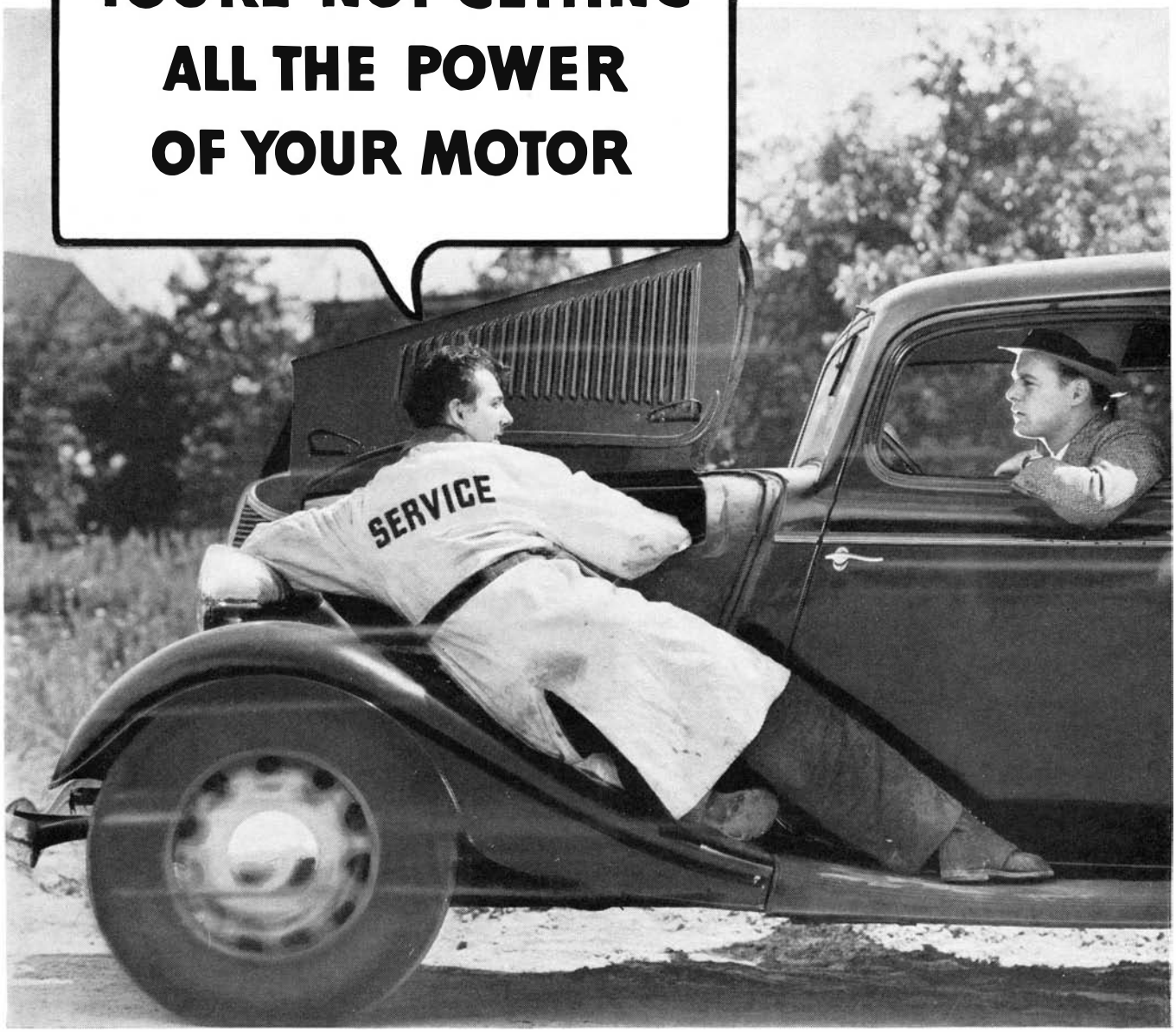
Hon. D. C. ROPER: Our Future Merchant Marine

SCIENTIFIC AMERICAN

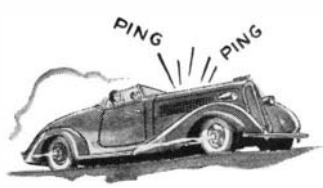
October · 1936 ★ 35c a Copy

YOU'RE NOT GETTING ALL THE POWER OF YOUR MOTOR



HOW TO GET ALL THE POWER

YOU LOSE power when the factory spark setting of your engine is *retarded—whatever kind of gasoline you use.* You lose power even when the spark is set for maximum power—if the gasoline knocks.

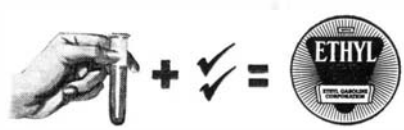


And knock is *expensive.* It means that you are tossing away good money in gasoline and oil—and that you are getting *less* power than your car was built to deliver. For knock wastes all three—gasoline, oil and power.

TO FIGHT THE KNOCK EVIL, with its waste and expense, most oil companies now use anti-knock fluids (containing tetraethyl lead) made by the Ethyl Gasoline Corporation.

And for cars built in recent years, with their high compression engines, these oil companies offer a special high compression fuel at pumps marked "Ethyl."

HIGHEST ANTI-KNOCK! At the Ethyl pump you get a special motor fuel of highest quality on every count in which enough anti-knock fluid has been *blended* to stand the highest compression and the full-power spark setting of your car.



And both the anti-knock quality and all-round value are *double-checked*—by the oil companies and the Ethyl Gasoline Corporation—at the refinery and at the pump.

START A REAL SAVING in your car's operating costs. Have your spark set at factory specifications for *maximum power.* Then fill up with Ethyl. See how much gas and oil you save. See how much better your car will run!

NEXT TIME GET ETHYL!

The SCIENTIFIC AMERICAN DIGEST

Of General Interest

Chemistry in Industry

Aviation

Health Science

World-Wide Radio

Camera Angles

SCIENTIFIC AMERICAN

Owned and published by Munn & Company, Inc.; Orson D. Munn, President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

NINETY-SECOND YEAR • **ORSON D. MUNN, Editor**

CONTENTS · OCTOBER · 1936

THE aerial photograph reproduced on this month's cover shows the traffic divider, part of the Triborough Bridge, located on Randall's Island, New York. By means of the various ramps, traffic from the three connected boroughs is routed safely without the use of grade crossings, and tolls are collected with a minimum of delay. Other photographs of the bridge and pertinent details are given on page 206.

SCIENTIFIC AMERICAN, October, 1936. Vol. No. 155, No. 4, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City.

Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

50 Years Ago in . . .

Scientific American

(Condensed From Issues of October, 1886)

WELDING—"According to the *Electrical World*, Professor Elihu Thomson, of the Thomson-Houston Electric Company, has invented a method by which metal wires can be welded together without the application of external heat, but simply by passing strong currents of electricity between the joint of the two pieces to be welded."

UNDERGROUND LINES—"Nearly a year and a half have passed since the subway commissioners were appointed, under a special act of the Legislature, to supervise the burying of the telegraph lines in New York City. To do this work intelligently, a special study of the subject was required, together with a comparison of the different methods proposed by inventors. As the telegraph companies had done nothing to further the objects of the commission, a subway company was formed. This company, receiving its franchise from the commissioners, is now engaged in laying the conduit."

MECHANIZATION—"The whole tendency of modern industrial progress is in the direction of abolishing manual labor in manufactures, and substituting for it machinery, which is being constantly improved, and which in the not distant future may be expected to reach still higher stages of perfection."

MACHINE GUNS—"The friends of H. S. Maxim will be glad to know of his success in London with an automatic machine gun of his invention. The *Mechanical World*, of London, describes Mr. Maxim's experimental works. . . . The guns to be seen here are extremely interesting from a mechanical point of view, as well as the process of manufacture and the tools employed. The Maxim machine gun is bound to play a very important part in future military operations, and will probably greatly alter the conditions of machine gun warfare."

PATENT OFFICE—"The receipts of the Patent Office for the year 1885 exceeded the expenditures over $163,710, while the balance on hand January 1, 1886, was $2,945,405.58; and yet the Commissioner of Patents cannot get Congress to appropriate a sufficient sum out of the surplus patent fund to enable him to employ a sufficient examining force to keep up the work of the office."

MORTAR—"Some details have come to hand concerning the new Fere gun from which the French expect so much. It is, we learn, a mortar of unusual size, throwing twelve shells with more than ordinary precision for its type. The shells are a trifle over three feet in length, and contain an explosive said to possess extraordinary power of destruction."

FAST STEAMERS—"A new company has been formed to run steamers between Liverpool and the Isle of Man. . . . The company has arranged a conditional contract for two first-class screw steamers, handsomely fitted and furnished, having triple expansion engines of about 1,500 horse power, and to be fitted with bilge keels, which prevent rolling to a great extent. . . ." They are "to steam at 17 to 18 miles an hour."

ALUMINUM TIN—"The applications of aluminum are now considerable, and M. Bourbouze, a French physicist, has added to their number by employing an alloy of the metal with tin. . . . The alloy he employs consists of 10 parts of tin and 100 parts of aluminum. . . . It can be soldered as easily as brass."

WOMEN SCIENTISTS—"An agreeable illustration of the capacity of the feminine mind to grapple with the abstractions of science was afforded in the recent annual meeting of the American Science Association, whose proceedings were illuminated by the personal participation of several lady members."

ELECTRIC BOAT—"On September 13 last the electric boat *Volta* crossed from Calais to Dover and back again under the propulsion of power stored in secondary batteries. The double trip was made with a single charge, which proved amply sufficient for the purpose."

BALLOON TRAVEL—"Among the means employed for traveling in a balloon over the sea, we consider as very important the use of a float for converting the balloon into a captive one, and the use of a cone anchor, permitting of the reception of water hoisted up from the ocean with a pail, since the sun at daybreak tends to cause the balloon to rise into the higher regions, and to make it lose, through expansion, a portion of the gas that it contains. With these several methods of anchoring one's self to the sea and taking in ballast, it is not impossible to undertake long balloon trips over the ocean."

GLASS RAILS—"Friedrich Siemens, of Dresden, has succeeded in casting glass in the same way as metal is cast, and obtaining an article corresponding to cast metal. This cast glass is hard, not dearer in production than cast iron, and has the advantage of transparency, so that all flaws can be detected before it is applied to practical use. . . . The hardness and resisting power of this cast glass are so great that experiments are being just now carried out at the Siemens glass foundry at Dresden with the purpose of ascertaining whether the material could be employed for rails on railways."

LONG DISTANCE—"While much is being accomplished in long distance telephony at various parts of the country, it has not yet reached a point as to efficiency which may be regarded as wholly satisfactory, nor has it yet proved itself formidable in competition with the telegraph. . . . In telephony 100 miles or thereabouts seem to be the paying limit at present, notwithstanding the fact that a line has successfully operated between New York and Chicago, a distance of nearly 1,000 miles, and several others have been experimented with, each giving more or less satisfaction according to conditions."

AND NOW FOR THE FUTURE

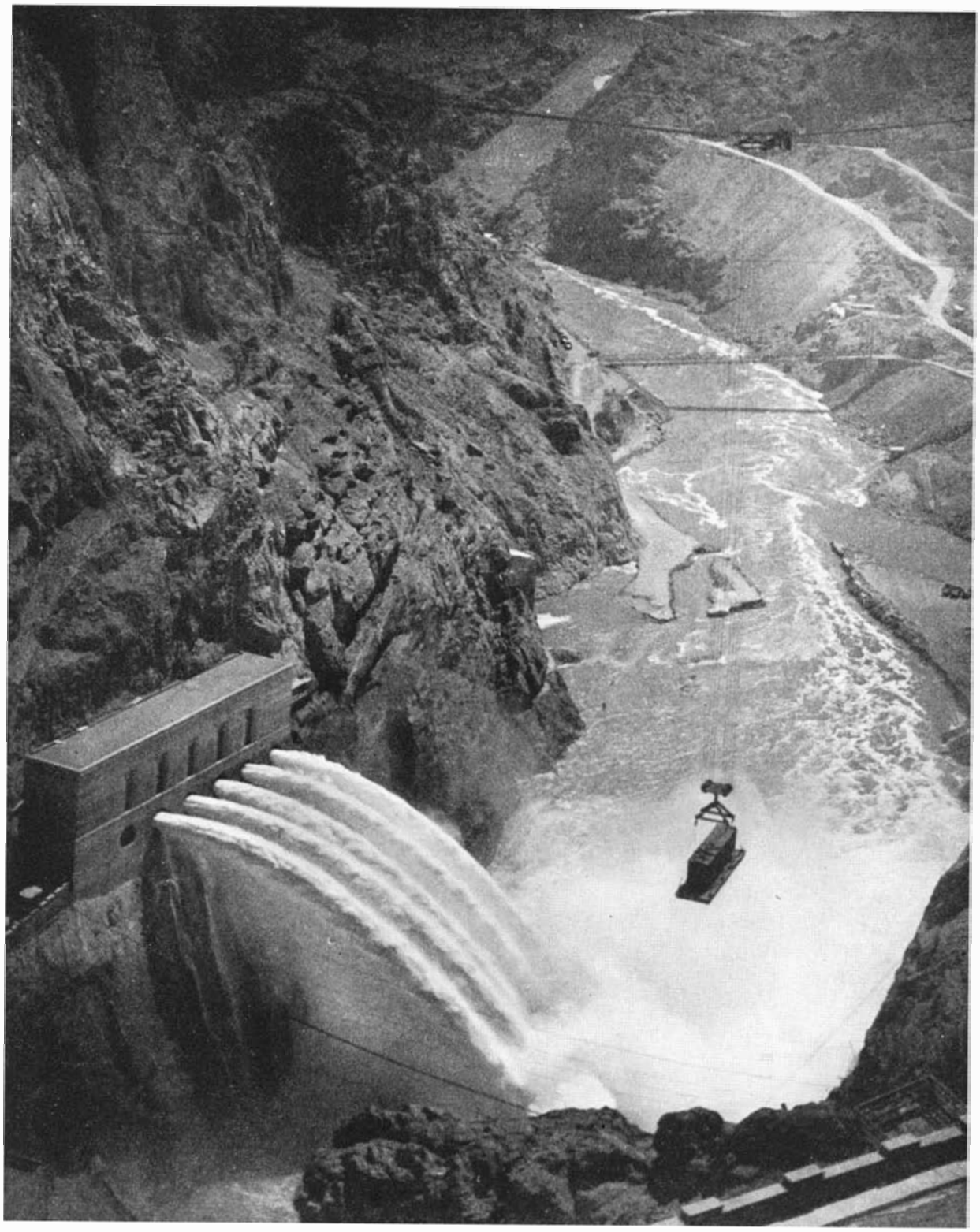
¶Latest Developments in Science's Battle With Crime, by Andrew R. Boone

¶Chemistry, Industry, and the Farmer, by Francis P. Garvan

¶The Albert Canal, in Belgium, Simplifies and Speeds Up Inland Transportation

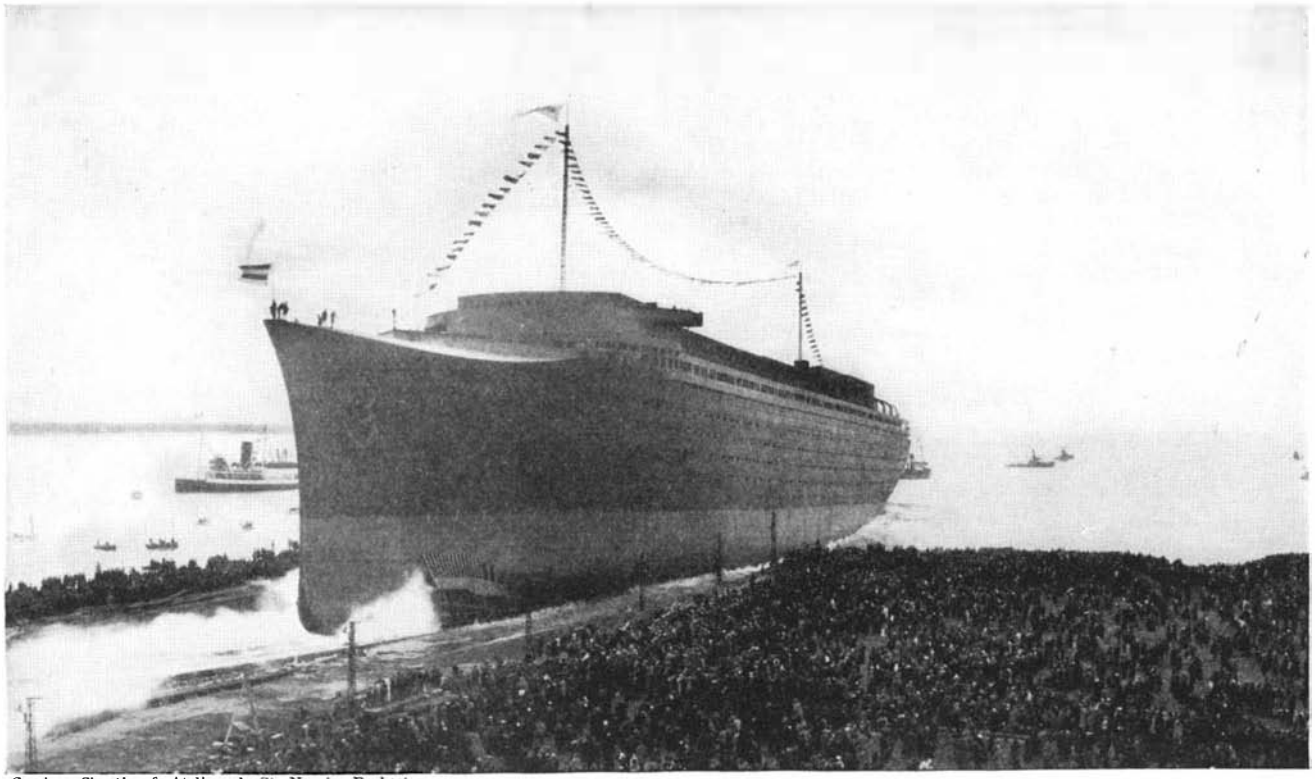
¶Taking the Guesswork Out of Flying, by T. Lee, Jr.

¶How and When Man Discovered Pottery, by Jotham Johnson



THUNDER OF WHITE WATER AT BOULDER DAM

THIRTEEN feet higher than Niagara Falls, this man-made fall of roaring water at the canyon wall outlet on the Arizona side below Boulder Dam, is a truly remarkable, 180-foot-high spectacle. This photograph, made from Lookout Point on the Nevada side, is reproduced through the courtesy of the Bureau of Reclamation. The freight car being lowered by a permanent cableway to the Nevada powerhouse, hidden by the canyon's brink, affords a striking comparison. Incidentally, it is simpler to deliver supplies and equipment to the plants in this manner than to deliver them piecemeal by cableway.



Courtesy Chantier & Ateliers de St. Nazaire Penhoet

As a modern giant, the *Normandie,* goes down the ways, the grease smokes under pressure of the fore poppet

Getting the Big Fellows OVERBOARD

As a Ship Goes Down the Ways, Spectators See A Spectacle but Know Not the Careful Preparations, the Dangers, the Suspense, and the Drama

By COMMANDER W. MACK ANGAS, (CEC) U. S. N.

OF the romance and drama of modern science and industry, much has been written and said. Dramatic moments occur beyond doubt in most fields of scientific and industrial endeavor, but they normally take place in the seclusion of an operating room, laboratory, or testing ground. The launching of a big ship is an exception to this general rule. When a great vessel is launched—in fact at the launching of any ship of noteworthy size—thousands of spectators glimpse one of industry's most stirring spectacles.

Though he views a remarkable spectacle, the average guest at a launching becomes so engrossed in the christening ceremony that he fails to appreciate the significance of much that is of real interest. Consider what the general spectator sees at a launching and then go behind the scenes and observe the less commonly understood features of the undertaking.

The day of an important launching is a busy one at a ship yard. Guests begin to arrive an hour or more before the scheduled time. Watchmen and yard police examine passes and invitations, direct automobiles to parking places, and see that the various guests reach the roped-off areas from which they are to watch the proceedings. The more privileged guests are grouped near the sponsor's platform at the bow of the ship which stands on the building ways with its stern toward the water. The ship is decorated with flags and the sponsor's platform, at the foot of the towering stem, is gay with bunting. There is a sound of hammering, the dull thud of wood mauls on oak blocking, as gangs of men remove shores and keel blocks and make final preparation for the release of the ship.

The crowd thickens, the sound of hammering stops and workmen crawl from under the ship and report to foremen that their assigned tasks have been completed and the ship is ready to go. Tugs and small craft move slowly and expectantly about the harbor. A patrol boat warns approaching craft to keep clear of the path which the new ship will take when released. The current, which has been running upstream, slackens as the turn of the tide approaches. On the platform at the bow an official of the ship yard warns the sponsor that a champagne bottle, especially when covered with a basket weave of ribbon, is not easily broken and explains the old nautical tradition of the bad luck that follows a ship which is not properly christened. Photographers' flash bulbs wink as last minute pictures are taken of the smiling sponsor, the champagne bottle in her right hand and a sheaf of roses in the crook of her left arm. All

noise of work around the ship has stopped and a band stationed near the bow is clearly heard playing popular airs. The photographers' activities stop. They reload their cameras for pictures of the actual launching. The band is quiet, and for several long minutes there is no sound and no movement except the slow drifting of the waiting tugs.

Suddenly a shrill whistle blast breaks the silence. There is an ominous creaking under the ship and slowly, almost imperceptibly, she starts toward the water. The sponsor smashes the wine bottle over the receding bow and those near her hear the words "I christen thee ———" The ship gathers speed and as the stern reaches the water, a pandemonium of whistle blasts breaks out from every tug and vessel within sight or hearing. Faster and faster moves the ship. The water is foaming along her sides now and the stern lifts as it becomes water borne. The grease on the two wood runways, down which the ship is rushing, smokes with the heat of the friction. A moment later the bow dips deeply as the cradle slides off the ends of the launching ways. The ship is afloat!

THE speed of the ship slackens as she moves out into the harbor and lines are heaved from her to the waiting tugs which are to tow her to the fitting-out pier where she will be completed. She moves slowly in toward this pier under the guidance of the tugs as the crowd of onlookers disperses.

As members of the sponsor's party stroll toward the luncheon which awaits the guests of honor, an admiral's wife is seen furtively dabbing at her eyes with her handkerchief.

"I always cry at a launching," she explains. "It makes me think of the time when my baby took her first step."

A few spectators find their way to the fitting-out pier to see the new ship brought alongside, but the rest have by now left the ship yard. All will say they have seen a ship launched, but the majority has seen little more than the christening ceremony. Few appreciated the tenseness of the responsible officials in those last few moments before the launching triggers were released.

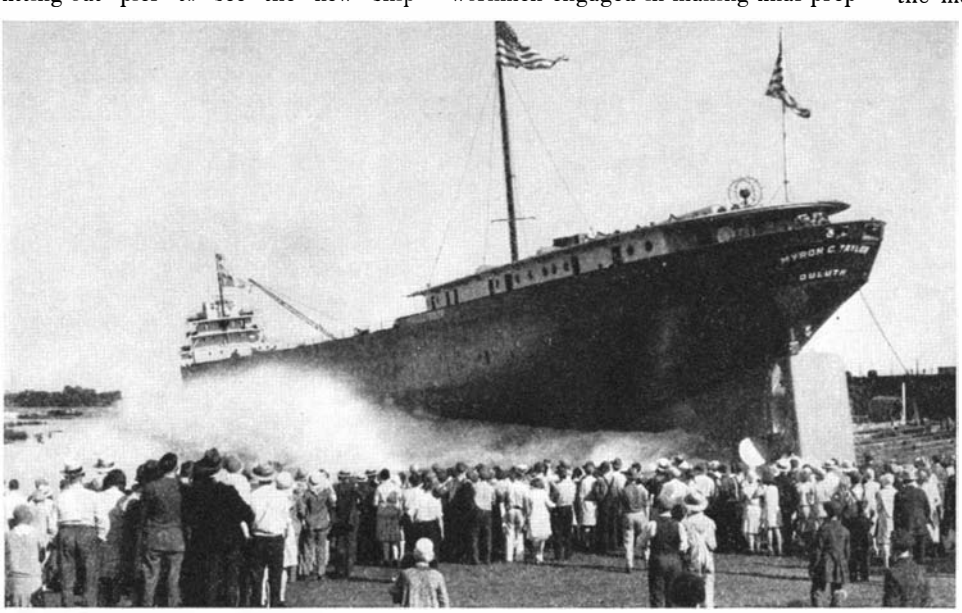
No sane engineer would undertake the launching of a large vessel down greased inclined runways, or ways as they are called, were there not a huge store of empirical data which can be drawn upon to predetermine the behavior of the ship under different assumed conditions. The builders of the early paddle-wheel transatlantic liners in all probability would have been unable to get such giants as the *Normandie* or *Queen Mary* into the water even if they could have built them.

That the builders of our early steamships would have had difficulty in launching a ship the size of a modern liner was demonstrated in the middle of the last century when the eminent British engineer, I. K. Brunel, proposed and actually carried out the construction of a ship of such size. The *Great Eastern*, with her length of 692 feet and gross tonnage of 18,914, while far smaller than such giants as the *Bremen, Europa, Rex, Normandie* and *Queen Mary*, would be, nevertheless, a big ship today. Despite Brunel's undoubted genius, the problem of getting the *Great Eastern* overboard was too much for him. The huge hull, which he attempted to launch sidewise, stuck on the ways and was not floated until three months had elapsed and the original company, formed in 1851 to build and operate the ship, had gone into liquidation.

Nor was the *Great Eastern* the only ship to get into trouble when launched. Ships have stuck on the ways; ships have broken away prematurely from their restraining gear and crushed workmen engaged in making final preparations for their launching; others have gone down the ways so fast as to become altogether unmanageable and have crashed into piers on the opposite shore before being brought under control. At least one large merchant steamer capsized and sank immediately after leaving the ways. The British battleship *Albion*, when launched in 1898, set up such a wave that 200 spectators were swept into the Thames and 50 of them drowned.

The Duchess of York was sponsor for the *Albion*. One can imagine her feelings when some 36 years later, as Queen of England, she pressed the button which released the heaviest hull ever to be launched, saw it start toward the waiting Clyde, broke a bottle of Australian burgundy over the moving stem, and, instead of the traditional "I christen thee ———," said "I am happy to name this ship the *Queen Mary* and wish good luck to her and all who sail on her."

THE launch of the *Queen Mary* was a complete success. A hundred seconds after the ship was released she was afloat and under control. Her builders had predicted that she would travel 1194 feet before coming to rest. She actually traveled 1196. Long experience with the launching of large ships into the restricted waters of the Clyde enabled the *Queen Mary's* builders to get the huge hull afloat without accident. Similarly the experience of our own yards and the big ship yards of France, Germany, Italy, Ireland, and Japan have enabled them to carry out their recent launchings successfully. Experience, forethought, and skill may be said to have overcome the risks of launching. Meeting a known risk with skill and experience may overcome it, but can not eliminate it. The inherent features of the risk are still there. A brief consideration of the mechanics and mechanism of ship launching should enable one to grasp how such an innately risky undertaking is successfully accomplished.



