The problem of humidity control would also be of less moment.

THE point may be raised that radiant heating will not answer the problem of summer cooling or provide a means for lowering relative humidity. In this respect it does not differ from existing systems. The coil system of panel heating does afford a means for circulating cool water through a house and this would be quite adequate for summer comfort in a region where the air is naturally dry. Where humidity is a serious problem some means would have to be supplied for removing moisture from the air, otherwise water-cooled pipes would cause condensation.

What radiant heating has accomplished beyond its own practical attainment is the injection of some new and valuable ideas into the whole problem of heating. And coming as it has when insulation and air conditioning are being studied as never before, the possibility of better heating systems is measurably greater. The ultimate goal is the attainment of comfort with the simplest possible system, and radiant heating may prove to be what we have been seeking.

Photographs courtesy: American Radiator and Standard Sanitary Corp.; C. A. Dunham Co.; General Electric Co.; Iron Fireman Mfg. Co.; and L. L. Munier.



Scheme of unique new heating system which is discussed in detail in the text. The hot combustion gases pass through a mixing chamber directly to radiators

UNDERPINNING TRINITY

Trinity Tower Was Subsiding . . . Old Foundation Extended to Bedrock by Monolithic Piers Through Quicksand . . . Pneumatic Caissons Used

By R. G. SKERRETT

THE massive masonry tower of famous old Trinity Church, which faces Wall Street from the west side of Broadway, in downtown New York City, is now, after 90 years of service, at last supported by the deep-lying bedrock. This recent engineering achievement was put through to prevent the tower from settling more and more and tilting increasingly towards the north and east. The task was a ticklish one and called for very careful work after deliberate preparation.

The combined height of the tower, spire, and cross is 280 feet 5 inches. The tower rises from a foundation of rubble masonry, with a central core of concrete, and that basic structure extends 12 feet downward from the ground surface. The total weight of the foundation, tower, and spire is 11,900 tons, on an area of about 2500 square feet, and is supported by coarse sand and gravel.

Years ago a subway was dug under Broadway close to the tower's foundation and considerably deeper than that structure. Years later, another subway was excavated beneath Trinity Place and close enough to the western or rear walls of the church to cause some settlement of that section of the structure, but support was provided by shifting the load to tubular piles that were jacked down to the deep hardpan and filled with concrete. Marked subsidence and tilting of the tower followed the erection of the two high office buildings directly opposite the front of the church at the neighboring corners of Wall Street and Broadway.

The first signs of trouble were fissures in the masonry over windows in the east wall of the body of the church, north and south of the tower; but the tower itself, because of its thick walls and massive foundation, remained unimpaired although it was moving bodily and settling. A survey quickly revealed that the tip of the spire was 17⅛ inches out of plumb to the eastward. Corrective steps were taken in hand as soon as it was practicable to do so, but the conditions controlling underpinning operations imposed skilful planning.

The sand-and-gravel stratum immediately in contact with the tower's original foundation is succeeded by a 10-foot layer of fine sand and soft, moist clay, that extends to the ground-water level. Below that there is a 24-foot bed of quicksand, a blanket of hardpan from 12 to 15 feet thick, and then bedrock. It was evident that the underpinning could, therefore, be done only with the aid of pneumatic caissons.

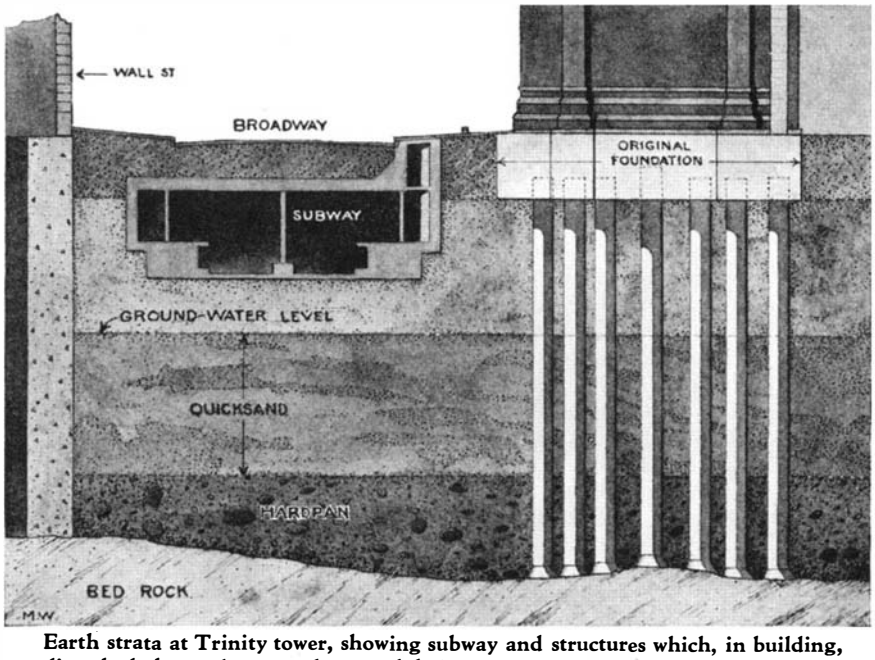
THE steel cylinders forming the shell of each of the 16 underpinning piers are made up of unit sections 42 inches in outside diameter and 49 inches long, with walls one half inch thick. An inside flange at each end of a section made it possible to bolt to it connecting sections; as the cutting edge of the caisson was forced deeper into the ground, another cylindrical section was added at the top where two 100-ton hydraulic jacks thrust upward against the tower masonry and downward upon the steel section. The caisson and cutting edge was made up of two of the cylinders to form a working chamber for a single sand hog, and immediately above it was an air lock.

The man in the working chamber cleared away the soil a pailful at a time, or he dug away the material beneath the cutting edge to allow the caisson to settle deeper. The man in the air lock lifted the pails of muck until he had several in his compartment. Then the door in the air-lock floor was closed, the air pressure was lowered until it fell to that of the atmosphere, and finally, the man opened the door over his head and hoisted the loaded buckets to the surface.

When the cutting edge was a few inches above bedrock, the rock surface was cleaned and a layer of concrete was placed on which to set steel members as a permanent seating for the cutting edge. The lower part of the steel casing was then plugged with concrete to a height of six feet. When that had set, air pressure was released, and the tube was filled with concrete to produce a reinforced pier. When once a caisson was started on its journey downward to bedrock, it took about four days to force it to its landing on the ledge.

The work of underpinning Trinity tower was carried to its conclusion within an area so restricted as not at any time to interfere with the regular services of the church. Skilful engineering made this possible.

The entire job cost approximately 100,000 dollars.



Earth strata at Trinity tower, showing subway and structures which, in building, disturbed the underground natural balance. New tower foundation is shown

NATURE'S AIRPLANES

By S. F. AARON
Illustrations by the author

IT is said that the Wright brothers lay on their backs for hours upon the sands of the North Carolina coast, watching the soaring flight of turkey vultures, or buzzards, as they are most often called. Much may have been learned from these great birds, for no winged creatures, excepting the famed albatross and perhaps the swallow-tailed kite, can show such remarkable staying powers on motionless pinions.

Because of its aerial evolutions the buzzard's flight has been called the poetry of motion, dividing this honor with the vastly different progress awing of the swallows. As is well known and often observed, it is not uncommon to see turkey buzzards, with a moderate gain of necessary momentum from a half dozen or so of powerful strokes of the wings, wheel in wide circles (Figure 1) and gradually ascend to several hundred feet without further effort than to take advantage of air currents, or, when these currents are not to be encountered, make an occasional dip downward at perhaps five degrees. At other times, when a certain direction is to be maintained and the currents are not propitious, added wing strokes are indulged in.

Alexander Wetmore, in *The National Geographic Magazine*, makes the statement that on calm days turkey vultures are loath to take to the air. This is an error. On days when flags hung limp on high poles and high overhead cumulus clouds could not be seen to move, I have observed these birds in considerable numbers cross the sky in great spirals and without effort. [Motorless glider planes are flown by seeking the upward currents beneath cumulus clouds.—*Ed.*]

MOST birds soar on motionless wings at times, as may most often be observed of those species larger than a robin: the grackles, meadow-larks, bobwhites, doves, and the many shore and water birds. Few of the smaller species, with the exception of the purple martin, at times the chat, the bobolink and the chimney swift, practice soaring. Many of the medium-sized and larger birds of strong flight rarely or never indulge in it —for example, the snipe and plover, the willet and curlew and kingfisher. The crow, the grouse, the true partridges, the mourning-dove and band-tailed pigeon, the ducks and the herons, adopt a slower advance on fixed pinions generally when approaching the spot where they mean to alight. The hawks and the larger owls possess the same habit; the osprey and the slow-flying buzzard hawks, like the red-tail, soar at times when in direct flight, or when desiring to make a closer inspection of the earth. This is true also of such water birds as the cormorant, the frigate-bird, the awks and their kindred, but he who sees a gull or tern advance on motionless wings has witnessed a rare sight, indeed.

Among the small birds, such as the warblers, finches, wrens, fly-catchers, orioles, shore larks, vireos, and so on, soaring is rarely or never practiced. With these, their light weight, relative to muscular power, is such as to make the chief effort of being sustained in air an easy matter. The same applies to the smaller bats and, of course, to the insects. Rather odd it is, therefore, to see some of the larger butterflies and moths soaring across beds of flowers, or through the moonlit woodlands. All other insects know progression in the air only by constant and rapid wing motion. And this may also be said of the dragon flies (the order Odonata), which have their anterior wings placed a little ahead of and above the posterior pair. This construction would seem to have been the model for the biplane (Figure 2). It might be expected, considering the rapid and often constant flight of these creatures, that they would gain some respite from intense activity by soaring at intervals.

The principle of aerial propulsion is well known and easily understood, yet certain misconceptions have arisen respecting it. There seems to be a common impression that, to gain a forward motion and speed, the downward stroke of the wing is also directed backward, thereby affording a greater driving force. Such direction, however, never

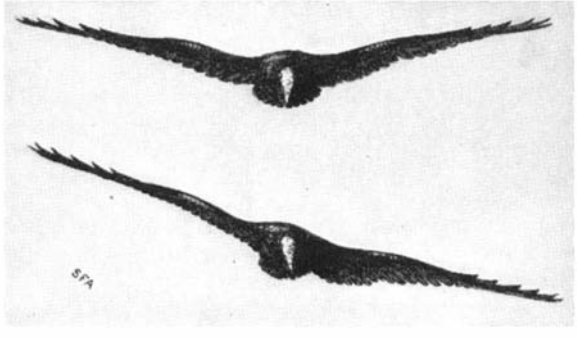


Figure 1: **A soaring turkey vulture. *Above:* Straight ahead. *Below:* Wheeling to the bird's left; the wing on the inner curve set to cause a greater resistance**

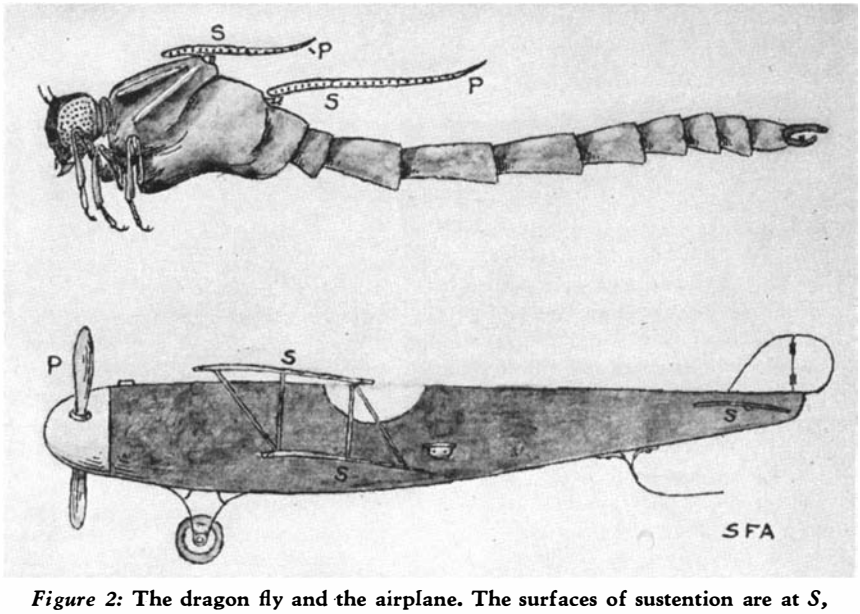


Figure 2: **The dragon fly and the airplane. The surfaces of sustention are at *S*, those of propulsion at *P*. The insect has no rear stabilizer or rudder. Its weight is proportionally less, its wing expanse and abilities as an aerial acrobat greater**

occurs; in all flying creatures the wing strokes are exactly at right angles to the line of flight, and propulsion is due entirely to the construction of the wing, which insures a slanting resistance to the air that serves to cause a forward momentum, exactly on the principle of the airplane propeller blades.

The rigid attachment and the muscular control of the wing anteriorly, and its posterior pliability which permits a limited upward slant in the downward stroke so as to drive the air backward, serve to drive the creature forward. In the upward lift of the wing this pliability permits the wing to come up edgewise and constitutes in all flying creatures an automatic control.

This same action is apparent also in the flight feathers of birds (Figure 3). The broader vanes give upward in the

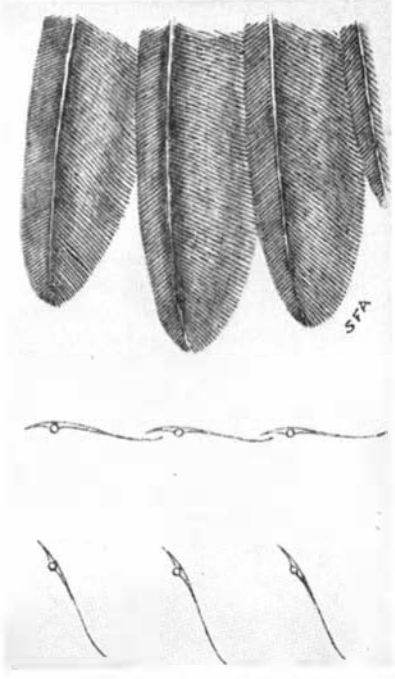


Figure 3: Top: **Flight feathers of a bird's wing.** *Center:* **A section of the same, with the posterior vanes braced against the stiff anterior vanes.** *Bottom:* **Sections during upward lift of the wing, with the feathers pivoting on round quills**

downward stroke and come into contact with the shorter anterior vanes, making a resisting surface, but in the upward lift the round quill pivots in its socket to let the air through the vanes thus separated. With the bats and the insects the pliability of the entire wing is sufficient to give the necessary slant for the forward motion and the lift.

The principle of soaring is also simple and is easily demonstrated by tossing a card—or other light, thin object—edgewise, its plane surface not necessarily entirely flat, but parallel to the earth and at right angles to gravitation. That is about all there is to it, except that the wings of soaring birds are somewhat adjusted to meet with varying wind currents, as may be best observed in the turkey buzzard as seen from a mountain top or dead tree-top close to a roosting place. This adjustment of the wings seems to have escaped observation, or at least recording, though the Wrights and others must have at least surmised it; hence the warping wing tips and ailerons used on airplanes from the first.

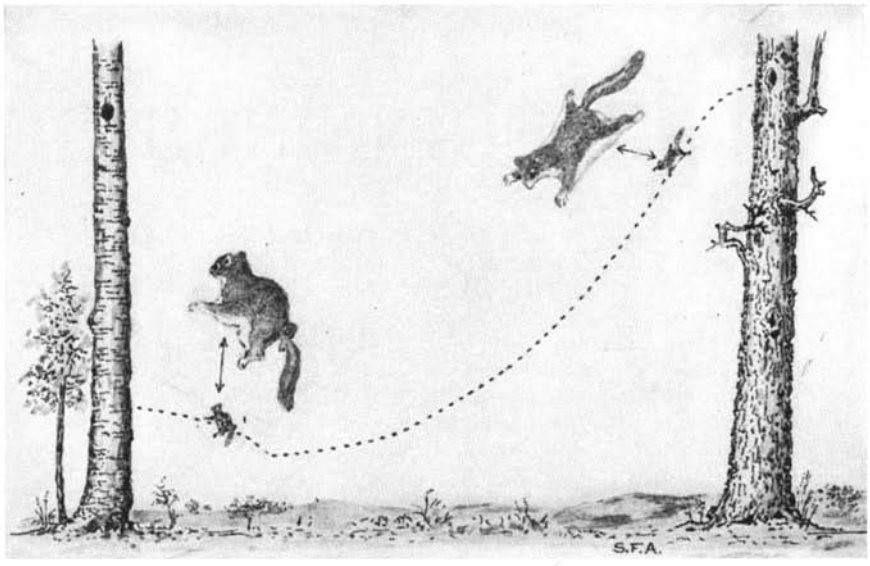


Figure 4: **The flight of the flying squirrel. The knowing little fellow sets himself in resistance to the air when near his goal, and is suddenly elevated from the downward or level course. The larger drawings show the attitudes represented**

NOT having a revolving propeller to give forward motion, the soaring bird depends upon its wings to give it momentum. This, of course, is a distinct advantage that can hardly be put into practice on airplanes. The chief function of the wings is to sustain the creature in the air; propulsion follows, automatically.

When a soaring bird wishes to rise or wheel it is not the tail alone that performs these deliberate turns; the wings are altered in relation to the line of flight. This alteration is no doubt instinctive, as it is when the desire is to hover or check momentum, observed also in such insects as the sphinx moth, many butterflies, the bee-flies and bees, and in the humming-bird. This action is governed entirely by the wing position in the downward stroke, it being such as to check both forward and upward momentum, thus overcoming the effect of the pliable posterior portion. It may also be observed in the hovering of a sparrow-hawk when the swift killer is looking for mice far below. The sudden shift of the wing stroke may be seen through a powerful glass as the bird again goes on, or darts to earth after its prey.

The shifting of the wings of soaring birds is very slight and is difficult to see from the ground below. When wheeling, and often without a very decided movement of the tail, one wing is lowered and held so as to meet with greater resistance, while the other and outer wing on the curve is not altered in the least.

The tail, perhaps oddly enough, plays so small a part in the flight of birds that the observer may readily note a bird that has lost its tail doing various flight stunts as handily as its tailed fellows. The chief purpose of the bird's tail seems to be as a stabilizer and an aid in sustaining the creature when in motion, and no doubt the effort is less when the tail is available. But the bat and swift insects are without tails.

The flying-squirrel offers an interesting example of the art of soaring minus wings, for the stretch of its membranous skin between fore and hind legs can scarcely be used for actual flying—though in case of an unusual fall the beautiful little creature will flap these membranes in order to check the downward velocity and even to carry the animal forward a little to a perch away from danger. I have witnessed this act when a flying squirrel was checked in its flight by a pole thrust upward, and when a red squirrel was shaken from a branch.

Contrary to common supposition that the downward and upward drive of the flying squirrel composes an even curve, attempted photographs (not good enough for reproduction, as was also the case of the buzzard mentioned earlier) distinctly indicate that the final upward slant of the little quadruped is effected by dropping the hind legs so as to cause the membrane to present a greater resistance and to pitch the squirrel almost suddenly upward (Figure 4). In the longest dives, rarely over 150 feet even from the highest trees, this upward curve may begin at least ten feet from the place of landing and lift the soarer three feet higher. On this principle very strong wind currents will lift a turkey vulture several yards if the bird sets its wings for the purpose.

The Beginnings of Pottery

Spilled Stew Gave the Cue . . . Centuries Before the Potter's Wheel . . . Made Commerce More Profitable . . . Opened Many Fields of Art

By JOTHAM JOHNSON
University Museum, Philadelphia

NINE thousand years ago this morning, more or less, a neolithic villager squatted at a smoking hearth outside his hut, preparing a savory stew. His cooking-pot was the hollowed-out lower half of a large gourd, blackened by previous encounters with the flames. His unhappy task was to keep the gourd near enough to the shifting blaze to boil the stew, but not close enough to burn it out.

Presently a crack opened down one side of the gourd and the juice dribbled out in a hissing cloud of steam.

New Stone Man had already used wet clay to hold together the reeds and

Interior of a cylix, or drinking cup, in Attic red-figured style. A whole lesson in Greek painting is here. The youth, holding a cylix of similar shape in his left hand, is about to fill it with the oinochoe, or pitcher, which he holds in his right, from the crater, or mixing bowl, at left. This cylix is now on view at the University Museum, Philadelphia

branches of his primitive roofs, so a new idea struck the cook. Chattering angrily to himself, he grabbed the gourd and daubed the crack with a handful of mud from the road, and in anticipation of further cracks smoothed a thin layer of mud all over the gourd.