Courtesy Great Lakes Engineering Works

A ticklish job: side-launching of a Lake freighter

A ship is not built on the launching ways, but on building ways. The launching ways are inserted under the hull a few weeks or days before the launching and the weight of the ship is transferred to them only a few hours before she goes overboard. The building ways usually consist of a heavy timber or concrete platform of about the length and width of the ship to be constructed. For the conventional endways launching, the ways are built at right angles to the shore and slope gently down from their inboard, or shore, end to the water's edge in a series of shallow steps. Each step extends

completely across the ways and if it is a foot in height the steps will be a little less than 24 feet apart, the slope of the building ways for a large ship usually being slightly more than one-half inch to the foot. As a general rule the larger and heavier the ship, the flatter the slope of the ways. Cranes for lifting material and equipment into place on the hull stand alongside the ways or travel over them on latticed girder runways supported by steel towers.

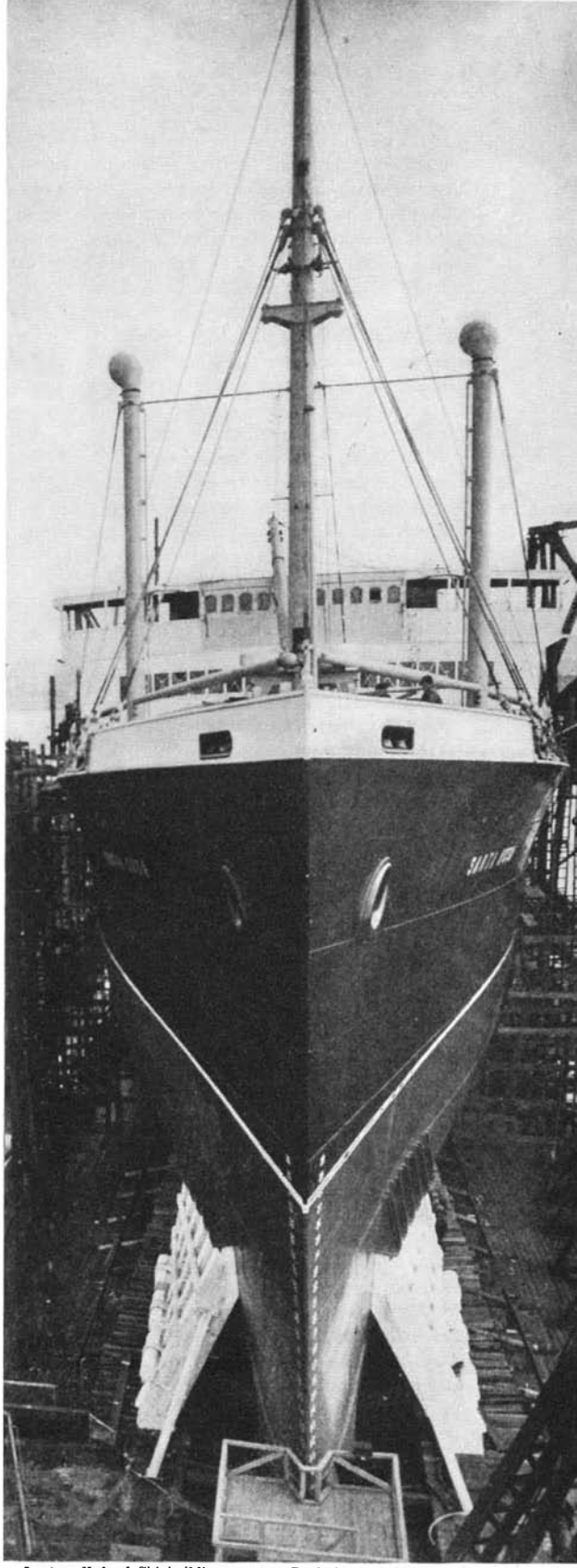
The keel of the ship is laid on a row of keel blocks which runs down the center of the building ways, each keel block consisting of several timbers resting one on another. The heights of the blocks are so adjusted as to give the keel a downward slope toward the water. The slope will be about the same as the slope of the ways—perhaps a little more, perhaps a little less—but for a large ship it will be a trifle more than one-half inch to the foot. As the ship grows under the hands of the builders, rows of timber shores are used to support the widening bottom. Later on, as the sides of the hull rise from the bottom frames, longer timber shores are used to support parts standing high above the ways and to brace the hull against rocking on the keel blocks. Finally the hull reaches a state of completion determined by the builders as proper for launching.

THE state of completion of the ship when she goes overboard may vary from a bare hull to a virtually completed ship. In fact, ships have been launched complete and ready to run. An extreme case occurred on the Great Lakes when a freighter was launched sidewise with steam up. She left the scene of the launching under her own power! But in the vast majority of cases a vessel, particularly a big vessel, is far from complete when she leaves the ways.

The state of completion at which the builders of a large ship elect to launch depends upon a number of factors. An important one is the relative ease of handling materials at the building ways and at the fitting-out pier. If the ways are equipped with heavy overhead cranes, the builders will often install boilers and machinery before launching, while at another yard these would have to await installation at the fitting-out pier where cranes of large capacity are invariably available.

The anticipated height of the tide is an important consideration when a launching date is to be selected. Tide tables are consulted and a date is usually chosen which will bring an exceptionally high tide at a suitable time of day. John Brown and Company, the builders of the *Queen Mary*, considered the tidal predictions for each day in the months of August and September, 1934, before finally selecting September 26th as the most suitable day. On this date it was estimated that even with adverse wind and weather conditions there would be eight feet, three inches of water over the way ends. With the favorable conditions that actually prevailed, the depth over the way ends was eleven feet, six inches. We had similar luck at the New York Navy Yard when the cruiser *New Orleans* was launched, the tide on the launching day being augmented by an east wind to such an extent that it threatened to flood the pits under the ways in which the launching triggers were located.

Other important related factors affecting the choice of a launching date are the weight of the ship at various stages of completion, the calculated strength of the hull, and the strength of the ways. Launching undoubtedly places on some parts of the hull the heaviest stresses that they will ever be called upon to bear. It is usual to add temporary internal bracing to enable the hull to withstand these stresses, especially if the vessel is to be launched at a fairly advanced state of completion and in consequence will be relatively heavy when launched. As an example of the differences which may occur between the launching weights of two vessels of about the same size when built under different conditions at different ship yards, it is only necessary to give the figures for the *Normandie* and *Queen Mary*. The ships are of about the same displacement or total weight. The *Normandie* weighed, with her cradle, 27,660 tons when she was launched, while the corresponding figure for the *Queen Mary* was 36,700 tons.



Courtesy Federal Shipbuilding and Dry Dock Co.

The *Santa Rosa* ready to go. The fore poppet, or forward part of the cradle, has been painted white

WHEN the hull is ready to go overboard the launching ways are installed under it. The ways consist of two main parts —the ground-ways or standing ways, and the sliding ways. The ground-ways, as their name implies, are the fixed runways down which the ship travels when launched. They are firmly supported by and attached to the building ways. The sliding ways travel with the ship when she is launched. They slide on the greased ground-ways and, together with the poppets and packing, which are about to be described, form the cradle which carries the ship down the ground-ways into the water.

The ground-ways are timber runways extending from the bow of the ship out into the water beyond the stern. They are of very heavy construction, being built of timbers not less than 12 inches square. Oak is often used for those parts of the ways which will be called upon to carry the heaviest loads. There are usually two ground-ways, each from six to ten feet in width, and they may be spaced from 25 to 30 feet apart center to center. The *Queen Mary* was launched from two ground-ways ten feet six inches wide and twenty-nine feet six

inches apart. The use of four ground-ways was considered for this exceptionally heavy vessel, but the idea was finally abandoned in favor of the conventional two. Four ways have been used successfully, however, notably in the case of the British super-dreadnaught *Nelson.*

The ground-ways take the general slope of the building ways, a little more than a half inch to the foot, and are securely supported by blocking which rests on the building ways. Each of the ground-ways has a ribband, something like a heavy wood curb, on its outer edge to guide the sliding ways. The upper surfaces of the ground-ways are finished smooth and then given a heavy coat of grease before the sliding ways are set on them. The ways are not merely greased —the grease is put on thick. When the airplane carrier *Saratoga* was launched at Camden, the ground-ways were given a three-quarter inch coat of stearine and an additional one-eighth inch of lighter grease was spread on top of that. The total amount of grease used for this launching exceeded 34 tons. The stearine is melted, poured onto the ways when still hot, and is ironed smooth with hot irons. Naturally it cannot be applied to the outer ends of the ways which are submerged at low tide. These are lubricated with soft soap deposited in closely spaced piles.

The sliding ways extend from the bow nearly to the stern. Their outboard end is usually in about the vicinity of the rudder of the ship. Somewhat shorter than the ground-ways, they are of similar materials and construction. They are usually built in sections of convenient length for handling, these sections being assembled and fastened together on the greased ground-ways. Before the sliding ways are put in place on the ground-ways, their lower surfaces are sometimes given a thin coat of stearine. Timbers and tie rods connect the two sliding ways and insure their acting together. Between the sliding ways and the hull of the ship is inserted packing consisting of heavy timber blocking. This packing conforms to the hull shape and, with the sliding ways, forms the cradle which carries the ship to the water. At the bow and stern, the packing is of unusually heavy construction and is fastened together very securely to withstand severe stresses, these extra heavy parts of the cradle being known as the fore poppet and the after poppet. Heavy steel latches or triggers prevent the cradle from sliding down the ground-ways prematurely. The release of these triggers, usually by pneumatic power, lets the cradle go.

THE assembly of the ground-ways and cradle under the ship does not complete the preparations for launching. The cradle is under the hull, but the weight of the hull does not rest on it. The hull is still supported by the keel blocks and shores upon which it was built. The task of transferring the weight of the ship to the cradle and launching ways is accomplished immediately before the launching. The previous day it is usual to split out alternate keel blocks, this being rendered easy by the inclusion in each keel block assembly of a piece of soft wood which can be readily split and removed. The blocks thus removed are at once replaced by blocks capped with a metal container full of dry sand and fitted with a valve or shutter through which the sand may be allowed to escape. A block which rests on the sand is fitted tightly against the keel, and wedges, provided in the keel block assembly, are driven up tight to make the sand boxes carry load. When the sand boxes are all in place, the keel blocks hitherto left in place, are split out and removed. These are not replaced.

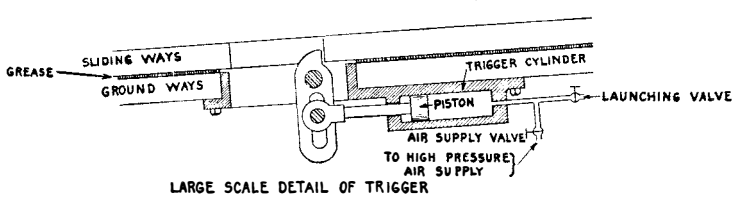
A few hours before the launching, the packing between the sliding ways and the hull is tightened up by driving home wedges which were placed between the timbers of the sliding ways and the packing. This is done systematically until the packing is tight. The sand valves are then opened allowing the sand to run out of the boxes, thus relieving the keel blocks of their load. The keel blocks and shores are finally removed and the ship rests on the cradle and is ready to go.

She is ready to go, but will she start when the triggers are released? If she starts, will she go too fast and too far?

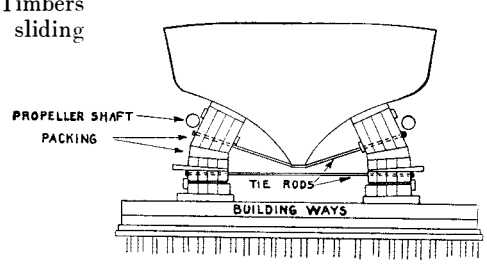
To guard against the contingency that the ship may not start, it is customary to mount powerful hydraulic jacks at the inboard ends of the sliding ways so they can push the sliding ways down the ground-ways, thus breaking the static friction and giving the cradle a start. I have seen jacks installed in this way many times, but it so happens that I've never seen them used. They are of great value, nevertheless, when a ship fails to start when released.

To prevent a ship going too fast down the ways, becoming unmanageable, and crashing into something at the opposite side of the river, a number of expedients are used, the elaborateness of these depending upon the degree to which the travel of the vessel must be restricted.

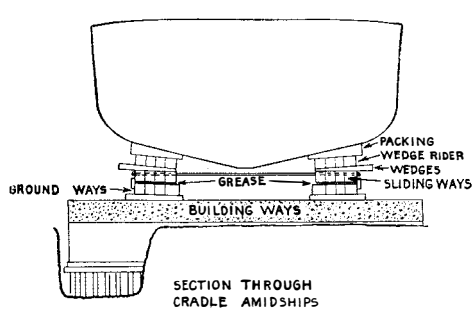
If the body of water into which a ship is to be launched is wide and deep, very little in the way of checking gear is necessary. The airplane carrier *Saratoga*



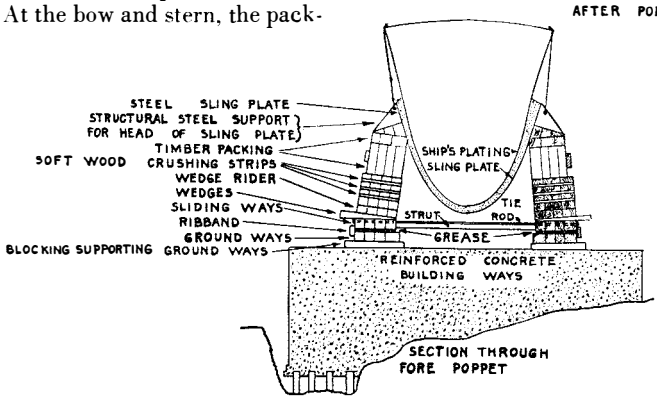
LARGE SCALE DETAIL OF TRIGGER



SECTION THROUGH AFTER POPPET

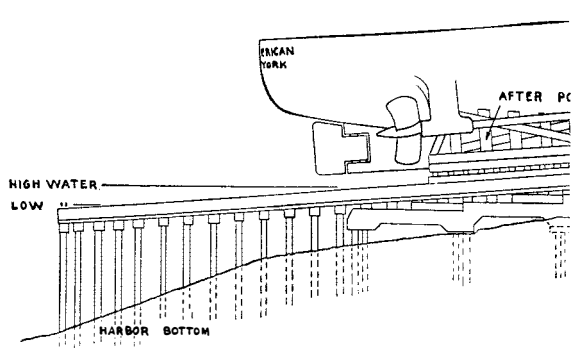


SECTION THROUGH CRADLE AMIDSHIPS



SECTION THROUGH FORE POPPET

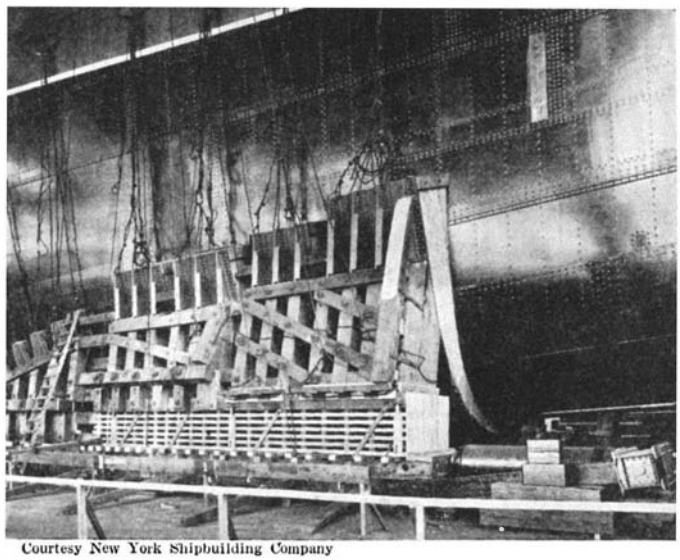
All drawings by the author



was launched under such conditions, the Delaware being a big river at Camden where the ship was built. A smaller vessel might have been allowed to run free at such a plant, but because of the *Saratoga's* great length and weight, it was necessary to make some provisions for checking her run. This was done by locking the propellers to prevent their turning and thus increasing their resistance to passage through the water, and by using anchors as drags to stop the ship after she was afloat. As the builders did not want to check the ship until she had left the ways, the propellers were left free to revolve during the actual launching and were locked with brakes installed on the shafts as soon as the cradle left the ways. Five anchors of 20,000 pounds weight each were dropped from the bow after the ship left the ways and slack lines were run from the stern to anchors previously planted in the river bed. The lines, or rather steel cables, to these anchors did not come taut until the ship was afloat. Actually the stern anchor lines broke at the shackles shortly after they came into play but, nevertheless, the ship was brought safely to rest after traveling about a thousand feet.

When a large vessel must be launched into closely restricted waters, much more elaborate checking gear is necessary. The American airplane carrier *Lexington*, and the Cunard-White Star liner *Queen Mary*, were both launched into narrow harbors, and it was imperative that they be brought to rest almost immediately after leaving the ways. This was done by arranging huge bundles of old chain on the ground alongside the ship and connecting these to the hull with steel cables so that they were dragged by the ship as she moved. The total weight of the chain drags used to check the *Queen Mary* was 2350 tons. The chain was arranged in bundles, each bundle weighing from 55 to 70 tons.

Other means of checking the run of a ship are sometimes used. A wood mask may be built over the propellers and the after end of the cradle to increase water resistance. When the battleship *California* was launched at the Mare Island Navy Yard, a system of hydraulic brakes was used. These acted on steel cables attached to the ship. The brakes worked well, but the cables broke and let the ship run further than she should have. So much for checking gear. Let us now return to a consideration of how the cradle carries the ship down the ground-ways into the water.



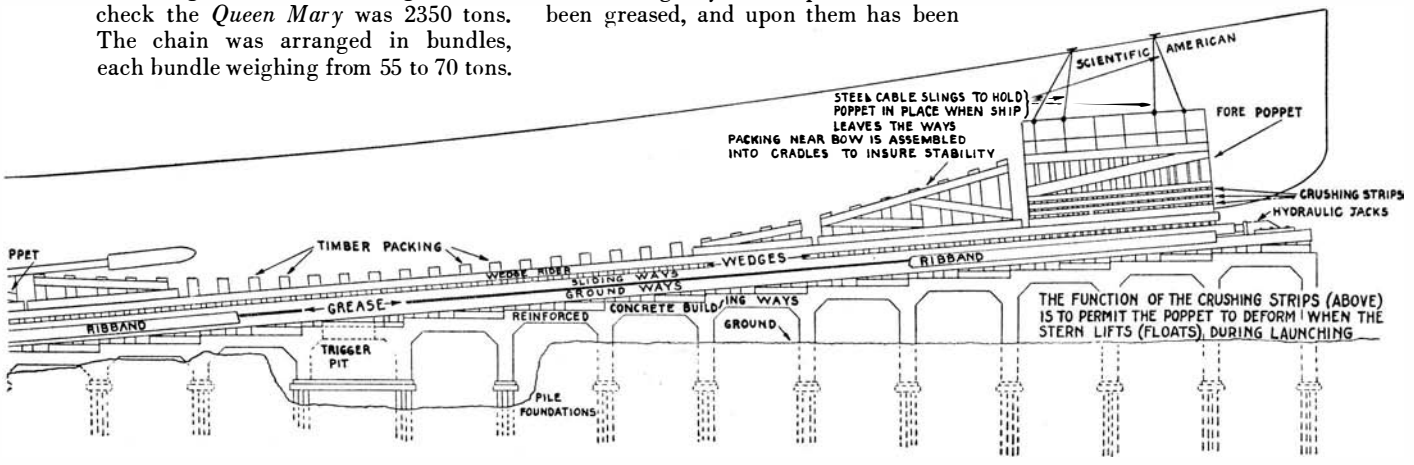
Courtesy New York Shipbuilding Company

Fore poppet of the S. S. *Washington*. This takes about a fourth of the weight of the vessel when the stern lifts

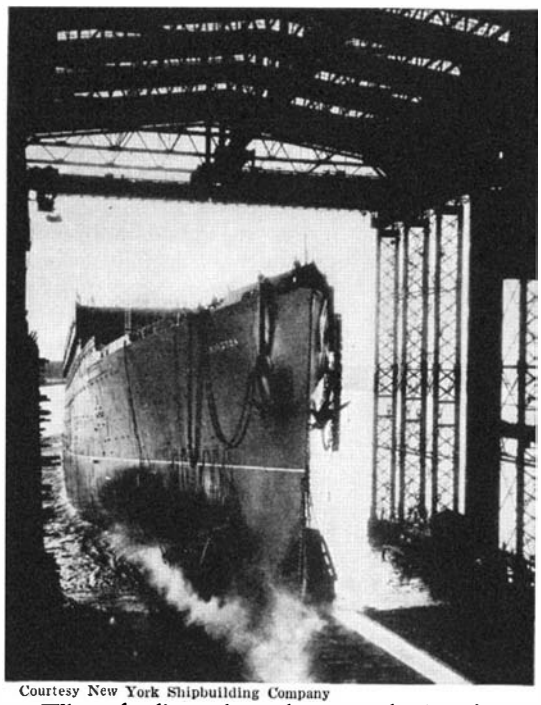
The forward and after ends of the cradle, or the fore poppet and after poppet, have been described as of specially heavy construction. The function of the poppets may be readily understood from consideration of what happens during the critical hundred seconds or so which elapse from the time the ship is released until she is safely afloat and under control. Let us imagine that a large ship is to be launched and the preliminaries have been accomplished. The hull has been inspected for overlooked openings, the standing ways are in place and have been greased, and upon them has been assembled the cradle which consists of the sliding ways, wedges, packing and the poppets. The wedges under the packing have been driven up tight, the keel block and shores have been removed, and the weight of the hull rests on the cradle. The huge steel latches called triggers fasten the sliding ways to the ground-ways. The weight of the hull strains at these as if eager to reach the water. A final inspection of the submerged ends of the standing ways has been made by divers to insure that no obstructions will hinder the smooth passage of the sliding ways over them.

As the hour of the launching approaches, observations of the strength of the current and height of tide are made. The tide must reach at least a predetermined minimum height to enable the ship to be launched safely, and there must be no strong cross current or cross wind to slew the ship off the ways.

With the release of the triggers, the cradle with the ship on it starts to move down the greased inclines of the ground-ways. The after poppet carries the weight of the overhanging stern, but otherwise the hull is supported for practically its entire length until the after poppet clears the ends of the ground-ways. By this time, the water is giving the stern some support, but not enough to float it. In consequence, the stern overhangs the ground-ways like a huge cantilever beam, the deck is subjected to tensile stresses and the pressure on the way ends rises to a maximum. This way-end pressure may amount to as much as 10 or 11 tons per square foot. Temporary shoring has been installed in the hull to resist the tendency of the way end pressure to crush in the bottom. As the ship slides farther into the water,



Diagrammatic drawing of ship on launching ways with keel blocks and shores removed—ship is ready to go



Courtesy New York Shipbuilding Company

When the liner clears the ways, the hanging anchors will be dropped to check her run

the deeper immersion of the stern increases its tendency to float, thus decreasing the way-end pressure and preventing the ship from tipping like a huge see-saw over the way ends as a fulcrum. Farther movement down the ways immerses the stern so deeply that it floats. When the stern floats, the ship is said to pivot. The stern is water borne and the entire ship is lifted off the ways, except the bow, which rests on the fore poppet.

About one-quarter of the total weight of the ship momentarily rests on the fore poppet and the resulting pressure on the ways is enormous. This fore poppet pressure has been calculated, and the ground-ways have been strengthened to stand it at the point where the poppet will be when the stern lifts. The poppet pressure should do no more than wipe the grease off the ways and perhaps make it smoke from the heat of the friction. A few seconds after the stern lifts, the fore poppet clears the ends of the ways, and the ship is afloat. Nothing remains to be done but to bring the moving ship under control, remove the fore poppet and the parts of the cradle which may be attached to the ship, and tow the newly launched vessel to the fitting-out pier for completion.

THE above description applies to an endways launching, this being the usual method of launching ocean-going vessels. The sidewise launching of the *Great Eastern* presented a different problem. Although the first attempt to get the *Great Eastern* overboard was unsuccessful, it must not be imagined that sidewise launching necessarily is undesirable. The technique of sidewise launching has since been highly developed on the Great Lakes, and many Lake shipyards use the method regularly.

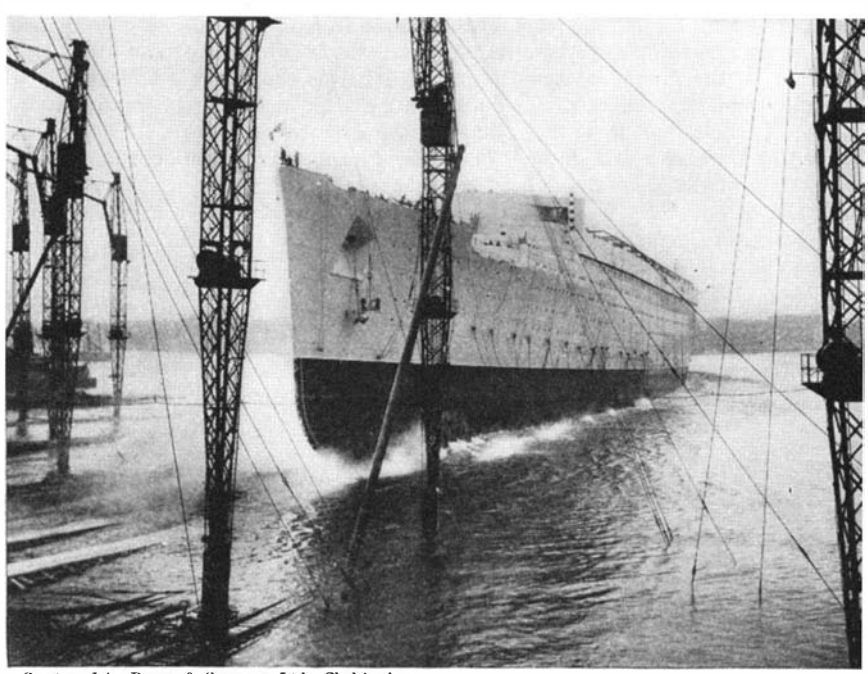
A ship which is to be launched sidewise is built on an even keel, not on a slope, and she is, of course, built close to the water's edge and parallel to it. When she is ready for launching, a number of rather steeply sloping ground-ways are laid under the ship, extending only to the water's edge instead of into the water, as in stern-first launching. The water must be deep enough to float the ship at the ends of the ways, for she will not move any appreciable distance after leaving them. The ground-ways are greased as for an endways launching, and sliding ways are placed on them, with packing between the sliding ways and the ship. There are no poppets. The ship is held by triggers on two or more of the ways. Simultaneous release of these triggers lets the ship go with a rush. She drops off the ends of the ways with a most spectacular splash, rocks violently a few times and is safely afloat.