The remains of the stew were pretty dry. He slopped in more water, out of another gourd, and grimly placed it back in the flames. When the stew was done he lifted it from the fire and found himself unexpectedly the owner of history's first clay pot.

The potter's wheel was centuries in the future. At the start it was simplest to mold vases around gourds, the natural models so familiar to primitive man. We have not discovered the first vase ever made but sites in Macedonia and elsewhere have yielded from below all other human traces specimens of cups and small pots in the shape of the bulbous lower end of a squash.

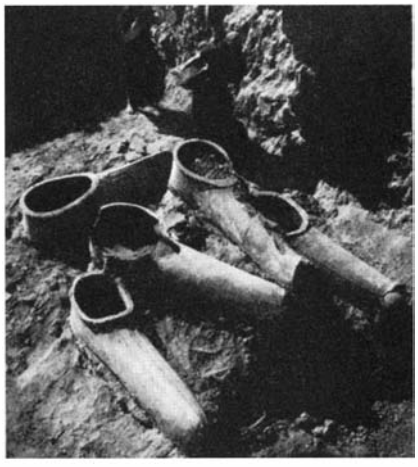
Clay and fuel were to be found everywhere and it was soon realized that the shapes and uses of pottery were practically unlimited. The excavations of the last decade, at a wide range of sites, have thrown new and stronger light on the spread of the new industry from one end of the eastern hemisphere to the other. Every human activity was expanded and facilitated as by no other single invention. The surprised cook received a variety of cook-pots with lids and without; also ladles, tripod supports, strainers, trays and jars for grains and liquids. Beer was discovered when a certain combination of grains left standing in water made a palatable drink, and one of the earliest (c. 4000 B.C.) seal-impressions found by Mr. Charles Bache at Tepe Gawra shows two men at work stirring some such mixture. Wine resulted from the first attempt to store grape juice for the winter. Table service was improved with cleaner plates, pitchers and mugs, and "flat silver" was not neglected, though here pottery was of little use; the knives were of stone or flat splinters of obsidian, the forks had only one tine, not unlike nut-picks, and the spoons were flat bone spatulas.

LITTLE milk jugs were made with nipple spouts to feed Baby, and decorated with small representations of the human breasts they replaced. Toy sheep and cattle lent plausibility to children's games of Thieves and Shepherds. Terracotta dice started mankind on the endless road to ruin, and his enemies broke his skull with clay slingstones and maceheads. Farmers stored their next year's seed more safely in clay storage jars, and shallow dishes with wicks hanging over the edge made simple lamps for winter evenings, but agriculture and the household were not the only gainers from the "invention" of baked clay. Terracotta spindle whorls and loom weights made spinning and weaving easier, and vats for dyes opened new fields of conquest. Tanks for tanning fluid were a boon to leather workers. As men's needs expanded, increasing interregional commerce depended heavily on agents and messengers, who used clay impressions of their principals' seals for identification. The seals themselves were of stone or bone, or more likely still of clay; and they and their impressions constitute our only approach to man's first artistic impulses.

With such cheap "letter-paper" as clay at hand, writing was not long in making its appearance. Messages and instructions were worked on clay tablets; pictographs must have done very well at first, but cuneiform script was destined to supersede them. When these tablets were baked they were practically indestructible; but seeking a still more forgery-proof form of contract ancient man enclosed them in clay envelopes on which he wrote a brief summary of the terms. If any dispute later arose the outer coat could be broken and the original examined by the contracting parties and the indispensable witnesses.

Commerce became more profitable when perfumes, oil, wine, and other liquids were shipped in terracotta jars instead of skins or pipes, on animal back and by boat; adequate water-jars made the first navigators less timid of the sea.

Through the following centuries religion was to make the most of the pos-



"Slipper" coffins, in green-glaze pottery, found in the Parthian cemetery at Nippur, Mesopotamia, by a University Museum Expedition

sibilities latent in the new medium of baked clay. Vessels and ritual instruments for use at the altar were manufactured, none more elaborate than those of Palestine and Crete. Figurines reminded gods of their worshippers and worshippers of their gods. Continual reminders of their interests, barge-owners set up before their guardian divinities model boats of clay, caravan drivers set up "covered wagons" and clay camels, loaded or bare, vintners dedicated wine-jars and warriors swords, shields and chariots; and the gullible sick set up little models of afflicted hands, eyes, ears, and intestines—a practice by no means extinct today.

Dr. Ephraim A. Speiser's excavations at Tell Billa in Mesopotamia yielded a small Hurrian shrine, now in Philadelphia, made of tiny clay bricks set in pitch. The Greeks made charming terracotta scenes of worship, and apotropaic plaques to ward off the Evil Eye and other unwelcome visitors. The Romans made model temple façades in one piece, and cheap incense-burners and family-size altars for household use; at Minturnae, in the refuse-heap of a vast potter's shop, I found two broken clay tomb markers.

All over the ancient world storage jars formed handy coffins for the dead, the smaller sizes serving for children and

Fragment of seal impression on clay from "Round House," Tepe Gawro

babies and the smallest urns for ashes, where cremation was practiced. Of course so admirable a material for real coffins could not be overlooked, and you may be sure that the early painted terracotta sarcophagi from Clazomenae in Ionia, the Etruscan ones which show the departed reclining on couches with their wives, and the green-glaze slipper coffins in vogue among the Parthians, are conspicuously displayed in the museums lucky enough to have them.

On the whole, architecture gained most of all from the discovery of uses for clay, though primitive man was very slow to take the hint. For centuries, as we saw, he used wet clay to bind the boughs and rushes of his roofs, and often his walls were of the same material. When these burned the clay was baked more or less rigid, in some cases preserving its shape through six millennia to be found by modern diggers. Nevertheless it was long before burned bricks gained a popular foothold, and they have never completely superseded sun-dried mud bricks in Western Asia and Greece. Yet one of the earliest uses of bricks was in architectural decoration, when the builders of Babylon's Ishtar Gate molded and glazed their exposed edges to depict monstrous dragons and chimaeras.

Specimen jugs and pitchers from the "Potter's Shop" at Minturnae

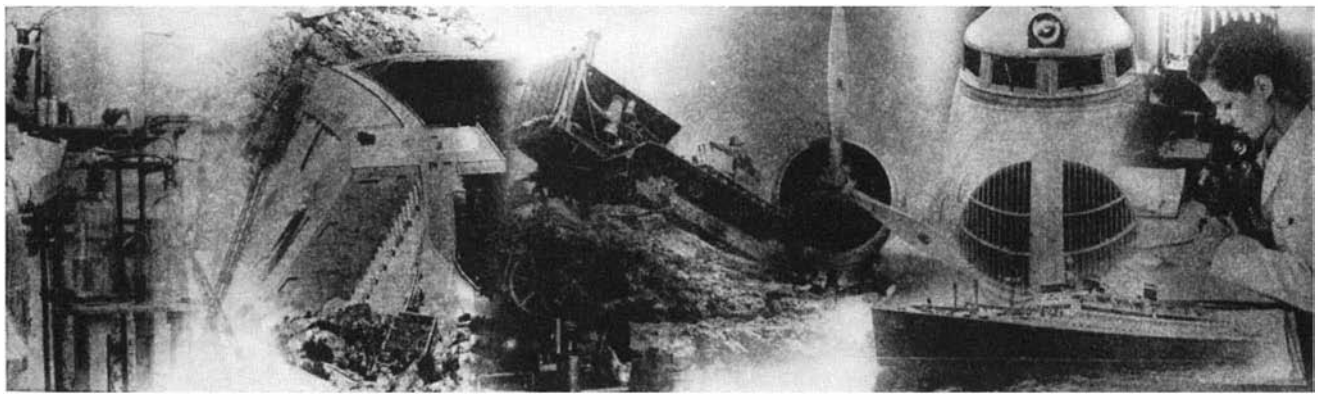
Sir Arthur Evans' explorations at Cnossos have disclosed the Cretans as the first patrons of good plumbing. Their wells and reservoirs, their practical conduits, their terracotta tubs and tile-lined baths and well-fitted subsoil drains are as celebrated as Minos' great storehouses and bright stucco walls. Most Greek cities placed intellectual above physical comfort but Olynthos in Northern Greece, as Dr. David M. Robinson has found, was very advanced in the matter of sanitation. The Romans carried this a few steps further when they built their great baths, heating the water and warming the rooms by blasts of hot air conducted through walls and floors built of specially designed hollow tiles.

Flat tiles of terracotta proved to make an almost perfect roof. They were (and still are) cheap to make and lay; they come and go in temperature extremes like shingles or slate and unlike sheet metals; they can be taken down for repairs and replaced, or sold for reuse second hand; they permit enough ventilation to save the rafters and sheathing from dry rot; and they are utterly unaffected by weather. Today they are relatively light, but in antiquity their tremendous weight was one drawback, making transportation costs high unless they were manufactured locally, and requiring massive construction under them. Yet such were their advantages that during classical times men hardly bothered to experiment with substitutes, except when out of vanity they roofed their temples with marble copies. When the roof tiles fell and broke, the Romans built the fragments into their concrete walls like so many bricks; broken pieces of the great Roman dolia or storage jars served the same purpose, until the demand exceeded the breakage and the Romans were forced into commercial manufacture of real bricks.

But if tiles made satisfactory roofs, it might also be possible, as the Greeks perceived quite early, to face exposed wall timbers with them too. Waterproof paint was not known, the earth washes of the time providing only short-lived surface color. Accordingly, they nailed flat plaques of terracotta to their architrave beams and friezes. At first these were merely painted, but Hellenic instinct for decoration soon molded three-dimensional designs, adding depth and the play of light and shade to color. The Etruscans took over the architectural terracottas of the Greeks but it remained for the Romans and their Italian kinfolk to extend their use to the furthest limit. Eaves and pediments, even door-jambs broke out in a flutter of gay colors. Special fluted sheaths were made for wooden columns, with suitable bases and Ionic or Tuscan capitals. And the molds in which all these were cast were also of terracotta. Terracotta objects are fragile but the smaller the fragments the less easily they break. Except that time and water have eaten some away, the fragments of every vase ever made still exist for archeologists to find and understand.

IN the course of history men forgot their simple beginnings. With no rational explanation of the source of fire, the shimmering imaginations of the Greeks wove to satisfy their children's curiosity a sober story of a superman Prometheus, an older Christ who gave his life for mankind. He stole a bit of the sun's fire, showed his fellows how to cook their food and warm their chilled bodies, and demonstrated the simple chemistry of firing pottery and smelting copper. The gods chained him, an object lesson, to a Caucasus crag and left a vulture to gnaw his vitals.

So the old story. Even though Man had fire from the beginning, ever since the first cave-dweller dragged home burning branches from a lightning-set forest fire, and though pottery and metals were discovered a thousand or two years apart, Prometheus is as good a name as any for Man's greatest benefactor.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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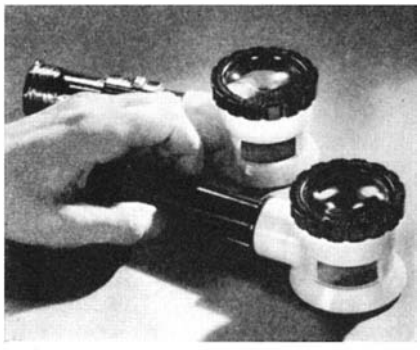
D. H. KILLEFFER
Chemical Engineer

Illuminated Magnifier

PROFESSIONAL men, police departments, stamp collectors, bankers, purchasing agents, textile men, mechanics, and manufacturers of all products requiring close surface inspection have found use for a new illuminated magnifying glass recently placed on the market. Giving five-power magnification with illumination of the field of vision, the new "Flash-O-Lens," made by E. W. Pike & Co., employs a double lens system.



Magnifier with a built-in light source for illuminating surfaces

The Flash-O-Lens is formed with a screw socket to one side of the lens barrel. Into this socket may be screwed a special battery case resembling a flashlight, in which are used standard flashlight batteries. A light projects into the space beneath the lenses to illuminate the work being studied. Extra equipment consists of an adapter to use, for the same purpose, current from the light circuit through an extension cord.

An accurate spacer ring of Bakelite holds the lenses in exact focus, while a white composition frame is employed to reflect the light. A side opening in the frame makes it possible to use instruments or a pencil while examining an object.

Improved Sulfur Cements

BY dissolving small amounts (up to 10 percent) of polysulfide rubber in sulfur cements, their resistance to mechanical and more particularly to temperature shocks is greatly reduced. Without this addition, sulfur cements go through a process of crystallization with changes of temperature, and very soon crumble. The addition of polysulfide rubber, a synthetic rubber-like material, apparently reduces this tendency to crystallize and greatly increases the usefulness of the cement. Sulfur cements are particularly valuable in bonding acid-proof tile when used to handle corrosive chemical solutions. They have also been used to bond brick paving of automobile roads.—*D. H. K.*

WAXED COAL

SOFT coal dust in the home has always been such a problem that a new process has been worked out for waxing coal to prevent the nuisance. The treatment is said to be permanent and the wax is non-volatile and non-spreading so that no odor develops in the basement and the floor is not oiled nor discolored.

Sulfurous Acid Preserves Cut Flowers

AT a cost of less than half a cent for each pint of water in which they are placed, cut flowers may now be kept fresher and more vigorous for longer periods of time before they wither and die. Experiments conducted at the scientific laboratories of the Hawaiian Sugar Planters Association in Honolulu, indicate that two eye droppers full of sulfurous acid (not sulfuric acid) added to each pint of water encourages buds to continue growing and leaves and stems to remain greener, and permits the flower itself to retain its freshness in some cases for days after it would normally cease to be attractive.

Sulfurous acid can be bought in pint bottles at almost any drug store at a cost of less than one dollar; one pint of the acid will serve as a cut flower preservative for more than 200 pints of water at the rate of two cubic centimeters of acid for each water pint; the average eye dropper has a capacity of one cubic centimeter.

Astonishing results have been obtained in some instances. The Hawaiian Sugar Planters' scientists have carried the experiment far enough to note that large-stemmed flowers, such as lilies, hydrangeas, chrysanthemums, gladioli, rhododendrons, and the like are more benefited than the delicate, smaller-stemmed varieties such as daisies, snapdragons, carnations, and so on.

"This," say the scientists, "is evidently because the vital forces stored by nature in the small-stemmed flowers are not great and become exhausted quickly. When they are gone the flower is finished. The larger stemmed varieties, however, have in some cases given us fine results. Hydrangeas have lasted four and five days longer than normal when the sulfurous acid was added to their water."

The scientists ask that the sulfurous acid treatment not be regarded as a fool-proof method of preserving all cut flowers, but do state it has been found more effective by and large than any of the hot water, aspirin, or other methods now used by florists. It is not to be expected that flowers which bloom but one day under normal conditions in the garden will bloom for longer periods after being cut. However, those of long life on plant or bush but which die in a day after being cut will be aided by the addition of sulfurous acid to the water in which they are placed.

All flowers given the solution should be watched and if the stems indicate they are being burned, less acid should be used; in

Pan-Pacific Press Bureau

Wilted hydrangeas, *right*, and a bunch preserved with sulfurous acid

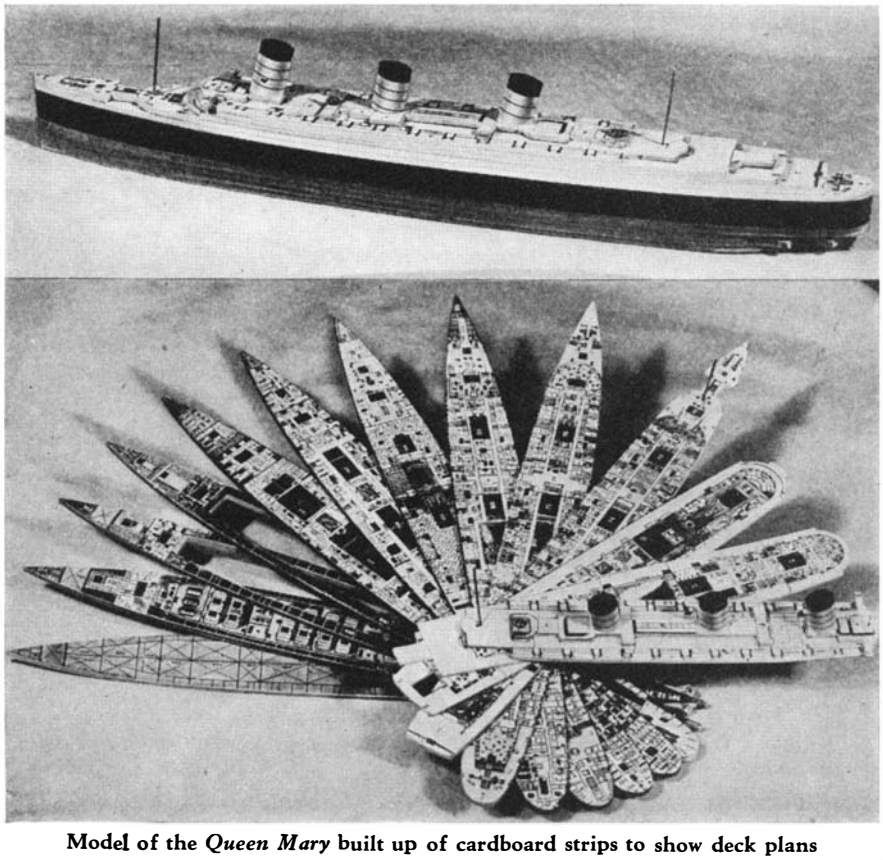
all cases a weaker solution, about one eye dropper of acid per pint of water, should be used for the more delicately stemmed flowers. Blooms that last for more than two days should have fresh water and solution given them. Home experiments should be made to determine what local flowers are benefited most by the sulfurous acid solution because different soil qualities in different localities may have some bearing upon the solution's effectiveness. Experiments along this line have not been made by the Hawaiian scientists. Special care must be taken not to confuse sulfurous acid with sulfuric acid which will kill the flowers.

FUNGI

WALCHA in New South Wales, Australia, claims a giant mushroom five feet two inches in circumference, 11 inches high, and weighing 17½ pounds.

R. M. S. "Queen Mary" with Removable Decks

TOYS do not usually find a place in this department, but the one shown in our illustration is so unusual that it will appeal as much to fathers as to sons. Made and sold by The London Electrotype Agency, Ltd., England, this model of the beautiful new *Queen Mary* is made of layers of heavy cardboard which may be swung around a pivot to expose the various decks. On each layer is the complete plan of the corresponding deck, there being 12 such removable decks. The deck plans were designed by G. H. Davis, the noted artist of *The Illustrated London News*. The length over-all of the model is 12 inches.



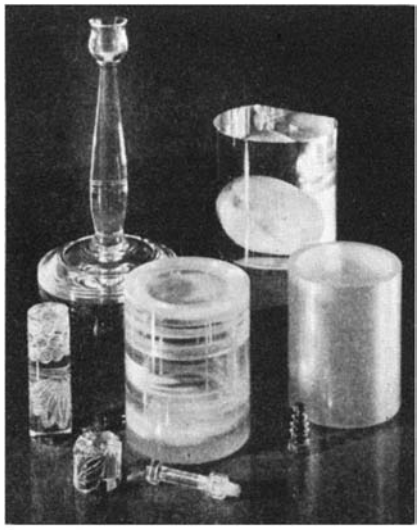
Model of the *Queen Mary* built up of cardboard strips to show deck plans

New Transparent Resins

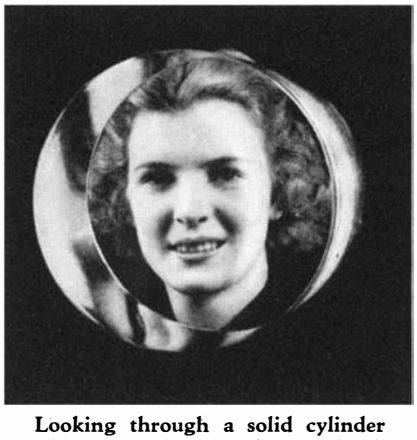
A NEW series of synthetic resins clear as optical glass are described as being strong, flexible, and non-shattering. These resins, polymers of the esters of methyl acrylic acid, are thermoplastic; that is, soften when heated, and can be sawed and machined. They are being marketed under the trade-name "Pontalite." In describing them before the American Chemical Society, H. R. Dittmar said: "The transparency, strength, high softening temperature, low specific gravity, and chemical resistance of polymethyl-methacrylate make it an outstanding plastic material of either the cast or molded type. The unusual clarity of this resin permits its fabrication into delicately tinted shades. With the combined use of dyes and pigments, materials of varying degrees of color and transparency have been prepared. The value of this resin is greatly enhanced by the ease with which it can be worked, engraved with unusual effects, and cemented to itself to give joints which for all practical purposes are as strong as the resin itself.

"The glass-like transparency of these resins suggests many uses as glass substitutes where strength, lightness, ultraviolet transmission, and ease of fabrication by molding are desired. Their substitution for glass in certain fields is facilitated by their remarkable chemical inertness. Among the many uses which have been evaluated and patented in the plastics field are safety glass interlayer, sound-recording records, dentures, and telephone and radio transmitter diaphragms. The low viscosity of the monomeric esters of methacrylic, together with the ease with which they can be polymerized, adapt them as impregnating agents.

"The dielectric properties of methyl methacrylate resin make it of value in the electrical and instrument field. These resins are used as textile sizing and stiffening agents. Their clarity, light resistance, water impermeability, resistance to alcohol, oil, alkali, and acid, and general compatibility suggest many applications in coating compositions and varnishes."—*D. H. K.*



Objects made of Pontalite. Note the delicately carved surfaces on some



Looking through a solid cylinder of Pontalite, 9¼ inches in depth

Soap to Match the Bathroom

SOAP made by a new process which requires a few minutes instead of many hours for completion is being marketed in colors which match the modern trend in bathroom design. Black, blue, red, green, brown, and gray are among the colors available. The trick has been to choose dyes which will color the soap but not the suds or the user.—*D. H. K.*

Squash-Pumpkin Hybrid

THE production of about a dozen fruits from more than a hundred cross pollinations between different varieties of pumpkins and squash made at the State Experiment Station at Geneva, New York, has thrown considerable light on the botanical relationships of these groups and, incidentally, has given rise to several new forms that seem to be either immune or highly resistant to squash mosaic. Many unsuccessful attempts to hybridize these two vegetables have been made during the past century, hence the success attending the Station trials is being watched with con-

Trawler *Storm* has a fish-hold lined with pure nickel sheets

siderable interest because of the many possibilities it holds for developing new and better varieties.

"Cucurbita is the technical name for pumpkins and squashes of which three annual species are more or less commonly grown," explains Prof. Van Eseltine, Station botanist. "These species are known as *maxima* which includes the winter squashes, such as Hubbard, Boston marrow, and related types; *moschata*, also known as the grammas and best illustrated by the Japanese Pie, Winter Crookneck, and the like; and *pepo*, or the pumpkins, the fall squashes, and the summer squashes or scallops, vegetable marrows, and similar forms.

"In each case, the forms within these groups crossed readily but the groups would not cross with each other. This seemed to establish the specific identity of the three groups. In 1930, an attempt was again made to cross these different groups in a study of the origin of the annual Cucurbitas. About a dozen fruits have been obtained from these crosses and while they present many interesting possibilities, including evidence of marked resistance to squash mosaic, much further study will be required before any very definite conclusions can come from these investigations."

CANNED WINE

NOT to be outdone by the brewers, American wine makers are now marketing their product in cans lined with synthetic resin.

New Type of Trawler

RADICAL departures in the design of fishing trawlers have been achieved in the Diesel-powered *Storm*, built by the Bath Iron Works for the Forty Fathoms Fisheries of Boston. In size, lines, and equipment, this vessel is a striking contrast to the old Grimsby type of trawler which has been standard on both sides of the Atlantic for the last 30 years.

Product of the highly competitive race to supply the American market with fresh fish of high quality, *Storm* is constructed with hull plates twice as heavy as those used in United States Navy cruisers in order to withstand the buffeting of winter seas. Her fish-hold is lined with pure nickel as the last word in sanitation, and a special air-cooling installation will keep it just above the freezing point to permit the delivery of "winter fish" the year 'round.

First of three vessels of this type, *Storm* has been followed by sister ships, *Surf* and *Swell*, which are now in service. Together they cost 600,000 dollars.

A feature regarded by veteran fishermen with almost as much amazement as the refrigerated fishholds is the provision of showers and washrooms for all hands. Other comforts are to be found in improved quarters for officers and crews and drying rooms for wet clothing.

The holds, however, are considered the most radical change. Fishing companies are reticent about the amount of spoilage they encounter in hot weather. In January, loss from this cause is practically nil, but in July, it is admitted, as much as 20 percent of the fish in the old-fashioned holds may reach port as second-grade quality.

The new refrigerating system is designed to eliminate this loss. Between the hull plates and the inner shell of the hold there is a three-inch lining of cork, through which air ducts run vertically. Dry, cold air is thus circulated to keep the hold at a temperature between 33 and 36 degrees Fahrenheit.

This temperature, in turn, controls the rate of melting of the ice in the hold and makes it possible to cut the load of ice which must be carried from 60 tons to 20 tons. This factor alone increases average hold capacity by 100,000 pounds, bringing total capacity up to 400,000 pounds.

The new trawlers are 144 feet, 8½ inches long over-all, and 131 feet on the waterline. They have a beam of 25 feet and are 13½ feet deep. They are so constructed as to be more easily driven through heavy seas in bad weather and as not to be "down by the head" when returning, loaded, from the banks. They will permit longer fishing in bad weather and quicker runs to the market. The stems have a pronounced forward rake with the lines immediately aft unusually fine to permit easy entrance into the water. The underwater lines aft are of cruiser stern type.

The main engines are 17½-inch bore by 25-inch stroke, heavy duty, solid injection McIntosh Diesels, capable of developing 600 horsepower at 180 revolutions per minute.

FOG

LONDON "pea soupers" are made in Hollywood by shooting live steam over solid carbon dioxide (or dry ice).

Really Dustless

ENTIRELY new types of five ton, dustproof and hygienic garbage trucks with rotating drums are now in use in Gothenburg, on Sweden's west coast. Both the ingenious trucks and the chassis are made in Sweden.

Each truck body is completely enclosed and has a capacity of seven cubic meters (247 cubic feet). The loading is dustless and is made directly from the covered garbage receptacles in the courtyards of apartment houses or factories. When the

One of the hygienic garbage trucks now in use in Sweden

For Christmas

Nothing makes more acceptable gifts than practical books

1. COSMIC RAYS THUS FAR—*By Harvey Brace Lemon.*
A short, compact, thoroughly authentic, popular summary of our present knowledge of cosmic radiation, by a professor who has a flair for popular presentation.—**$2.15** postpaid.

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5. FOOD, FITNESS AND FIGURE—*By Jacob Buchstein, M.D.*
A popular treatise on foods, their content and effect in our diet, also on beverages, food fads, vegetarianism, fasting, and weight control. Detailed 14-day diets.—**$2.15** postpaid.

6. WHY BE TIRED?—*By Daniel Josselyn.*
Short and to the point, this book should be a tremendous help to all "office athletes"—those sedentary workers who work as strenuously as laborers but do not realize it except that they are usually "dog-tired."—**$1.10** postpaid.

7. FOR STUTTERERS—*By Smiley Blanton, M.D., and Margaret Gray Blanton.*
Said to be the first book to point a way to the recovery of normal speech through the application of well-tried principles of medical psychology and psychoanalysis. What the individual, the parents, and the teacher can do.—**$2.15** postpaid.

8. 1500 NEEDED INVENTIONS—*By Raymond Francis Yates.*
A revised edition of a book published three years ago, expanded to include many additional subjects. Crammed with short, pithy paragraphs describing various desirable inventions in a number of different fields.—**$2.65** postpaid.

9. FUN WITH ELECTRICITY—*By A. Frederick Collins.*
Electric phenomena with directions to perform the experiments that exhibit them. Simply written, this book has proved a source of enjoyment and mental stimulation to mechanically inclined individuals. **$2.15** postpaid.

10. HOW TO MAKE A GHOST WALK—*By Joseph Dunninger.*
How the so-called psychic mediums perform some of their stunts. Delightfully humorous, it tells how to develop "psychic forces", how to tip tables, produce "spirit" messages on slates, how to read sealed messages, etc.—**$1.15** postpaid.

Junior Scientists' Selection

AMONG the welter of new books for children this year, there are a number of excellent ones for the Junior Scientists. Most of those mentioned briefly below are for the ages of six or eight to fourteen; contain interesting facts presented in easily readable fashion; are well illustrated; and will make splendid Christmas gifts from the elders who read this page.

17. HOME CARPENTRY, *by Edwin T. Hamilton,* contains over 100 different articles, ranging from book cases to bed-tables for the amateur craftsman, and includes 200 illustrations and plans.—$3.20 postpaid. . . . 18. OUR NAVY, *by Charles J. Finger,* gives an outline history of this important branch of our national defense (ages 10 to 14).—$2.15 postpaid. . . . 19. THE BOOK OF LIVING REPTILES, *by Raymond L. Ditmars,* famous curator of the New York Zoo, *and Helene Carter;* all about crocodiles, alligators, snakes, turtles, and lizards—where and how these strange creatures live.—$2.15 postpaid. . . . 20. DO YOU KNOW ABOUT FISHES?, *by Janet Smalley,* a new picture book in four colors and black-and-white, by the Philadelphia artist-author who has been so successful in making facts exciting for little children.—$1.40 postpaid. . . . 21. FAMOUS AMERICAN TRAINS AND THEIR STORIES, *by Roger Reynolds.* Dramatic stories of the best-known American trains—how they got their names, what rivers, mountains, deserts they cross.—$1.15 postpaid. . . . 22. MIGHTY ENGINEERING FEATS, *by Harriet Salt.* An authentic book for young people 14 and over. Vividly and authoritatively discusses 10 of the mightiest engineering feats which have gone into the making of our country. Photographs and line drawings.—$2.70 postpaid. . . . 23. MORE SONGS OF WILD BIRDS, *by Albert R. Brand.* Three double phonograph records made direct from nature are included with this volume, which is a guide to bird song for boys and girls of all ages.—$2.65 postpaid.

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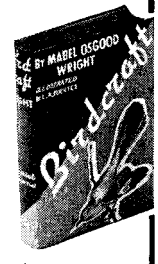
By MABEL OSGOOD WRIGHT



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By HOMER D. HOUSE

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16. This superb book has 364 color plates and 340 pages of text. Hundreds of wild flowers in all parts of the United States can be identified through the pictures and the descriptions, which were written by the noted authority, Dr. House, State Botanist of New York.

11. IF YOU ARE GOING TO DRIVE FAST—*By Ray W. Sherman.*
Captain Edward V. Rickenbacker has written the introduction, in which he says "I believe it is the obligation of every car driver and owner to become acquainted with this book". It sets forth ways and means to inject a greater amount of safety into the ever-faster driving of our time.—**$1.15** postpaid.

12. HANDBOOK FOR THE AMATEUR LAPIDARY—*By J. Harry Howard.*
The latest book by the author of "The Working of Semi-Precious Stones". This newest book provides practical instructions in all kinds of gem cutting for the beginner and for the advanced amateur. It is a real shop-book.—**$2.15** postpaid.

13. GETTING ACQUAINTED WITH MINERALS—*By George Letchworth English.*
Aimed specifically at the amateur collector, this volume tells him how to go about collecting—what to do and what not to do. It includes a general elementary treatise on crystallography and mineralogy.—**$2.65** postpaid.

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truck is in motion, the circular, welded drum rotates slowly, thereby reducing the size of the contents by means of constant packing. To unload a truck, the rear circular wall of the drum is swung upward on hinges and the contents emptied in short time. Many foreign cities have also ordered a number of these trucks, among them Oslo, Norway, and Chemnitz and Potsdam, Germany.—*Holger Lundbergh.*

New Synthetic Adhesives

A NEW synthetic resin made from zinc chloride, urea, and formaldehyde (offered under the trade name "Lauxite"), has been developed as an adhesive for plywood. The new resin has a remarkably high speed of reaction at relatively low temperatures and forms a bond stronger than the wood itself. After heat treatment, the resin becomes permanently hard and has a high resistance to water and weather at ordinary temperatures. In comparison with phenolic resins used for the same purpose the output of the press units is practically trebled and manufacturing troubles are eliminated. The cost per joint with the new resin is about the same as with a good casein glue but the elimination of re-drying and the absence of stains as well as other advantages make the cost of the product with this resin much less than with a casein glue, and the quality is greatly superior.

Before heat treatment the new resin is soluble in water and can be applied in water solution to the wood. After heat treatment it becomes relatively insoluble and can only be dissolved by prolonged boiling. Other possible uses for resins of this kind, of which there are many variations, are in the field of plastic molding (because of the greater speed possible) as well as in sizing paper, textiles, straw, felt, and so on.—*D. H. K.*

Smooth Olive Oil Racketeers Foiled by Federal Food Men

IT was a good racket while it lasted—the "olive oil" racket with cheap tea-seed oil substituted for the more expensive olive oil. But a Federal chemist has at last found a way to identify the tea-seed oil, and the Food and Drug Administration has started legal action to confiscate thousands of gallons of the adulterated oil. The salad oil racketeers will now have to abandon tea-seed oil as a source of illegitimate profits just as in the past they have had to abandon cottonseed oil, peanut oil, sesame oil, sunflower-seed oil and others as adulterants of olive oil.

For some time the Food and Drug officials have been suspecting the substitution of tea-seed oil in "olive oil," but they could take no action against suspected stocks, because they could not go into court and prove the adulteration which the racketeer would deny. Tea-seed oil resembles olive oil closely in many respects, and answers to all of the recognized tests for olive oil. To make a case stick, they needed just one reliable test in which tea-seed oil would react in a way distinctly different from olive oil. The test just developed is that kind of a test.

Tea-seed oil is a commodity virtually unknown to most buyers of salad oils. It is pressed from the tea nut, or seed, produced by a plant closely related to that from which leaves for beverage tea are harvested. The major use of the oil, which is imported from the Orient, is in paint and textile industries. It may be used as a table oil when refined, and is not unwholesome. The Administration would have no ground for action against tea-seed oil sold as tea-seed oil. But it should be sold for what it is. Use of the tea-seed oil as an adulterant in olive oil is clearly a violation of the Food and Drugs Act.

"The operations of certain individuals in the salad oil business have been a source of concern to Federal officials in recent years," said W. G. Campbell, chief of the Food and Drug Administration recently. "They began with the adulteration of olive oil with cottonseed oil, peanut oil, sesame oil, sunflower-seed oil, and other fairly well known edible oils, for which identifying tests were developed. Competition among the racketeers led to the use of less and less of the costly ingredient—the olive oil—until oils were found in which there was no olive oil at all."

Pectin in Photography

PECTIN, familiar to American housewives as a valuable aid in jelly making, has been suggested and used in Germany to replace gum arabic in the process of photo-engraving. Gum arabic or gelatin becomes sensitive to light when treated with potassium chromate. Apparently pectin, which is derived from fruits and has the property of gelatinizing in solution, can be made similarly sensitive to light.—*D. H. K.*

Synthetic Golf Ball Covers

CELLULOSE acetate compounded with an excessive amount of plasticizing agent has been suggested to replace gutta percha as the cover of golf balls. Since cellulose acetate is derived from wood, perhaps it is proper to suggest that golf balls may soon wear wooden overcoats.—*D. H. K.*

The Lindbergh Navigation Watch

ANOTHER phase of Col. Charles A. Lindbergh's inventive genius is revealed in his Longines-made navigation wrist watch

which permits direct reading of the Greenwich hour-angle, necessary in determining longitude. Describing his invention, Col. Lindbergh wrote, in part: "The dial is graduated both in time and in arc. . . . The chronometer is first set on Greenwich Civil Time, then correction is made for the equation of time taken at local noon. . . . Mrs.

New navigation wrist watch with the features described in the text

Lindbergh used a dial graduated in degrees for navigating our transcontinental flight. . . . She was able to save considerable time in working out lines of position."

The central dial is graduated into seconds of time and minutes of arc, 15 of the latter corresponding to 60 of the former, for the earth turns through one quarter of one degree every minute. The minute hand indicates minutes of time on the dial, and degrees of angle of the earth's rotation on the bezel, for the earth turns 15 degrees an hour. The hour hand not only indicates the passage of time, but also shows the number of degrees through which the earth rotates, marking 180 degrees in a 12-hour period.

The dial marking seconds of time may be rotated to synchronize this watch with radio time signals, and the rotatable bezel compensates for the equation of time without the need for mathematical computations at each reading.

Land Tilts; Harbors Deepen

CANADA and the United States may have reciprocal trade agreements but the United States is benefiting at the expense of Canada in another matter over which man-made laws have no control. Harbors on the American side of the Great Lakes are getting deeper and those in Canada are becoming shallower.

The reason, as revealed recently by Capt. H. V. Canan, U. S. Corps of Engineers, is that the region about the Great Lakes is tilting about a "hinge line" which roughly is in the direction of 20 degrees west of north.

This tilt, says Capt. Canan in *The Military Engineer*, is generally improving conditions in harbors on the American side of the Great Lakes. He adds:

"This action is of material rather than merely scientific interest and amounts to as much as 0.3 feet in some harbors. Considering vast harbor areas which are maintained to prescribed depths, a large saving in maintenance dredging costs will result when the effect of tilt on American harbors is given proper consideration.

"This uplift also affects the flow and the flow equations in the connecting rivers of the Great Lakes, and in computing flows for these rivers over extended periods its effects are clearly recognizable. Tilt has also been a factor in decreasing the available depths over the sills of the locks at Sault Ste. Marie, Michigan.

"Much of the evidence presented of decreasing lake levels is in reality the effect of tilt. Reports indicate that in about 1860, North Bay, Wisconsin, was an important harbor for schooner navigation, as many as 35 boats tying up there at one time. Adjoining a rock ledge, old ring bolts used for mooring these boats can still be found. Correcting the present charts for the stage of 1860, only about 3 feet of water would have been available. This loss of depth can only be attributed to earth tilt."

Describing what effect the observed land tilting will have on the future of the Great Lakes, Capt. Canan says:

"There has been much sensational speculation as to the geological future of the Great Lakes. Rather than the danger of the lakes draining down the St. Lawrence through failure of the outlet plugs, the more apparent danger, if tilt persists, is the draining of the Great Lakes above Niagara down the Mississippi system. While speculation of this sort may be mentally stimulating, any danger is so remote, and the engineering steps necessary for prevention are so relatively simple, that there is little danger of losing the vast investment made by the United States and Canada on the Great Lakes."

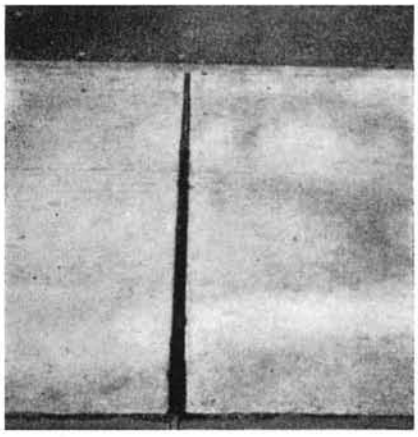
Generally accepted explanation for the land tilt on a line passing through the Great Lakes is that the land to the north, in Canada, is still rising from the enormous squeezing which it received during the last Ice Age.—*Science Service.*

Expansion Joint Bumps

MANY concrete highways are notoriously bumpy because of extruded joints. Such joints not only are undesirable but also are a constant menace to the safety of cars since they tend to throw the car out of control.

A new material for expansion joints, which is rapidly being adopted by concrete highway designers, is made of tough cane

Solid asphalt expansion joint filler mushroomed out; result—a bump



New expansion joint filler after use. No mushrooming; hence, no bump

fibers. Called "Flexcell," this material is impregnated with a special asphaltic compound which gives it permanency and additional resistance to water. Its chief advantage lies in its ability to withstand the compression of expanding concrete while at the same time it maintains a close bond with the concrete on both sides. It expands as the concrete contracts, thus keeping a tight joint under all conditions.

The long, interwoven, cane fibers provide necessary rigidity for easy and quick installation. The compound is not affected by extreme temperatures, so that it may conveniently be handled under all working conditions. It is light in weight, easily cut, and may be stored on the job since it holds its shape indefinitely.