A ship launched sidewise has practically no tendency to run after leaving the ways and the method is, therefore, much used in restricted waters. Advocates of sidewise launching furthermore claim that there is less tendency to strain the hull than in endways launching, and that the ship may, therefore, be brought to virtual completion before going overboard without the resulting heavy weight causing excessive stresses during launching. There is, however, the risk of the hull slewing on the ways. This would result in the bow going overboard before the stern, or vice versa, which would undoubtedly set up severe, if not destructive, stresses. The danger of slewing is probably the reason that our largest ocean liners and men-of-war invariably are launched endways, though conservatism undoubtedly has something to do with it, a yard having a long and successful record with endways launching being naturally hesitant to adopt an unfamiliar method with a large ship. The devil-you-know is preferable to the devil-you-don't-know.

SO much has been said of the risks of launching large vessels that the question of whether or not these risks can be entirely eliminated naturally arises. The only way to eliminate the risks completely is not to launch the ship, and in some cases this is an entirely practical solution. A ship can be built and floated without launching her! This is frequently accomplished by building the ship in a dry dock of the graving dock type, and floating her out at any convenient stage of completion. At least six vessels, small ships to be sure, are now under construction in dry docks at east coast ship yards. One west coast yard has a dock that was specially constructed for shipbuilding and is used exclusively for this purpose.

Graving docks are large masonry lined basins much like canal locks. They are normally used for docking and repairing ships. The ship enters the flooded dock through an opening which can be closed with a watertight gate of some kind. When the ship is in the dock, the gate is closed and the water pumped

(*Please turn to page* 244)



Courtesy John Brown & Company, Ltd., Clydebank

Heaviest ship ever launched—the *Queen Mary*—entering the waters of the Clyde

OUR POINT OF VIEW

Age

POPULATION trends indicate, according to oft-repeated prognostications, that we shall become a nation of old people within the present century. The sense of this is not that science will give us everlasting life but rather does it mean that fewer children are being born while the average life span is being raised. New figures on phases of this question were made public almost concurrently by William L. Austin, director of the Bureau of the Census, and Dr. Robert E. Chaddock, of Columbia University.

Advances in the science and practice of surgery and medicine, improved sanitation, labor-saving inventions, and a higher standard of living, according to Mr. Austin, have added a decade to the average life since the turn of the century. Thirty-six years ago the average length of life for white males was 48 years and for white females 51 years; today the figures are, respectively, 59 and 63. Women still live longer despite the fact that they are no longer the "sheltered beings" of the Nineties, and have met the rough and strenuous competition of men in business! The figures show, too, that the number of babies dying in the first year of life has been cut in half. This contributes heavily to the raising of the figure for the average life span; but cynics say that science, in saving many physically unsound babies, is contributing to a higher mortality rate for later ages, that the first serious illness will take these off rapidly! All of us would like to be in that one-fourth of each male generation which will reach the age of 77, and some are hardy enough to wish to be in that one-tenth which will reach 83.

Approximately 6,500,000 persons in this country are now over 65, reports Dr. Chaddock. What luck for Dr. Townsend at 10 cents (membership dues) per week per oldster! But this is only a start —this group will be trebled in 50 years. There is little change in the proportion of the productive group from 20 to 44, reports Dr. Chaddock, but there has been a steady decline in the proportion of persons under 20 and a corresponding increase of those over 45. Mere man will be interested to learn that numerically, *at least*, there is a trend to equality of the sexes!

Many adjustments in our industrial and economic systems will be needed to take care of this aging population. Perhaps the most important thing is to give the productive worker the chance to support himself at a more advanced age. Otherwise, taxes to support him will skyrocket—or maybe they will anyway!

Radio Culture

EVERY now and then someone recalls the widespread early predictions that radio would prove of tremendous educational value and puts a blunt question as to the *proved* value of radio in education. Little discussion of this subject is heard nowadays and the puzzled inquirer takes it for granted that, having noted non-fulfillment of their prophecies, the idealists have backed water. It is pointed out often that the air waves are crowded with jazz, airy persiflage, and considerable clowning that is valueless except as entertainment.

The subject may well be re-opened with a slight revision of terms—a revision which carries us even beyond the original thought. Instead of "educational," let us use "enlightenment." The word education implies learning by rote or cramming of orthodox facts, while enlightenment covers the entire scope of man's activities. Book "larnin'" is only a small part of the broader culture which is enlightenment.

On such a basis, radio broadcasting has done so much good for all the people that we may overlook its more obvious faults. Radio education, or as we prefer to call it, radio enlightenment, is not the broadcasting of lessons, although certain stations have performed an admirable service to the public in this manner. Lessons are drudgery. Radio excels in broadcasting programs which millions follow because they are interesting, although they do not recognize these programs as educational. In pointing this out, General James G. Harbord, of the Radio Corporation of America, said that "Educators realize that the best teaching attracts and holds attention, while delivering a satisfactory and stimulating message. It is obvious that it benefits by what is loosely called showmanship."

Amazement has of late often been expressed at the conversation of the man-in-the-street on economics and sociology, politics and international affairs, war and peace, and the pros and cons of almost every conceivable subject. He reads neither the serious magazines nor newspaper editorials. But over the radio he has heard the voices of political candidates, of kings and dictators, of opera stars and commentators on everything under the sun. He has heard leaders in every walk of life, educators, lecturers, writers, scientists, as well as cranks and propagandists discuss and argue the subjects closest to their hearts. News broadcasts and radio dramatizations of events of past and present add to his vast store of knowledge and opinions.

There is your education! It is enlightenment and culture. It is progress. It is the fast-moving progress no other agent before radio was capable of achieving. And yet radio stands not entirely apart; it must go forward as a force for enlightenment in company and co-operation with books, magazines, and newspapers—onward to a glorious future culture!

Photographically Speaking

WE have frequently been asked by some of those of our readers who have not been bitten by the camera bug: "Why do you devote so much space to your 'Camera Angles' department?" The obvious answer, of course, is that a large proportion of our readers want news and information of the sort published under this heading. But behind this is something more, something that covers a lot more ground than just the photographic hobby itself.

To many scientific pursuits, be they vocations or avocations, photography has become an indispensable adjunct. From the laboratory technician, with his intricate research equipment, to the field worker in the science of archeology, from the amateur astronomer to the sports enthusiast, from the globe-trotter to the casual week-ender, the camera in some one or more of its multitude of forms has become an absolutely necessary medium for making permanent records of a multitude of things. Instrument recordings and excavated artifacts, new planets and a record-breaking high-jump, scenes in distant lands and the week-end hostess, all are recorded on the sensitive film, faithfully preserving exact detail for future reference.

With such a broad field of application, it is no small wonder that the science of photography attracts so many devotees who see in it something more than photography for photography's sake. The hobby, if you must think of it as a hobby, has such wide implications that it fits in neatly with almost anything else that you may be doing. This spirit, we believe, is reflected monthly in the columns of "Camera Angles," and is largely the reason why more cameras are being used today than ever before.

By ANDREW R. BOONE

COAST DEFENSE

WHEN a 200-mile-an-hour army bomber streaked across Muroc Dry Lake in southern California recently, dropping parachute flares and gas bombs over a mock battleship painted on the sand, while a second bomber a mile above dumped high-explosive bombs on the illuminated target, the art of bombing was revolutionized.

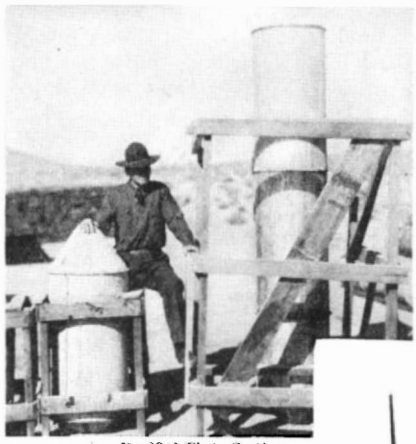
"Night bombing by flashlight," as the army bombardiers term the practice, means that while one or two planes bring illumination to a target on the darkest night while flying only 2500 feet up, the bomb-carriers appear a few seconds later. Thus the fire of anti-aircraft batteries is divided, and while the 7-mile-long beams from 800,000,000-candlepower searchlights follow the flare-dropping ships and the sound detectors are tuned to their powerful motors, those that do the real damage remain undetected until too late.

In the recent maneuvers, bombing squadrons of the 1st Wing demonstrated that they not only can speed overnight to the defense of any point along the Pacific Coast, but also proved that they can place their bombs accurately from great heights. From 20,000 feet, the flying hens loosed their "eggs" on the striped outlines of the battleship. Turrets made of wood and muslin, placed near the center of the "ship," were destroyed by the first salvo.

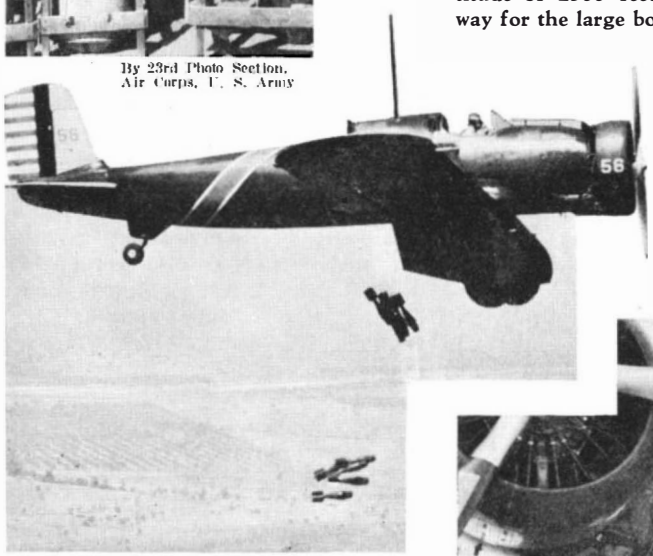
But the skilled pilots and bombardiers of the Air Corps do not conduct all their air raids with live bombs, for the giant one-tonners cost 750 dollars each. In their stead, during the recent maneuvers lasting 10 days and nights, they dropped 240 concrete bombs, the first time this type of dummy projectile has been used by any air force. All were manufactured on Muroc Dry Lake in metal forms, according to a formula worked out by Capt. Philip Schwartz, ordnance officer on the staff of Brig. Gen. Henry B. Clagett. Bottles of smoke screen solution fitted within the fin shatter on impact with the earth to provide a realistic "explosion."

TO avoid frequent landings for additional loads of bombs, an ingenious method has been developed whereby radio signals take the place of steel or concrete. For example: Orders from wing headquarters reach the 19th Bombardment Group to send up its bombers this afternoon for "radio bombing" flights, the trim planes to take off at one-hour intervals.

At one o'clock the first ship, carrying pilot, bombardier, and two mechanics, rolls down the tarmac at March Field, rises and quickly climbs to 8000 feet.



In the sheet-metal forms shown at the left are cast concrete "bombs" used by the Army Air Corps in practice maneuvers. These "bombs," with a device for giving out a cloud of smoke on impact, make possible extensive practice operations at much lower cost than with real bombs

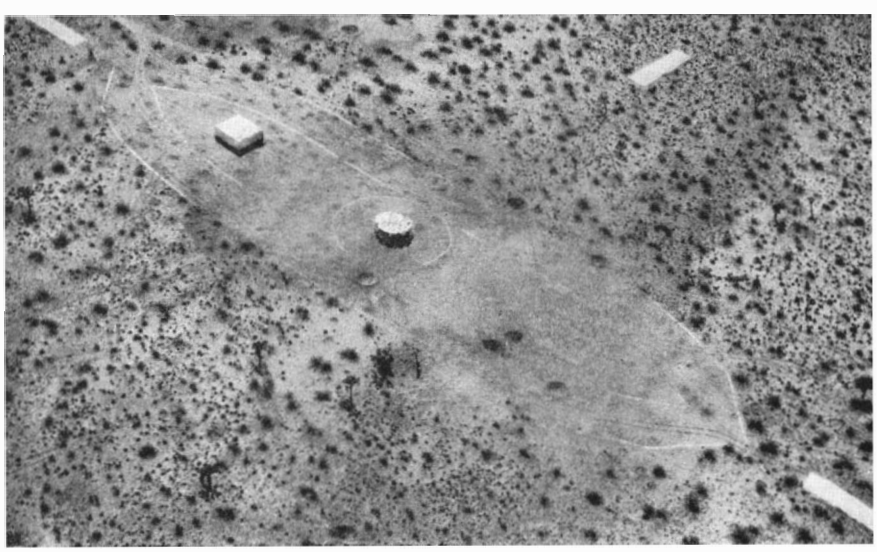


By 23rd Photo Section, Air Corps, U. S. Army

Attack plane dropping gas bombs on "enemy" anti-aircraft battery from an altitude of 2500 feet, thus preparing the way for the large bombers that come over at 7500 feet. At night, the attack planes drop flares

Official photograph, U. S. Army Air Corps

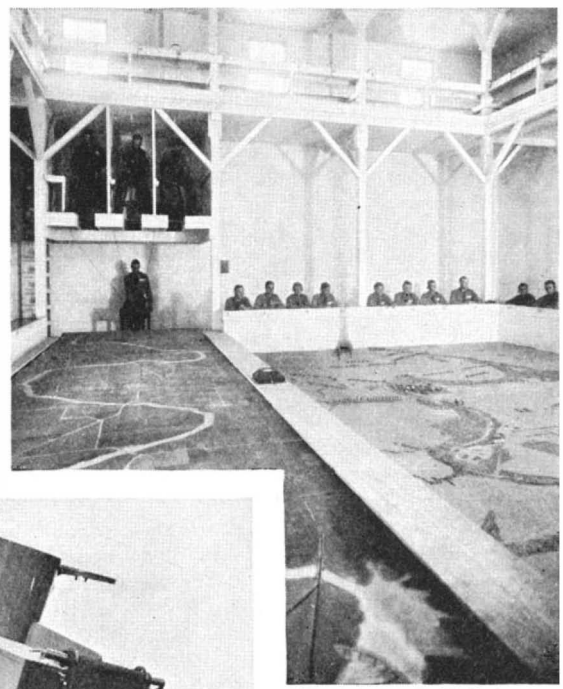
Placing one of the concrete "eggs" in the carrier of a huge bombing plane. These "bombs" cost 12 dollars, as compared with 750 dollars for live high-explosive bombs of the same size



The "battleship" on the sands; note hits made by aircraft bombs

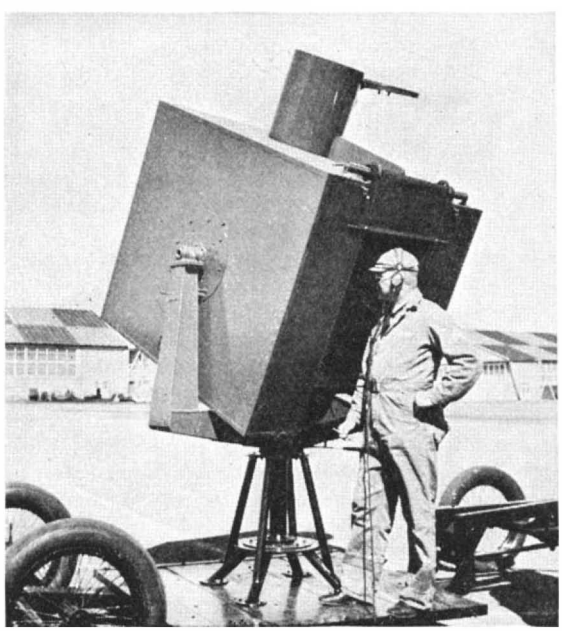
From the Air

Night Bombing . . . Deceiving Anti-Aircraft Gunners . . . Concrete Practice Bombs . . . Radio Bombing

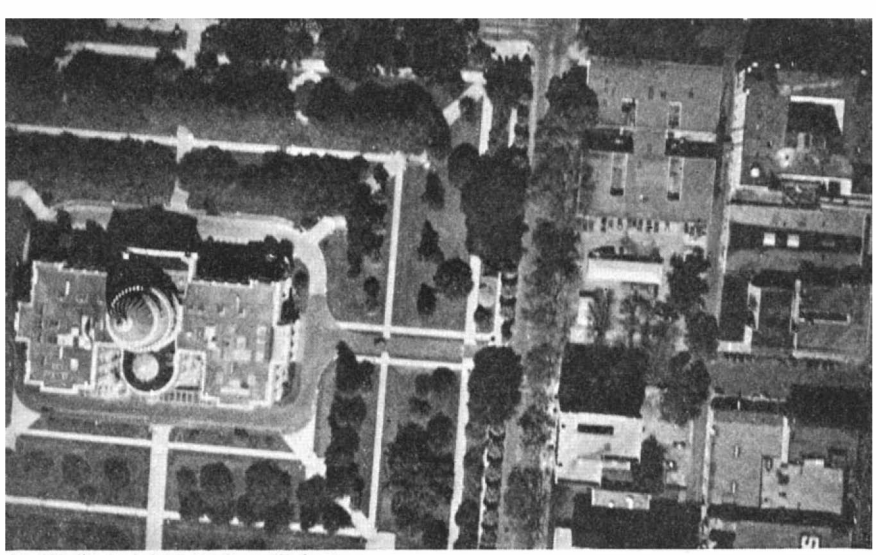


Official photograph, U. S. Army Air Corps

Aerial bombardiers being trained in an indoor range where the "landscape" is a moving curtain painted to show houses, bridges, airports, and so on. The men in training sight on a certain objective when given their orders, press a release, and their hits or misses are recorded by the scorer



The camera obscura hut used for training bombardiers in flight. Radio signals from the plane to the ground, sent at the instant when the bombardier has aligned his sights properly, enable the scorer to determine the accuracy of the trial. Time allowance is made for the bomb flight



By 15th Photo Section, Air Corps, U. S. Army

A night photograph taken by the light of a parachute flare

As the plane gains altitude a truck, containing two-way radio apparatus through which the pilot and ground crew talk to each other, drawing a box-like device known as a camera obscura, rolls out onto the concrete apron.

The camera obscura is in reality a tiny hut, mounted on a four-wheeled trailer, containing in the roof a lens which projects the plane's image on a large square of paper. As the plane approaches, its image moves rapidly across the chart. Aloft in the bomb bay the bombardier sights carefully on the distant target. He speaks into the plane's interphone system, directing the pilot along a path which will carry them directly over the camera. "Turn left," he orders, "steady . . . now right . . . steady . . . stop." Then he fires.

MEANWHILE, one of the operators has swung the hut around until the lens faces the on-coming bomber. Now its image appears at the top edge of the chart. Each second the operator pencils a tiny mark at the nose of the image. Soon through his ear phones a radio signal announces that the bombardier has pressed a button releasing the theoretical bomb, a costless dot or dash which speeds to the camera station at a speed as fast as light itself. But the observer does not stop here; he must allow for the time required for a bomb to fall 8000 feet. If the "shot" has been accurate, a mark will be made directly on the spot occupied by the hut.

When storm and fog close in on the flying fields, the men continue their bombing indoors. Three bombardiers sit on a platform near the ceiling; below them a device known as a "miniature range," which is a small-scale strip of terrain painted on a canvas, moves slowly on an endless chain. Below him, the bombardier sees bridges, railheads, farm houses, airdromes, highways, cities, and ammunition dumps, moving along as though he were flying above this scene.

Suddenly the commanding officer gives orders to bomb a certain target—a railway bridge, for instance. As the bridge moves into line with the cross hairs of the sights, each bombardier turns a crank to set his instrument for ground speed, keeping the cross hairs lined up on the target until an automatic signal indicates that the mechanical plane is set, and pulls the release handle when the target crosses a second point on the sight. This operation signals to the scorer, who notes the hit or miss.

The Mists of Madness

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

THE case was pronounced one of death by suicide. He was suffering from the "hand washing" mania. Every day, fifty times a day, he washed his hands. He had to. He tried everything he knew, got the best medical advice, but the mania persisted. So one day he took a hatchet, amputated his left hand, thrust his right under a buzz-saw and cured himself—permanently. A ghastly example of the "compulsion" in its worst form.

Then we have the "obsession." In a certain asylum a chap is spending his days by request—by his own request, strange to say. Everyone is staring at him—so he thinks—and it irritates him terribly, so terribly that he knows perfectly well he would commit murder if free. He deliberately chooses the least of two evils, for his case is hopeless. No power we know of can shake that nagging obsession.

Nor can we do very much more for the third of this group, the so-called "phobia" or morbid fear. I had an odd old acquaintance whose life was just one long dance on a frying pan because of his horror of cats. A kitten would simply make his hair stand on end, while a full-grown cat was just indescribable. His reaction, in pure self defense, was to establish a dead line around his house and any puss which crossed that sacred boundary mewed his last to the accompaniment of a shotgun. This peculiarity, needless to say, made him extremely popular with all neighbors and landed him before the police more than once.

I wish you would keep these three types of mental illness in mind as representing one broad group of "neuroses." Strange as it may seem, they all have a very simple explanation. There is a fundamental sanity to insanity, in these borderline cases as elsewhere.

NOW let us take examples from another group of the neuroses. The reason for this grouping will be explained shortly. For example, consider the "hysteric." His or her symptoms are legion, but the typical case of the lady who screams, faints, weeps, has terrific temper tantrums, and makes herself generally "charming" when her will is crossed will do as an example to bear in mind. Then we must place "perversion" in this second broad group. Here we have a very wide sweep of cases from the invert to those horrible cases of assault on little girls which certainly justify lynching if such justification can ever be obtained. We might cite as a third type of case belonging to this broad group that of the "hobo," the tramp who, from the psychologists' point of view, belongs to this lunatic fringe.

We do not, of course, wish you to infer that we cover all classes of the near insane in the above groupings. We merely choose certain cases to illustrate what we will say later. Nor are all these cases clear-cut and dramatic. Compulsions run everywhere, from your own tendency to "knock on wood," through such relatively harmless cases as Samuel Johnson's touching every other lamp post, up to the very serious "hand washing mania;" obsessions from your own uncomfortable feeling that your neighbor is talking about you, through your very definite dislike for Protestant or Catholic, Negro or Japanese, up to those serious cases which may very easily end in murder. Phobias are countless. We have fear of closed spaces, fear of open spaces, fear of light and fear of dark, fear of water and fear of sand, even fear of fear. Some phobias are so slight as to make no impression whatsoever on the individual; others cripple an entire life.

In this article we are mainly concerned with the borderline cases which can be pretty clearly distinguished from those in which the individual is completely insane. These people on the fringe are only the part-time insane, so to speak. The chap with the hand washing mania is quite normal when he doesn't have the urge to wash his hands. The fellow who fears cats doesn't worry about rats or dogs. Keep cats away and he is quite happy. The pervert passes for normal among most of his friends, and the hysteric is quite a charming person —sometimes. In other words, this borderline group is still in touch with reality. A large part of the time the individual lives in a real world and acts like a normal human being. Suddenly a cat appears on the horizon or someone stares at him; then, for the time being, he is as insane as the best of them. One writer sizes up the condition of these cases by saying that they have one foot on reality and the other on a banana-peel. Results depend on where they put the pressure.

Despite the great differences which seem to exist between various types of mental disease, the explanation of insanity is relatively simple. Either there is damage to the brain or there is not. Syphilis of the brain, tumor, a fractured skull, or other factors may temporarily or permanently upset the individual's mental balance. Here the causes are more or less obvious. But those cases we have been citing have nothing wrong with the brain. Examine their thinking apparatus after death and it is just as good as yours or mine. Then why the insanity?

The answer is fairly clear and can best be given by referring you to your camera. Your brain is essentially a photographic plate, but there are several ways of getting at it. One set of pictures comes in through the eyes, but the plate can also be reached through the ears, the mouth, the nose, the sense organs in the skin and others. We can lump all these together in a very simple manner under the word "attention." Whatever has your attention at any particular moment, be it a good picture, a bad smell, or a boring lecture, coming through eyes, nose, ears, or what you wish, is registering on the camera of your brain. This is simply what you call learning, and all insanity of the type we are considering is learned. Your acquaintance is unbalanced or on the borderline because he has learned how to be insane. Moreover, in the great majority of cases, he has gone insane for exactly the same reason you go to college. It pays. More of this later.

THE near insane and the insane are as they are because the camera of the brain worked too well. This camera is peculiar, in that it has a remarkable sensitizer—emotion. Under normal conditions your brain works with average efficiency. Any emotion, however, such as fear, love, or hate, immediately jumps its efficiency in very marked fashion. The camera plate becomes very sensitive and anything which occupies your attention at that moment becomes burned in so deeply that in many cases it never can be erased. For instance, a soldier in a moment of intense fear had his eyes glued on a German helmet. Fear sensitized the brain, and the helmet was the object of his attention. Result: a case of "shell shock," in which the main symptom was the vision of this helmet and the face beneath it accompanied by great terror. Another soldier was shaving in front of his dugout when a shell

Borderline Insanity and Full Insanity . . . Types of Neurotics and Why They Exist . . . Types of Insanity and What Can be Done About Them—Not Much

passed between his legs but did not explode. At that moment of intense terror his attention and his right hand were occupied with his upper lip. As a result his arm was "frozen" in this position. He was unable to lower it.

This is exactly what happened in the cases cited in the first paragraphs. For instance, the hand washing maniac as a child got his hands in filth, was terribly disgusted and at that moment the thought uppermost in his mind was of washing his hands. Result: a hand washing compulsion. The cat phobia is quite clear. As a child a cat, whose kitten had just been killed by a dog, went mad, flew at the boy and bit him badly. The case with the obsession of staring is not so clear. Records cannot always be obtained. It is probable that, as a child, when intensely angry he was forced to do the will of a parent by being "stared down." Other cases would indicate some such explanation.

THIS principle of brain sensitization through emotion is essential to the understanding of all mental disease which does not involve actual brain injury, such as a tumor. We do, however, need another hypothesis to obtain a complete picture. This is the famous "pleasure" principle, which is simply another phase of our first, and explains not so much how they got that way as why they stay that way. It states that man will at all times seek pleasure and avoid pain. The pleasure may be remote, as in the case of the martyr at the stake seeking heaven or yourself in the dentist's chair avoiding a future toothache, but the principle always holds. Not all, but the great majority of mental cases are where they are because they enjoy it. They are incurable because they don't want to be cured. It is a pleasure for them to be sick and, like all sensible people, they intend to stay that way.

This is very well illustrated by that second group of cases from which we chose hysteria, perversion and the hobo as representatives. The working of the pleasure principle is splendidly seen in the hysteric. Johnny has not got his lesson ready, is certain to be punished and does not want to go to school. The fear aroused under such circumstances is far greater than we adults realize. As a last desperate move he plays sick. The result is miraculous. He finds himself the center of attention and he sidesteps school, both at one blow. Then Johnny does what any sensible child would do under the circumstances—he cultivates this marvelous source of power. Fortunately the attempt generally ends in disaster, to the tune of a slipper on the rear end. But sometimes the child scores a brilliant success. He learns to sidestep every responsibility and center sympathy on himself by feigning sickness. Then, as the years go by, he learns his lesson too well. The fake stomachache becomes "nervous" indigestion when faced with any strain. The childish tantrum becomes a genuine hysterical "fit." He really cannot control the symptoms any longer and he illustrates beautifully the working of the pleasure principle in these margin cases—for it almost always "backfires." The pleasure is generally far outweighed by the pain which results.

This principle of brain sensitization, plus the pleasure principle, is also well seen in the case of the pervert. Here the individual learns to gratify his sex urge along homosexual lines. The emotion which sensitizes the brain is obvious. Fully 95 percent of these cases are the result of learning by seduction at a relatively early age. Also it is very obvious that there is definite pleasure associated with these activities. And, just as clearly, there is a very grave danger of "backfire," for the life of the pervert is no bed of roses. As the old darky put it, he's always "on the edge of a verge." One false step and disgrace, even imprisonment, are the rewards which society offers him.