ALBINO

LACK of pigmentation, occurring relatively often in most animals, is seldom found among bats. The Field Museum of Natural History is, therefore, fortunate in having an exceedingly rare specimen, an albino bat of the species *Myotis lucifugus*, which was caught in Wisconsin.

PLENTY PULPWOOD

WESTERN Washington and Oregon contain enough potential pulpwood to supply all the pulp mills of the United States for 50 years, according to Thornton T. Munger, director of Pacific Northwest Forest Experiment Station. With intensive forest management, according to Munger, the forest acreage in this area can grow annually sufficient pulpwood to supply the present needs of the nation's pulp and paper industry indefinitely.

Munger called attention to the fact that the Pacific northwest, particularly in the coast region, is a prolific producer of important pulpwood species, including spruce, hemlock, and white fir, and that investigation has revealed instances of a growth of better than two cords per acre per year.

As a practical matter, according to Munger, the pulp and paper industry cannot depend upon the exclusive use of this pulp timber, since the same species are in demand for lumber.

"In the distant future," stated Munger, "when the non-growing old stands are out

(*Please turn to page* 362)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

MERE men occasionally qualify as stenographers, nurses, ladies' tailors (said to be much better than women at that trade), and even milliners, but women telescope makers are still more scarce. Here, however, are accounts of two women who have qualified.

Mrs. Bessie M. Brownlow, 288 North Eighth St., Marshfield, Oregon, writes: "In perfecting the instrument shown in Figure 1, the Scientific American's book 'Amateur Telescope Making' was consulted freely and frequently. For the mirror a disk of commercial plate glass, 8″ in diameter and 1½″ thick, was used. Grinding was done outdoors with the tool mounted on a deeply set post, and the time consumed was 8 hours, 5 minutes.

"Applying the Foucault test, after a short period of polishing with the conventional pitch lap, revealed that I had developed a hyperboloidal figure. I could, of course, have reversed my disk and gone through the process of re-grinding, but instead I chose to rub out my error with rouge, and from that point forward I worked 'up-hill'. I poured a new lap and proceeded, but shall not attempt to explain at length the altering of facets and modification of strokes which were necessary before I was able to detect the shadows which told me that at

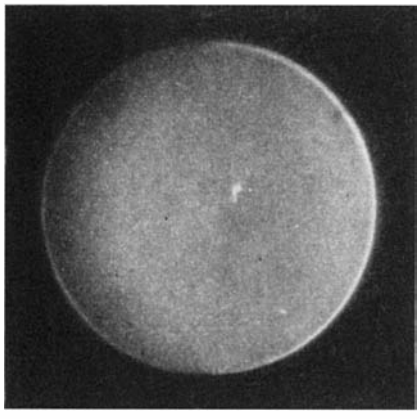


Figure 2: **Mrs. Bussey's mirror**

last I had achieved a satisfactory parabolic surface. Final tests were made on Saturn and Vega with the mirror temporarily mounted in the tube, and even in its unfinished state the image was sharp and well defined."

Mrs. Brownlow states that two sons assisted to the extent of devising the cell block and making the mounting. She also gives credit to Mr. H. B. Donahay, who had previously made two Newtonians, for his counsel.

WE had always heard that H. E. Bussey of Atlanta was a wizard telescope maker who followed the hobby years before there was any "A. T. M.", but now it appears that the same household holds a wizardess as well. Figure 2 is a focogram of a mirror made by Mrs. Bussey, and Figure 3 is the ronchigram. The mere man in the

Figure 1: **Mrs. Brownlow and scope**

case writes: "My wife had listened and looked in silence at 25 years of my efforts to make a good mirror. She said, some time ago, that if the materials were provided, she would prove that a woman could beat a man at it. I didn't like the way she said it, the man of course being myself, hence materials were immediately produced. I was not permitted to touch the mirror, except that in final figuring a 'pile of rocks' showed up in the central inch and I was permitted to use a small polisher to remove them, and of course I did this with careful supervision and copious advice from Mrs. Bussey. The mirror is excellent. A hair got across the film and looks like a scratch but there are none, and the central spot is the photographer's fault. I was the photographer."

And Mrs. Bussey writes: "I realize that it would have been utterly impossible for me to have produced anything like as good a mirror if it had not been for the guidance I received,"—a graceful recognition, though we hate to publish it, preferring to believe that the ladies can do it without *any* help. In fact, we know one who could but, confound it, she won't.

SOMETIMES we wonder just how important it is *in the average case* to test a mirror across different diameters. Once the test rack is adjusted so that the reflected cone strikes the most convenient place to do the testing, it is always a temptation to place the mirror on the rack with the same diameter up (usually determined by some landmark or blemish on the disk). This may have the unhappy result that some kind of flexure is accidentally masked, but it is human to take a chance, on the presumption that the figure itself is a surface of revolution and the flexure, if any, will sort of "unlax" if talked to in nice purring language—which it won't. From the depths of our stock drawer we fish up an old photograph, Figure 4, sent in 1928 by Mr. Henry H. Mason of Florida, since deceased. It is self-explanatory—a belt hung from a pulley, with a little crank for rotating the mirror. Before his death Mr. Mason was building a large (20″?) Cassegrainian and had a large Ritchey-type grinding machine. These remain at East Pensacola, Florida, a fact which may interest some southern amateur on the look-out for something that ought to be put into use.

AS these notes are being written, on October 15, it is at last possible to say something a little less indefinite about that "new book" we have been promising for a year or so. At last we were able to get in all the many contributions and work them up into a single pile and this, when sent to the printer on September 18, made a manuscript of 860 typewritten pages. This is now being set in type and every day or two brings us a dozen more galley proofs to be corrected and sent to the authors to be again read and corrected. As there are just 47 chapters, some of them as long as many books themselves, all this is quite a "job of work" (try it and see).

When will the book be ready? We still don't know, and if you are impatient please don't shoot the editor—he is doing his best. We have set our hopes on being "out of the trenches by Christmas." Piloting a complex book through preparation is worse than rearing quintuplets, and this *is* a complex book—in addition to which there will be a lot of it—pretty close to the size of "A.T.M." and on the upper side at that.

Here are some of the chapter subjects: Everest on his close mirror technic. (He was asked to set down "everything he knew," and this item should run to 30 pages of compact dope, all practical and

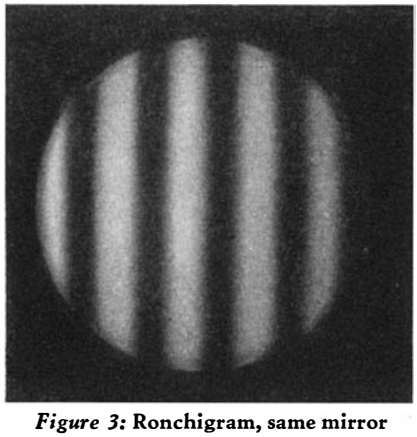


Figure 3: **Ronchigram, same mirror**

definite. If you've seen some Everest mirrors you'll know what that means.) Chapter on use of sub-diameter tools. One on metal tools. Another on metal mirrors. Warner on detecting astigmatized mirrors—a subtle game, this. One on the Zernike test, by Dr. Burch, English physicist. Huh—what's that test? It's a new one and mighty interesting. Selby on flat making—full, detailed dope. Clark on small lenses and eye-

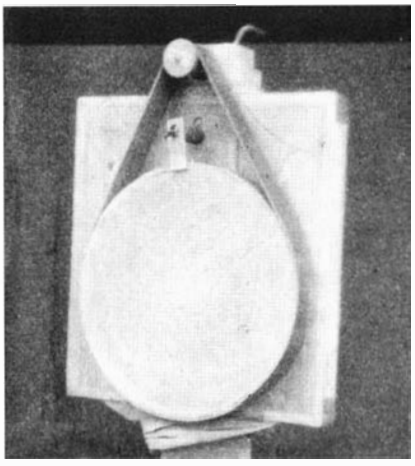


Figure 4: **Mr. Mason's support**

piece making—all practical and very detailed. Taylor on the metal parts for a refractor, likewise practical. Kirkham on rifle sights. Haviland on the refractor—the longest chapter in the book, about 40 pages uniform with those of "A.T.M." Chapter on making setting-circles. H. A. Lower on design of clock drives, with auxiliary chapters on spring drives. A long, very detailed section on the Springfield mounting, by Porter and Ferson. Porter has revised his famous mounting and made it neater, heavier, and more rugged. He tells how to make the patterns, Ferson tells how to cast them, and Porter again tells how to machine and finish the whole mounting. Detailed dimensioned drawings—the whole Springfield down cold.

To continue: Making a 19" reflector. Schmidt, telescope. Camera obscura, by Dall—this is an interesting item. How to make a Synchronome clock, by Souther. Micrometers. Chronograph. How to aluminize mirrors, by Strong. Scanlon on observatory design. Meteor timer, by Halbach. This the main drift in Part I, but much has been skipped.

Part II, a much shorter part, more on the use than the making of things: Halbach on organized observing. Millman on meteor photography. Von Arx on celestial photography . . . and so on for nine more chapters. We hope to publish next month a more detailed announcement of all chapters in the book, and later the precise data.

What is the name of the book? A year ago it was to be called a "Supplement" to "A.T.M." Then it grew too big for that and we dubbed it "A.T.M., Vol. II." Later we became afraid the uninitiated beginner would think he had to get this as well as "A.T.M.", all at one time, and would pass out, so we renamed it "Amateur Telescope Making—Advanced," and that's final; we call it "A.T.M.A." Hence this book isn't a part of "A.T.M." but a wholly separate book—though it is being printed uniform with "A.T.M." in every way.

WHEN Prof. Russell's article on the red reflection nebula near Antares came in, and mentioned a Schmidt camera used by the Yerkes staff at McDonald Observatory in Texas, we suddenly recalled that C. H. Nicholson, one of the Amateur Telescope Makers of Chicago, made the optical elements of that camera. Urgent requests for data and a photograph brought the former from Mr. Nicholson and the latter, Figure 7, from Dr. Struve (through

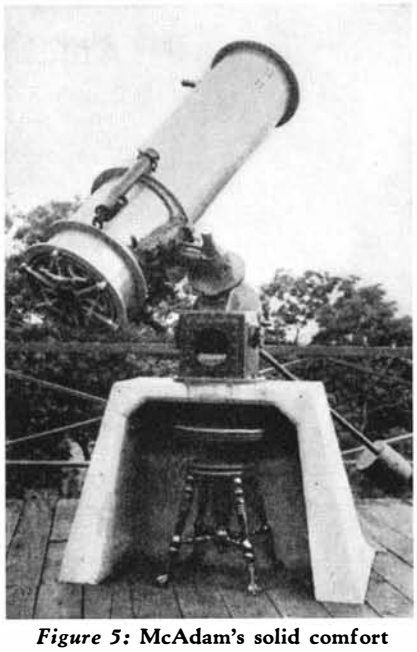


Figure 5: **McAdam's solid comfort**

the kind assistance of A.H.C. of Chicago, who can produce, at instant's notice, anything anybody wants). Mr. Nicholson writes:

"Dr. Otto Struve, Director of the Yerkes Observatory of the University of Chicago, who is also in charge of the construction and operation of the new McDonald Observatory, indicated to the Chicago amateurs his inability to produce from professional makers two Schmidt cameras to be used in connection with the quartz spectrograph and the 82" telescope of the Texas Observatory.

"As a good deal of original research hinged upon the procuring of these instruments, Dr. Struve suggested that the Chicago Amateur Astronomical Association attempt the task as one means of aiding in the advance of astronomical knowledge. Mr. William Callum and Dr. A. H. Carpenter, the guiding spirits of the Club, requested me to build the first camera.

"The specifications for this camera were that the mirror was to be of Pyrex, 122 mm clear aperture and 180 mm focal length, with a correcting plate of UV glass at center of curvature and of 92 mm clear aperture.

"Although the mirror gave me no real trouble, I found the correcting plate very difficult to figure, for the reason that it was necessary to do all the correcting by fine grinding with small tools and then repolishing to examine the figure. This involved a great deal of time, as it is very easy to make large errors when figuring by grinding in this manner. Testing was done by pinhole at focus of the Schmidt camera and the knife-edge at focus of a 6" telescope. All curvature was placed on the front surface, necessitating a convex curve at the center, changing to an equal concave curve at the edge of the plate.

"Upon completion it was tested by Dr. Morgan of the Yerkes Observatory Staff and found to yield star images as small as he had ever seen; their size being limited by the grain structure of the photographic plate and were therefore less than the resolving power of the optical combination."

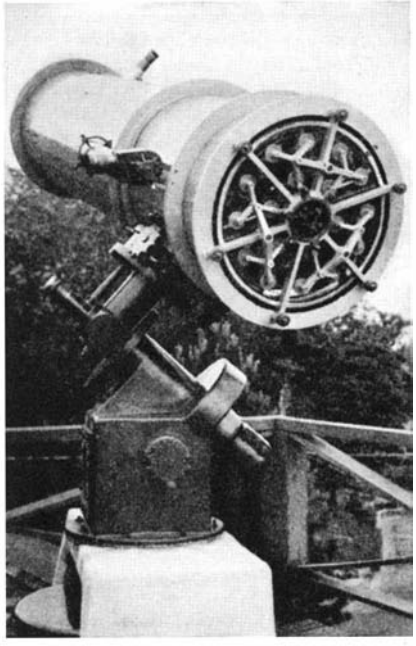


Figure 6: **McAdam's support system**

Dr. Struve points out that the photograph (Figure 7) shows the camera "in highly foreshortened form, as seen from the top. The correcting plate is in the plane of the top surface of the box, and we are looking through this correcting plate into the camera. A part of the spherical mirror shows as a white segment upon which is projected the device for holding the plate." A.H.C. states that the mounting (that is, for the Schmidt itself) was designed by Dr. G. W. Moffitt of Yerkes and made by Gaertner.

Schmidt enthusiasts will find, in addition to the matter in "A. T.M.A.," by Russell, Wright, and Lower, an excellent article on the Schmidt, by Prof. C. H. Smiley of Brown, in the October, 1936, *Popular Astronomy*.

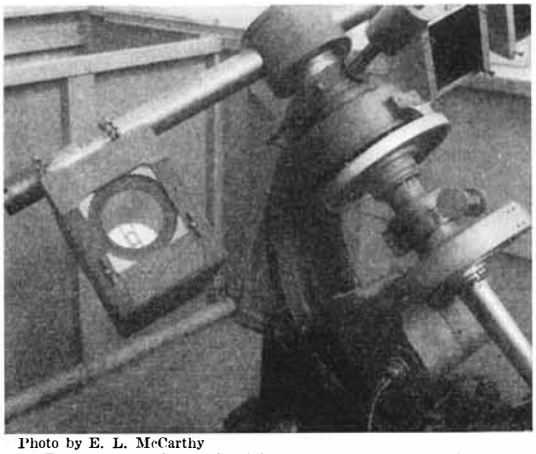


Photo by E. L. McCarthy

Figure 7: **The Schmidt camera temporarily attached to the Porter mounting on Yerkes' roof**

FIGURES 5, 6, and 8 show a telescope made by J. V. McAdam, a mechanical engineer, Hastings-on-Hudson, N. Y. It is a 12½" Newt-Cass combination of Springfield type. The first feature is the solid concrete bench pedestal built for solid comfort—not having to straddle a pier. We long-legged fellows have a hard time folding

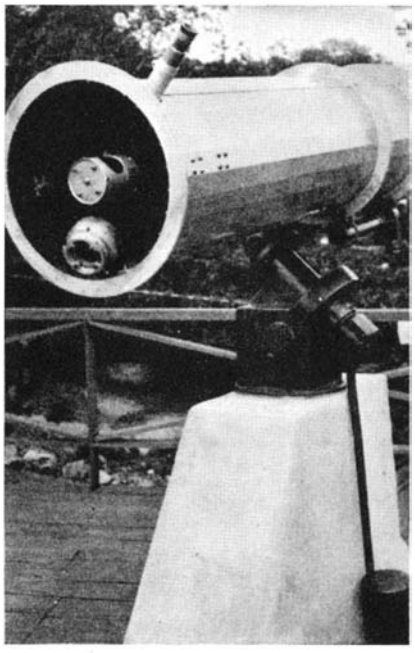


Figure 8: **McAdam's two supports**

up our hind legs in just such places, and McAdam's solution of the jack-knife leg difficulty is fine. He writes:

"Wires for the motor drive and light inside the mounting come up through the concrete. The P.A. has a hole clear through it for locating it on the celestial pole; a 1¼" tube with cross-wires fits into the eyepiece tube, and there is a peek-hole in the south end of the P.A. I find this ideal for adjusting: just turn the cross-wire tube till it is in the right hour for Polaris, move the mounting till Polaris is at the cross-wires, and clamp down.

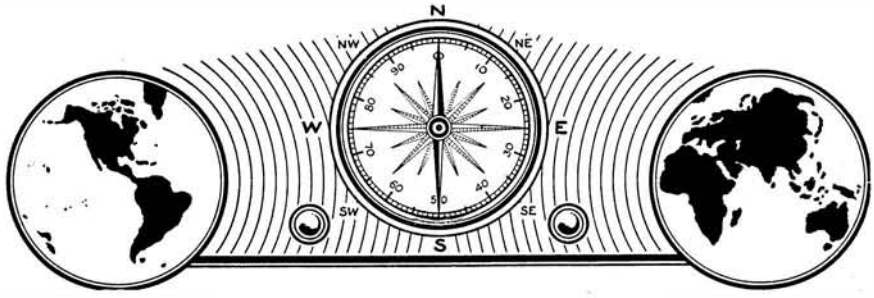
"Dec. axis is a 2½" steel tube (2" internal) pressed into P.A., with a 6", 10-P. gear keyed to outer end, and the casting carrying the tube rotates on this steel tubing, carried around by a worm running on the stationary worm gear. The P.A. has an 8", 10-P. worm gear with hand wheels on either end of the worm shaft, the motor clutch being operated by the left thumb.

"Figure 6 shows the cell and flotation system with part of the first prism adjustment. The prism is carried on the inner end of a 2¼" tube mounted on the six-leg spider extending into the barrel. For a change to the Cass the prism assembly is removed. Castings of the cell can be had at cost, in duralumin.

"The final photograph shows the combination support for the Cass secondary and Newt prism.

"Both mirrors are Pyrex. A tin can cover over both ends of the barrel puts the scope up for the night, whereupon everything is water-tight without further shelter. Once I had to chop it out of the ice but it functioned, even then."

THE question often comes up, "can anyone successfully make his first mirror on a machine, with no previous hand experience to learn the 'feel' of the work?" We have generally recommended making at least one mirror by hand but advice of that kind seldom is taken willingly by a tyro who has the machine complex. Can it be done? Another question: Does anyone silver mirrors any more, or have aluminized mirrors already made a clean sweep?



WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN
Editor, *All-Wave Radio*

Dx Season is Here

THE DX season is now in full swing. Practically all bands are free from atmospherics, and stations normally unreceivable during the summer months are now coming through in fine shape. The 49-meter band is now worth listening to, and the 10-meter amateur band, which was dead during the hot months, has come to life.

A batch of new stations has arrived on the scene and they are worth listening for. The more important ones are:

Call	*Frequency*	*Location*
VQG	19620	Nairobi, Africa
IBC	17620	San Paolo, Italy
ITK	16385	Somaliland, Africa
——	15230	Prague, Czechoslovakia
IBC	14410	San Paolo, Italy
IBC	11955	San Paolo, Italy
——	11760	Prague, Czechoslovakia
COCX	11450	Havana, Cuba
HIN	11280	Ciudad Trujillo, R. D.
ITK	10480	Somaliland, Africa
PSJ	9660	Rio de Janeiro, Brazil
RAN	9600	Moscow, U. S. S. R.
VPD2	9540	Suva, Fiji Islands
HS8PJ	9350	Bangkok, Siam
IDU	7890	Eritrea, Africa
HIN	6243	Ciudad Trujillo, R. D.
——	6115	Prague, Czechoslovakia
GSA	6050	Daventry, England

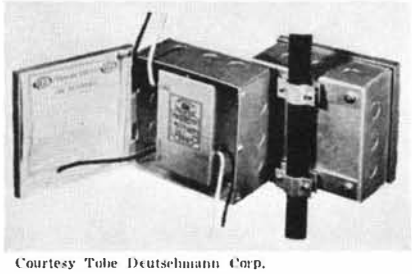
The frequencies given in the above list are in kilocycles. Divide by 1000 to read in megacycles; thus, VQG operates on a frequency of 19.62 megacycles.

Filter for Oil Burners

TO eliminate the radio interference which prevents intelligible reception of broadcast and short-wave programs during the ignition period of an electrically ignited oil burner, a special "Filterette" has been developed.

This unit, installed between the primary of the ignition transformer and the remainder of the oil burner wiring keeps ignition interference off the power system without in any way affecting the operation of the burner. Contained in a standard cut-out cabinet 6 by 6 by 3 inches, the Filterette conforms to the rigid electric wiring regulations surrounding oil burner installation. It comprises a series of specially designed high-frequency inductances in both sides of the power-supply line to the oil burner ignition system and has associated with these inductances, in the correct relation to provide maximum interference attenuation, capacitive sections constructed so as to be safe for continuous AC operation in circuits containing high transient voltages.

An important feature contributing to ease of installation is the provision of detachable mounting brackets, as shown in the accompanying illustration, by means of which the Filterette may readily be attached to one of the pipe standards supporting the oil burner. The brackets are so constructed that the Filterette may be mounted either vertically or horizontally, whichever is more convenient for the electrician making the installation.



Courtesy Tube Deutschmann Corp.

Radio filter for oil burners

Signal Absorption

IS there a theoretical limit to the number of radio receivers which can receive a broadcast from a particular station, asks a radio fan of General Electric's engineers. By rough calculation, engineers have estimated that within a 100-mile area of WGY in Schenectady, it would be eight hundred billion. That number of radio receiving sets all working at once in the area would probably absorb the energy output of the station, but as there are approximately only a billion people in the world there seems no danger of this ever happening.

New FCC Short-Wave Regulations

EXPLAINING the reason for the change in announcements over stations W2XAD and W2XAF, Schenectady, N. Y., B. W. Bullock, assistant general manager of broadcasting for General Electric, recently explained the effect of the new Federal Communications Commission regulations regarding short-wave broadcasting in this country.

Under the new regulations, he said, stations that have been "experimental relay broadcast stations" are now known as "international broadcast stations," the new name being significant of the service rendered. The rules also provide that no United States short-wave station may operate with less than 5000 watts power. A reduction in the

transmitter frequency tolerance from 0.03 to 0.01 percent, he said, will reduce international interference. The aim of the FCC, he said, is to place emphasis on the foreign service of United States short-wave stations and to encourage programs of international scope.

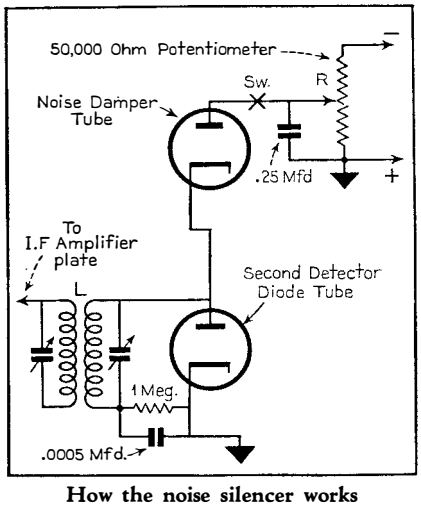
New Noise Silencer

THE development of a system for silencing man-made noise in radio receivers was described in these columns some time ago. The operation of the system is based on the knowledge that such noise impulses as those radiated by the ignition system of an automobile, by a vacuum cleaner, dial telephone, and so on, are of such short duration that if the radio receiver is made inoperative during the time the impulses are present, the noise may be silenced without creating an apparent break in the continuity of the received radio program.

This noise-silencing system has proved its practicality in innumerable instances, but its use in some cases has affected the operation of the receiver with which it was employed.

A new system has been developed which, aside from its simplicity, has the advantage of wide applicability. It can be used effectively in conjunction with any type of superheterodyne receiver without apparently disturbing receiver stability and without requiring complex alterations in the receiver circuit. Besides, the new system requires but one tube, and under certain conditions no additional tube at all.

The former system of noise silencing employed a fast-acting automatic volume con-



How the noise silencer works

trol circuit which influenced the gain or amplification of a special tube inserted in the intermediate-frequency amplifier. The new system operates directly from the diode second detector in the receiver and dampens or short-circuits this stage on the appearance of noise impulses. The additional 6H6 diode tube attached to the second detector actually functions as a fast-acting electronic switch.

The circuit of the new noise silencer is shown in the drawing. The lower tube represents the diode second detector of the receiver, which is fed by the intermediate-frequency transformer L. The upper tube, which is a simple diode similar to the one used in the receiver, is the noise damper. A voltage balance is maintained between these two tubes so that under conditions of no noise the damper tube remains inoperative. Upon the appearance of a noise impulse in this circuit, however, the voltage balance is affected, the damper tube draws current and in so doing effectively short circuits the second detector diode tube. At the termination of the noise impulse, the voltage balance is re-established, the damper tube becomes inoperative and the second detector again functions normally.

The proper voltage balance is established by the manually controlled potentiometer, R. This is adjusted to the normal signal-voltage level as maintained by the automatic volume control in the receiver. Therefore, any voltage greater than the signal voltage will dampen or short circuit the second detector tube.

The switch, SW, is used to discontinue the action of the noise damper tube when receiving exceptionally strong signals under which condition the noise damping action is not required.

"Q" Signals

NO doubt you have heard amateurs repeat such letter groups as QRA, QRZ, QSL, and so on, and wondered just what they meant. These are the International "Q" signals, known to radio operators throughout the world, but possibly not so well known to all short-wave listeners.

Each "Q" signal may take the form of a question or of an answer. Thus, QRA? means "What is the name of your station?", or when used by the amateur simply, "What is your location?" or "What is your address?". The answer might be: "QRA—220 Circle Road, Eastchester, N. Y."

Here are the "Q" signals most commonly used by amateurs, the interpretation in each case being given as a statement rather than a question:

QRA—My location is ———.
QRK—I am receiving you well.
QRM—You are being interfered with.
QRN—There is static interference.
QRT—Stop sending.
QRX—Stand by.
QSA—The strength of your signal is ———.
QSL—Please acknowledge.
QSO—I am (was) in communication with ———; I can communicate with ———.
QSY—Change transmission to frequency of———.

These interpretations are at slight variance with the originals, since the amateur follows a slightly different form of communication practice. Thus, QSO actually means, "I can communicate with ———," but the amateur gives it a broader meaning. He will say, "I had a 100 percent QSO with so-and-so," meaning that he talked or communicated with such-and-such an amateur and that the entire conversation was intelligible. Likewise, QRM is used by the amateur to denote interference. He will say, "There is plenty of QRM," meaning there is plenty of interference, but not necessarily that the station with which he is communicating is being interfered with —though that is usually the case.

The amateur has his own abbreviated language as well—a hangover from the days when all communication was done by telegraph key. Thus, FB means "fine business"; HI denotes laughter; K means "go ahead" or "start transmitting"; R means "all right" or "okay"; OM means "old man," OW "old woman," and YL "young lady." An XYL is an "ex-young lady" or the wife. The number 73 means "best regards," and 88 means "love and kisses."

CAMERA ANGLES

Conducted by JACOB DESCHIN

Pictures By Candle Light

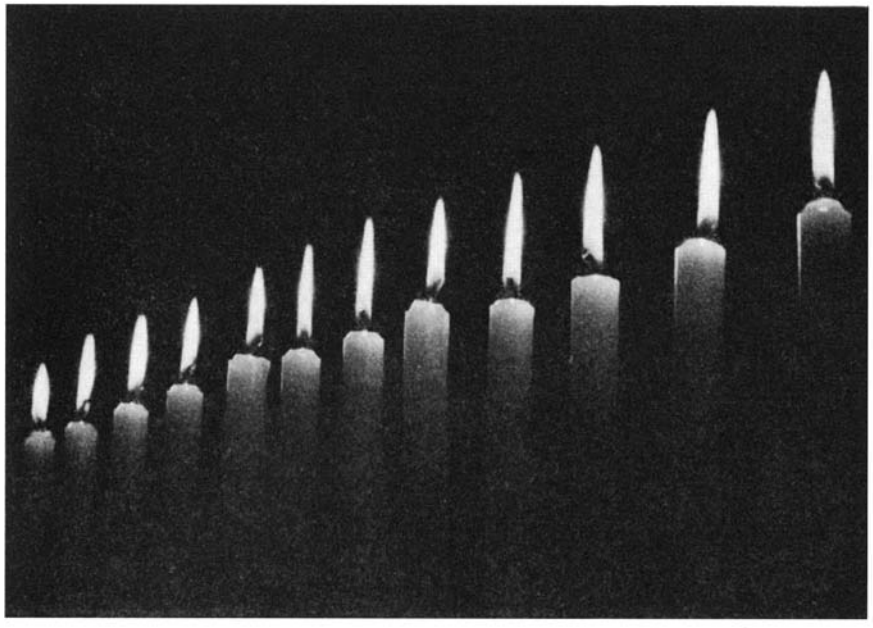
CONSIDER the candle and the varieties of shapes, colors, lengths and thicknesses in which it is available. From the humble penny candle for the tiny birthday cake it ranges all the way up to elaborately designed pieces fit to grace a king's table. Now it is simply utilitarian, as in the case of the thick so-called plumber's candle or the cheap candles that furnish light when the fuse blows out; now its tiny flame on the anniversary cake goes whisking away before the determined blowing of the chief guest. In one of its most delightful roles, it lends atmosphere and romance to the dinner table.

Candles have often been used in photography to illuminate a face and in this phase they have been looked upon as an aid in the making of trick pictures, but their usefulness as both illuminant and subject has not been exploited to the full extent of their varied possibilities. Two such opportunities are here illustrated. In "Design for a Bookplate" the plumber's type of candle was used and the glass bottom support intentionally employed to carry out the idea of a simple home workshop. Incidentally, the type of candle base or holder that is used may often make or spoil a picture. Poverty may be depicted by using a chipped saucer and a candle nearing almost the end of its life span; elegance will be suggested by the use of a tall tapered candle in a decorative candlestick. In this connection, the dictates of style have it that a short candlestick should support a tall candle, a tall candlestick a short candle.

"Lighting in the New Year" is a suggestion that might be used for a New Year's greeting card, the word "Greetings" being printed or written in letters of graduated sizes in the upper triangular space, while the number of the year is placed in the triangular space in the right-hand corner at the bottom. It is obvious, of course, that the newly lighted 12 burning candles represent the 12 months comprising the new year about to start.

Exposures may be quite short if it is desired to record only the flame of the candle but when, as will be the case in most instances, you will want to record at least some of the candle itself, a considerably longer exposure will be needed and some reflecting material employed, as in the case of the boards in "Design for a Bookplate." The New Year greeting designed was photographed at such an angle as to produce the result seen, the larger candle having been, of course, nearest the lens. However, reversal of the negative in printing was found to give a better arrangement. The candles are standing on the edge of a length of board and the background, being dark, does not show, leaving the space at top and bottom clear for the lettering. In order to get over-all sharpness despite the near viewpoint of the camera lens, the diaphragm was stopped down to F:32, but an exposure of 10 seconds was found to be ample.

"Design for a Bookplate"



"Lighting in the New Year"

Photography by candle light lends itself to varied inventions. By giving the subject a little study, supplemented by considerable experimentation, some quite original ideas may be evolved which may not, at first thought, seem possible. One inspired photographer once had the happy thought of photographing two thick candles quite close up, only one of which was burning, the other, having been blown out, sending up curls of smoke. The candles were, of course, illuminated by another light, doubtless artificial, and this leads to the suggestion that some fine things may be done by employing artificial light to get a diffused, subdued, general illumination for a candle set-up.

Paper Towels

IN the cause of cleanliness, let us suggest the use of paper towels in the darkroom. A rack to hold the regulation roll may be had for about a quarter and the rolls of towels cost about a dime a piece. Attached in a convenient place they will prove a comfort on many an occasion, especially, of course, during a busy period of darkroom activity. The rack holds the towel roll firmly enough to permit tearing off one of the perforated sheets without having to use both hands, yet is sufficiently loose to allow rolling.

Cooling

DURING the summer this department offered, in the nursery ice box, a method of keeping solutions within reasonable working temperature all the time. With winter upon us, we now offer the window box for the same purpose. The solution may be much lower in temperature than is desirable but, as has been remarked here on another occasion, it is much easier to raise temperature than to lower it. Our experience has been that immersion of the container in hot water will raise the temperature about 10 degrees in a minute or two.

Annuals Time

THIS is the season of the photographic annual. Full page reproductions enclosed in ring binders assail us from all sides. All of them have something worth while in them, though some are marked by a higher general excellence than others. Glance through them all at your dealer's and buy one or more—if you can afford what it takes. In the main, they contain the work of the best photographers of the day and you can do worse than ape some of the better ones. Of course, we do not really mean aping, for every photographic worker should try to infuse something of his own individuality into every picture he turns out, but a close study of the work of the better photographers and an effort to take from their work certain ideas to help develop his own should be attempted by every serious amateur. Another service of the photographic annuals is the inspiration and incentive to better work that permeate their contents.

Spotting Glossy Prints

THE idea of "doping" a glossy print in order to make pencil marks "take" has been tested by this department and found to measure up almost perfectly, working better, however, on chloride than bromide papers. Spotting glossy prints has always been the bugaboo of the hobbyist, who has often given up the attempt as a bad job and turned the print out on a semi-matte paper instead, on which spotting is very much easier. But there are times when a glossy print is the only thing that will do, as in the case of pictures submitted for reproduction. Dropping some retouching dope on the area to be spotted and then rubbing it well down makes a good working ground for the pencil and may furnish the solution to some of your spotting problems.

For Mailing Pictures

HERE'S a penny saver that may be useful to those readers who mail a sufficient number of photographs to make it worth while. Instead of purchasing the regular "photomailers," the cost of which mounts up considerably when many are used, such as would be the case with those who submit pictures to magazines and newspapers or the salons, buy ordinary clasp envelopes, which are quite cheap when purchased in quantities of 50 or 100, and a dozen large sized

sheets of corrugated paper. Cut up the latter to the sizes required for fitting into the envelopes, and you have as efficient a "photomailer" as you could wish.

Photoflash Work

A SPEED flash exposure scale devised by the distributors of the Kalart outfits for synchronizing flash bulb and shutter will be found useful to those interested in this attractive phase of photography. The scale calls for the use of one flash bulb in connection with Verichrome type film, exposures on supersensitive panchromatic or similar extra fast film being made at one stop smaller than that indicated in the scale. The scale follows:

Distance lamp to subject	Lens stop to use with Standard No. 20 (25 c. list) 1/100 or 1/200th sec.	No. 10 (15 c. list) 100th sec.
6 feet	F:16	F:11
10 feet	11	8
15 feet	8	6.3
20 feet	6.3	4.5
25 feet	4.5	3.5

Concerning the speed of the flash bulb, generally understood to be about 1/50th

With one Photoflash bulb

second, Kalart has this to say: "A standard size flash bulb has a total effective duration of about 1/50th second. However, during this short period of time the light emission is not constant. Upon ignition, the light gains rapidly in intensity, remains at maximum intensity for only 1/200th second, then dies out gradually."

Answering the query of how it is possible to expose a film properly at 1/100th second, it is further added that "actually about 70 to 80 percent of the entire light output is generated in one quarter of the entire light duration" and that this high intensity, usually referred to as the "peak," lasts, as above indicated, about 1/200th second.

Referring to the "hard, flat lighting usually associated with speed flash photography," the distributors say that "it is due to the flash bulb being fired directly from the battery case attached to the camera" and that it can be overcome "by simply using an ordinary lighting fixture which is not permanently wired to the house lighting system" and plugging the electric cord of that lamp into the socket of the battery case, thus offering "a flexible means of

changing the location of the lamp in relation to the subject, independent of the camera's position."

While in full agreement that this ability to move the position of the flash bulb away from the camera itself is a great advantage, permitting the firing of as many as three flash bulbs in various positions in relation to the subject and in perfect synchronization with the camera shutter, this department does not subscribe to the implication that the flat lighting resulting from having the flash next to the camera need necessarily be hard. It is all a matter of proper exposure, the accompanying illustration being proof of this. While the lighting is flat, it is not hard, and the modeling in the face is adequate. A small flash bulb was used.

CONTRASTS

WHEREVER there is contrast, there is human interest. The biggest and the smallest, the youngest and the oldest—the world never tires of hearing about them. Likewise, when a full grown man of normal

The long and short of it

height dances with a midget woman, the camera shooter sees a chance for an unusual picture and fires away.

Try thinking of the various contrast subjects that might be included in a collection of such pictures. For example, a baby's hand in the palm of a large-handed man, a dog and a horse with heads together in quiet "conversation," a midget automobile next to a huge truck, perhaps with the driver in the one "barking" up to the one in the other.

NEGATIVE HUMIDOR

A STORAGE box for safe-keeping of films is the Mirotex Universal Humidor designed to store 162 rolls of 35-mm film and other film roll sizes up to and including the No. 127. It is made entirely of steel, is completely humidified and vented, is finished in black crackle, and is provided with a safety two-key lock. It has a leather handle.

ILLUMINATION FOR COPYING

FOR even illumination of a photograph or manuscript or any other flat object for copying purposes, there must be a light on each side of the subject, each of an intensity equal to the other. However, this department has had the experience of using but a single light source and that to one side only in

copying a glossy print. The light used was the Ventlite, the distinctive characteristics of which are an oversize reflector and a so-called deflector, a cup-like affair in front of the light bulb, which throws the light back into the reflector and then out again. This results in throwing out four wide swaths of graduated light intensities, strongest in the center and weakest at the extreme edge. By shifting the position of the reflector so that the second band of light from the last covered the picture being copied, an even illumination was obtained of sufficient intensity to make a perfect copy.

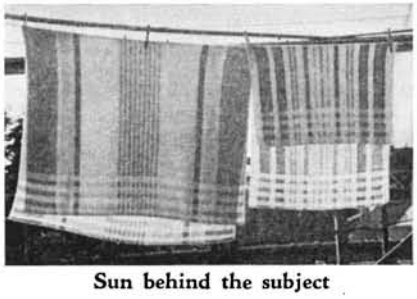
For Color Workers

THE Omag Trichromatic Separation Filters set into a special holder which brings each of the three filters, red, blue, and green, into position as needed, should prove quite attractive to users of the Leica who are interested in color photography. The filters are made from either solid-colored optical glass or gelatin. To permit the use of the special holder with standard orthochromatic and panchromatic filters for general photography, the filters are interchangeable.

Translucence

FOR recording the finest detail in photographing translucent subjects the best lighting is, contrary to the general photographic rule, that which is placed behind the subject. If front lighting must be used because certain parts of the subject are opaque or semi-opaque and will not photograph by transmitted light alone, the front light should be considerably weaker than that behind the subject though, of course, sufficiently strong to do the job.

A perfect subject in this connection is a lettuce leaf. In order to get an impression



Sun behind the subject

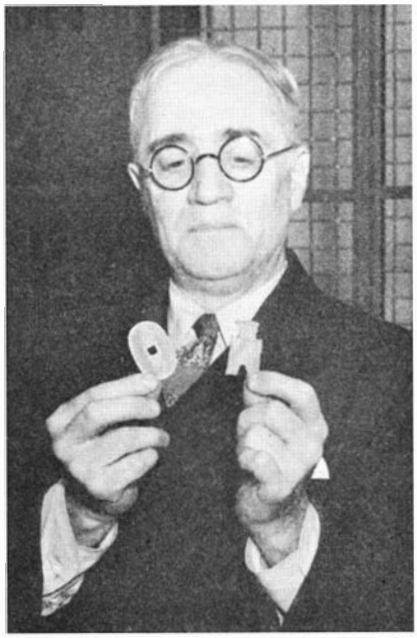
Lettuce leaf

of a section of the leaf so as to reveal the variety of vein thicknesses and shapes, ranging from almost thread-like lines to the quite thick ones, the latter suggesting tree branches, a short-focus lens was used, permitting focusing quite close to the leaf. The leaf was on a plane with the surface of the lens in an attempt to get as near over-all sharpness as possible and the only light used was that directed through the leaf.

The picture of the hanging towels was made as the sun was setting directly behind the towels.