ALL of which, I think, gives us a very neat classification of these near insane wherein no brain injury is involved. Basic to all is the idea of brain sensitization through emotion—through *any* emotion be it pleasant or unpleasant, such as fear. Some impression occupying the attention at that time, be it a cat, a movement of the arm or the basis of a perversion, is indelibly burned into the brain. That is the picture and the whole picture in our first type of neurosis as represented by the compulsion, obsession, or fear.

But note that in our second large group, as seen in the hysteric, pervert, and hobo we have the pleasure principle added.

The individual deliberately repeats the original experience everytime he gets a chance. The hysteric enjoys being sick, the pervert would not be otherwise even if he could, and the hobo is having a lovely time. For that reason this group tends to be the more numerous and almost wholly incurable. Your hand washing mania case does *not* enjoy it. He really wants to be put straight. The case of the cat phobia certainly would never go around looking for mad cats to bite him—which is exactly what the hysteric or the pervert does. As a result the phobias will at least do their best to get well, whereas the hysterics will do their best to stay ill.

We would like to complete our picture by showing how this same line of explanation applies to the cases of real insanity—the "psychoses" which you see in the asylum. We can illustrate from the "big three"—dementia praecox, paranoia, and manic-depressive insanity. Do not be worried by the names, for they are all to be explained very simply. All these types are pursuing the pleasure principle in somewhat different ways, but the real insane, believe it or not, are the lot who are really logical. They illustrate in true form the sanity of insanity. Take your case of dementia praecox. This type of insanity is very common; in fact, the majority of cases in any asylum would come under this head.

THE patient who suffers from dementia praecox is living in a world of dreams. He sits in a corner all day long smiling to himself, making senseless movements with his hands, or wanders aimlessly about talking utter nonsense. But he is really having a grand time. His dreams have come true—because he lives in a dream world. For him you simply don't exist. If you can get him to talk he will give you a marvelous story of how he has a bride on the moon, a palace at the South Pole with an orchestra of polar bears, or ten billion dollars in the local bank. Name it and you can have it! He represents the perfect working of the pleasure principle. He got his start the same as our other cases, only the emotion was always pleasant. Then he made the very wonderful discovery that it was really almost as much fun to *imagine* you were doing something very nice as to do it. Besides, it took much less effort and you couldn't fail. So he began using his imagination more and more, becoming less and less interested in this cruel, sordid world until he just forgot about it completely and day-dreamed his way right into Heaven. For that is where he is. He's happy and will always remain so in spite of depressions or new deals.

Paranoia is just as interesting. This is the chap who thinks he is Napoleon, Alexander the Great, or George Washington. We say he has delusions of grandeur. He also has delusions of persecution which make him a very dangerous type of madman. Strange to say, his brain remains quite clear, he knows where he is and what he is doing, *but*

he is Napoleon, for all that, persecuted by his enemies. Like anyone who is being persecuted he is very likely to hit back, and his clear mind makes him all the more dangerous. But the working of the pleasure principle is obvious. He really believes he is Napoleon, feared and persecuted by the entire United States. As such he feels very important —and very happy.

Manic-depressive insanity does not give nearly as convincing a picture. The typical case has a period of mania in which he is literally on top of the world —so much so that he has to be locked up. Then he will have a fit of depression in which he will weep for weeks on end. The whole thing may then clear up and never return, or it may return at certain intervals. The working of the pleasure principle is obvious in the manic state but not so clear in the depressed. In fact, we suspect that there is an actual organic basis for this psychosis but as yet we know too little about it to make definite statements.

WE can now get a very consistent picture of mental disorder if we think back through the article. Remember that we are talking only of those types in which the brain is not injured. First and least important are those disorders which demand only the theory of brain sensitization by emotion. We illustrated from compulsion, phobias, and obsessions. A picture is printed indelibly on the brain but the subject does not like it. He does everything in his power to cure the condition and conceal the symptoms. So this type tends to be the least numerous and least severe. The next group, however, as represented by hysteria, perversion and the hobo, tends to be much more crippling because here we see the pleasure principle at work. The patient enjoys being ill, he re-exposes the photo plate on every occasion, so to speak, and parades his symptoms in so far as he dares. Both of these groups—the neuroses—tend to be on the lunatic fringe, but they are still tied to reality.

Finally you have just to carry the same principle a step further and you have the hopelessly insane. They have carried the pleasure principle through to its logical conclusion. They actually believe their own delusions, live in a world of dreams, cut themselves entirely clear from reality and are, perhaps, the happiest of all mortals.

So there is your picture. Then why don't we do something about it? The answer is obvious—we can't! The dice are all loaded against us. The first group offers some hope, but here you have the analogy of your photo plate. Over-expose your plate on a cat fight, take it down to the photographer and tell him to remove all traces. He may be able to do a great deal or nothing at all. It depends on how much exposure you got and how sensitive was the plate. The bets are that he will leave some lasting scars.

With the last two groups, however, the odds are all in favor of your wasting your sweetness on the desert air. The hysteric, for example, will do everything in his or her power to block a cure; the dementia praecox is so supremely happy that he won't even take time to give you a hearing.

DUE perhaps to a natural human tendency to sort things out and classify them sharply in regimented compartments, all neatly and ideally arranged where they can be counted and weighed and appraised statistically, many persons have gained the impression that it is possible to make definitely sharp diagnoses of each case of insanity and to say, in given instances, "This man is a schizophrenic (dementia praecox), that man is a paranoiac, and that one a manic-depressive." Unfortunately the actual cases do not always stack up just that way, and very often a given case exhibits some of the symptoms of several types of insanity or of neurosis. Hence if your friend—or enemy!—whom you suspect of being just a bit "peculiar", fails to fit exactly some one of the descriptions given, do not give up hope—he may still be whatever he is.— ***The Editor.***

There are really only two possible ways of dealing with these mental disorders when the pleasure principle is involved. You can offer a line of conduct that gives more pleasure, or you can make the present line of conduct so painful that they will avoid it. The first looks hopeful but does not yield much result. The pervert or hysteric reacts to this treatment in much the same way as would the average American if you tried to compel him to substitute snails for oysters on his dinner menu. You could present the most convincing arguments proving that, once he came to like snails, they would be much better for him and he would really enjoy them far more. He might admit it—to your face. He might even try snails—once or twice. Then he would probably send both you and the snails to the devil—which is just what the mental cases generally do.

Nor is the attack through discipline much better. Something can at times be done. One army doctor was in the habit of curing shell shock, which arose from a desire to avoid danger, by glaring at the patient and announcing, "Now, my man, there are just two people who know what's wrong with you. I'm one—you're the other. If you aren't *cured* in 24 hours, I'll send you up for a court martial." He cured most of his cases. But you can't keep on swinging a whip indefinitely over peoples' heads and expect lasting results.

The only attack on the problem is through mental hygiene in childhood. In other words, prevention. Almost all of these conditions arise before the age of ten at the latest. Our great enemy is the pleasure principle, which, as herein illustrated, always causes trouble by carrying over *childish* pleasure into adult life. "God bless father and mother, and make them happy—if they're not too old for that sort of thing," was Johnny's famous prayer. Our whole training of Johnny must be based on the realization that some day he will be an adult, and that society will either lock him up or make him very unhappy indeed if he *is* "too old for that sort of thing" on the adult level.

THUS, the neurotic presents one of those contradictions so often seen in psychology. He is as he is because of the pleasure principle. He resolutely resists treatment for the same reason, yet he may be very unhappy. His pleasures are those of the child but he lives in an adult society. Nor can he ignore that society, try as he may. Despite his ridicule of convention and his passionate demand for self-expression, he knows that he walks between the devil and the deep sea—between the asylum on one hand and prison on the other. Let him but overstep those despised conventions and society is ruthless, regardless of his ruination, as indeed it must be in self-protection.

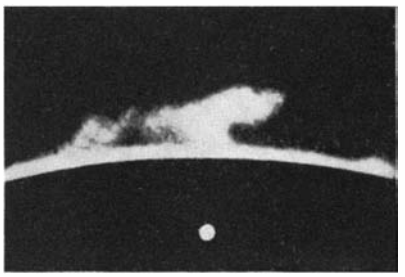
Under the strain of modern life we may expect an increase in mental disease. Normalcy involves the facing of reality in an adult world, an assignment which is becoming less and less attractive as civilization becomes more complex. Our only hope, if hope there be, of stemming this rising tide of maladjustment, lies in education.

We must teach the child to face reality in an adult world. That is a tremendous task, for which we must learn to recognize those signs which tell us that the child is becoming wedded to childhood pleasures. Then we must perfect a technique with which we can change his diet, all to be so simple that the average school teacher can understand and apply at least the broad principles.

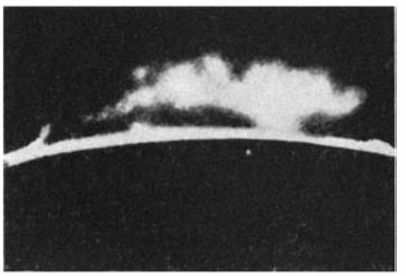
Progress? Very slow, for the problem is far from simple. Under the guidance of such organizations as the National Committee for Mental Hygiene we are at least learning to visualize the problem, but we may truthfully say that, up to now, our progress has indeed been slow in actually dispelling the mists of madness.

THE SUN REAWAKENS

By ALBERT G. INGALLS



May 14, 1936



May 15, 1936

A quiescent type of hydrogen prominence, changing but little in a day

"TRUE to the prediction of the 'eleven year cycle,' solar activity is increasing and for two or three years the sun should prove a most interesting object for the observation of sun-spots and prominences." Four years ago[1] Scientific American contained an article entitled "One Man Who is Having Fun," which told how Gustavus Wynne Cook, of a Philadelphia suburb, had created an unusually large and expensive private astronomical observatory. A later article[2] described further additions to this observatory, and stated that a staff of professional astronomers was being maintained by Mr. Cook. Since then the Cook Observatory has received further additions in staff and equipment, and is now regarded as a part of the professional astronomical commonwealth of the nation and world.

The opening sentence, quoted above, is from a communication from Mr. Cook, who also sent some photographs of solar prominences which are shown on this page. They were taken this year at the Cook Observatory, by means of a spectroheliograph. In looking at these vast outgivings of heated solar gases the reader should keep in mind the relative scale of size, which is provided by the small circles afterward placed on the photographs by Mr. Cook. These represent the earth on the same scale, and the convex curves are those of the sun's surface. It is fascinating to imagine the earth exposed for a single second to a flame the size of the prominences shown: like a butterfly in a bonfire, singed, seared, and despoiled in a moment.

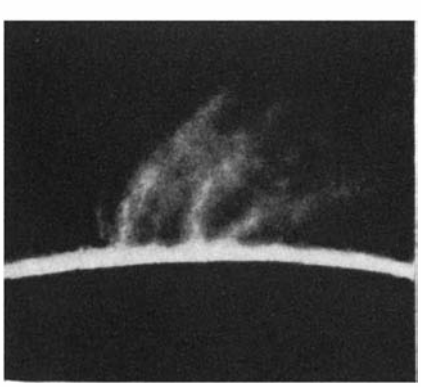
Every 11.2 years (on the average) the number of sun-spots gradually increases from almost none to several hundreds per year, and more or less in unison with this the number of solar prominences increases also, from none to 20 or 30 visible at any one time. Beams of electrons are shot out of sun-spots and these sometimes strike the earth, causing magnetic storms and auroras.

The last previous period of maximum sun-spot and prominence activity occurred about the middle of 1928. Therefore the next peak is due in 1939. We have already passed the dip between these two maxima, and at present are well up the rising part of the curve toward the new one. As Mr. Cook's comment at the opening of this article implies, some interesting things connected with the sun are on the make at present, and will be on the make for two or three years to come. Astronomers, both professional and amateur, become more sun-conscious at such times as this.

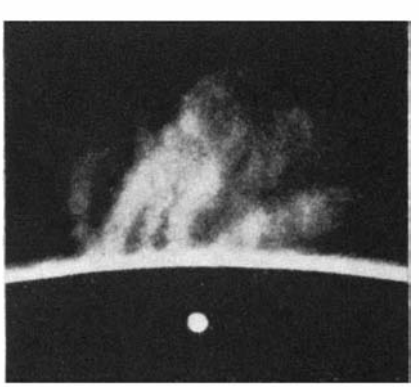
Solar prominences are projections from the upper layers of the sun's atmosphere of hot gases, and their color is predominantly red. Thus the reader will be fully justified by scientific facts if he imagines the "flames" of the hydrogen prominences shown on this page as red. Nor is the red of hydrogen prominences a faint or filmy thing called red by mere courtesy, as in the case of some of the "colored" stars where the observer must almost be first hypnotized in order to believe he sees the faint color of the star as described in books about the pretty stars. When a hydrogen prominence is seen through a Hale spectrohelioscope, visually operated brother of the photographically operated spectroheliograph with which these photographs were taken, he sees them red—as frankly and definitely red as grandfather's red flannel underwear. The reason: atoms of hot hydrogen radiate in wavelengths which excite the sensation of red on the retina.

At the top are two photographs (more precisely, spectroheliograms) of a "quiescent" type of hydrogen prominence, which Mr. Cook has called the "Dog Prominence" because of its shape. These were made at an interval of 24 hours. Quiescent prominences behave in a relatively lazy manner, often lasting several days with only slow changes in form. The three lower spectroheliograms exhibit the other type, the eruptive kind; no lazy floating or drifting here! They sometimes shoot up at the rate of 200 miles per second. Regarding this one Mr. Cook writes, "This eruptive hydrogen prominence was first photographed at 11:48 a.m. and again seven minutes later, and again eight minutes still later, at which time it showed a height of 80,000 miles and a breadth of 75,000 miles. This prominence," he adds, "was of unusual size—the largest eruptive prominence for several years."

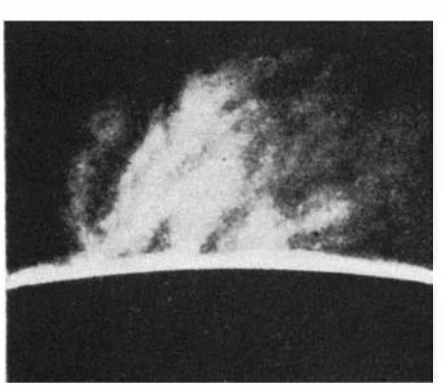
[1]August 1932, page 74.
[2]June 1935, pages 318-320.



11:48 a.m.



11:55 a.m.



12:03 p.m.

An eruptive prominence of immense proportions, which shot up at great velocity on April 14, 1936

Mystery Shafts of Ipswich

Suspicions of Roman Age . . . Strange Condition of Affairs . . . A Peculiar Feature Was Observed . . . A Foxy Trick But Not Foxy Enough . . . Suspense

By J. REID MOIR
President of the Ipswich Museum, England

FROM the archeological standpoint the brickfield of Messrs. Bolton and Co., Ipswich, England, may perhaps lay claim to that frequently misused title—unique. For a considerable number of years a close watch has been kept upon the diggings for brickearth there, while extensive excavations have been carried out for archeological purposes. This work has resulted in getting together flint implements ranging in date from the earliest to the latest relics of the Bronze and Iron ages, and very numerous remains from alluvial ground of the late Roman period. But the interest of the Ipswich brickfield has recently been greatly increased by the discovery there of three very deep, filled-in shafts of a type hitherto unknown in England, and in some particulars, unlike those found elsewhere.

The shafts lie roughly in an east and west line and about 10 feet distant from each other. They are all of a remarkable character. The shaft first uncovered shown at the right side of Figure 1, proved to be a clay-lined cylinder—approximately three feet ten inches by two feet four inches in internal diameter, which passed down through the harder clay and deep into the underlying Eocene sand. The walls of this structure averaged nine inches in thickness (in places where extra strength was required, they were considerably thicker), and were made from puddled clay smoothed off on the inside by some instrument, probably of wood, which occasionally had left its impress upon the surface of the wall. The shaft was filled with a peculiar loamy material evidently brought from some other part of the brickfield, and was practically devoid of archeological relics. In fact, the only thing of the kind found in the shaft, and about 16 feet from the surface, was a small fragment of pottery which is believed to be of early Roman antiquity. The other discovery made in the infilling was a piece of matted hair, referable to either the badger or rabbit, lacking in any recognizable significance. It is of interest to note, however, that a precisely similar piece of matted hair was found in the infilling of the neighboring shaft while this was being excavated.

Shaft Number 1—the clay-lined cylinder—was traced to a considerable depth without reaching its base, and it was decided, in view of the peculiar and somewhat dangerous conditions attending its examination, to devote attention to the neighboring Shaft Number 2, shown toward the left in Figure 1. This presented a fundamentally different appearance (Figures 2 and 3) from Shaft No. 1, being some six feet in diameter, and filled in, as to its uppermost 18 feet, in a careful and elaborate manner. The center of the shaft, marked *A* in Figures 2 and 3, was composed of a pillar of puddled clay, some three feet wide, and with a rounded base, while its periphery was outlined with a layer of black pebbles, marked *B* in Figure 3 and sketched in Figure 2, evidently procured from a deposit of these which occurs in the immediate vicinity of the shafts. Between the central pillar or core of clay and the main walls of the shaft, had been built two walls of whitish clay with a globular base (*C*, in Figures 2 and 3). These subsidiary walls did not wholly surround the central mass, but had been built on either side of it. Between them and the walls of the shaft, and the central core, had been placed sand. Very careful notes and drawings, supplemented by photographs, were made of this strange condition of affairs, representing in all probability a ceremonial sealing in of the shaft. Below the 18-foot level the infilling was of a haphazard nature.

In both shafts Numbers 1 and 2 a peculiar feature was observed, in that, at some considerable depth from the surface, the clay walls of the shafts coalesced, forming a basin extending over the whole internal area (*D*, Figure 2). It is difficult to explain this, but it may represent a device to induce any later excavators of the shafts to imagine that they had reached the bottom, and thus abandon their enterprise. In the present case, however, the use of a metal probe at once showed that the shafts extended downward below the clay basin, and the work of excavation proceeded. The investigation showed that the shaft was roughly bottle-shaped and passed through a great depth of sand lying upon the chalk. When the latter was reached, the excavation changed in character, assuming in plan a more or less hour-glass form, and this was continued as far as the recent diggings extended.

Unfortunately, soon after the chalk was reached, a great and increasing quantity of water was encountered, necessitating the use of pumps for its removal. The use of these gave rise to

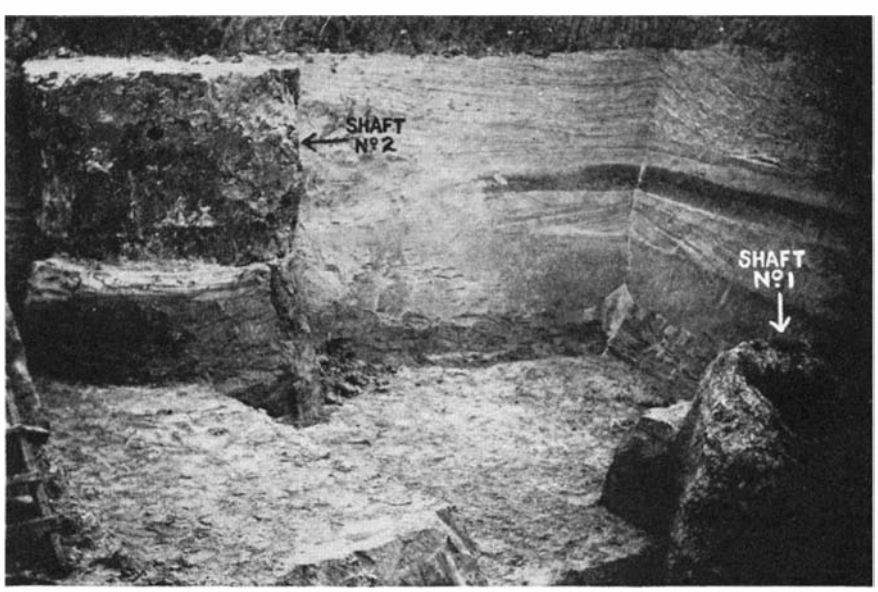


Figure 1: **Showing shafts No. 1 and 2. In excavating, the earth was carefully dug out from around the two shafts, leaving them standing partly in the clear**

much trouble and expense, and, upon a depth of about seven feet from the surface being reached, the inflow of water rose to some 15,000 gallons per hour. To cope with such an inflow still more powerful pumps would have been required, but the financial resources available were not sufficient to meet the necessary expenditure, and with great reluctance the work had to be abandoned. Its undertaking had made necessary the use of timbering and was not devoid of danger, but fortunately the digging was carried out in safety.

IT became clear that the ancient excavators had used a primitive form of timbering in sinking the shafts, as impresses of this were visible in places on the outside of the infilling. From an examination of these impresses it seems that the wood used was split off the outside of a tree trunk, as one side was approximately flat, while the other was convex. Several small pieces of wood were found in the infilling of Shaft Number 2, and these probably represent fragments broken off when the timber was drawn as the infilling of the shaft proceeded. Pieces of chalk bearing pick-marks were discovered considerably below the present water level in the chalk, showing that this level has risen some distance since the days when the shafts were originally dug.

It is to be regretted that, as with Shaft Number 1, the infilling of Shaft Number 2 yielded very little of an archeological nature, but what was discovered may be of considerable significance. When the chalk was reached two pieces of silver sheeting were found, and these the authorities of the British Museum think may represent part of the fittings of a casket or treasure chest, broken off when it was being lowered into the shaft. A fragment of polished marble also discovered may, too, have formed a part of such a casket.

At a lower level than these relics were found a *pavé* of chalk flints placed close together and covering the whole interior area of the shaft, *E* in Figure 2, and some pieces of brick, apparently of Roman date, which have the appearance of having been broken off during the building of some structure.

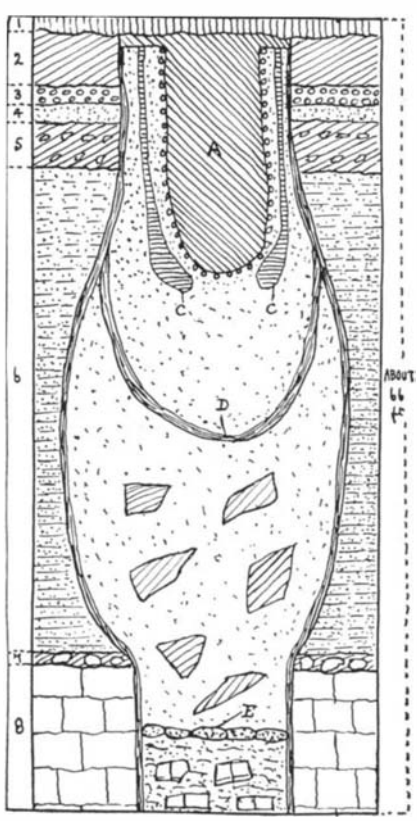


Figure 2: **Cross-section of No. 2. *A*, puddled clay outlined in pebbles. *C, C*, whitish clay walls. *D*, the "trick" (?) wall which did not trick. *E*, a *pavé* of chalk flints**

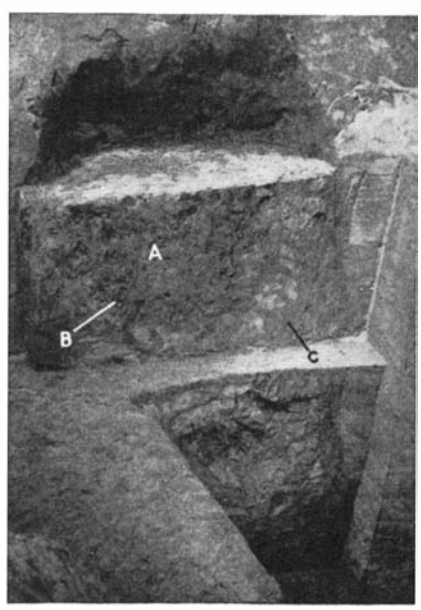


Figure 3: **This photograph corresponds in detail and in lettering with the cross-section at the left, except that it exhibits only a third or somewhat less of the total depth of the well, as indicated at the right side of Figure 2—i.e., "about 66 ft."**

Another curious feature was provided by the unctuous clay material about three inches thick, covering the walls of the shaft where it entered the chalk. This material, which contains an appreciable quantity of hair, has been analyzed, and found to possess a considerably larger amount of what was originally organic matter than is present normally in ordinary geological deposits in the brickfield and neighborhood. It is conceivable that if blood (the result of some sacrificial rites) had at one time been present in the shaft, this would account for the abnormally high organic content in the material.

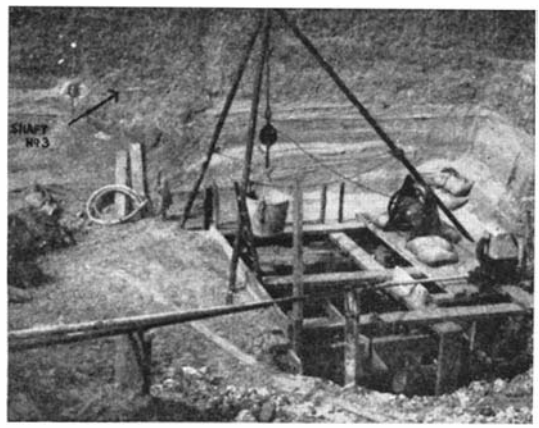


Figure 4: **The timbered mouth of Shaft No. 2, showing the equipment used in the excavation. Arrow points to filled-in portion of Shaft 3**

It is thus apparent that these shafts (Number 3, Figure 4, resembles Number 2 and remains unexcavated) exhibit many mysterious aspects, and it is greatly to be regretted that their complete excavation was not possible. If adequate funds were available there is little doubt that the site, which is in danger of being built over, could be successfully examined, and it is highly probable that objects of much archeological interest and value would be recovered.

THE shafts are situated close to a Roman burial ground, and about a quarter of a mile from the Roman Villa at Castle Hill, Whitton. It would seem likely, therefore, that the excavations are to be associated with Roman times. This view is strengthened by the discovery in France of what are known as *puits funeraires*, which are deep shafts —some penetrate to a depth of 120 feet —of the early Roman period. It was the custom in those days to bury the ashes of the dead in cinerary urns, and accompanied by numerous funerary objects, in such shafts with, it is supposed, the two-fold view of protecting the departed, and preventing haunting of the living. Many of these funerary objects are of great beauty and value.

Other burial shafts of the late Roman period, such as those of Cyprus, led down to a chamber or chambers where the coffin was placed, together with a wealth of funerary furniture. It is not possible to say whether the Ipswich shafts belong to one or either of these periods, but their association with the Castle Hill Villa of late Roman date would point to their being of the latter epoch. In any case, the recent excavations have opened a new chapter in English archeology and filled those who carried out the work with profound admiration for the skill with which the ancient shaft-sinkers overcame the many difficulties which confronted them.

NEW LIGHT ON THE

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.

ONE of the most perplexing of astronomical problems is the origin of our solar system. It presents a large central body surrounded by many small ones, all revolving about it in nearly circular orbits close to the same plane and in the direction of rotation of the central body; and this property is repeated four times in the satellite system of the planets from Mars to Jupiter. This cannot be an accident. Some orderly process must have been operative. The earth's large satellite and Neptune's, which revolves in the opposite sense to the planet's rotation, look more like peculiar cases of the operation of such a process than like absolute exceptions. Yet a century of investigation has served mainly to emphasize the difficulty of even guessing what really happened.

Laplace's old theory—that a large nebula, flattened by its rotation, shed, as it contracted, ring after ring from its periphery—was overthrown toward the end of the last century by simple dynamical arguments based on the principle of angular momentum.

This might be described in Newtonian language as the "quantity of rotation" of a system. Take the mass of any particle, multiply it by its distance from an axis (passing through the center of gravity of the whole), and again by its velocity in the direction in which rotation about this axis would carry it, and we have the angular momentum of that particle. Add all these and we get the angular momentum of the whole system. It is important because, as follows at once from Newton's laws of motion, this total angular momentum cannot be altered by any forces acting within the system between its parts, even if they involve friction and degradation of energy. It can be changed only by influences from outside.

NOW more than 98 percent of the angular momentum of the solar system resides in the orbital motions of the planets. The sun's rotation is so slow that it adds very little. Yet the planets all told have but 1/7th of 1 percent of the total mass.

A process which, without external aid, would concentrate 98½ percent of the rotational momentum of an isolated system into 1/700 of its mass would have been very extraordinary. Indeed, careful mathematical studies by Moulton, Jeffreys, and others, show that it would be more than extraordinary: it would be dynamically impossible.

This great obstacle was cleared in 1900 by Chamberlin and Moulton who suggested the first form of the "encounter theory." According to this, a star, coming from the depths of space on a path which happened to pass very close to the sun, caused by its attraction great eruptions of matter from the sun's intensely hot interior. Some of this molten matter fell back, some may have been carried off by the star, but the rest

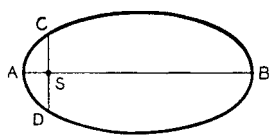


FIG. 1

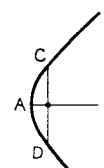


FIG. 2

was set into motion laterally by the star's attraction and remained circulating around the sun, after the star had receded into space, in orbits nearly in our plane. Whether this matter originally congealed into a multitude of small "planetesimals" which later became aggregated into the planets, or whether the latter were of nearly their original size from the start, is a detail—important, but less so than the main idea. Jeffreys and Jeans have presented convincing arguments in favor of the latter alternative, attributing the ejection of the planets to the action of huge tidal forces as the star almost grazed the sun. Jeffreys has later gone further and assumed that the star actually hit the sun in a "side-swiping" collision. This form of encounter accounts for the relatively rapid rotation of the planets better than the others, but the whole set of hypotheses meets with very grave difficulties and once more on grounds connected with angular momentum.

It follows from the laws of gravitational motion that there is a simple relation between the angular momentum per ton possessed by a body moving around the sun and the size of its orbit—provided that this "size" is properly measured. Instead of taking half of the longer axis of the elliptical orbit (*AB* Figure 1), we must draw a line *CD* through the sun perpendicular to this and take half of *CD*. The angular momentum per ton is then proportional to the square root of this distance. This proposition still holds good for a parabolic or a hyperbolic orbit (Figure 2). For an elliptic orbit (Figure 1) the perihelion distance *AS* is always more than half of *CS;* for a parabola it is just half; for a hyperbola, smaller. Now, in order to disrupt the sun by tidal action, much more to collide with it, the star must have come so close that *SC* could hardly exceed 5,000,000 miles. The total angular momentum of the star as it moved about the sun must have been enormous, but the angular momentum per ton would remain small—about one quarter of that possessed by the earth in its orbital motions and less than 1/20 of the value for Neptune.

To get the planets out of the sun and give them orbital motions of their present type, the star would have had to impart to them very much more angular momentum per ton than it itself possessed. The difficulty of devising a process by which the angular momentum of many tons of the star's mass could be concentrated into a single ton of the ejected material is as great as the older one which wrecked the Laplacian theory. Moreover, even if it could have happened, the distance *SA* would have been but a few millions of miles, while *SC* (corresponding to the angular momentum per ton for most of the planets) would have been hundreds of millions, so that the mass would have flown off in a hyperbolic orbit and never returned.

THE writer of these lines pointed out this difficulty a year or two ago but saw no way to get around it. This has now been done with marked success by Mr. R. A. Lyttleton, a young Englishman holding a visiting fellowship from Cambridge to Princeton.

The writer had considered in a general way the possibility that before the birth of the planets the sun had been a double star, and that it was the other member of the pair that got hit by a passing star; but he saw no way of getting rid of the main mass of this companion and of the intruding star and leaving stuff enough to make the planets. Mr. Lyttleton has shown by simple reasoning that it would have been entirely possible for the third body to impart such a speed to the companion that it was sent off into space in a hyperbolic

ORIGIN OF THE PLANETS

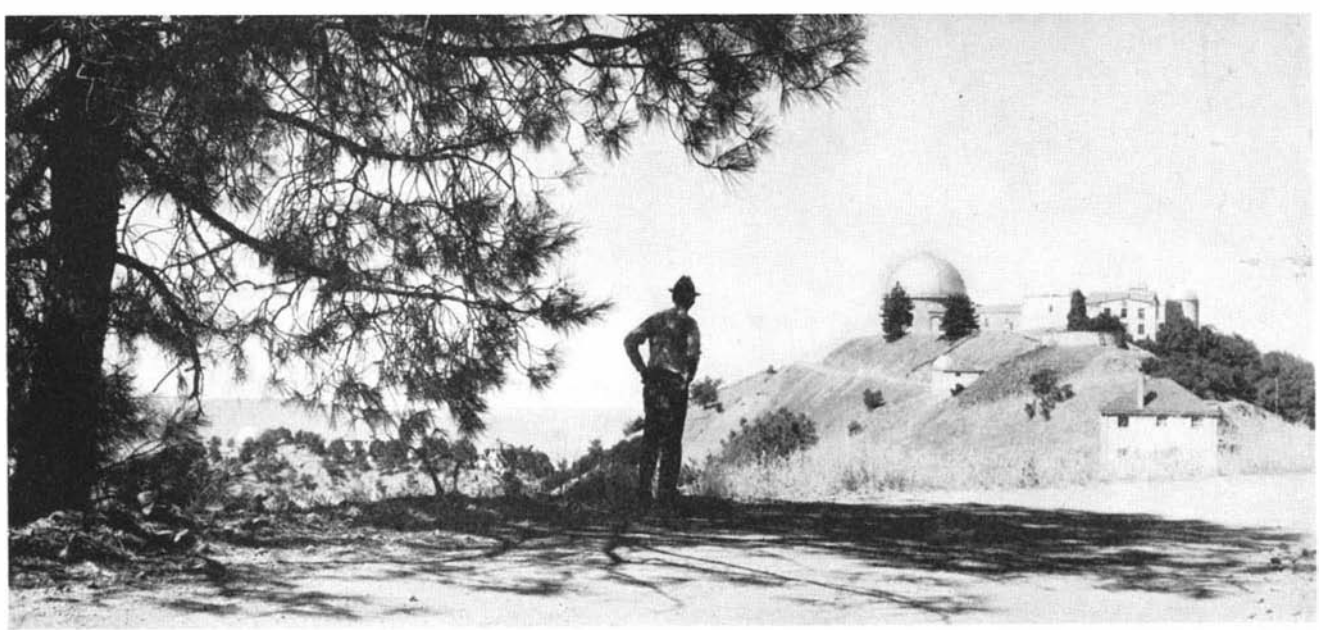
The Lyttleton Theory, New Explanation of Planetary Origin, Which May Continue To Be Heard Of . . . Extant Explanations Did Not Wholly Satisfy

orbit without being itself so much slowed that it was unable to escape from the sun's attraction. (The alternative that the companion was ejected and the interloper captured is also possible but does not concern the present problem.) Suppose that the companion and the interloper actually collided. As they separated, a long filament of material composed of stuff mixed by the collision would drag out between them. The part of this nearest the companion and most nearly sharing its speed would fly away with it, possibly forming eventually one or more planets revolving close to it, and the same would be true for the interloper. But if companion and interloper went off in quite different directions (as is probable) the middle part of the filament would be left with a much smaller motion, relative to the sun, than either of them, and this motion might very easily be too slow to escape the sun's gravitational pull. Part of the filament would then give rise to bodies moving about the sun in permanent orbits. These would all extend to a distance as great as or greater than that of the place of the collision, but the angular momentum per ton would be much greater for some parts of the filament than for others. If it condensed into a number of lumps, the primitive planets then would have very different values of the angular momentum per ton, as the actual planets do. It is entirely possible, nevertheless, that all should circulate around the sun in the same general direction.

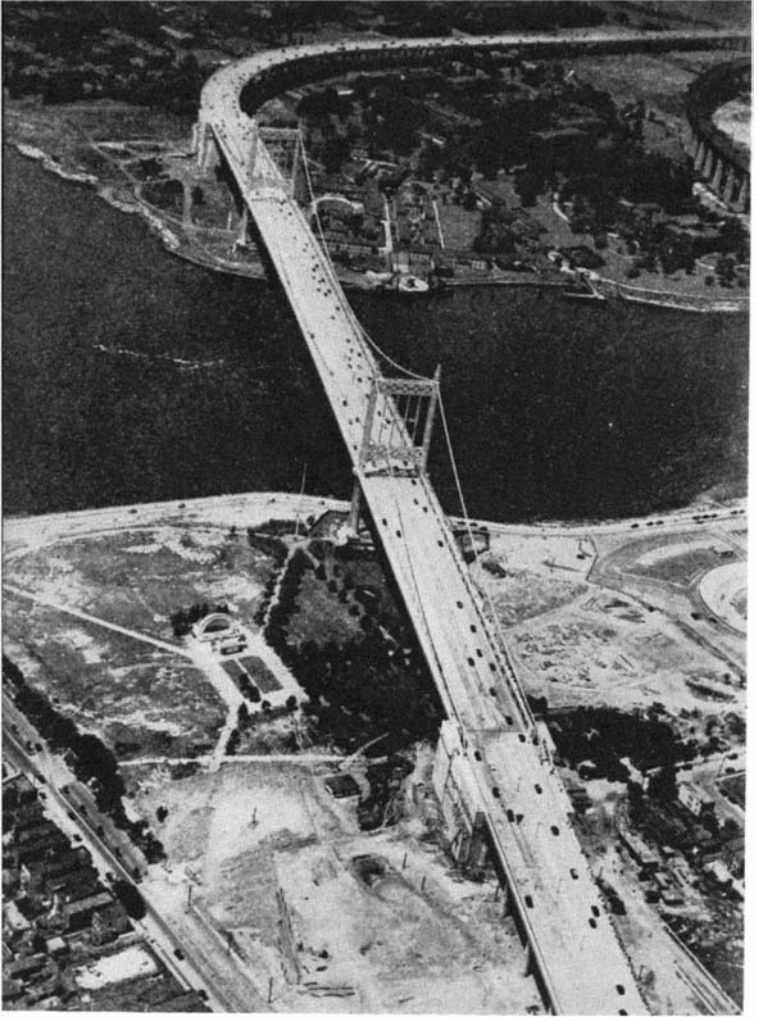
The second great obstacle to a rational theory of the origin of the planets has thus been successfully removed.

MOREOVER, Lyttleton's theory without further assumptions removes a third great difficulty; namely, the origin of the satellite systems. These are obviously miniatures of the solar system and we might justly expect that a theory which explained the origin of one would explain the other. The best that could be done on the earlier theories of a close encounter with the sun was to assume that the next time the embryo planets came near the sun, its attraction pulled the satellites out of them. But by this time the planets would have settled down to nearly elliptical orbits, and the argument from angular momentum per ton shows that the distance (SA, Figure 1) must have been about half their present distance—far too great for tidal disruption. On the new theory the orbits of the new-born planets would all pass through, or very near, the point of encounter. Only the differences in their periods would prevent near-collisions at their next returns. Fairly close approaches, sufficient to cause considerable changes in the orbits, should occur repeatedly, and, in the course of time, it is likely that some pair of planets would collide, or barely miss one another, and thus provide satellites for one or both of them. In the satellite systems, the central body has most of the angular momentum and the distances of the attendants, measured in radii of the primary, are much smaller than for the planetary systems, so that the original difficulties are no longer hopeless. Even the retrograde satellite of Neptune may be accounted for as a result of a collision in which the other body passed around Neptune in the opposite sense to the planet's rotation. The relatively enormous size of the moon remains troublesome but certainly no more so than on any earlier theory.

All told, the new suggestion marks a very important advance in the attempt to interpret the past of our system. Difficulties still remain but these are rather of a physical than a dynamical nature, and were common to all the older theories as well. The old fatal troubles which left the would-be student of cosmogony almost in despair are apparently vanquished.—*Jamestown, Rhode Island. August 2, 1936.*



A photograph of Lick Observatory, taken by Oscar S. Marshall, an amateur astronomer of Pasadena, California—one of the founders of the "Telescope Makers of Springfield" (Vermont), an amateur movement which has spread far beyond its origins

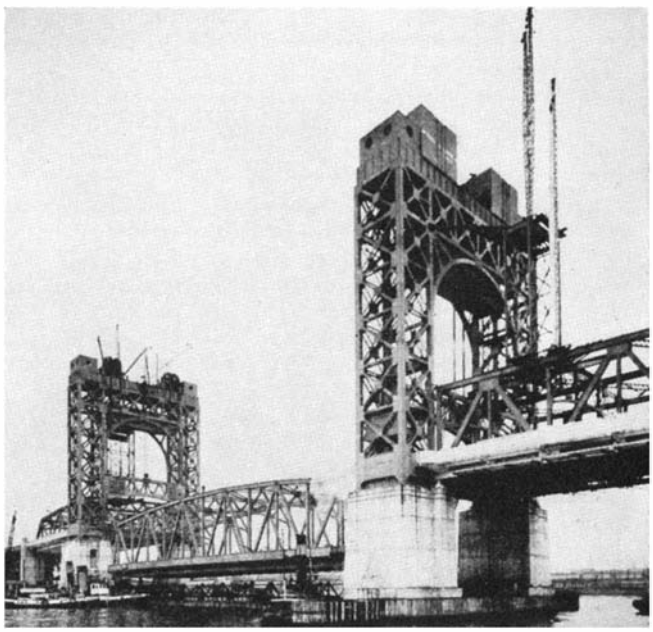


The suspension span over Hell Gate, looking from Queens. The main span is 1380 feet long, the side spans 705 feet. Vertical clearance over the river is 135 feet. Width over all is 113 feet, and the towers are 315 feet high. The span is stiffened against wind by trusses 20 feet in depth and a system of bracing below the roadway. The roadway itself will safely accommodate eight lanes of motor car traffic

Four Bridges

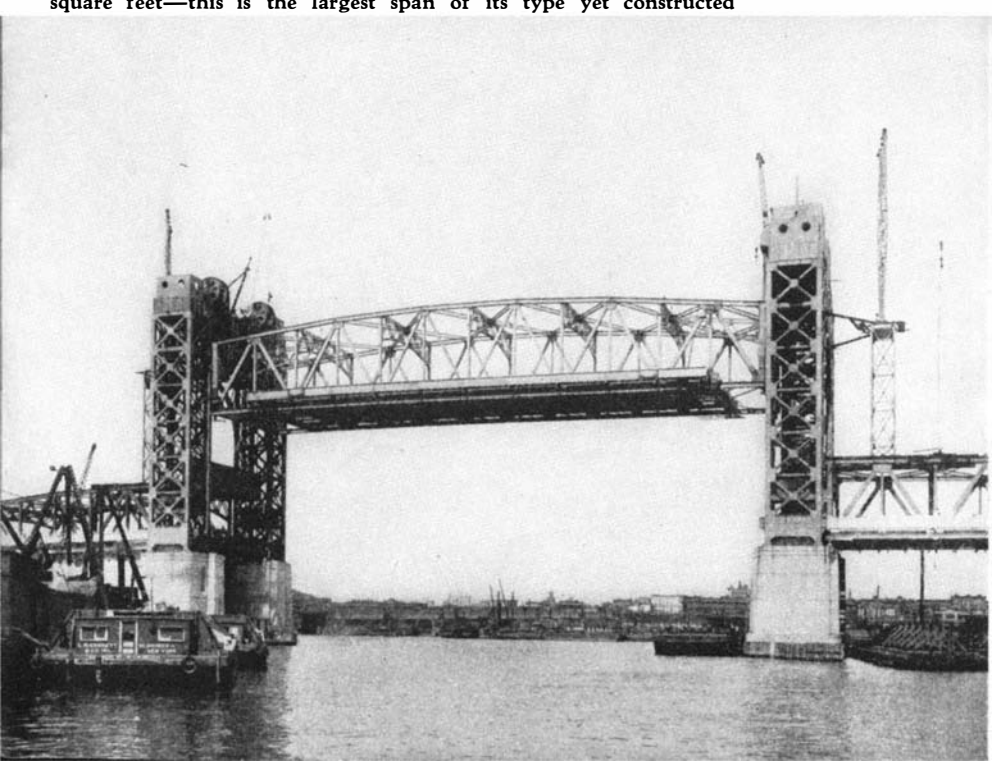
Seven Years Building . . . Unite Three Boroughs . . . Traffic Sorter . . . Part of an Express Highway System

MOTORISTS in the most congested traffic area in the world have recently been able to try out a marvelous piece of engineering designed especially to speed up motor traffic and eliminate congestion. This area is a part of Greater New York, and the engineering marvel is the Triborough Bridge. In order to visualize the scope of the project, it is necessary to keep in mind the fact that New York City is composed of five boroughs, one of which—



Hoisting the vertical lift span from car floats on which it was constructed. Massive design of the 210-foot towers is shown in this photograph

Vertical lift span in the Manhattan branch, during construction. The lift span has a length over the channel of 310 feet, is 55 feet above the water in lowered position, and can be raised to provide a clearance of 135 feet. Measured in terms of deck area—29,000 square feet—this is the largest span of its type yet constructed



Manhattan—is situated on an island, and another—Queens—on the western tip of Long Island. Any traffic entering or leaving Manhattan must make use of bridges, tunnels, or ferries. To eliminate many of the traffic difficulties occasioned by this—from the motorist's point of view—unfortunate geographical situation, the Triborough Bridge was conceived. Construction started on October 25, 1929. With a lapse in construction from the spring of 1932 to November 1933, due to lack of funds, the bridge was completed in July 1936. Total cost was 60,300,000 dollars.

Although this newest of the really great bridges is usually referred to in the singular, it is really composed of four over-water spans, with connecting

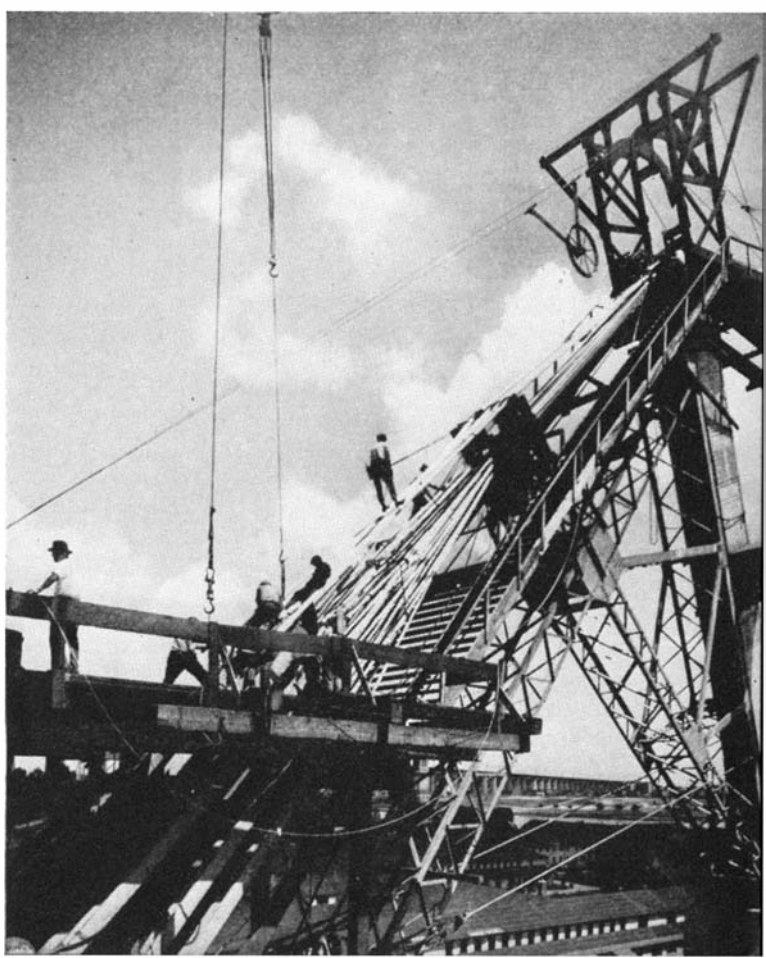
In One

links, and a model express highway, totalling 17½ miles in length. The air view directly to the right gives a complete picture (looking east) of the bridge structures and connecting links. In the right foreground is Manhattan; in the left foreground, the Bronx; and in the upper background, Queens. Traffic from Queens is carried first on a suspension bridge over Hell Gate in the East River, thence on a plate girder viaduct structure across Ward's Island, Little Hell Gate, and Randall's Island. On the latter is a traffic-dividing junction with the Manhattan branch of the structure. From the junction, truss spans carry the roadways over the Bronx Kills and a large railroad yard to the Bronx. The design here is such that, if the Kills ever is made navigable, the truss may be converted into a lift span. The Manhattan branch consists of truss spans on Randall's Island and a vertical lift bridge across the Harlem River. The Manhattan approach separates into two branches to carry traffic directly into the streets of the island or to the street grade at the waterfront as shown in the illustration below.

Aerial view of the Triborough Bridge, showing the completed project and some of the approach highways, which, in themselves, constitute a remarkable system for speeding up and by-passing traffic around congested thoroughfares. The traffic divider on Randall's Island (see also our front cover) eliminates all grade crossings, enables traffic to go its way without interference, and permits the collection of tolls with a minimum loss of time

Ramps at the Manhattan end of the bridge. Traffic to and from the interior of the island uses separated ramps; east waterfront traffic makes use of the curved approach shown

Cable spinning operations at the Ward's Island anchorage of the Hell Gate suspension span. Two parallel cables 20¾ inches in diameter, each containing 9176 wires, carry the weight of the span through steel suspender ropes which pass over grooved cable bands spaced 29 feet apart. These suspender ropes are attached to steel floor beams, eight feet deep, which span the full width of the deck of the bridge



Our Merchant Marine To Be

Merchant Marine Act of 1936... Direct Subsidies ...Helps Development, Shipbuilding... Strengthens Competitive Position ... Aids National Defense

By HON. DANIEL C. ROPER
Secretary of Commerce

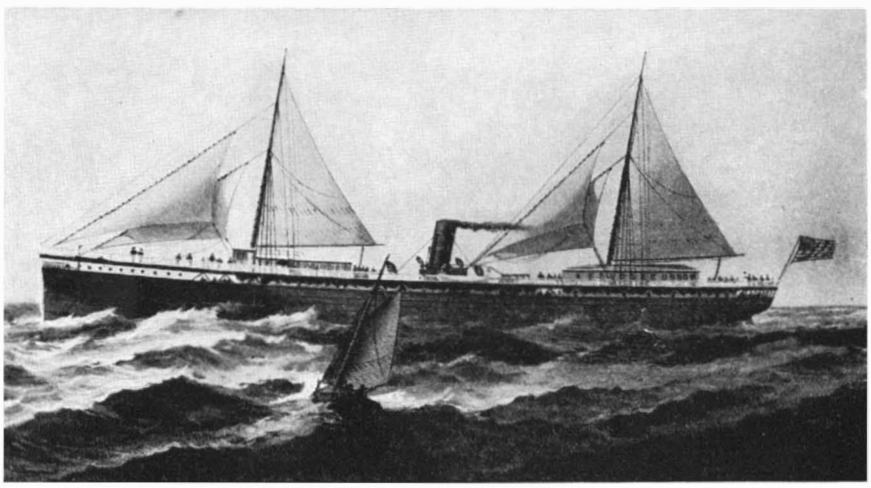
THE day Congress adjourned it enacted a measure which had engaged the attention of Congressional committees for more than a year and which on the statute books will be known as the Merchant Marine Act of 1936. The declared purpose of this Act, the fourth great merchant marine measure to be enacted into law during the past generation, is to further the development and maintenance of an adequate and well-balanced merchant marine under the American flag.

Despite divergent views as to the merits of the bill in the form in which it finally passed both Houses, its enactment brought a feeling of relief to those who realize our weak competitive position on the country's essential trade-routes. New legislation had become absolutely necessary if we were to preserve and improve the maritime position which we have won since the war. It was clear to everyone that the system of indirect subsidies established by the Merchant Marine Act of 1928 had not produced the results expected by its proponents. Not only had it lent itself to certain abuses of administrative power, but it had failed to protect the American taxpayer from the unconscionable practices indulged in by some of the shipowners who were receiving Government aid. Perhaps the outstanding weakness of the Act was its failure to bring about a sufficient number of replacements to modernize a fleet which has become so obsolete that without generous subsidies it can no longer hope to compete in international trade.

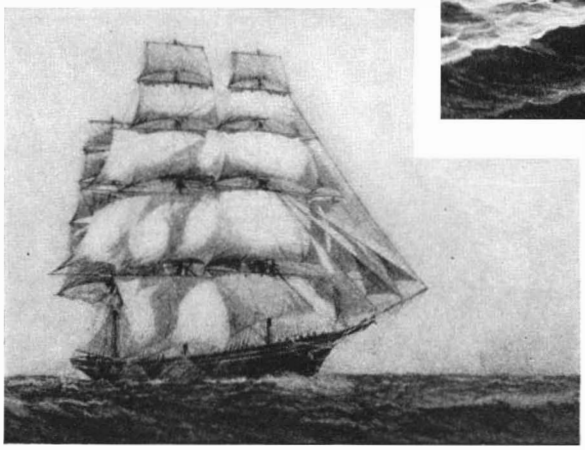
The new law substitutes a system of direct aids for the indirect subsidies now granted in the form of compensation for the carriage of ocean mails. It contains numerous provisions designed to prevent laxity of administration. It places on the shipowner certain definite obligations which were lacking in the old law and which it is felt will adequately safeguard the interests of the Government. Finally—and to me this is the best feature of the new legislation—it will make possible the early and orderly replacement of our antiquated tonnage, including about 200 cargo ships which have already seen their best days and which, because of age, slow speed, and high fuel consumption, are dissipating a large part of the financial aid received by their owners for the maintenance and improvement of essential services. These antiquated cargo vessels, operated at excessive cost, have for years been waging a losing contest on the country's overseas trade-routes, in competition with the newer and more economical ships that have been built since the war by our numerous maritime rivals.