News Pictures

PICTURES intended for reproduction in newspapers or feature articles in popular magazines have a journalistic flavor about them which puts them distinctly in a class of their own. While a fine technical and almost pictorial result is often achieved



"Coin Collector"

by the news cameraman, in general he is little concerned with such points as good composition, perfect technique, and so on. Often he must shoot and run away; more often he must shoot before the subject gets away. There is no time in such situations for the fine points of photography. Get the picture, is what the editor said, and get the picture he must if it's the last thing he does. Sometimes, however, this same photographer is sent on a so-called feature assignment and we know from the work he turns out on these occasions that he does, after all, know a good deal about what makes a good picture.

An example of the feature type of picture is the coin collector here illustrated holding a couple of ancient Asiatic coins. The picture was used to illustrate a popular article on coin collecting. Having the man hold the coins was a happy thought since a mere photograph of the coins themselves would not have given the idea of size.

Photographing Sculpture

A SCULPTOR who had some trouble in finding a photographer who could light his bust of Greta Garbo in such a way as to reveal the modeling in the face finally came to this department with his problem.

Sculpture photography

The result was the print here reproduced. A single light was used, well diffused and placed alongside the camera. Soft highlights strategically distributed gave shape and roundness to brow and cheek, nose, lips and chin, neck line, throat and shoulders. Photographing sculpture need not be any more difficult than any other type of photographic work if the subject is correctly lighted.

For Table-Toppers

IF you have been looking for a new way to create figures for your table-top pictures, try the newest kink in the amateur sculpture line—that of newspaper sculpture. This consists of moistening yesterday's newspaper and using it for modeling "clay." Very little artistic ability is necessary to turn wetted strips of newspaper into such things as knights or Indians or humorous figures and fitting them neatly into an original table-top set-up. In addition to the wetted newspaper, the other principal article required is a piece of wire, which after being bent to the desired "skeleton" form is then "clothed" with the wet paper molded to the required shape. Afterward it is "dressed" with colored "construction" paper or ordinary white paper and painted. Finally, the whole thing is shellacked.

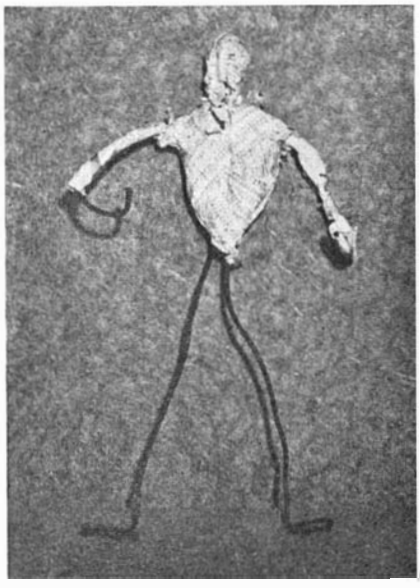


Table-top figure under construction

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 349)

of the way and all lands are in producing condition, it is estimated that the potential annual growth for the region will be 8,000,000 cords. This, of course, can be accomplished only if the lands that are logged are kept productive and if fires are controlled. The more intensive the forest management, the better and larger the future forest crop will be."

Flexible Glass

AIRPLANE constructors tell us that they have found a flexible glass which can be used for windshields in any form desired without impeding vision.

Airplane fuselages have failed of real streamlining because of the windshield. An abrupt line to the windshield may double the air resistance of an otherwise beautifully shaped body. With the advent of flexible glass, we may expect windshields to blend completely into the rest of the craft. We know of at least two commercial airplanes now being constructed which will make use of this new material, and no doubt there are others.—*A. K.*

Aerial Fox Hunting

THE National Aeronautic Association now encourages curious air games by issuing special kits of instructions, badges, sets of clues, and the like.

Here is how sportsmen pilots play the game of Fox Hunting in the air:

One plane is designated as the "fox" and takes off 15 to 20 minutes ahead of the others. Each pilot has a map of the territory over which the hunt is to be flown, divided into sections, each section being given a characteristic symbol. The "fox," before leaving tells the contestants which section he will fly to first. He may land anywhere in this area and lay down a cheese cloth symbol, thus indicating which section he will fly to next. The problem is to find these symbols, follow the "fox," and fly close enough to his plane to be recognized by him. The first pilot to do so is the winner, but to claim the prize he must submit his map, a duplicate of that which the "fox" used, showing the correct location of every symbol left by the "fox." The hunt is usually flown over a territory of about 20 miles square.

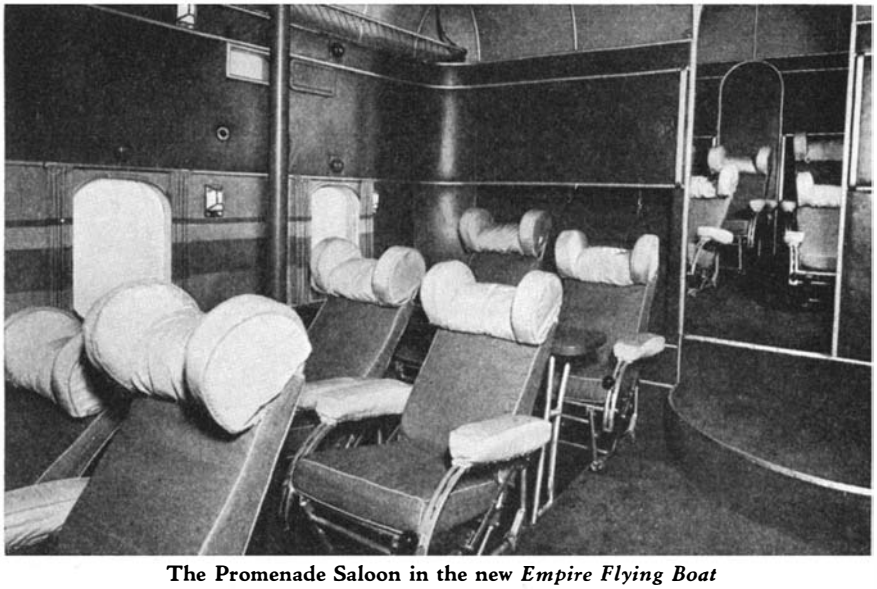
Other games with self-explanatory titles are: Treasure Hunt, Aerial Golf, Scavenger Hunt, and Hare and Hounds. Apparently sportsmen pilots get lots of fun out of these curious and novel games.—*A. K.*

Conquest of the North Atlantic

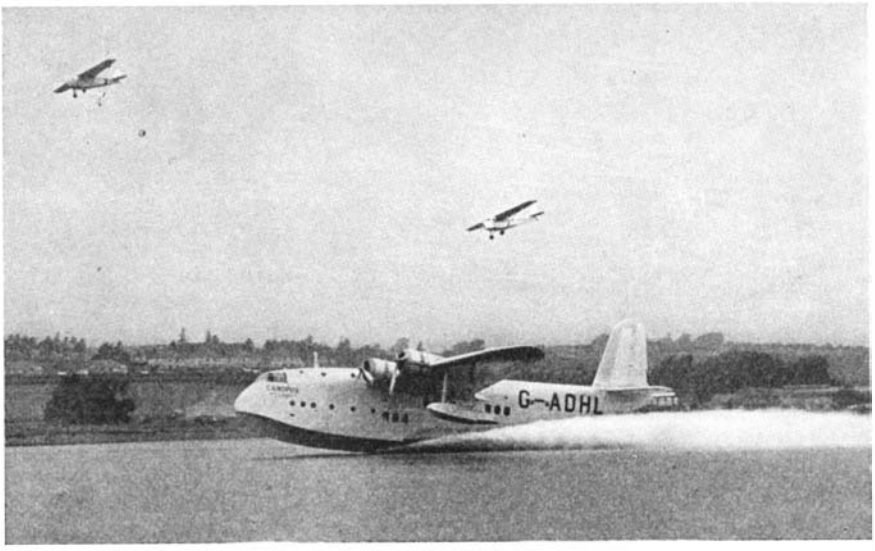
THERE is immense activity in preparation for the heavier-than-air conquest of the north Atlantic. There are, first of all, recurrent and apparently reliable reports that Pan American in conjunction with the British Imperial Airways are soon to put into operation transatlantic and New York-Bermuda airlines.

The tests of the Short Brothers *Empire Flying Boat*, to be employed by Imperial Airways, have just been completed. Hitherto the British have built excellent, seaworthy and airworthy flying boats, but they have been clumsy in appearance, biplanes with many struts and wires, and rather slow in speed. The photograph shows that British designers have now profited by the example of the Martin and Sikorsky *Clippers*. The *Empire Flying Boat* is just as "clean" as the American products. It is of all metal construction of the high wing, internally braced type, with wing tip floats. Fully loaded they will weigh nearly 18 tons. The normal pay load including crew will be between 3½ and 4 tons. The Pegasus air-cooled engines, rated at 740 horsepower, are supercharged, provided with variable pitch propellers and the N.A.C.A. cowl. Each boat will be equipped with all modern navigational instruments, including the Sperry Gyropilot. The normal cruising range is only 800 miles, which is considered adequate for the short stages contemplated.

In the fore part of the hull there are two decks, the upper of which is the control room for the Captain and the First Officer. Immediately behind this is the radio station, and further aft the mail hold. Mail will be dealt with in flight. The "Promenade Saloon," as the English call it, is shown in one of the photographs and is also remi-



The Promenade Saloon in the new *Empire Flying Boat*



Empire Flying Boat ready to take off on a trial flight

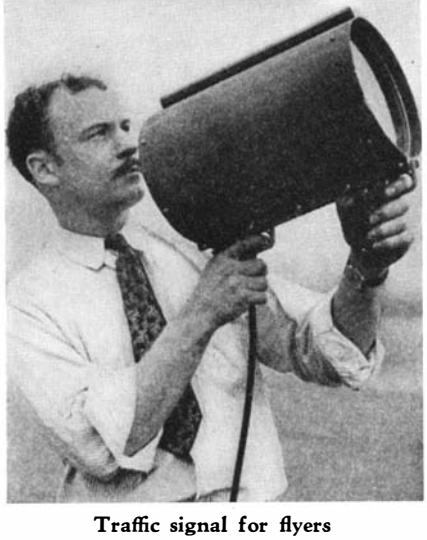
niscent of American flying boat practice.

Another British plan for the north Atlantic is to load a land plane very heavily and to catapult it for the start of its north Atlantic flight. The catapulting, of course, is to permit the carriage of the immense amount of fuel necessary for non-stop operation.

We have already referred to the "composite aircraft" in these columns but with very little detail. The composite aircraft is now reaching completion. The upper component will be a two-float seaplane powered with four 350 horsepower engines. The lower component will be a large flying boat, like the *Empire Flying Boat.* Altogether there will be eight engines in use with a combined power of 5000 horsepower. All the experts seem to agree that there will be no difficulty either in the launching of the "composite aircraft" or in the subsequent flying of the detached upper seaplane component.—*A. K.*

Portable Air Traffic Light

SUBSTITUTED for the old flagging system at Logan Field, Baltimore, Maryland, shortly before the flood, the portable traffic light shown in our illustration has seen continuous duty since. When flood conditions forced commercial, Army, and Navy plane operations from Washington, D. C. to Baltimore, the portable signal proved useful day and night.



Traffic signal for flyers

A powerful beam is cast by the light operated by the pistol-like triggers. With the triggers, the operator may signal with red, green, or white light. As a white light, it may be used as an ordinary searchlight. As a green or red light it keeps the plane in the air until the field is clear for landing. It is also used for directing the planes in taking off.

A Controllable Cowling

AT take-off, the speed of the airplane is slow, yet the engine is operating at full power and requires all the cooling air it can possibly get. At cruising the engine is operating at only 75 percent of full power, but the air streams past it at 200 miles an hour. The ordinary fixed cowl is apt to give insufficient cooling at take-off, therefore, yet produce too much drag or air resistance at high speeds.

Engine cowl that is adjustable

On the British engines, the Mercury and Pegasus, this difficulty is met by using a controllable cowling, the rear part of the cowling as shown in the photograph, being movable in and out. An endless chain operates a screw mechanism, and can set the rear cowling flap at zero or as much as

30 degrees to the surface of the main cowl. The outlet is decreased or increased in area accordingly. Thus the pilot can secure more air in starting up or can close down the cowl and increase the aerodynamic efficiency at high speeds.—*A. K.*

CATAPULTS TO HAVE WIDER USE

THE weight of an airplane divided by the area of the wings is termed by engineers the loading per square foot. In pioneer aircraft this loading was of the order of five pounds per square foot; now the figure has risen to as much as 30.

Why this increase in surface loading? Because greater loading means either higher speed or the ability to carry a more useful load in the form of gasoline, passengers, and so on.

To fly non-stop across the Atlantic, to increase the commercial payload, designers would like to increase this wing loading still more. But there is a limit to the increase, because the speed necessary for take-off goes up with the amount of load carried by the wings. Eventually the ship is so heavily burdened that it will not take off satisfactorily. Its excellency in the air is then purely an academic conception.

Perhaps the catapult will come to the rescue, shooting the heavily loaded craft into the air, and once in flight it should be able to take care of itself.

Catapults have been used for many years by the navies of the world, for launching fighting planes from the limited deck space of battleships or cruisers. The German Lufthansa has used them in commercial work over the south Atlantic. Now the signs of the times indicate that the use of the catapult is likely to become much more widespread.

Thus quite recently the Lufthansa gave New Yorkers a striking demonstration of the catapult at work by launching two seaplanes, the *Aeolus* and the *Zephyr*, each weighing 14 tons, from the mother ship, the *Schwabenland*. The launchings were carried out successfully on Long Island Sound.

In American catapults the explosion of gunpowder is frequently the actuating medium. In the *Schwabenland* catapult, compressed air is employed. The air is compressed in a tank at more than 2000 pounds pressure, and is released at variable pressures into a 15-foot cylinder. The piston moving in the cylinder actuates the catapult by means of two cables connecting the sliding cradle of the catapult to the piston. The pressure is kept continuously under control, so that the acceleration is kept from reaching too high a value. These huge seaplanes travel only 150 feet on the cradle but reach a speed of at least 85 miles an hour and leave the mother ship without the slightest tendency to downward movement.—*A. K.*

FLYING AT A DOLLAR AN HOUR

THE Cub Flyers are employees of the Taylor Aircraft Company. Taking advantage of the fact that their company builds an inexpensive, easily maintained, low-powered plane, ten workers in the plant organized a flying club. Membership increased overnight. At present over seventy members have soloed. Their ship never misses a day in the air, and one week flew a total of 163 hours. The engineers and mechanics are enthusiastic about their sport, which is also their vocation, and at lunch time it is not uncommon to see a welder drop his torch, grab his lunch box, and complete his noon day meal cruising at 3000 feet. But the most extraordinary thing is that it costs the club members only a dollar an hour to fly. Of course this group has exceptional opportunities for reducing costs. But it is not unreasonable to believe that even a group entirely unconnected with the industry could operate on similar lines, at a cost of say two dollars an hour. Private flying today need not be so very expensive for people who know how and are willing to co-operate.—*A. K.*

AUTOMATIC LANDINGS BY RADIO

BLIND landings by the use of instruments are not new and their technique has been fully described in these columns. But pilots seem to over-control when making instrument landings. A new system has now been developed by United Air Lines, in

Antenna for automatic landings

which a combination of the automatic pilot and radio control has resulted in landings of wonderful precision and smoothness. A series of 250 tests has been highly successful.

The system consists of two radio beams. One is a directional beam sent out by a special transmitter operating on 232 kilocycles. This is the runway marker beam which is narrow—only five feet wide at the landing circle at the middle of the airport, and only ten feet in width at the boundary of the field.

The second radio signal is the landing beam sent out from a transmitter operating on 93,000 kilocycles. This is a curved beam following the normal gliding path of a transport plane. The beam is transmitted along the runway, gradually curving upward until it is 60 feet above the ground at the border of the field.

A special antenna is used on the nose of the transport for reception of these signals, as indicated on the photograph. On the instrument panel of the plane is a special device which has two needles, one vertical and one horizontal, operated by the electri-

cal impulses from the directional and landing beam stations. The vertical needle registers the location of the plane with respect to the runway markers beam, while the horizontal indicator records the position with respect to the curved landing beam.

The pilot preparing to make an automatic landing intercepts the landing and runway beams at an elevation of approximately 1000 feet, at a distance of five miles from the airport. After he has so maneuvered the plane that it is exactly on the landing and runway beams as indicated by the two needles, the flier throttles down to a speed of approximately 80 miles an hour and then turns over the controls to the automatic pilot. The human pilot now takes his hands and feet off the controls and concentrates his attention on the instrument with the two pointers. Occasionally he adjusts a knob on the automatic pilot control, if the needles indicate deviation from the prescribed course. Otherwise the device does all the work. The transport follows the curved beam which gradually flattens out as it approaches the runway, and the plane comes down and makes a perfect two-point landing with tail up. Then it is up to the pilot to apply the brakes, just as soon as the tail wheel also touches the ground.

This combination of radio guidance and automatic pilot is truly a remarkable example of modern applied science.—*A. K.*

British Air Progress

GREAT BRITAIN is meeting Germany's effort in the air most energetically. Planes are being built by the hundreds, and it is reported that fighting ships *in production* will have a high speed in excess of 300 miles an hour. In one particular aspect of military aviation the English probably lead the world; namely, in their robot airplanes, controlled from the ground by radio (as already described in these columns). For the time being, these robot planes are not being built for the romantic task of bombing the enemy without risking a pilot's life, but for the more prosaic, useful task of serving as target planes. No other air service has available a moving target of this type, and its value in aircraft training is indisputable.

Hitherto the surface vessels engaged in controlling the flight of robot airplanes have been any available cruisers fitted with the special radio apparatus required. The system worked admirably when the number of pilotless target planes was limited and firing practice comparatively rare. But an increase in numbers of such targets, and more time devoted to anti-aircraft gunnery, have made imperative the use of a special mother ship. This will be the *Argus*, an obsolete aircraft carrier, which will carry special gear for launching and salvaging the robots.

In another item of English news, we find a description of well equipped ambulance planes. Besides medical stores, oxygen tanks, and so on, these planes carry an oxygen tent consisting of a collapsible expanse of airtight sheeting which can be lowered over the patient's head and shoulders, and also a blood transfusion apparatus. Curious additions to flying equipment!

One of our photographs shows a recent addition to the British air forces—the Westland "army co-operation" monoplane. Compartments for both pilot and observer are carefully enclosed. The pilot is placed above the wing to have ample vision in front. Cockpits are as carefully heated and as comfortably arranged as in commercial airplanes. Gone are the days when fighting pilots were fully exposed to the airstream. The Westland carries both the Handley-Page slot and the flap.—*A. K.*

Selling Air Transport to the Public

THE business of the airlines grows both steadily and rapidly. We have often had occasion to comment on the wonderful technical developments which are a partial explanation of this growth, but the airlines are also making a strong, conscious, and continuous sales drive to secure more customers.

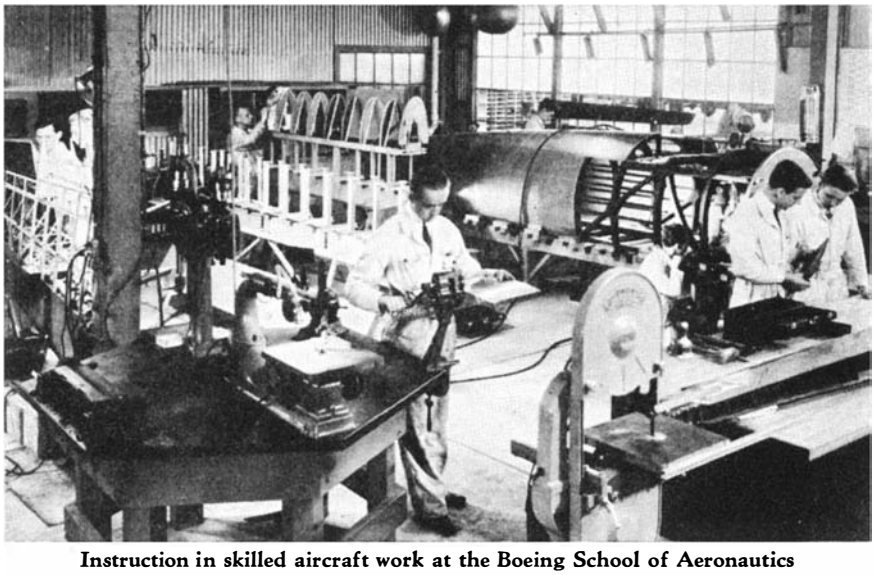
They are particularly anxious to get a man or a woman into the air for the first time. Some people just cannot decide about this. One business man closed an argument about taking a first flight by saying: "Young man, I would feel about as secure in an airplane as an elephant hanging head down over a cliff with one leg tied to a daisy." Accordingly "first fliers" are sought in every possible way just as "first voters" are the object of special solicitude by politicians.

Airline executives endeavour to dispel the notion that pilots are intrepid explorers. They are not. They are just good pilots, with fine mechanical knowledge of their planes and engines.

Every important city in the United States now boasts an airline ticket office. Young men are selected for these offices and for outside promotion work with the greatest care, and are given a two months' schooling in the Reservations Department.

In line with this policy, pilots must be fairly young, good looking, and courteous. We have heard a great deal of stewardesses. Now stewardesses are to be displaced by

A new army monoplane used by the British air forces



Instruction in skilled aircraft work at the Boeing School of Aeronautics

stewards, and these men are to be as good as stewards on a crack ocean liner.

The attitude of the insurance companies in regard to life and accident policies of air travelers was at one time exceedingly hostile. By statistical studies and by frequent papers read before insurance societies, the aviation people seem to have proved their point to the satisfaction of the insurance men. Thus D. T. Harvey, Vice-President of the Massachusetts Indemnity Insurance Company, recently wrote as follows:

"Concerning the comparable hazards of the various modes of transportation available to-day, this company has, on a basis of experience, promulgated a ruling that executives or salesmen traveling by air on regularly established air lines are to be classified as 'A,' whereas executives or salesmen traveling by automobile are to be classified as 'B' risks."

Such efforts, among others, are legitimate and evidently efficacious.—*A. K.*

80 PERCENT FORECASTS

CONTRARY to general opinion which holds that the weather man is nearly always wrong, he is right over 80 percent of the time in forecasting the weather, according to Dr. J. H. Kimball, meteorologist in charge of the Government's bureau in New York.

A Shortage of Skilled Airplane Workers?

WE are credibly informed that there is actually a shortage of skilled mechanics in airplane factories. This is understandable because the Army and Navy are placing large contracts for fighting aircraft, because the construction of private planes is growing, because traffic on the airlines is growing so rapidly that equipment has to be expanded or replaced, and finally because the work in the airplane factory is of a highly specialized character. In what other industry have so many minute rivets to be inserted? Where else is sheet metal of such minute thickness placed over large areas? Where else, in big construction, is so much accuracy needed? Where else does safety depend so much on skilled workmanship? To meet this shortage—which may be only temporary, young men should be warned—trade schools all over the country are giving attention to aircraft handiwork, and many high schools are giving vocational courses in this field.—*A. K.*

Can Science Save Civilization?

WHEN an entomologist looks at an ant-hill and writes learnedly and interestingly about what happens in that insect community, that, admittedly, is science. But when social workings of a nation or the world are viewed with a critical, scientific mind, the cry is likely to arise: "That's not science."

Physicists, chemists, and biologists have been reluctant to admit economics, political theory and practice, history, and sociology into the category of "science." But an increasing volume of scientific voices has warned that those who give new command of natural forces have an obligation to see that research is put to socially safe uses.

An eminent British man of science, Sir Richard Gregory, Bart., editor of *Nature*, is the latest to urge that "it is the duty of men of science to assist in promoting more worthy uses of the new powers they are continually placing in the hands of the community." Otherwise the world seems likely to be reduced to "a place of dust and ashes."

"The impacts of science with society are now so numerous that scientific studies in the realm of social biology are even more necessary for civilized life than researches in the physical sciences," Sir Richard contends.

"It is an ironical comment upon modern civilization that the social reaction to the gifts of plenty made possible by the progress of scientific knowledge is not a corresponding increase of human welfare but distress and unemployment and the prostitution of scientific effort to purposes of destruction.

"In so far as science has brought about increased control over the forces of Nature, it accepts responsibility for these conditions. It insists, however, that such deplorable consequences are not essential, but are due to the neglect of the application of scientific methods to the solution of social problems.

"Our distributive and economic system

remains on the basis of a pre-scientific age, wholly unadjusted to the needs of a changing world, and unable to bear the burdens placed upon it by the problem of new and almost incredible abundance.

"Science can provide the world with everything required for the maintenance of a growing population in a rising standard of comfort; but there are no accepted principles for the right use of the new powers, and international agreements are mainly adjustments of national interests conceived in confined political atmospheres and determined by expediency. While this spirit prevails, the prospect of finding a formula which will unite civilized peoples for the general well-being of humanity seems almost hopeless.

"A regenerative influence is required to save civilization from disaster, and the mission of science in the changing world of today should be to introduce it into the field of social biology, and thus enable us still to believe in the highest destiny of man." —*Science Service.*

PARSEC

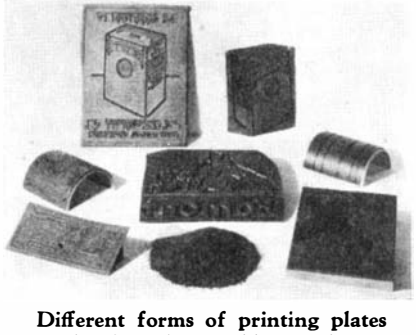
WHEN astronomers speak of a parsec, think of it as 3.26 light years or 200,000 times the distance from the earth to the sun or 20,000,000,000,000 miles—any one of them will do. And don't get dizzy if a star is said to be distant one megaparsec—a million parsecs!

Synthetic Rubber Printing Plates

MADE of an oil-proof, moisture-proof synthetic rubber that can be vulcanized and processed just as natural rubber is, a new type of printing plate has been developed and placed on the market which is said to have marked advantages over the rubber plates now in use.

The synthetic rubber, known under the trade name of "Thiokol," has been successfully used for blankets for newspaper presses and, outside the printing industry, for gasoline hose and tubing, gas cells for lighter-than-air craft and cable sheathing. It comes in sheet, liquid, and powder form. Plates made of it are said to be completely impervious to the action of the chemicals contained in printing inks and to gasoline, kerosene, and other washes.

Other advantages claimed for the plates are that they materially reduce the time required for makeready as compared with metal plates, use anywhere up to 50 percent less ink, practically eliminate offsetting and the need of slipsheeting, are senstive on the press, print detail sharply and clearly, wear longer than rubber plates, do not swell or deteriorate on exposure to air, chemicals, or moisture, and do not squash. They can be used for the same types of printing as plates made of natural rubber, including posters, folders, broadsides, catalogs, cutouts, and so on.



Different forms of printing plates made of synthetic rubber, and, *center,* a pile of the raw material used

A curved synthetic rubber printing plate, and an example of its work

The "Thiokol" plates can be molded from type forms, line engravings and halftones of up to 120 line screen. They can be mounted on either wood or metal base—a laminated wood base is recommended for most purposes—and can also be furnished glued to a metal back for use on patent base in the same way as 11 point electrotypes. They have been used for both flat and curved plates as shown in the illustrations.

In making "Thiokol" plates a sheet of matrix board, previously heated, is placed over the type form or engraving, very much as in the making of a stereotype matrix. Over this in turn is placed a thin sheet of tin, brass or steel to prevent the matrix from sticking to the top of the press, pressure is applied, and the matrix is taken from the form and cleaned off for plate making.

A "charge" of the "Thiokol" in powder form—as much as is needed to make the plate—is then spread over the matrix, pressure is applied again, usually in a hydraulic press, and in about six minutes the plate is made. After trimming and mounting, it is ready to put on the press. Thirty-five minutes, it is stated, is liberal time for making a plate from start to finish.

Printers having equipment for molding rubber plates can use it also for molding "Thiokol" plates. For those who do not, it is necessary to ship their original forms to "Thiokol" plate makers.

Freezing to Death is Fun

SIR JOSEPH BARCROFT, one of the world's leading physiologists, described at Yale experiments to which he had subjected himself in order to find out what happens to the mind in the early stages of freezing to death. Speaking on the Dwight H. Terry Lectureship, Professor Barcroft, who is professor of physiology at Cambridge University, told how he had deliberately lowered his temperature to a point approaching unconsciousness.

"What comes back when I recall the attempt to reduce my body temperature?" he said. "Certain effects on the heart were interesting but in no way arresting, but what comes back is the effect on my mind. There was a moment when my whole mental outlook altered. As I lay naked in the cold

room I had been shivering and my limbs had been flexed in a sort of effort to huddle up, and I had been very conscious of the cold. Then a moment came when I stretched out my legs; the sense of coldness passed away, and it was succeeded by a beautiful feeling of warmth; the word 'bask' most fitly describes my condition: I was basking in the cold. What had taken place, I suppose, was that my central nervous system had given up the fight, that the vasoconstriction had passed from my skin, and that the blood returning thither gave that sensation of warmth which one experiences when one goes out of a cold-storage room into the ordinary air. Perhaps I can express the change which took place in another way.

"Up to the point at which shivering ceased, nature fought the situation; my instinct was to be up and about, an effort of will was necessary to remain the subject of the experiment; after that point I gladly acquiesced, initiative had gone. Doubtless a second and more advanced stage would follow in which inertia would lapse into unconsciousness. For I suppose that, had the experiment not ended at that point, my temperature would have fallen rapidly and I was on the verge of the condition of travelers when they go to sleep in extreme cold never again to awake."

OIL—COAL

THE nation's visible oil supply would cover the state of Ohio with a pond three quarters of an inch deep; the total supply of coal in the country, if spread over the same state, would be 76 feet deep.

Grasshopper Bait

USE of odors to attract insects to eat poisons prepared for them has been shown to be effective in controlling many types of insect pests. Cotton boll weevils are attracted by certain organic amines, and the Japanese beetle can be lured into a trap with geraniol, the principal constituent of the odor of geranium. The latest addition to the list is the use of amyl acetate (sometimes called banana oil) to attract grasshoppers. The following mixture has been suggested as an effective poison for grasshoppers: bran, 100 pounds; salt, 5 pounds, sodium arsenite, 1 pound; molasses, 2 gallons; water, 6 to 8 gallons. After thorough mixing, 3 ounces of technical amyl acetate (technical grade is preferred because of its stronger odor) are added and the mixture broadcast or spread where grasshoppers can get it. This mixture is said to be sure death to grasshoppers.—*D. H. K.*

Aluminum Mail

FIFTEEN THOUSAND aluminum rings went into the making of an actual reproduction of the armor worn a thousand years ago by the Vikings. This modern Brynje (ring armor) was made by Otto Goetzke, vice president of Church & Company, jewelry manufacturers. It is believed to be the only complete costume of its kind in existence. It took three years of part-time work and an infinite amount of patience to complete it. The reproduction weighs only five pounds, whereas its iron equivalent would weigh 15 pounds.

Chain mail made of aluminum rings

Mr. Goetzke says that the only point in which his armor differs from that of the Vikings is that he did not close the rings, while the Vikings overlapped their rings and joined them together with rivets.

New Rôle for Chlorophyll

THAT chlorophyll, the green pigment usually associated only with the leaves of plants, is found also in lettuce seed and may be the agent through which light stimulates germination of light-sensitive seed, has been discovered by Lewis H. Flint, Bureau of Plant Industry, United States Department of Agriculture, and E. D. McAlister, Division of Radiation and Organisms, Smithsonian Institution.

Thus it is believed that the chlorophyll not only is important in the manufacture of plant food in the leaf, but also plays a big part in germination due to its sensitivity to light rays.

A little more than two years ago Flint discovered that certain lettuce seed which failed to start growth under ordinary conditions would germinate in 24 hours if soaked for an hour or longer and exposed to sunlight or the proper kind of artificial light.

First the physiologists adopted the practice of soaking the seed before making the germination test. This seemed to help in breaking the dormancy. In the soaking process seed was generally exposed to a diffused light for a short time. This suggested that light might have something to do with the germination.

Subsequent tests showed that light did play an important part in starting the seed growth. First light tests were made with an ordinary Mazda lamp and the seed was exposed for 10 minutes. Results were easily noticeable when 100 minutes of soaking and 10 minutes of light exposure gave 90 percent germination in seed that would not germinate at all in darkness.

Exposure to direct sunlight for four to 60 seconds produced the same effect, and it became of interest to find out which rays of light were producing the effect.

Flint continued his tests along this line by "breaking" a light ray into its component parts, ranging from the ultra-violet short rays to the infra-red long waves. The lettuce seed was tested under the various light wavelengths to determine the germination trends from this standpoint.

Results were fairly uniform inasmuch as the seed showed a negative reaction to the short violet rays with the promotion of germination reaching its peak in the yellow, orange, and red, or longer rays.

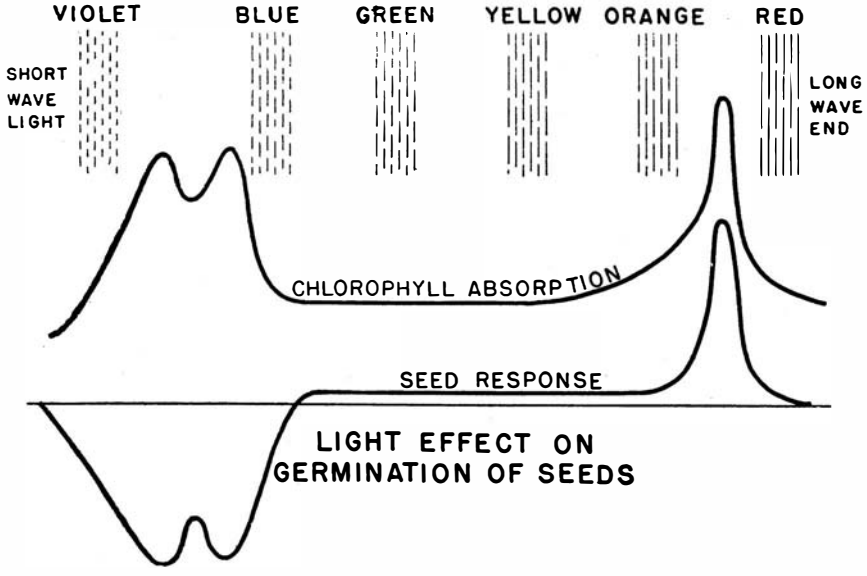
Physiologists discovered long ago that the chlorophyll in the plant absorbed large quantities of violet and blue short rays as well as the orange and red long rays as shown in the graph. The medium length green rays passed on through without any noticeable effect.

Tests with the seed showed that the absorption of the violet and blue short rays corresponded with absorption of the chlorophyll in the leaf, but that these rays had a negative or holding-back tendency in the germination tests. However, the seed followed the same general tendencies in absorbing large quantities of the orange and red rays which tended to promote germination. Also, like the plant chlorophyll, the seed response to the medium-length green rays was comparatively little.

In regard to these findings, Flint and McAlister declare:

"The close analogy between the critical wavelengths of radiation influencing seed germination and the critical wavelengths of radiation absorbed by chlorophyll and allied pigments places a distinct emphasis upon what perhaps is a new and promising viewpoint.

"With an increased interest in qualitative



light effects the results in this test emphasize the desirability of more adequate knowledge of the quality of light at the earth's surface and the modification of that quality with time of day and year, with altitude, and with water vapor in the earth's atmosphere."

Artificial Breeding Makes Eggs More Fertile

SIMPLIFIED methods for artificial breeding of poultry, which in tests produced higher fertility than natural mating, have been developed by poultry scientists of the United States Department of Agriculture. A 97 percent fertility of eggs was obtained by these new methods as compared with an average of 85 percent in the natural matings at the National Agricultural Research Center, Beltsville, Maryland.

The new methods make it possible to fertilize more than a hundred hens daily from the semen of a single rooster. It is easy to breed one to two hens a minute by the artificial method. Ordinarily, poultrymen provide a male for each 10 or 15 birds in their flocks during the breeding season.

The scientists found they could collect semen from male birds by stimulating certain nerves. The process is repeated on different males until the desired quantity is collected. In fertilizing a hen, her abdomen is pressed gently until the oviduct protrudes. A syringe is then used to put the semen into the oviduct. Two or three drops of undiluted semen injected daily into a hen are sufficient for maximum egg fertility. Previously, hens have been bred artificially by collecting the semen a male has deposited in the oviduct of one hen and transferring it to other hens.

With the new procedure, hens in battery plants can be inseminated without transferring them from their laying quarters. Otherwise, it is necessary to remove the hens from their laying batteries to floor pens or other quarters for natural breeding. These new artificial methods also promise to be of great value in cross-breeding experiments, especially in cases where it is difficult to get fertile eggs. Tests by the Department show that natural mating almost never produces fertile eggs when either the female or the male is four times as heavy as its mate.

HEAVY FOOD

OLD Mother Earth is putting on weight at the rate of nearly a pound an hour, on a diet consisting of stone and iron. This material comes in the myriads of shooting stars which enter the earth's atmosphere every 24 hours.

1,000,000 Volts

THE accompanying illustration shows the 1,000,000-volt, direct current, electrostatic generator designed by Dr. John G. Trump of the Massachusetts Institute of Technology for the Huntington Memorial Hospital in Boston, where it will be harnessed to a huge X-ray tube for the production of high voltage short waves of great penetrating power for the treatment of malignant diseases.

The new generator is expected to be

High-voltage electrostatic generator

capable of producing a greater intensity of gamma-type rays than the combined output of all the radium available for medical use. It is expected to be ready for operation late this winter.

The big cascade-type X-ray tube to be used with the generator will be made up of 20 porcelain sections about 12 inches in diameter with diaphragms between each section to focus the stream of high-speed electrons in their passage from the upper end to the gold target at the bottom. The treatment room is directly under the generator and will be equipped to accommodate as many as three patients at once.

Honest Weight

VERIFICATION of the honesty of heavy duty scales has occupied the minds of Government officials in many places this autumn. The state of Pennsylvania has bought special equipment and announces that it will check every big scale in the state. The National Bureau of Standards reports that it is going over every Federal scale. Other communities which operate special trucks with test weight equipment include the District of Columbia, the City of New York, and the State of Massachusetts, according to a report of the Autocar Company, whose weight-testing truck appears to be standard and is used by all the above authorities.

Sleet Danger

A SOLID wall of frozen sleet on the windshield is a winter driving peril most car owners vividly remember. Special fans, heaters, flexible tubing to direct the car heater output against the glass, chemical solutions, and so on have been used to combat this hazard with varying success.

The newest sleet-removing device, called Sleet-Master, is a spare wiper blade, to hook on in a second, in place of the regular rain blade, whenever sleet strikes. It both melts the sleet and wipes the windshield clear. Entirely self-contained, it requires no connections, puts no load on battery or motor. It comes complete with two refills made of salt and an ingredient which retards the tendency of salt to dull car finish.