While the high cost of operating obsolete ships is fully realized by naval architects, marine engineers, and, of course, by the individuals who have the misfortune to own them, I believe that it is not so well understood by the public at large. We can draw a graphic parallel by saying that the attempted successful operation of a ship built according to pre-war plans and specifications is a good deal like trying to make money with an auto truck of the vintage of 1914. In both cases there are excessive repair costs, excessive fuel bills, slowness of delivery, and a consequent inability to secure high-grade business. Furthermore, when the ships—or trucks—are slow, a larger fleet is required to transport a given volume of freight than would be the case if the carriers were fast, modern, and economical to operate.

The fact that the United States, due to its large number of old cargo ships, has the most antiquated and non-competitive merchant marine of any of the principal maritime nations, is no reflection on the American shipbuilder. Our possession of this obsolete tonnage results in part from the haste which marked our war-time shipbuilding activities, and in part from our subsequent failure to realize how great a handicap these old vessels impose on the American



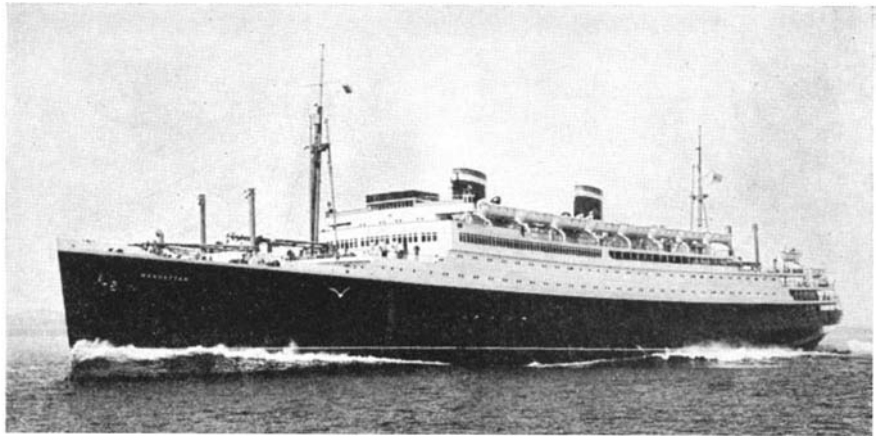
A steam-sail hybrid of the past century, representative of an important transition period



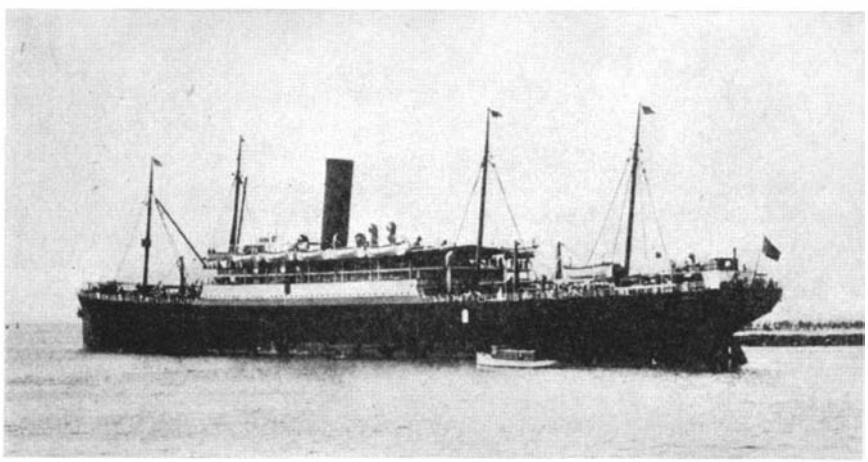
Finer than any sailing vessels ever built elsewhere, the American clippers were world-famous carriers of cargo

shipowner. As a matter of fact, at the time they were built we had little choice as to type, sizes, and speeds. So urgent was the demand for tonnage to replace the losses inflicted upon Allied shipping by the German submarines that instead of designing ships to embody the latest developments in construction and propulsion, we built our large fleet of cargo vessels from already existing plans and specifications. In other words, we saved time by sacrificing modernity, and I am sure that no one can justly blame us for doing so.

The Merchant Marine Act of 1936 provides the ways and means of building new and efficient units to take the place of this emergency construction, much of which was outmoded even when launched. A few figures will help us to realize that the new legislation came not a day too soon—that unless these old ships are speedily replaced with modern tonnage, the United States will stand in imminent danger of losing its position as one of the great maritime nations.



One of the two finest liners of our merchant marine, the *Manhattan*



An American steamer of 1904 vintage, still in use although antiquated

APPROXIMATELY 45 ships of our foreign trade fleet are 20 or more years of age—the period usually held to constitute the life-span of a steel ship. Three hundred and ninety-four more will reach this age within the next six years. Now, while a ship 20 years old may still be in fair physical condition, the fact remains that in this age of rapid mechanical progress there are other factors of obsolescence which must be taken into consideration. Reverting to our parallel of the gasoline truck, we can say that no alert business man would consider the use of trucks built 20 years ago, even if they had never seen a day's service and were just as good as when they left the factory. For the reason that international rivalry in shipbuilding has produced improvements in marine design and equipment analogous to those which have taken place in the automobile industry, I think that we should consider the factor of mechanical obsolescence, as well as that of mere age, in computing the useful life of a ship.

If this suggestion has merit—and the experts tell me that it has—the figures I have just quoted become fairly sinister in their implications. They show that under the new legislation, and with the least possible delay, we should plan and launch a ship-building program designed to replace, within the next few years, a grand total of 439 ocean-going ships, of approximately 2,600,000 gross tons. The magnitude of the undertaking can be realized from the statement that on January 1st of this year our entire foreign trade fleet, counting vessels of 2000 gross tons and over, totaled 485 ships, of 3,037,000 gross tons. In other words, with the exception of 46 ships, the greater number of which were built under the provisions of the Merchant Marine Act of 1928, every American vessel now engaged in overseas foreign trade will within the next six years be 20 or more years of age, and therefore well beyond the dead-line of complete obsolescence if we compute the dead-line on the basis of operating efficiency and economy.

Now that new legislation has been enacted, I have every confidence that the replacement of our old ships by modern competitive tonnage will be undertaken with the same dash and enterprise invariably displayed by our people when faced with a real emergency. Have we the shipbuilding talent and facilities necessary to insure the success of a program of this magnitude—a program which, when completed, will be outranked only by our achievements in this line during and immediately after the war? Let us glance for a moment at the long and illustrious record of the American shipbuilder, which extends over a period of more than three centuries.

Our shipbuilding activities during the Colonial Period and during the clipper ship era is a story which I need not dwell upon here. It will suffice to say that no finer sailing ships than the fast American clippers were ever built anywhere. During the early Nineteenth Century, American shipbuilders were pioneers in the development of mechanical propulsion, and in the period preceding the Civil War they led the world in the use of steam as the motive power of ships. It is true that after the war, absorbed as we were in the country's internal rehabilitation and development, we became so dilatory and apathetic in our attitude toward everything maritime that it was not until 1893 that our steam tonnage exceeded our tonnage under sail. Great Britain's mercantile marine had passed this crucial point five years earlier.

BY 1914, two of our best equipped shipyards were preparing to go out of business, owing to a dearth of work, when a veritable deluge of orders was precipitated by the outbreak of hostilities in Europe. At the time of our entrance into the war there were but 61 shipyards, with 235 launching ways, in the entire country. Eighteen months later, when hostilities ended, the number of shipyards had been increased to 341, with more than 1200 launching ways. At the peak of production we had a force of shipyard workers exceeding in number all the inhabitants of Wyoming, Nevada, and Alaska combined. We built 2316 vessels, of more than 13,000,000 deadweight tons—enough to line both sides of the highway from Washington to Baltimore, and among them were the fabricated cargo ships al-

Air view of an American shipyard equipped to build fine ships

ready referred to. The world had never seen anything like it.

Another lull ensued, and it was not until the Merchant Marine Act of 1928 was placed on the statute books that the American shipbuilder was given another opportunity to show what he could do in the way of building merchant vessels. This time the disturbing factor of haste which characterized the feverish war construction program was absent. Since there was no call for volume production, each ship could be planned for its particular trade-route requirements. As a result, the 33 splendid combination passenger and freight ships built under the provisions of the Act of 1928 are the equals, in workmanship and operating efficiency, of any vessels of comparable types, sizes, and speeds that the best foreign yards have ever produced. The fact that most of these vessels have managed to show an operating profit, even in the face of depressed conditions in international trade, constitutes the strongest kind of an argument for a replacement program that will give us a modern fleet.

OUTSTANDING among these new ships are the two largest merchantmen ever built in the United States—the well-known liners *Manhattan* and *Washington*. If present plans do not miscarry, a third vessel of approximately the same type, size, and speed will be built in the near future. I mention these vessels not because of their deserved popularity, but in order to correct an impression that they represent the ultimate achievement of which our naval architects, marine engineers, and shipbuilders are capable. The idea seems to prevail that because they are less than one-third the size of the *Normandie* and *Queen Mary*, the United States lacks the talent to build real superliners. That there is no justification whatever for such reasoning is shown by the fact that about 10 years ago—antedating any of the popular liners of today—two superships were launched in the United States that can still match (and perhaps exceed) the speed of any foreign superliner, while in propelling power they exceed all but one. The American ships referred to are the airplane carriers *Lexington* and *Saratoga*. These two great ships of the United States Navy show what our marine architects, engineers, and designers can do.

Prediction is always hazardous, and I would be loath to say that superliners will never be built in the United States. There are two schools of thought on the subject and both have persuasive arguments. The adherents of one school justify the huge expense and the element of financial risk which are always present in such undertakings on the ground of national prestige and national defense. The other school takes the prosaic stand that ships of smaller size are likely to prove better investments. While I have an open mind on the subject, I cannot lose sight of the fact that for the cost of one superliner we could build a large fleet of cargo liners of the most approved design, and after all these cargo liners are the real backbone of the merchant marine. It would seem the part of wisdom to take care of our essential requirements before we go in for costly luxuries.

I have been at some pains to show that what the American Merchant Marine needs above all else is a comprehensive replacement program. Considerable planning along this line has already been done—in outline, if not in detail—and I am sure that the United States has the technical talent to put the plans into effect, now that the necessary legislation has been enacted.

The new vessels to be built under the Merchant Marine Act of 1936 will embody all the safety devices required by the respective types of ships. Passenger vessels will be planned to incorporate the most approved safety features which modern science has devised, with especial reference to compartmentation, stability, fire-resisting materials, fire-fighting equipment, and life-saving appliances. American naval architects and marine engineers, the peers of any in the world, may be counted upon to plan ships every whit as safe as the best productions of our maritime competitors. In this connection it might be well to point out that according to a comparative table recently issued by Lloyd's, the British classification society, the United States and Sweden tied for lowest place in the ratio of vessel losses to total tonnage during 1934 and the first half of 1935. This showing, it seems to me, goes far to refute the unjust criticisms which from time to time have been levelled against the safety of American merchant ships.

THE Merchant Marine Act of 1936, a compromise measure, is by no means a perfect piece of legislation. There is comfort in the thought, however, that any defects, omissions, or ambiguities which may develop under trial can be corrected by legislative amendment at future sessions of Congress. The strong point in the basic philosophy of the Act is what I may call its double-barreled insistence that no matter what happens the United States is at long last going to have an adequate merchant marine.

I take it as a happy augury that the Merchant Marine Act of 1936 becomes effective at a time when we are rapidly emerging from the depression. If wisely administered, it should give us, within the next few years, a strong and adequate merchant marine, capable of competing successfully with the ships of any nation, and of meeting the requirements of an expanded Navy in time of national peril. Moreover, the contemplated shipbuilding program will stimulate activity in the heavy industries, furnish maximum employment for American shipyards, and thus prove a contributing factor in stabilizing national recovery.

The Commission or Authority provided for the administration of this Act is probably the most important that will be appointed in this decade. Its personnel needs to be of the highest citizenship caliber obtainable. It must be free of political control, free of group or interest control; men of tested and proved integrity, of national vision and capable of thinking for and acting for our entire people and nation.

By Margaret Bourke-White, courtesy TWA

Sky City of Acoma, New Mexico, said to be the oldest continuously inhabited Indian village in America

AMERICA FROM THE AIR

THE conquests of centuries, the geographical marks left by each succeeding wave of American pioneers, pass in majestic array beneath the fuselage of your swift air-transport plane, as you cross the American continent after leaving your breakfast table on the Atlantic only to seat yourself for late supper the same day on Pacific shores. As sky travelers pass high above places of scenic and historic interest, the many legends which forever attach themselves to chapters of American history become less obscure. At the end of a flight over the transcontinental airways, one is able to speak intelligently of the Enchanted Mesa, the Sky City of Acoma, Meteor Crater, Inspiration Rock, the Grand Canyon, and scores of other historic locations of scenic grandeur.

In less than 16 hours a half-hundred anecdotes of history come out of the past and refresh your memory as the co-pilot in his friendly conversation describes the ever-changing panorama below you. Even if you fly at night, and the clusters of lights which slip by below mark some city or town, there comes to mind the tortuous journeys completed by wagon-train to found these various cities years ago; perhaps the co-pilot will tell you that in the last half-hour's flight you have covered a distance which would have required three weeks by covered wagon.

THIS age-old trail followed by skyliners has been marked by the bleached bones of those who succumbed to its devastating thirst, has felt the crunch of iron-bound wagon wheels, the drive of pounding pistons, the plodding of sandaled feet, and now, far above it, is heard the whirr of glistening propellers.

No other mode of transportation can give to the traveler such an understanding of this country's magnitude. In traveling from Atlantic shores to the Pacific with the sun's shadow, the sky traveler can see approximately 20 percent of the total number of square miles within the United States on this one trip. With perfect visibility at 8000 feet, the horizon appears 118 miles distant, giving a visible area of 236 miles by 2567, making a total of 605,812 square miles of scenery.

Night flying, especially in moonlight, can only be likened to standing by the rail of a sleek ocean liner as it plows its way through moonbeams reflected on dark water. A peculiar light filters over the landscape below and, contrary to popular opinion, it is easy to note various ground formations and see quite a distance to the right and left of the plane's course.

Cities and towns take on a different personality at night, each having its distinctive formation of boundaries marked by lights and shadows. Los Angeles is acclaimed by air travelers to be the most dazzling approach in darkness. Then come Chicago and New York. The clear atmosphere of the Pacific Coast lends an enchanting aurora to a myriad of lights set like jewels against a background of velvet.

SCIENCE VERSUS MAGIC

Oil Prospecting by Physics . . . Will Average Oil Strikes Nine Times out of Ten . . . Using a Simple Pendulum . . . Incredible, Uncanny Sensitivity

By AUBREY D. McFADYEN

ALL over the world small bands of scientists are "playing doodle-bug in the face of mother-earth," as the natives jestingly describe their work. These scientists so quickly and quietly carry out their mission in a community that their presence is scarcely noticed. They operate alike over valuable and worthless lands, over mountainous and coastal regions, even out to sea. Their mission is to search for deposits of oil—the life-blood of modern civilization.

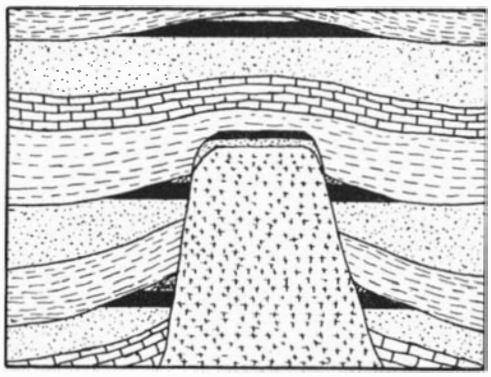


Figure 1: **A cross-section of a typical salt dome. The "sands" (dotted areas) are topped by oil reservoirs around the dome**

As between nations, war may be waged to guarantee an ample oil supply. But as between rival oil companies, seeking reserves to meet the future needs of their patrons, a war of friendly, though keen, competition is being waged constantly. The strategy of this war has resolved itself into a contest to discover and explore new oil sources. The battles of the major oil companies are being fought by the geophysical explorer.

The procedure followed by the geophysical explorer at first blush appears like Black Magic in its darkest form. Yet a little investigation into the work of these scientists reveals that their practice is based upon some of the simplest things of every-day life, operating under elementary principles of physics known to every school boy. Ordinary clock pendulums of great accuracy comprise the wands which divine the location of oil reservoirs. The principle of sound echoes is relied upon to measure the depth of the oil-bearing formation below the surface of the earth.

Oil, geologists tell us, is derived from animal and plant remains. In ages past this organic matter became embedded in porous layers of sediment which make up portions of the earth's crust. Later it was decomposed, yielding petroleum. This explanation is verified by the fact that oil occurs in all the fossil-bearing layers of the earth. Oil never occurs in paying quantities, however, unless there is a porous stratum overlain by an impervious stratum which blankets or seals the oil against evaporation.

If the make-up of the earth's crust were exactly uniform, there would be an even distribution of oil throughout the areas of the earth where plant and animal life have escaped long since by evaporation.

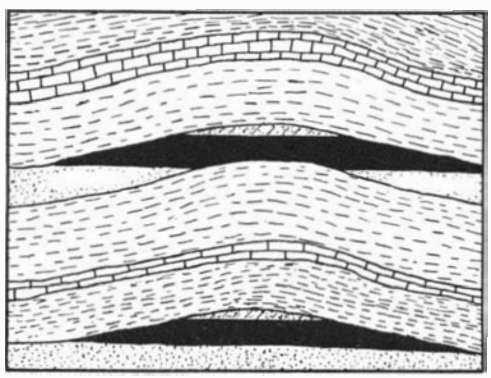


Figure 2: **Cross-section of a typical oil and gas bearing anticline. Oil (black) and gas (diagonal lines) are shown in rocks on top of the "sand" or sandstone (dotted)**

It cannot be told in advance that oil is present in the reservoir formation. The oil may have escaped in ages past; it may have migrated during some remote period when the inclination of the porous stratum was different; or it may never have been there, due to absence of plant or animal life in that area. At most, the geophysicist can locate only a subterranean formation of the kind which experience teaches to be a likely storage place for oil. Geophysicists offer no fixed formulas for discovering oil. In the last analysis it is the drill which actually finds oil. However, a skilled exploration party, working in a favorable region, will average strikes in nine out of ten forecasts.

The most productive oil fields today are in the Gulf Coast area, and these fields present a peculiar, though familiar, geological picture—the salt dome formation. Huge plugs of almost pure salt are pushed up from the "floor" of the earth (Figure 1). These salt plugs measure from one-half mile to four or five miles in diameter, and are believed to extend as far as 20,000 to 30,000 feet into the earth. In pushing their way up, the salt plugs have broken through porous layers of the earth's crust, bending them up to an angle such that reservoirs for oil are provided either had flourished or been deposited. But the earth's crust has formations which provide reservoirs into which the oil has collected and remains stored. Since the oil globules originate in a porous stratum, they have a tendency to move along that stratum, when and if it is at all inclined, combining with other globules enroute. If the stratum is one which bears water, the oil, being lighter, will float ahead to the peak of the stratum, where it will be concentrated; that is, provided the stratum does not reach the surface, in which case the oil will

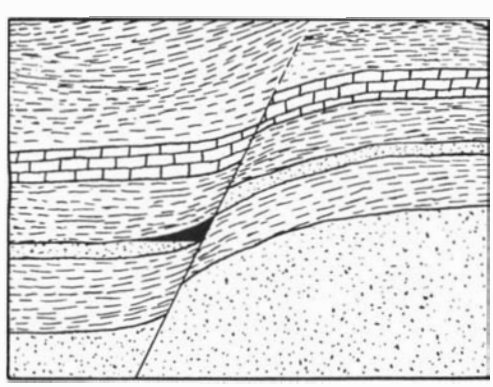


Figure 3: **How a fault breaks the continuity of an oil-bearing sand, seals the end of the stratum and permits oil gradually to accumulate there—if the seal is tight**

along the flanks of the plug, as well as on top of it. Later, the oil contained in the distorted layers has moved into these reservoirs, the crest of the plug usually providing a vast dome filled with oil.

Assuming, as the oil men know from experience, that these salt plugs are capped with oil, how would one proceed to locate the salt plug?

The story begins in 1583 when the great physicist Galileo, according to tradition, was distracted from his worship in the Cathedral at Pisa by a chandelier swinging from the ceiling. Its regular rhythm caused Galileo to check the period of its swinging with reference to his pulse beat. From this beginning Galileo brought forth the modern pendulum, and developed its laws. First of all, Galileo made it plain that a pendulum swings by reason of "gravity" or pull of the earth upon it.

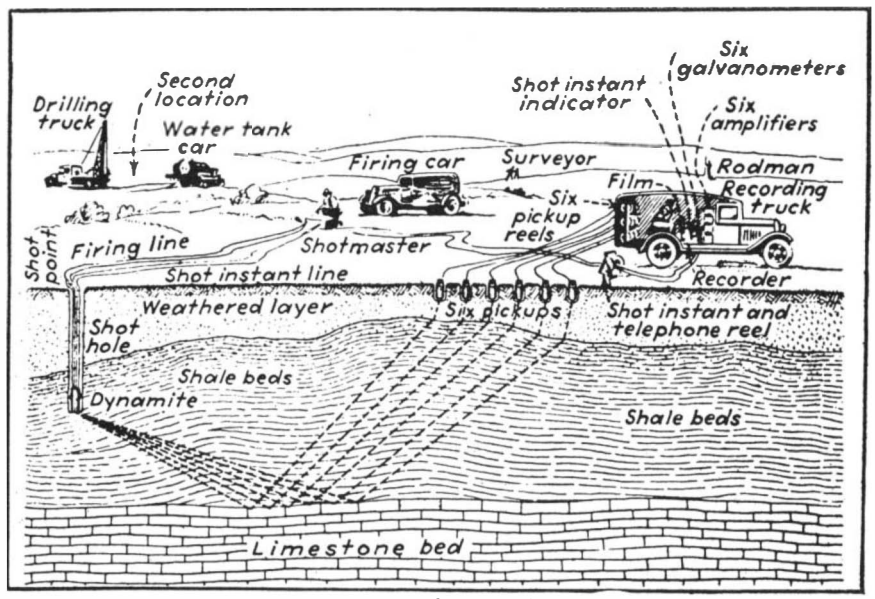


Figure 4: **Layout of a seismic or artificial earthquake prospecting apparatus**

HUYGHENS, a Dutchman, being impressed by the extreme regularity of the period of oscillation of the pendulum, put it to use as a time-piece. Later Huyghens' pendulum clocks covered the globe.

It was known as early as 1671 that a pendulum clock loses time upon being moved toward the equator, since the centrifugal force of the earth's rotation increases as the equator is approached. It also became known generally that pendulum clocks lose time when carried from one place to another place of higher elevation; for example, if carried to the top of a mountain. When placed upon a mountain the pendulum is slightly removed from the bulk of matter constituting the earth, whereby the pull of the earth upon the pendulum is diminished, resulting in its period lagging, with consequent inaccuracy of the clock. It would be "slow." It was later discovered that pendulum clocks also vary in time if moved over different portions of flat land. Why? Men of science explained that this is due to variations in the pull of the earth at these several places, because of non-uniformity in the make-up of the earth's crust beneath. For centuries these facts were known. It remained for a new type of experimenters, led by Dr. E. E. DeGolyer, to put these facts and principles into practical use.

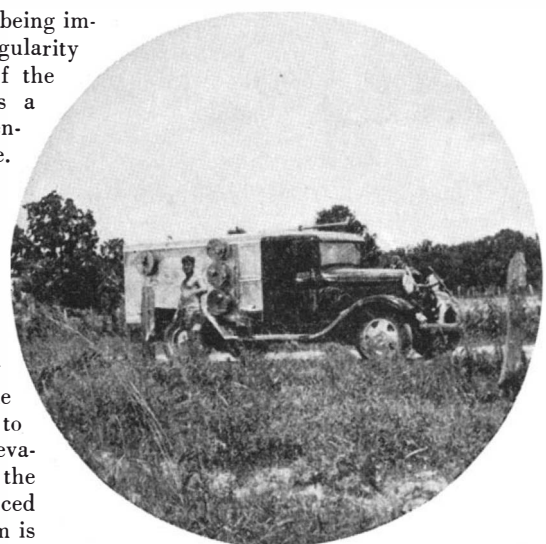


Figure 5: **A seismic prospecting operator's field truck carrying the recorders**

These huge bodies of salt, they reasoned, being lighter than average areas of the earth, should lessen the pull of gravity of the vicinity where present. Obviously the variation in the pull of the earth due to the salt plug will be very slight, probably not over four or five ten-millionths from its normal value, but there should be a difference. But what could measure so small a force? They concluded that, if a pendulum be placed over or adjacent to a salt dome, it should run "slow." After several hours it should be possible to detect the effect of the salt plug upon the period of its swing.

Tests demonstrated the truth of this reasoning. There was found to be enough salt in the average salt plug to vary the pull of gravity as much as 20 to 50 ten-millionths from its normal reading (980 dynes). By comparing the pendulum readings at points spaced two or three miles apart along a selected course, it was found possible to chart accurately the sub-surface formations. The world was thus taught how to strike a salt dome "right on the nose."

The work of Dr. Harvey C. Hayes of the United States Geodetic Survey went far toward bringing the pendulum method of geophysical exploration to its present high efficiency. In practicing the Hayes pendulum method, a string of exactly matched field pendulums is set up, with the individual pendulums two to five miles apart along a course to be explored. Each field pendulum station is equipped with a radio set for automatically sending a signal to the base station upon each swing of its pendulum. At a prescribed time all the pendulums in the expedition are cocked, whereupon a radio signal from the base station simultaneously releases all for swinging movement. Each swing of each field pendulum is flashed back to the base station, where the progress of the entire set of pendulums is recorded automatically in parallel lines upon a photographic strip. At the end of two hours, or thereabouts, the relative positions of the pendulums may be compared by drawing a line through the points on the record strip indicating the position of each pendulum. This line indicates the geological picture of the area below.

IF a pendulum is to be useful in geophysical exploration, its period must be known to within one one-hundred-millionth of a second. This extreme accuracy of pendulums is necessary because the set-up must be sensitive to a departure of two ten-millionths from the normal pull of gravity.

The pendulum method is not restricted to finding salt domes. It is effective for locating the crest of "anticlines" of all types. An anticline (Figure 2) is nothing more than an arched upward bulge or upfold of the earth's crust. The most common form is where the sub-stratum takes a wave formation, oil sometimes being entrapped under the crests of the waves. This formation is quite commonly encountered in nearly all sections of the world, but the mere presence of an anticline does not give assurance that oil lies under its fold.

In another type called "fault forma-

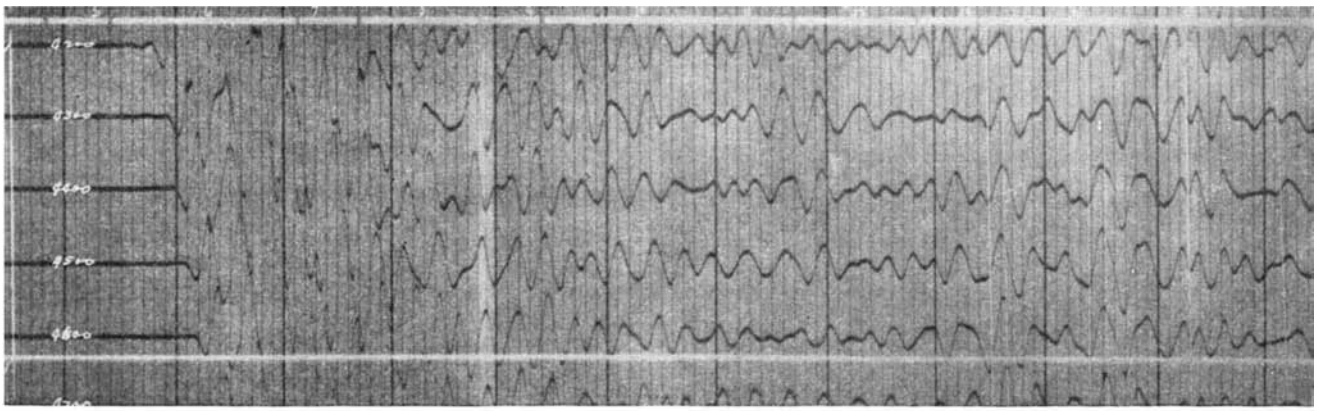


Figure 6: **An actual oscillograph record of a seismic shot in the field**

tions" the strata have become sheared, with the strata at one side of the shear being pushed up and sometimes forming a pocket (Figure 3). These are quite common in the Oklahoma area and about the California coast, and in these regions usually provide excellent oil reservoirs.

In every case where the denser, impervious stratum of rock which blankets in the oil rises toward the surface, the period of oscillation of the pendulum will be accelerated by it. In this way the high point of the anticline may be detected, whether it be the crest of a wave formation or the rocks at one side of a fault.

THE crowning achievement in geophysical research is the modern seismic prospecting set-up. For this, again, the world is primarily indebted to the genius of Dr. DeGolyer, who took the crude apparatus developed in Germany and developed it to its present efficiency.

In this set-up (Figures 4, 5) a charge of dynamite is exploded electrically, and the impulse or shock thereby given to the earth travels downward until it hits a reflecting layer. At this layer the seismic wave is reflected toward the surface, where its presence is recorded by several vibration detectors. Each detector is a specially constructed instrument which converts the mechanical vibration of the ground into electrical impulses. These impulses are amplified and recorded in parallel lines on a moving strip of photographic paper, making an oscillograph record (Figure 6). On the same sheet of paper are also recorded the electrical impulses which detonated the dynamite, and a series of timing marks at equally spaced intervals of one hundredth of a second.

If the time of travel of the seismic wave through the earth is known, it is possible to calculate the depth of the reflecting layer simply by measuring the time between the blast and the arrival of the reflected shock at the vibration recorder. The seismic wave may be regarded as a sound wave traveling through the earth's surface, and the arrival of the reflected wave as an echo. The accuracy involved in determining the depth of the reflecting layer may be as good as one-tenth of one percent under favorable conditions.

The seismic method *does not find oil, as such,* any more than does the pendulum method. The reflecting layer gives no clue that will indicate the presence of minerals or other valuable sub-surface deposits. It indicates only the depth of the layers of the earth, or that there is a distinct discontinuity of shape in the geology of the region, which is of prime importance in the geologic study of any prospecting survey.

The seismic apparatus is now used extensively in conjunction with the pendulum set-up to check the depth below the surface of the layers of stratum or salt bodies picked up by the pendulum test.

The incredible sensitivity of the seismic pick-up can be appreciated only after witnessing its performance in the field. As a preliminary check upon the apparatus, a member of the crew steps off 500 paces, and taps the earth lightly with his foot. The little recording pen must trace in exact response to his tapping.

Figure 7: **Returning after taking a field reading on a torsion balance**

"We dig a hole about a yard deep, to get a firm footing for the seismic unit," one geophysical prospector stated. "These seismic detectors, although of a light, portable type, will sense incredibly small tremors of the earth. For instance, we shave off all grass about the spot, for even its quivering in a breeze will be picked up by the instruments. The wind frequently upsets our apple-cart. We find it necessary to fill the hole above the instrument level with the surface of the ground, to avoid air concussions caused by gusts of wind."

"During the test," he continued, "every one must remain absolutely still. Even to shift your weight from one foot to the other might affect the readings given by the instruments. That is why we first drive all cattle, rabbits, and the like from the vicinity we are checking."

In a few minutes the geophysicist is scrutinizing a jagged line which the seismic apparatus has picked up and the recorder put in permanent form. What does the jagged line say? To read it would appear to an outsider somewhat like trying to decipher by sight the melody cut in the sound groove of a phonograph record. But this man has a trained eye. For years he has been decoding such signals. A smile spreads over his face. "The peak of the subsurface incline is right there," he points out. "The formation breaks sharply and appears to present a nice receptacle.

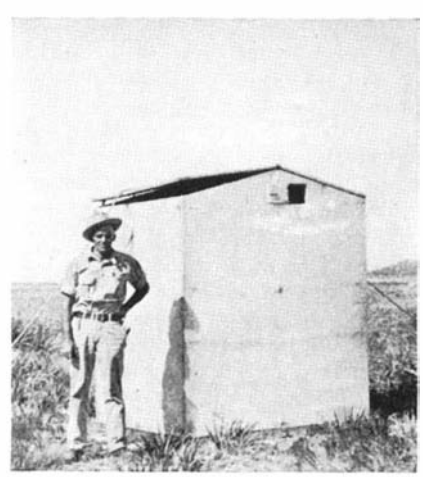


Figure 8: **Hut for a torsion balance, to diminish effects of wind**

Probably it is filled with valuable oil."

The present trend in gravitational instruments is toward a single unit structure, which is both simple and accurate, while designed to give absolute readings. These new gravity meters are transported in succession to the several spots where the pendulum stations are ordinarily located. Since they give an absolute reading, the expense and trouble of

Figure 9: **Dr. Ludwig W. Blau, formerly a Texas professor of physics**

comparison with a standard, as for instance the pendulum base station, is eliminated.

In the early stages of development, gravity meters took the form of the "torsion balance" as designed by Eötvös. It was as late as 1923 that Dr. DeGolyer brought the first torsion balance to the United States from Hungary.

A TORSION balance (Figure 7) consists of a pendant wire upon the free end of which is carried a cross-rod, the cross-rod in turn carrying at either end a weight. The weights are exactly equal, so that the cross-rod is normally in balance. One of the weights, however, is hung from the rod, thereby bringing it closer the earth than the other. The pull of gravity acting on the two weights, the one being nearer the earth than the other, is resolved into a twisting, or torsion of the wire. The degree to which the balance rotates and twists the wire is an index of the pull of gravity of the terrain under test. The torsion balance is of uncanny sensitivity, being affected by a variation of one ten-millionth of a dyne. Two pages back it was mentioned that the normal force of gravity is 980 dynes. Hence the sensitivity of the balance is about one part in 10,000,000,000.

More recent types of gravitometers take the form of small, easily portable units. One comprises a small body suspended by a piezo-electric crystal to the influence of gravity. Delicate electrical means in circuit with the crystal measures any variations in the earth's pull upon said body. Another and extremely simple device is nothing but a glorified capillary tube. The height to which the fluid will rise in the capillary varies with variations in the pull of gravity.

In working the "serpentine" formations about Austin, Texas, the apparatus so far discussed encounters a strange rival. Curiously enough, this formation generally presents "serpentine plugs," so-called, which have been pushed up from below quite similarly to the salt plugs. These plugs contain much of the mineral "magnetite," an iron ore which may be readily detected by means of a delicate magnet. The principle is simple. As the crest of each plug reaches nearer the surface of the earth, the influence of the magnetite therein upon the instrument increases. Geophysicists now have a special magnetic device called a "magnetometer" for this use. It has remarkable sensitivity. The geophysical explorer must first see to it that no magnetic material whatsoever is about his person. The presence of a key in his pocket, or so much as a steel pin, or a single iron tack in his shoe, might introduce disastrous error into the forecast.

Strangely, two nations that yield but small quantities of oil have been forerunners in the study and development of apparatus for charting the structure of the earth's crust. These nations are Germany and Japan. Germany has been motivated by an interest in pure science and the hope of discovering oil or mineral deposits. Japan presents an entirely different story. Frequent earthquakes, with resultant destruction of property, brought the Japanese nation face to face with the need for earthquake prediction. Under Dr. Kyoji Suyehiro, director of the Earthquake Research Institute of Japan, maps of the entire sub-surface of Japan are being made, showing precisely which sections of the earth's crust are most subject to quakes. The same kind of instruments, as devised by the Japanese for use in locating earthquake areas, are equally adapted for use in locating oil wells. In each case the same information is sought—the nature of the earth's "floor."

Although authentic reports indicate an available oil supply sufficient to care for our own nation for about 25 years. the oil companies do not cease their vigilant search for new fields. The major oil companies allot millions of dollars annually for geophysical explorations. Even small concerns keep as many as 20 exploration parties in the field. The investment of oil companies in service stations seems to indicate their conviction that they are in the business permanently.

"I HAVE revised and expanded my estimate of the available oil supply so many times," says Dr. Ludwig W. Blau, Chief of Geophysical Research of the Humble Oil Company (Figure 9), "that now I will not even venture a guess. We have shot over the same areas of the Gulf Coast three times, and on each occasion we have located new wells. This is due to the great improvements in our instruments, also because we can now drill to depths heretofore undreamed of. First we reached the shallow, piercement domes alone. Now we are picking up the deep-seated ones, which seem to offer a new source of production. The day of working wells at depths of 10,000 to 14,000 feet has arrived."

Eleven more or less official forecasts of our oil reserve have been made in the past 20 years, each succeeding estimate being higher than the one before. If the 1920 estimate on recoverable oil remaining in the fields of the United States had been correct, automobiles today would be rusting by the roadside, and men formerly employed in the petroleum industry would be seeking jobs in other fields. It is the work of the small bands of geophysical explorers, even though it appears that they are just "playing doodle-bug," that forestalls our facing such an event as an actuality.

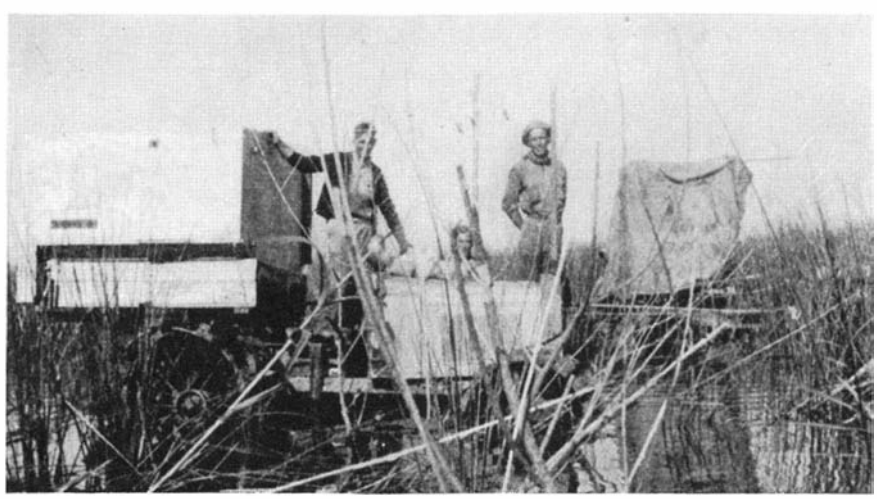


Figure 10: **Seismic prospecting with a seagoing tractor in a Louisiana swamp**

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

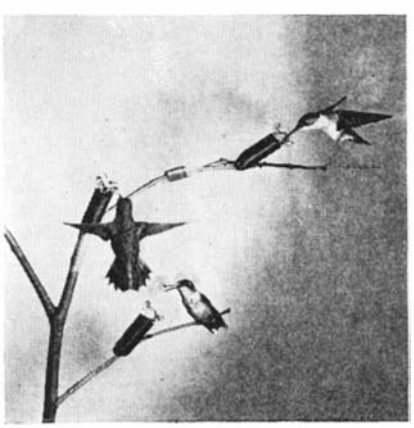
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER

Chemical Engineer

Stopping Humming Birds' Wings

A REMARKABLE one-hundred-thousandth-of-a-second stop-motion photograph of female ruby-throated humming birds hovering about vials of sweetened liquid is reproduced on this page. Professor Harold E. Edgerton, Kenneth J. Germeshausen, and Herbert E. Grier of the Massachusetts Institute of Technology, where this high-speed method of photography was developed, found that, in hovering, the wings move at the amazing speed of nearly 60 beats a second. Although perches are provided, the birds prefer to hover while feeding. This photograph, probably the first of its kind showing the wing action of the humming bird, was made at the home of Mrs. Laurence J. Webster at Holderness, New Hampshire, where Mrs. Webster, founder of the New Hampshire Nature Camp, has devoted years to the study of wild bird life. These tiny visitors are so tame they take food from Mrs. Webster's lips and perch on her head and shoulders while awaiting their turn to feed.



Humming birds hovering

Gasoline from Gas

CRACKING heavy oil to increase the output of gasoline from crude oil results in splitting large molecules of the oil into smaller ones. Some of these split molecules are the right size for gasoline but others are too small and have been used as gaseous fuels in place of liquid gasoline. Several methods have been suggested for "reforming" these fragments of molecules into the larger ones of liquid gasoline. Recent investigations by Ipatieff and Corson of the Universal Oil Products Company have shown that it is possible by the use of phosphoric acid as a catalyst to convert more than 70 percent of ethylene into liquid fuel. They have further found that the "reformed" gasoline from ethylene (one of the plentiful gases produced in cracking) has an unusually high octane rating so that it is especially valuable in modern motors.—*D. H. K.*

KING COTTON

COTTON still holds its position of importance in the textile fiber field. This is mainly due to its numerous industrial uses. For example, more than half a million bales were used in automobile tires in 1935.

Pneumonia Today

FORTY years ago there was an attitude of absolute pessimism on the part of the medical profession and public health workers regarding pneumonia. Doctor Osler then said that pneumonia was a self-limiting disease for which nothing could be done to abort or prevent. A similar more or less hopeless attitude has persisted until recent years, during which new and hopeful additions have been made to our knowledge of pneumonia.

One of the new principles which has been evolved is the recognition of the fact that pneumonia is not a single disease, but a group of diseases. When we use the term "pneumonia" we are about at the same stage as we were 50 years ago when "enteric fever" and "inflammation of the bowels" were common terms. The recognition that pneumonia is not one, but a group of diseases has been one of the most important factors in developing present-day methods for its control.—*Health News*, bulletin of the New York State Department of Health.

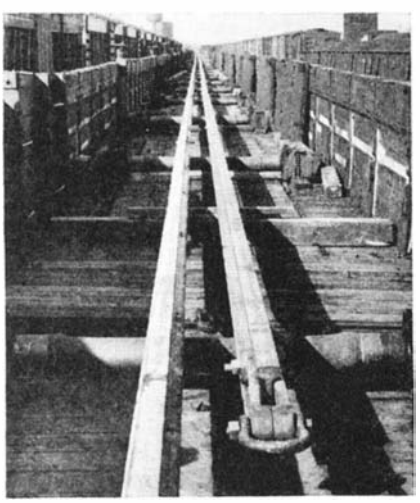
Mending

MENDING woods—those plastic, putty-like mixtures of wood flour and a bonding agent—have been with us for some years and many uses have been found for them. They are particularly valuable in the home or factory workshop for woodwork, furniture repair, and so on.

Four well-known companies—the Sherwin-Williams Company, Premier Chemical Corporation, Detroit White Lead Works, and Acme White Lead and Color Works—have recently developed and put on the market new mending woods in which the bonding agent is a Bakelite resinoid. This base is said to provide superior bonding strength and has many other advantages. The resinoid makes the wood, after hardening, impervious to common acids and alkalies, water and gases. All four of these companies package their mending woods in both cans and collapsible tubes.

Longest Rails Ever Laid

CONTINUOUS welded rails, 4000 feet long, the longest ever laid on a railroad system in one piece, are shown in our illustration as they were prepared for



Four thousand feet to the other end

laying in the Blossburg tunnel of the Northern Pacific Railway's main line through the summit of the Rockies just west of Helena, Montana. The rails were welded together aboard 90 gondola cars from which the ends had been removed. The picture shows them on the cars.

Journals served as rollers underneath the continuous rails and facilitated unloading which was accomplished by parting the train in the middle and pulling half the cars at a time out from under the rails, permitting them to settle to the track. Each continuous rail weighed 85 tons. Similar continuous rails were laid recently in the 4000-foot Bozeman tunnel of the Northern Pacific between Livingston and Bozeman, Montana.

EXPLOSIVES

DURING the first six months of 1936, 30,249,819 more pounds of industrial explosives were used in the United States than in the corresponding period of the year before. Mining, construction enterprises, and quarries used most of these explosives, but farmers used more than the preceding year for ditch blasting, tree planting, and so on.

A Railroad Experiments

THREE new experimental types of passenger coaches, representing highly modernized features of interior arrangement and design, and all completely air-conditioned, have been produced by the Pennsylvania Railroad and are now being operated in test service between New York, Philadelphia, Baltimore, and Washington. The principal object of the trial runs, which will later be extended to other sections of the railroad, is to ascertain the reactions of the public to the new features of comfort and convenience embodied in these cars.

Experimental car No. 3525, known as Scheme No. 1, provides seating capacity for 60 passengers. It embraces new double seats, revolving so that any pair may be placed facing in the normal crosswise position, outward facing the windows, or inward facing the aisle.

Experimental car No. 3521, Scheme No. 2, also has a capacity of 60 passengers. The double revolving seats, built on stainless steel frames, provide an entirely new feature in the form of folding trays fitting into the backs which may be used by the passengers at the rear of any pair of seats for writing or game playing, or for the serving of coach lunches. The cars are constructed with long flush windows having no projecting sills or frames and each consists of a single pane of glass 2 feet 8 inches by 5 feet 2 inches, giving an extremely broad and inviting range of vision.

Experimental car No. 1735, Scheme No. 3, is intended primarily for use in long-distance overnight service. It accommodates 42 passengers in 14 double seats on one side and an equal number of single seats on the other. The seats are all of extra width, all revolve and all are made to recline in three positions at the touch of a button. This car is equipped with extra large toilet and wash-rooms in the center. In the air-conditioning equipment of this car the cooled air enters through a decorative duct in the ceiling which distributes it evenly throughout the car.

Scheme No. 3. One of three new experimental railroad coaches

Speed and thrills are assured on this new dirt-surfaced road-racing track

Vacuum Packed Milk

BY passing the top of a full milk bottle through a space filled with live steam and then capping it quickly, milk is now packed in a partial vacuum. The caps used are metal so that when the steam shut up in the small free space in the bottle condenses to leave a vacuum the milk is completely protected. The advantages claimed for the new method of packing are that the milk will remain fresh at room temperature for as long as 48 hours and can be kept in a refrigerator for 6 weeks; the seal cannot be tampered with and is tight enough to prevent any contamination; because the vacuum on the top of the bottle holds the cap tightly in place, there is no leakage either in or out of the bottle. The new method of sealing is carried out on an automatic machine and is completed within 30 seconds.—*D. H. K.*

Million Dollar Track Revives Road Races

A FOUR-MILE, serpentine, dirt track costing a million dollars to build and accommodating more than 50,000 spectators will be ready on the old Roosevelt Field in Long Island, New York City, in October, when about 50 cars will race for prizes totaling about 75,000 dollars. Road racing seemed to be finished in 1917, owing to its dangers, but the new track will bring the sport back with all the thrills but minus many of the hazards. The October event, which will be a 400-mile contest, will be run on a track containing 20 turns—reverse turns, hairpins, double twists, and others—but the track is all on the flat and therefore under engineering control at every turn.

The track carries on the speed tradition of the site on which it is constructed, for it is the field from which transatlantic flights have been started by such ace flyers as Lindbergh, Chamberlin, and Byrd.

George H. Robertson, vice-president and general manager of the Motor Development Corporation of New York, which is building the track and who himself a quarter of a century ago won the Vanderbilt classic, said, in commenting on the plan of the track:

"The track will be protected on each side, the full length of the course, by steel guard rails. Beyond the rails, and between the track and the spectators, there will be a safety zone 30 feet wide. At the edge of this zone there will be a heavy steel wire fence.

"At various points on the course signal lights will be placed, each having a red, a yellow, and a green light. In the event of serious accident, any one of five field judges situated in towers at different points can throw the yellow light to all cars to slow down. The chief judge can throw the red light which will stop all cars if necessary. The green light is the all-clear riding light."

Additional protection is being provided

by concrete walls at the most important turns. Since on the straightaway it is expected that the drivers will be making up to 150 miles an hour, a chute has been provided at the turns so that if the driver overrides the turn he can roll harmlessly down the chute and out of the way of the cars behind him. The track will have a treated dirt surface and the width of the track will vary from 60 feet to 100 feet, while the straightaway will be 80 feet wide except at the pits, where the width is 100 feet. There will be a 150 foot width for the turn at the end of the straightaway—the hardest of all.

Prize Winning Paper on Rocket Design

ANNOUNCEMENT has just been made that the annual prize of 5000 francs awarded in the Rep-Hirsch Astronautical competition in Paris will be divided between the American Rocket Society and Alfred Africano, the author of a paper entitled "Design of a Stratosphere Rocket." We heartily congratulate both the Society and its president, G. E. Pendray, whose patient efforts we have described, and the author, who is following up this triumph by a trip to Europe to survey the latest foreign developments in rocket design.

Mr. Africano has given us permission to abstract his valuable work, and we are all the more happy to do so because it constitutes not only a record of skilled experimentation but a thoroughly sound introduction to this new and difficult art.

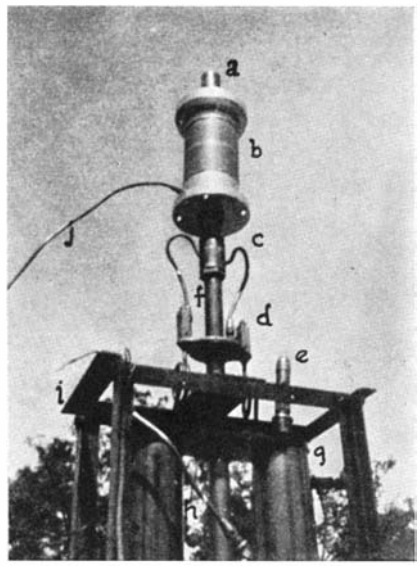
First of all there is given a description—for the first time in truly technical form—of how rocket motor experiments may be carried out. While infinite patience and some courage are required for such investigations, the expenditures are relatively small. Other groups besides the American Rocket Society are sure to make similar attempts in various parts of the country.

The arrangement of the proving ground on the estate of Mr. Pendray, the instrument

Rocket proving ground

board, and the barricade which protects the experimenters are shown. In another illustration there is a close-up of a typical rocket motor in position for a test.

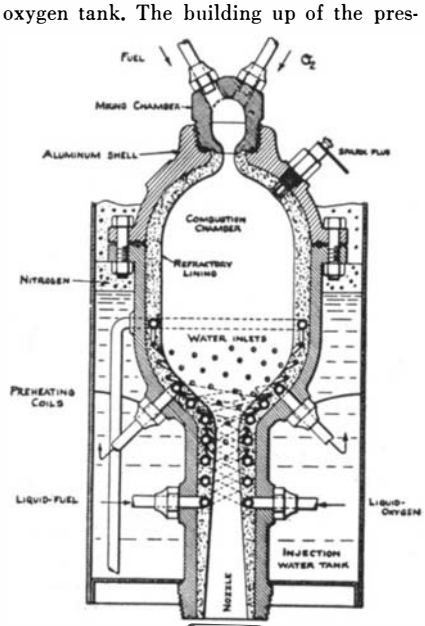
The main elements of the rocket motor may be listed as follows: a. The nozzle from which the jet issues; b. The aluminum combustion chamber; c. Fuel and oxygen inlet; d. Quick-opening valves; e. Safety valve; f. Hydraulic piston (for test purposes only); g. Copper liquid-oxygen tank; h. Copper liquid-fuel tank; i. Angle-iron



Test set-up for rocket motor

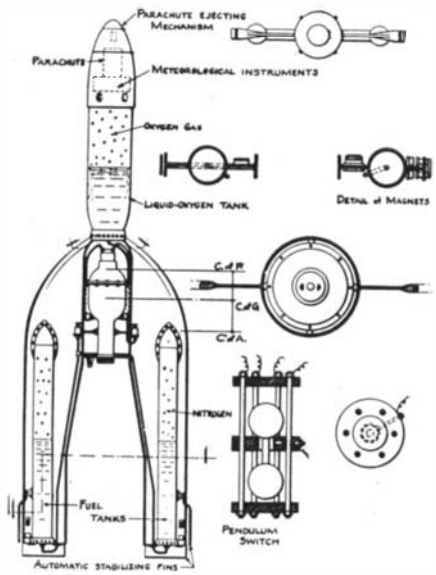
frame of proving stand; j. Pipe connection to chamber pressure gage.

The nozzles used at first were of cast aluminum, which burned out after each run. Later, the nozzles were machined from nichrome steel rod, threaded at the lower end so that they could be screwed into the exhaust end of the combustion chamber. The combustion chamber itself was made of aluminum for all but one of the rockets. It consisted of two cylindrical end parts, shaped inside as hemispheres of one-inch radius. In between the hemispheres cylinders of varying lengths could be inserted and bolted rigidly in place. Thus the effect of varying length/diameter ratios could be determined. The fuel (generally gasoline) and the liquid inlet orifices were drilled in a nichrome plug, screwed into the lower or feed end of the combustion chamber. Both the fuel tank and the liquid oxygen tank were made of copper, three inches in outside diameter and 21½ inches long. The liquid oxygen was poured into the tank by rather primitive methods. As the liquid oxygen (intensely cold to begin with) absorbed heat from the air, it built up pressure in the free space at the top of the oxygen tank. The building up of the pressure was rather slow, about 125 pounds per square inch in a minute's time. Nitrogen gas under a pressure of 450 pounds was forced into the top of the fuel tank. This slow building up of the pressure was a blessing to the investigators since they had plenty of time to run behind the barricade. When a pressure of 450 pounds per square inch in the oxygen tank was also reached, a switch was closed, firing a gunpowder fuse securely fastened to the mouth of the nozzle. The moment this fuse was seen to be burning vigorously, two quick-release valves were opened simultaneously by a tug on a cord.



Interior arrangement of the parts of a rocket motor using liquid fuel

If the method of ignition succeeded—as it generally did—a jet of brilliant white



A contemplated stratosphere rocket and details of some of the important features. A parachute is provided to carry instruments to earth

flame shot up instantly three or four feet from the nozzle and the typical powerful roar of the rocket motor was heard, making the surrounding ground vibrate from the intensity of the sound and forces being released. Reports were that the roar of the jet was heard three miles away, and this will be readily believed by anyone who witnessed the tests.

There was plenty of excitement for the courageous men who practiced this fascinating hobby. But they did not seek amusement alone. On the contrary, little by little they developed a real technique of experimentation.

Since the jet reaction was downward, its thrust was made to force down a piston in a cylinder filled with water. The increased water pressure registered on a gage, and gave a continuous indication of the amount of thrust obtained during a run. A second gage was connected to the fuel tank measuring the pressure of the nitrogen gas as it forced the fuel into the combustion chamber. A third gage measured the pressure built up above the liquid oxygen. A fourth recorded pressures in the combustion chamber. The fifth dial showed the time of combustion in seconds.