CURRENT BULLETIN BRIEFS

(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)

SHARP FOCUS AND ACCURATE EXPOSURE, by Dr. W. Kross, is a little 46-page book for the amateur photographer who is particularly interested in obtaining the best possible results with his camera. Illustrated with photographs and drawings pertinent to the text. *American Photographic Publishing Co., 428 Newbury Street, Boston, Mass.—40 cents.*

MORE GOODS FOR MORE PEOPLE is a 13-page booklet discussing the tremendous part played by invention and the mechanization of factories in solving the problem of raising the standard of living of the American people. *Write for Bulletin 1236A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

RESONANCE AND ALIGNMENT is a 91-page book, board covers, written for the radio service man. It covers briefly and succinctly, with pertinent illustrations, the subjects of the title as applied to modern radio maintenance. *John F. Rider, 1440 Broadway, New York City.—60 cents postpaid.*

DOWTHERM FOR HIGH TEMPERATURE HEAT TRANSFER SYSTEMS is concerned with the efficient transfer of high temperature heat in industrial plants. Illustrated with numerous line drawings, photographs, and charts. *Write for Bulletin 1236B to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

LIST OF INSPECTED HOUSEHOLD ELECTRICAL APPLIANCES is, in main, a tabulation of all types of electrical equipment, giving the names of manufacturers of approved appliances so that they can be readily identified. *Underwriters' Laboratories, 207 East Ohio Street, Chicago, Ill.—Gratis.*

RESEARCH . . . AND IMPROVED EQUIPMENT tells the story of present-day Pullman cars, for steam, electric, and Diesel operated trains, as well as other rolling stocks developed by the Pullman-Standard Car Manufacturing Company. *Write for Bulletin 1236C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

COMMON MUSHROOMS, by Leon L. Pray, describes and illustrates a number of the most common and conspicuous mushrooms of the United States. Enough information is presented to enable a careful observer to distinguish the more important species. A bibliography on the subject is also given. *Field Museum of Natural History, Chicago, Ill.—50 cents.*

RAINFALL INTENSITY-FREQUENCY DATA presents tables and maps that give the statistical probabilities of excessive rainfall in the continental United States. Prepared by Dr. David L. Yarnell, of the Bureau of Agricultural Engineering, it is of particular value to engineers and students of weather. *Superintendent of Documents, Government Printing Office, Washington, D. C.—10 cents coin.*

THE STORY OF FIRE is a small pocket-size booklet which tells of man's use of fire from the Paleolithic Age to the present day. *Write for Bulletin 1236D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NEW YORK ADVANCING; A SCIENTIFIC APPROACH TO MUNICIPAL GOVERNMENT is in the nature of a composite report of the undertakings of all departments and boroughs of the city. It contains 358 pages plus a comprehensive index and is nicely printed with fine illustrations. *Municipal Reference Library, 2230 Municipal Building, New York City.—50 cents.*

AIR CONDITIONING AND AUTOMATIC HEATING FOR THE HOME, by Willis H. Carrier, describes and illustrates typical applications for both oil and gas fuel. *Write for Bulletin 1236E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION, 1935, contains 465 pages of selected papers on scientific subjects such as weather, astronomy, cosmic rays, electricity, vitamins, atoms, biology, fish, butterflies, flight, ancient man, archeology. *Superintendent of Documents, Washington, D. C. —$1.00.*

AIR OPERATED CONTROLLERS explains in non-technical language the principle of operation of many different types of controlling devices for use in various industrial applications. *Write for Bulletin 1236F to Scientific American, 24 West 40th Street, New York City.—Gratis.*

THE DEVELOPMENT OF THE ASPHALT JETTY FOR HARBOR PROTECTION, by Colonel F. B. Wilby, U. S. A., is an 8-page illustrated pamphlet of particular interest to engineers concerned with the protection of water front property. *The Asphalt Institute, 801 Second Avenue, New York City. —Gratis.*

GREAT FOREST FIRES OF AMERICA, by John D. Guthrie, is a plea for the prevention of forest fires, dramatized by a brief yet gripping series of reports of fires which have devastated large forest areas of the United States. Campers can help the cause by following the four rules laid down on the inside front cover of this booklet. *U. S. Department of Agriculture, Washington, D. C. —Gratis.*

FACTS ABOUT METAL POLISHING is a 40-page illustrated booklet, pocket size, that covers the subject of the title from the viewpoint of industrial polishing. It defines the various polishing operations usually employed, and then tells how they are accomplished and what types of polishing materials are to be used. Gives tables of materials. *Norton Company, Worcester, Mass.—Gratis.*

Books SELECTED BY THE EDITORS

GREEN LAURELS

By Donald Culross Peattie

THE author of the widely-read "Singing in the Wilderness" has given us something else that sings, and a lovely song it is. "Green Laurels" is a book for those who see more in nature than pedantic lists of facts—it is fine writing and fine natural history and a book likely to survive permanently, like the writings of Thoreau (there is much similarity). To state what would be technically true—that it is a history of natural history—would be to overlook its main point, though it has been given very favorable review in professional journals of science. The accounts of the lives of Buffon, Linnaeus, Lamarck, Cuvier, Audubon, the mad Rafinesque, Goethe, Darwin, Wallace, Fabre, and others are the vehicle for the author's own expression, and the reader is not likely to be disappointed in what he gets, provided he has any poetry in him.—$3.95 postpaid.—*A. G. I.*

THE AMERICAN ANNUAL OF PHOTOGRAPHY

1937—Volume Fifty-One

NO amateur photographer's library can be considered complete unless it contains the latest edition of this well-known book. Each year it contains numerous articles by authors in various fields of photography, together with full-page reproductions of outstanding photographs. This year's edition is no exception to the rule. Containing 324 pages of text, including a miscellany of formulas and hints for the photographer, it measures up to established tradition in every respect.—$1.65 postpaid.—*A. P. P.*

THE MICROSCOPE

By Simon Henry Gage, Emer. Prof. Histology and Embryology, Cornell University

OF all works on elementary microscopy this one by Professor Gage is and for many years has been the foremost, the most comprehensive and the "central" book. It is the recognized standard text and handbook. That position could never have been held since 1908 had the book not been frequently revised. This new edition is the sixteenth. The book now contains 593 text pages, 313 figures and is quite a heavy chunk of a book. Its scope is: microscopes and their parts, bright-field microscopes, lighting, experiments, polarization, optics of microscopes, microspectroscopes, ultra-violet microscopes, interpretation of appearances, magnification and micrometry, drawing with the microscope, photographing with the microscope, cover-glasses, mounting, fixing, sectioning and so on, microincinerations (new chapter), history of microscopes. This is neither a stiff, advanced treatise nor a light-weight book, but it gives microscope theory in terms that plain people can understand after a little study. An amateur microscopist who has no copy of Gage on his special shelf is like a man with a hole where his front teeth were.—$4.25 postpaid.—*A. G. I.*

THE CRIME AND THE CRIMINAL

By Dudley D. Shoenfeld, M.D.

WITH the subhead "A Psychiatric Study of the Lindbergh Case," this book presents many facts regarding this famous case that hitherto have not been known to the general public. The author figured largely in the apprehension of the murderer of the Lindbergh baby and followed closely the legal aspects of Hauptmann's battle for life. The book is a complete record of the crime and trial as seen by the author.—$3.65 postpaid.—*A. P. P.*

THE ANATOMY OF FRUSTRATION

By H. G. Wells

WHAT is wrong with human life? Why is the human race so frustrated in politics, morals, education, and individual psychology? Why can't we do things right? These are the questions about which Mr. Wells has built his newest book, which is evidently a statement of his thoughts about it all, placed in the mouth of an imaginary American industrialist named Steele. If you like Mr. Wells, you will like this, and if you don't you doubtless will not. —$2.15 postpaid.—*A. G. I.*

THE WAR IN OUTLINE

By Liddell Hart

DISCUSSIONS of the World War are legion. The various commanders, the diplomats on all sides, the expert tacticians have all contributed their share to the flood of studies of all phases of the War. Now comes a précis of the whole affair, written by one who has been acclaimed the greatest military historian writing today in the English language. Tersely, and perhaps sometimes in language that is too sharply clipped, he gives the story of the War from "The Spark and the Powder" through to the complete collapse of Germany. For those who wish to review the War in its broader details, without the difficulty of studying the finer points of strategy, this is a most admirable book. It has the merit of brevity, being only 285 pages long.—$2.15 postpaid.—*F. D. M.*

COLOUR CINEMATOGRAPHY

By Major Adrian Bernard Klein

ALTHOUGH numerous and expensive attempts at the production of colored motion pictures have been made during the past 30 years, it is only very recently that the changes in technology have made possible colored films that may be considered at all satisfactory. Even present-day films have occasional and very noticeable defects. This does not detract, however, from the credit due to the various workers in the field who have expended time and energy untiringly in the search for success. The present book, after an historical summary, explains the technical basis of colored motion picture photography and describes, in complete detail with pertinent illustrations, the various systems in use today. —$7.20 postpaid.—*A. P. P.*

DYKE'S SELF STARTER

By Warren A. Taussig

USED in connection with that grand old book "Dyke's Automobile and Gasoline Engine Encyclopedia" (17th Edition), the present book is a "self-instructor" on the subject of automobile engine starting devices. In the first section of the book is a series of questions with direct references to the Encyclopedia. Then follows a repair section and a series of special answers to the questions in the first part of the book. This book is of no value to the reader without the Encyclopedia.—$1.40 postpaid. —"Dyke's Automobile and Gasoline Engine Encyclopedia"—$6.50 postpaid. —*A. P. P.*

CRIMES OF THE HIGH SEAS

By David Masters

"THE scuttler may trap himself with his own lies." This statement by the author seems to be the keynote of the success of Admiralty Courts in defeating the purpose of those who scuttle

ships for their insurance. This is one phase of the romance of the sea which, while it makes most interesting reading as this author presents it, has never reached the public in sufficient detail to show the prevalence of such crookedness. Mr. Masters, who has formerly written for Scientific American, has collected from official records the case histories of a large number of such crimes, some of which date back for many decades. He shows that shipping men, when they do plan such a crime, are equally as thorough in their scheming as are the crooks in the detective magazines of today. We recommend this for all those interested in the lore of the sea.—$2.65 postpaid.—*F. D. M.*

MEDICINE AND MANKIND

By Doctors Pool, Watson, Haggard, Brooks, Draper, Kennedy, McCollum, and Carrel

SEVEN popular medical lectures given at the New York Academy of Medicine by noted physicians have been published as the chapters of this book and they make fascinating reading: How we learned about the human body; medicine in the days of Louis XIV; contributions of the primitive American to medicine; the common denominator of disease; the organic background of mind; the story of the vitamins; and the mystery of death—these are the subjects.—$2.15 postpaid.—*A. G. I.*

BEAUTY BEGINS AT HOME

By Katharine Wellman

RECIPES for cosmetics—415 of them—comprise the most important part of this book. The recipes cover full directions for making and storing such a variety of cosmetics as cleansing creams, artificial sun tan, lipsticks, hand creams, and face packs. The book tells what beauty treatments can and cannot do and how to obtain the best possible results by the compounding of preparations from pure ingredients. This appears to be no ordinary beauty culture promotion material, but rather to be grounded on the bedrock of common sense. A valuable appendix gives sources of materials and price lists.—$2.15 postpaid.—*A. P. P.*

OUR NAVY

By Charles J. Finger

ESSENTIALLY a narrative rather than an exposition, this new volume is an excellent outline history for young people. It carries through from the period of the American Navy or, rather, from 1772 when there was no such thing as an "American Navy" but only a few scattered sloops doing duty as war vessels, through to the present day. The last chapter, for example, pertains to the conquest of the air, and discusses the various airships our navy has operated since the World War, the airplanes, and the aircraft carriers. It ends fittingly: "And today . . . there are those who dream of a day when neither navy nor army will be needed; the dream is glorious, but it implies a nobler civilization than the world has ever seen."—$2.15 postpaid.—*F. D. M.*

THE STUDY OF MAN

By Ralph Linton, Prof. of Anthropology, University of Wisconsin

AN introduction to social anthropology—race, society, the family, marriage, tribe, state, social systems, discovery, function, culture, interests, and so on. It is not a textbook, yet to the outside reader it would give the practical equivalent of an elementary college course in social anthropology.—$4.20 postpaid.—*A. G. I.*

DIGESTION AND HEALTH

By Walter B. Cannon, Prof. Physiology, Harvard Medical School

MORE scientific than general and popular is this book, which discusses the scientific problems of the nature of appetite and hunger, the nature of thirst, also digestion and bodily vigor, indigestion from pain, worry and excitement. Its style and language are easy to understand but the various problems are approached more from the point of view of causes and mechanisms than cures—which is what is meant by the statement that the book stresses the scientific side. Some interesting experiments are described.—$2.15, postpaid. —*A. G. I.*

AIRPLANE AND ENGINE MAINTENANCE

By Daniel J. Brimm, Jr., and H. Edward Boggess

AIRPLANE mechanics and all those who are really interested in the how and why of airplane engines will find in this book a veritable gold mine of pertinent information. It is an instruction book, pure and simple, and by no means a running story of airplane engines or their developments. It is thoroughly illustrated with photographs and drawings which are of great assistance in following the terse yet comprehensive text.—$2.20 postpaid.—*A. P. P.*

DOWN TO EARTH

By Carey Croneis and William C. Krumbein, Department of Geology, University of Chicago

TRAVELERS and motorists often wish they could interpret the striking phenomena of the rocks they see wherever they go but even they probably do not sense the fact that, for every earth feature they see which has a scientific meaning of its own, the student of geology finds a hundred others right in plain sight. Just as a traveler in Europe misses most of what there is to be seen if he does not carry along a knowledge of history, so a traveler going anywhere misses a whole realm of science by having little knowledge of geology. The present book would equip the average reader to travel with eyes that comprehend a broad and ever fascinating science. It covers all elementary aspects of geology, without jargon and in simple, attractive terms and language. It happens to be an elementary college text but is one of the newer kind designed to make students want to learn. Pleasant reading in place of drudgery. A large book of 484 illustrated pages. —$5.25 postpaid.—*A. G. I.*

BE GLAD YOU'RE A NEUROTIC

By Louis E. Bisch, M.D., Ph.D.

PRACTICALLY everybody has at least some neurotic traits. Are you oversensitive, overconscientious, unduly worried about things, self-conscious, jealous or suspicious, a day dreamer, cynical, unduly disorderly or too orderly, superstitious or cultish, easily fatigued and poorly relaxed, emotionally unstable? If you have some of these or of about 50 other kinks you are somewhat neurotic (there is no hard and fast line between normal and neurotic). But is it awful to be a neurotic? Here the author takes a refreshing tack. No, he says—be glad you're neurotic, for normal people are extremely stupid. The geniuses—great inventors, for example, or Napoleon—have all been neurotics.

The author says he is himself a neurotic. And who on earth is in a better position to understand neurotics than a neurotic? For a normal person doesn't sense what it is all about. Hence this book, by a neurotic, is a very revealing book and it ought to give half the world a basis on which to understand the other half. Persons who have had continued trouble getting along with other people ought to get a new orientation from it (and incidentally, so ought normal folks but they won't read it). There is in the book a test by which you can rate your own degree of neuroticism (or genius?). The best thing about this book is that it doesn't preach at you or try hard to get you to reform—it's more fun being a bit nutty. It has a very readable style, and is likely to have a wide sale.—$2.15 postpaid.—*A. G. I. (one of them).*

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For MEN
who want to become independent in the NEXT TEN YEARS

IN the Fall of 1946 two business men will be sitting in a down-town restaurant. "I wonder what's going to happen next year," one of them will say. "Business is fine now—but the next few years are going to be hard ones, and we may as well face the facts."

The man across the table will laugh.

"That's just what they said back in 1936," he will answer. "Remember? People were looking ahead apprehensively—and see what happened! Since then there has been the greatest growth in our history—more business done, more fortunes made, than ever before. They've certainly been good years for *me*."

He will lean back in his chair with the easy confidence and poise that are the hallmark of real prosperity.

The older man will sit quiet a moment and then in a tone of infinite pathos:

"I wish I had those ten years back," he will say.

● Today the interview quoted above is purely imaginary. But be assured of this—it will come true. Right now, at this very hour, the business men of the United States and Canada are dividing themselves into two groups, represented by the two individuals whose words are quoted. A few years from now there will be ten thousand such luncheons and one of the men will say:

"I've got what I wanted."

And the other will answer:

"I wish I had those years back."

In which class are you putting yourself? The real difference between the two classes is this — one class of men hope vaguely to be independent *sometime;* the other class have convinced themselves that they can do it within the next few years. Do you believe this? Do you care enough about independence to give us a chance to prove it? Will you invest one single evening in reading a book that has put 400,000 men on the road to more rapid progress?

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It explains how for more than twenty-five years it has been the privilege of the Alexander Hamilton Institute to help men shorten the path to success; to increase their earning power; to make them masters of the larger opportunities in business.

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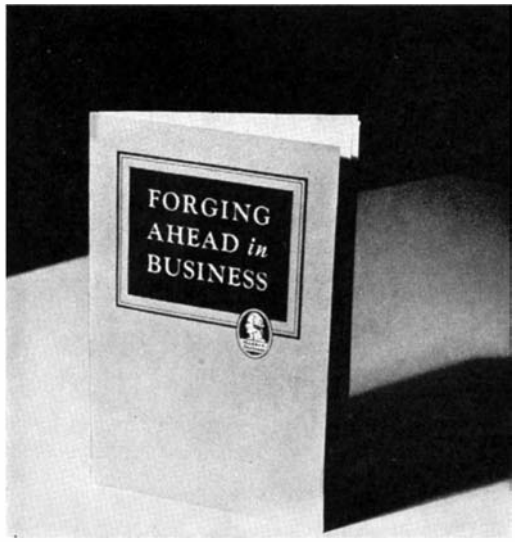

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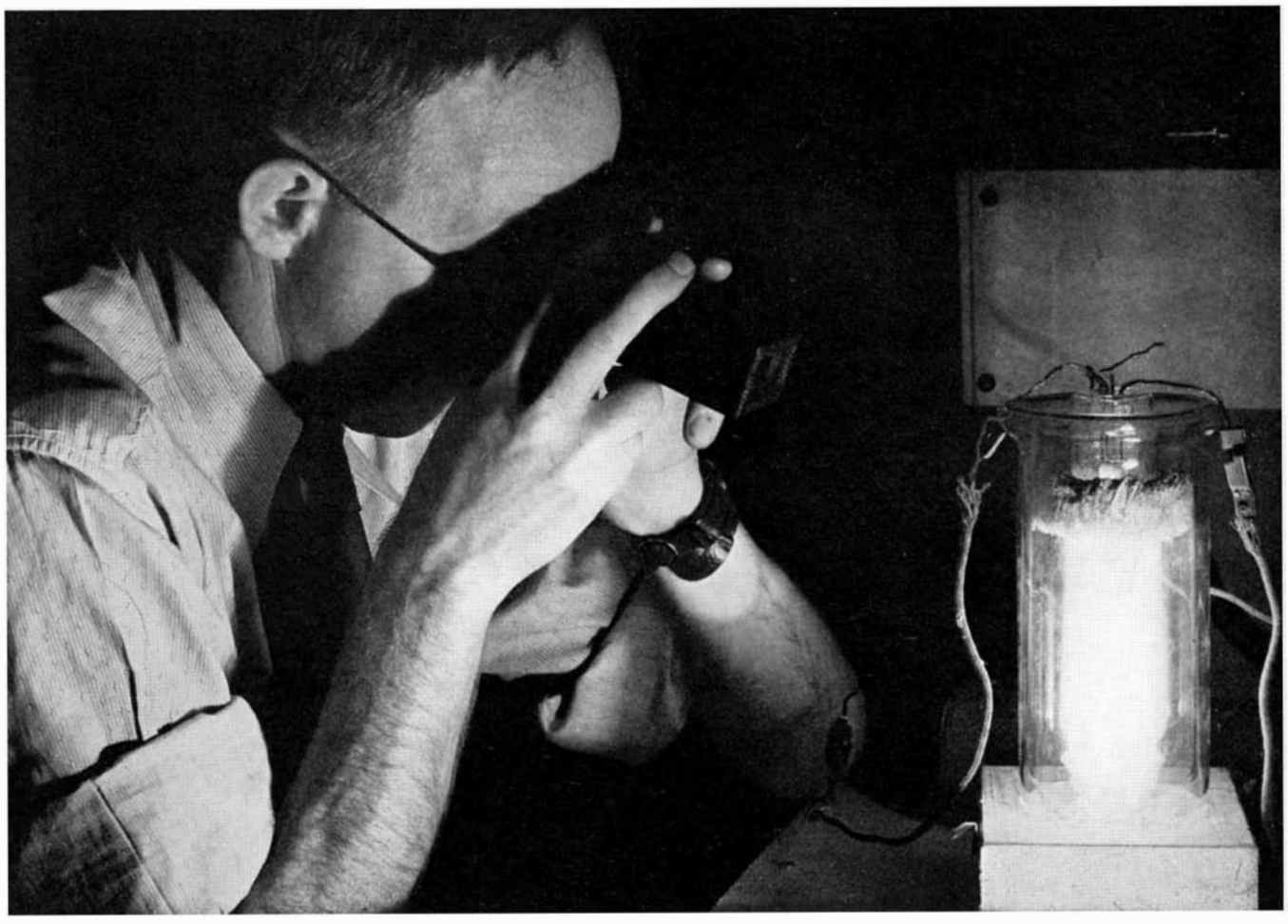

This Light Can Save 5000 Lives a Year

And it can save the suffering caused by more than 80,000 unnecessary accidents; it can prevent an annual economic loss of more than $180,000,000—death, injury, waste, that are the result of preventable night accidents. This fearful toll can be stopped by the adequate lighting of the primary highways of the nation.

Already the golden-orange, danger-dissipating light of sodium lamps is lifting the terror that lurks on dark roads. As these lamps illuminate more and more miles of highway, they will save thousands of Americans otherwise doomed to meet injury or death in night accidents. Sodium lamps are among the latest of the many aids to safety to which the General Electric Research Laboratory, in Schenectady, has made important contributions.

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