By photographing these dials simultaneously with a motion picture camera, the exact relationships of these five quantities at all times during combustion was permanently recorded. In addition, detailed records were kept during each run of the kind and amount of fuel and liquid

oxygen used, the rocket motor dimensions, and all observed phenomena. Something like a pint of gasoline was used on the average run, and about a quart of liquid oxygen.

With the chamber of dimensions previously given, and with a nozzle throat of about ½ inch diameter, jet reactions of between 57 and 128 pounds were secured. The duration of the reaction was about eight seconds. The velocity of the exit jet was estimated to be about 4000 feet per second. The thermal efficiency was somewhere in the neighborhood of 6 to 8 percent, which is low.

A great number of things were learned from these tests. Alcohol proved a more efficient fuel than gasoline. Nichrome nozzles stood up remarkably well under the terrific temperatures of 3000 degrees, Fahrenheit (so estimated from the white color of the jet flame), much better than the cast aluminum nozzles which were first thought to be adequate. A carbon chamber and nozzle proved unsatisfactory. The alcohol burned more smoothly than the gasoline because of its chemical homogeneity. Contrary to a general belief, the liquid fuels proved to be infinitely superior to gunpowder. Gunpowder is violent, dangerous, acts much more quickly than the liquid fuels but develops a smaller value of jet reaction multiplied by time. If these experiments had done nothing more than dispel the notion that gunpowder can be used for rockets, they would have thoroughly justified themselves.

We cannot, unfortunately, go into all the mathematical treatment which Mr. Africano has given this subject. His paper will be a classic from which references will be drawn for many years to come. In particular, he has gone carefully into the actual design of a rocket for high altitude flight. While the present thermal efficiency and the propulsive efficiency of the rocket motor are low, Mr. Africano has made out an excellent theoretical case for a high speed high altitude rocket, with serious possibilities for meteorological and cosmic ray research, and with possibilities also as an offensive weapon. It is a strange thing that every advance in applied science seems to lead to a new method of destruction.

Without going into the actual calculations, we shall refer briefly to two sketch designs which the author has supplied.

A careful reader, by following these diagrams, will see readily how the experience gathered at the test stand has led to an entirely logical conception of a rocket motor with combustion chamber, water cooling, refractory linings, ignition, nitrogen control of the fuel, and so on. One of the diagrams shows a stratosphere rocket equipped with a parachute-ejecting mechanism to carry the meteorological instruments down safely. A magnetic control is also provided for the parachute ejection.—*A. K.*

A Hardship to Private Fliers

AN elaborate system of traffic control has been developed by the Department of Commerce. Flights on a heading from zero to 179 degrees—that is, east, generally speaking—must be at odd thousand feet, that is 1000, 3000, 5000 feet, and so on. Flights on a heading from 180 to 359—that is, West—are at even thousand feet, 2000, 4000, and so on. Crossings are at 500, 1500, 2500 feet, and so on.

Air transport planes fly according to this formula and are in contact with the airport by two-way radio so that overtaking at the same level, or collisions are guarded against. Pilots leaving airports receive careful instructions.

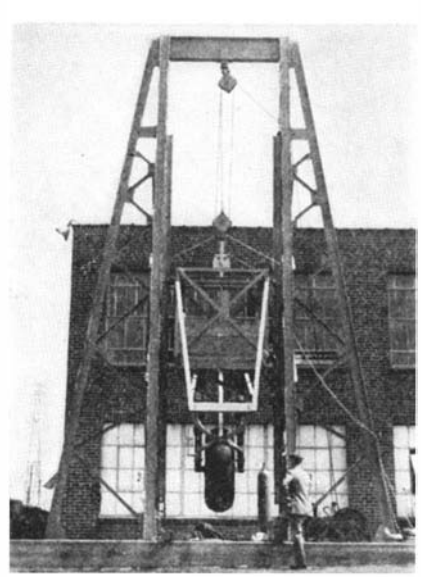
But private planes are not as a rule equipped with two-way radio telephone, because of the expense involved. In conditions of low visibility they do not receive permission to use airways. That is a serious hardship for private owners who wish to use the airway aids to navigation in cross-country work. Yet how can the rule be changed? The answer is that the rules cannot be changed, but that manufacturers must find a way of building inexpensive sets, and they are already working on these lines. Moreover, if a ship has been bonded with copper strips connecting all metal parts, a radio telephone set can be rented and quickly installed for a special flight.—*A. K.*

Largest Drop Test Jig

ELABORATE methods of calculating the strength of the airplane have been developed, and structural failures in flying are rare indeed. Nevertheless, engineers sometimes prefer to test various parts of the aircraft to destruction instead of relying solely on calculation. One of our photographs shows the method employed by the Boeing Aircraft Company in testing the main landing gear assembly of one of its giant four-engined bombers. This "drop-test jig" is the largest in the world.

Thirty feet in height, the jig is constructed of structural steel on a concrete foundation. Loads are placed on a moving carriage which is guided by large ball bearings fitted around a track running the entire vertical length of the jig.

To simulate the shocks likely to meet the bomber in a rough landing, a load of 16,000 pounds of lead was placed on the carriage of the jig and dropped 24 inches to produce the tremendous impact load of approximately 40 tons. As the entire gross weight of the bomber is only 16 tons, and as this weight is distributed between the two wheels, this means that the landing gear



Severe test for airplane wheels

and shock-absorbing struts were able to absorb more than five times the weight of the airplane—which is considered ample strength by the best authorities.—*A. K.*

Should Airplane Fares Be Reduced?

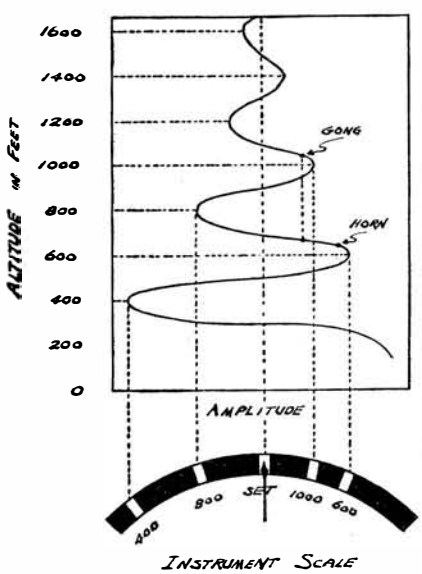
AIRLINE passenger fares average six cents per mile. Until June 1, 1936, this compared favorably with rail plus Pullman fares. After that date the cost of rail plus Pullman was reduced about 20 percent.

But last year there were 746,969 paid fares on the domestic airlines, yet only 200,000 individuals traveled by air. This indicates that people who use the air do so frequently and they can reduce the cost of air travel by buying scrip tickets (500 dollars worth of air transportation for only 425 dollars). Also, obsolescence in air transport is rapid, equipment is expensive, and the higher cost of tickets is more than balanced by the time saved, the reduced expense for meals while traveling, and so on.

Hence the opinion of a well informed group of aviation men, chatting peacefully after lunch, was that air travel is worth some differential and that the operators who are just coming out of the red should keep to the present scale of prices for some little time.—*A. K.*

A Radio Echo Altimeter

SOME eight years ago Dr. E. F. W. Alexanderson of the General Electric Company developed and tested a radio echo altimeter of considerable promise. No detailed description was ever released, and the instrument did not pass into commercial use. Now that fog and blind flying are more



Indications on the radio altimeter

commonly practiced, interest in the radio echo altimeter is reviving, and we were glad to read even a rudimentary description of the device in the *Journal of the Aeronautical Sciences.*

The radio echo altimeter consists of a single-tube radio receiver, operated with a single wire antenna trailing behind the plane. The receiver is so designed and adjusted that it radiates a wave towards the ground and almost simultaneously receives the echo reflection of this wave returning from the ground.

The radiated and reflected wave combine

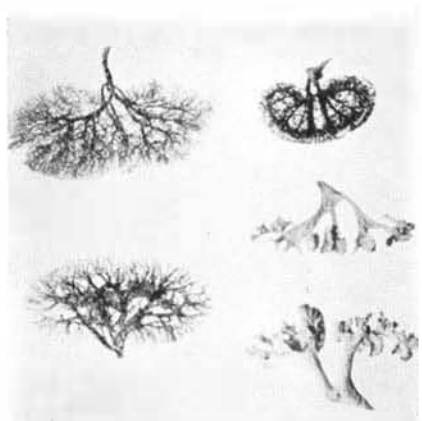
into the characteristic patterns of a "standing" wave with well defined maxima and minima which are directly indicated on an instrument dial. The appended diagram illustrates the working of the instrument. At some predetermined height—say 1500 feet or more—the pointer is at "set." If the height above the ground drops to a little over 1000 feet a gong rings. At 650 feet, a horn sounds. Below this the needle swings with more and more amplitude. Thus, warning to the pilot flying over hilly country is complete. Flight tests proved satisfactory under conditions simulating what is likely to occur in actual cross country work. The whole instrument weighed only six and one half pounds.—*A. K.*

OCEAN TREASURE

ONE square mile of the Atlantic Ocean 76 feet deep carried a treasure of 73,094,600 dollars as it was pumped through the bromine plant near Wilmington, North Carolina, during the past 12 months. That plant was interested, however, only in the ethylene dibromide.

"CORROSION SPECIMENS"

PHYSICIANS are interested in the blood vessels which supply each organ of the human body or any animal organism with blood. They are constantly studying the arteries which carry blood from the heart to the organs, as well as the veins which carry blood away from the various organs to the heart. In order to make these vessels visible in organs removed from the body,



A group of "corrosion specimens"

a new method has been developed by Dr. Joseph K. Narat at the University of Illinois, College of Medicine.

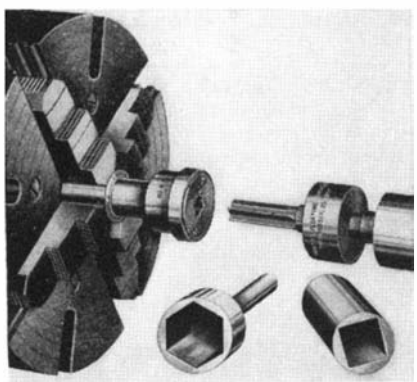
The organ is freed from blood by flushing the blood vessels with water and an air stream. After that the resin Vinylite is injected into the blood vessels. A manometer gages the necessary pressure. The solution of resin injected into the arteries is stained red, and that injected into the veins is stained blue. After the injections, the blood vessels leading to the organ are tied with a string to prevent leakage. The organ is then immersed in water for 24 hours; the resin solution precipitates and solidifies.

The next step is to transfer the organ to a concentrated solution of hydrochloric acid, in which it remains for three or four days. The acid gradually digests all the

tissues except the injected blood vessels. After the organ has been removed from the acid and washed with water, a specimen is obtained which reproduces the blood vessels, the distribution and shape of which can now be studied.

Rotating Drills—Square Holes

THE old conception of utter impossibility expressed in the traditional "square peg-round hole" idea must be revised. The rotating drill which, as everyone knows, has always been used to drill round holes, has



The drill rotates, but produces holes with square or other angles

now been so modified that it will produce not only square holes but triangles, hexagons, and pentagons. Watts Brothers Tool Works are producing angular drilling tools which do this job so successfully that large numbers of nationally known companies are now using this equipment. The angular drills look more like heavily fluted reamers and are used in connection with full floating chucks.

To cut a square hole with the speed of an ordinary drilling operation, a Watts drill of three lips is used. The heel of each "land" rocks the drill into turning a corner as its lip finishes a side cut. The full floating motion of the chuck allows the drill to move off the center in a series of minute, alternate cycloid curves the cords of which are parallel to the sides of the hole being drilled. The eccentric shape of the drill heel, under this motion, forces the lips to parallel these cords. The completed hole is perfectly matched so that no additional hand tooling is necessary.

Many uses have been found for this equipment, for the drills cut high carbon steels, iron, cast iron, brass, aluminum, micarta, Bakelite, and so on.

Makers of socket wrenches have found that wrenches drilled in this manner are stronger and cheaper. Automobile manufacturers and machinery makers are counterboring round holes to take square or hexagonal bolt heads with Watts drills.

Psychoanalysis for $5,000

YOU need to have money, maturity, and intelligence before you put yourself into the hands of a psychoanalyst. So states Dr. Harold Thomas Hyman, New York City physician, who for 15 years has been collecting experiences in this method of treating human ills.

Dr. Hyman who, needless to say, is not a psychoanalyst, reports on 43 cases treated by psychoanalysis in the *Journal of the*

American Medical Association. From Dr. Hyman we learn that the total fee for psychoanalysis averages between 5000 and 6000 dollars a case. The average visit costs the patient something less than 10 dollars, and there are likely to be from 250 to 270 sessions a year. It takes from 18 months to two years to terminate an analysis.

Although those who practice the Freudian method claim that age is not a factor in treatment, Dr. Hyman holds that before the middle twenties only the unusual person can obtain any insight into the procedure. Beyond the age of 40 or 45 there seems little possibility of altering individuals, he declares.

The successful patient must have a plastic and trained intelligence. As a rule such patients are recruited from the professions and the arts. The average man or woman is wholly unable to grasp or to utilize this form of therapy, in his opinion. Those with profound psychiatric disorders have neither the receptive attitude nor the moral fiber to profit from the information that is disclosed.

Among the 43 cases Dr. Hyman discusses, 15 suffered from profound psychiatric disease. The treatment of 12 of these by psychoanalysis resulted in "dismal failures." In two patients the results are still questionable, and one—a homosexual—made a brilliant recovery.

Twenty-eight patients suffered from less serious disorders—hysteria, anxiety states, obsessions, and the like. Seventeen of these were distinctly benefited, and 11 experienced no significant aid, according to this critic.—*Science Service.*

WHALE-OIL VARNISHES

BY suitable treatment whale-oil varnishes are made in Germany which dry quickly to yield an excellent film comparable with that of linseed-oil varnishes. Other treatments of whale oil produce a thick product which can be used as a plasticizer or softener for nitrocellulose lacquers, and which functions well in the four-hour varnishes now made with tung oil.—*D. H. K.*

WIDE WIND PITS FOLLOW OVERGRAZING

HUGE pits covering as much as six acres and reaching a depth of 15 feet in some places, supply vivid evidence of the disastrous effects of wind erosion on grazing lands of the west. In one demonstration area of the Soil Conservation Service, in north central Utah, the wind has dug several of these yawning land eaters.

Before the demonstration was started, none of the land in the Utah project area had been fenced or plowed and there had been little or no control over grazing. As a result, overgrazing practically killed out the native grasses and browse plants which formerly grew in this section and held the soil in place.

Wind erosion may occur any place where overgrazing, overcutting of timber, or some other form of land abuse has left the soil unprotected from the ripping action of the wind. Already dust "blizzards" have done great damage in the southwest and in the Dakotas.

In combating wind erosion in the Utah demonstration area, in Salt Lake and Tooele Counties, grazing has been restricted and a good start has been made toward

starting new plant growth on the land. The Soil Conservation Service is introducing several varieties of grass, including crested wheat grass, in an attempt to keep the soil out of the air and make the country suitable once again for grazing and agriculture.

The Abbot Sun-Power Boiler

SUN power will be translated into steam engine power in the near future at the Smithsonian Institution at Washington, D. C. Dr. Charles G. Abbot, the Institution's secretary, is now engaged in putting the finishing touches on an apparatus in which 36 square feet of aluminum mirror surface will capture enough of the poured-out energy of the world's central heating plant to run a one-half horsepower engine, *Science Service* reports.

Dr. Abbot's new apparatus represents an improved evolution from earlier experimental models. Every part has been carefully planned to achieve a higher thermal efficiency than has ever been attained with solar boilers and other types of sun-heating apparatus.

Dr. Abbot states that the efficiency of his "sun-fired" boiler will be about 15 percent, which compares favorably with the efficiency of a coal- or oil-fired boiler—with the advantage that its fuel cost is zero.

Vitamin D Skin Cream

BASED on the latest researches in vitamins, cosmetic preparations are now being marketed which give milady vitamin D, the sunshine vitamin, in a form readily assimilable through the skin. In other words, it is possible by the use of cosmetic creams to give a person the effect of a sun bath in the dark. Several manufacturers have applied research findings on the absorption of vitamin D from fats containing it through the skin to improve their products in this respect. Careful tests, according to R. Schuler writing in *Drug & Cosmetic Industry*, have shown that rickets in rats can be cured by the administration of vitamin D dissolved in fats to the skin of the animal. Despite the advantage to persons of creams of this kind, it is hardly likely that they will make it unnecessary to include this vitamin in the diet since the curative dose as applied through the skin is about ten times greater than that required in food.—*D. H. K.*

Break Your Matches in the Woods

"THE careless smoker is a forest enemy. The careful smoker is a forest friend," says the United States Forest Service. Careless smokers—who neglect a few simple precautions—caused 47,845 fires last year, or 23 percent of all forest fires.

Careless smokers started more fires than were started by railroads, logging, and debris burning; more than three times the number caused by carelessly left campfires; and more than three times the number set by lightning.

A real woodsman always breaks his matches in two before casting them aside—a little habit which makes sure that every match is "out," says the Forest Service. He also crushes out the fire in pipe ashes and

(*Please turn to page* 237)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

NOW and then someone makes a reflector of the Gregorian type, and one such telescope (Figure 1) was made by Paul A. Chamberlain, 8054 Honore St., Chicago, Ill., who writes:

"The mirror is a disk of No. 5 Carpenter stainless steel, forged to 8¼" x 1", machined to 8" x ⅞", ground, polished and figured. It weighs 16 pounds. The secondary is of No. 3 Carpenter stainless steel similarly handled. Both are chrome plated. The focus of the primary is 34", radius of curvature of secondary is 10¼". *P* measures 5.75" and P' 47.25", *e.f.l.* being *f*/32.

"The tube is made of six duralumin tees. The fork, polar axis housing, cell, short tube around cell, and support for secondary are all aluminum castings. The polar axis has

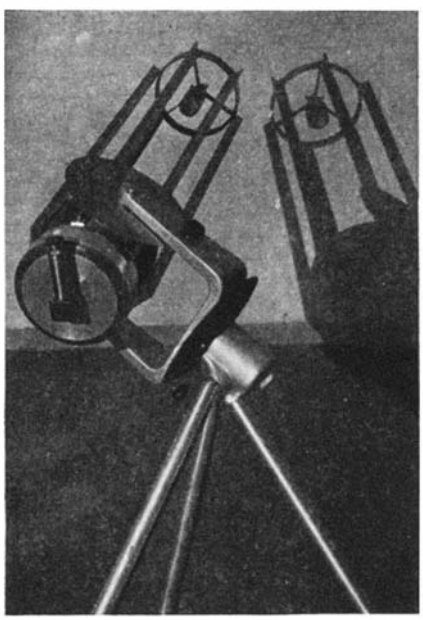


Figure 1: **Metal mirrored Greg**

roller bearings. The declination axis is 1".

"The tripod is made of three 1½" O.D. duralumin tubes. The eyepiece holder is fastened to a tube which swings around the optical axis. Having used some telescopes which require the observer to be a contortionist, I determined to arrange my instrument so that after using it some time I could look the neighbors straight in the face. The observer can be seated while at work. The total cost was $59." [The details of grinding and figuring this metal mirror will not be presented here, having been included in a chapter on that subject in Vol. II, "A.T.M." This is now at the printer's and will be announced when ready—considerably later in the autumn.—*Ed.*]

HEAVY oak tripod legs instead of the spidery legs sometimes seen on tripods characterize the 6" telescope in Figure 2, made by Newman E. Brown, 414 Connecticut Drive, Erie, Pa. He says: "The tube consists of a sheet of rawhide fiber, .060" thick, rolled up on a mandrel to three thicknesses. I cemented each layer as I went around, and riveted the final edge. This makes a tube of

Figure 2: **Rawhide tube, good legs**

remarkable rigidity, and exclusive of optical parts, weighs only 9½ pounds.

"The mounting consists of a worm gear steering unit from an old automobile. The gear shaft serves as my polar axis.

"All material, except optical parts, I obtained from scrap of a large industrial plant at a total cost of about three dollars."

"WHAT interests me is the new found use for another flivver part—the rear axle housing, as a pedestal," Russell W. Porter commented when shown the photograph in Figure 3. Welby Powell, R.F.D. 1, Clarksville, Tenn., is the maker. His letter:

"I have completed my first telescope, which has an 8" mirror of Pyrex. I used your book, 'Amateur Telescope Making,' as a

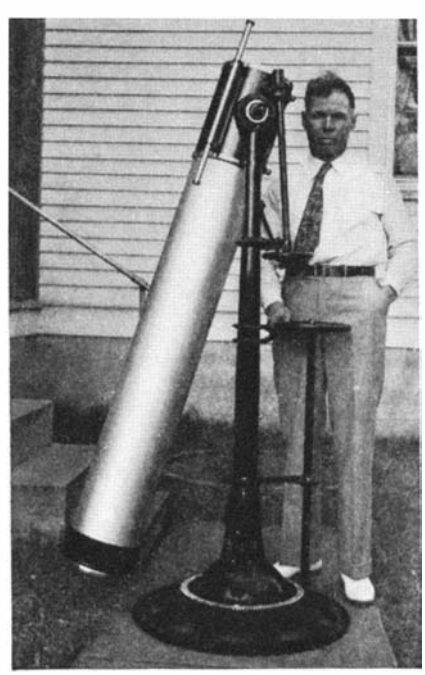


Figure 3: **Note altitude screw**

guide and picked up some 'Don'ts' of my own.

"My mounting is a portable type which I built from discarded machine parts, excepting the tube which I rolled from 20-gage iron. I wanted to get away from the necessity of following the eyepiece into so many inconvenient and almost impossible positions, so I fitted it into the journal of the declination axis. You might call it a portable mounting with a fixed eyepiece." [Note that all of the telescopes in Figures 1 to 6 are portable.—*Ed.*]

MOUNTING a 12" telescope semi-portably is no problem if you don't have to trundle it far. Figure 4 shows such a one, made by Edward J. Hejna, 3358 Jasper St., Philadelphia, Pa. It is a "Wheelemout" Type.

"I read about the 'Twelve Inch Club' in the June number," he writes, "and am send-

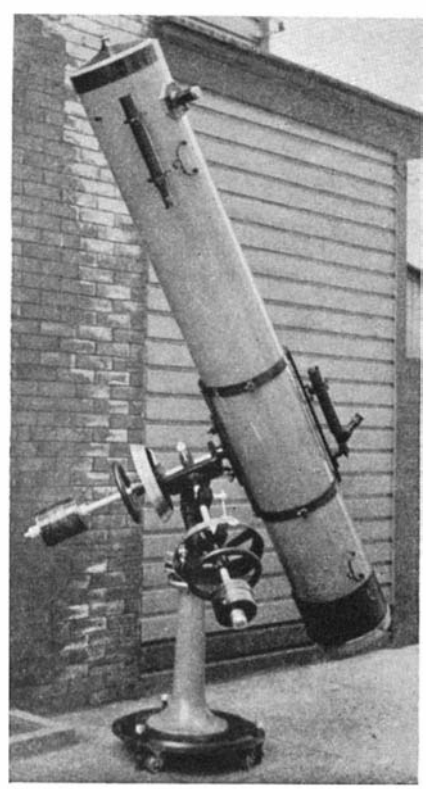


Figure 4: **New member of 12" Club**

ing a photograph of my telescope, which has a 12 7/16" mirror of *f*/8 ratio. The polar axis shaft is 1 3/16" in diameter, solid, and runs on ball bearings. The base is on ball bearing casters and the total weight of 550 pounds may be raised on three screws, making the telescope very steady." Mr. Hejna wishes to exchange photographs of telescopes with other amateurs.

A VERY portable portable is shown in Figures 5 and 6, and was made by Merle Foster, 677 32nd St., Oakland, Calif. "While it is portable," he says, "it can also be readily attached to a stationary mounting. But when the atmosphere does not permit clear observation it can be placed in a

Figure 5: **"Slip-stick folder-up"**

car and easily taken to a better locality.

"The backbone has a focusing and folding mechanism, like a slide rule, and this also permits focusing on relatively close terrestrial objects, as well as compact folding. It has a rack and gear."

ONE telescope which is *not* portable—it weighs 1000 pounds—is shown in Figure 7. Joseph E. Boehm, 3511 N. Seminary Ave., Chicago, Ill., is the maker and he says he has been plugging at the job, which is an unusual one, for the past five years. It is a 14" and, in its observatory (Figure 8), is situated at Lake Geneva, Wisconsin. But let us have the description from the tenacious maker. A man who will stick to a job five years must have determination.

"The telescope is a Cass-Newt combination. The *f*/5 primary mirror is used with a 4½" x 6½" Newt diagonal to cover a wide field for photography.

"Tube assembly is of all-aluminum construction and consists of a tube, internally reinforced, having a cast ring at its lower end which supports the threaded, removable mirror cell. Duplicate threaded tube outlets permit accessories to be interchangeable for either Cass or Newt observing position. A declination setting circle and 4000-to-1 slow motion are provided. Declination bearings are bronze.

"The hollow cast aluminum fork was bored out undersize and hydraulically pressed on the 3¼" steel polar axis shaft. Upper

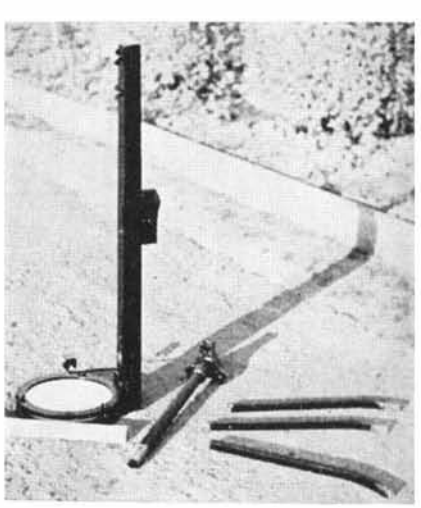


Figure 6: **Dissected—compacted**

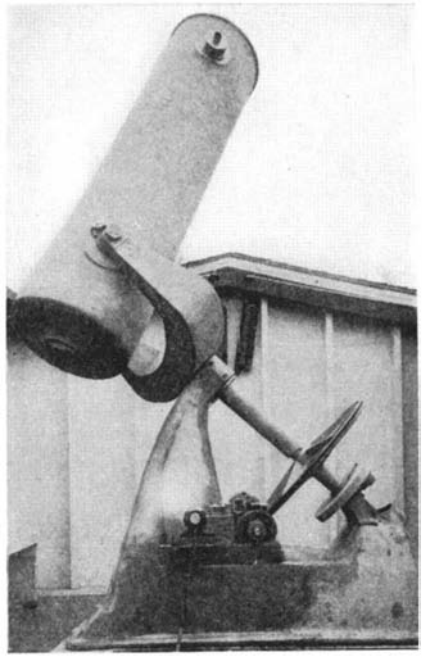


Figure 7: **Five years at hard labor**

polar axis bearing is bronze, while the lower bearing is a 6″ annular ball bearing. The R.A. setting circle is electrically driven to eliminate setting calculations.

"The cast-iron base weighs 600 lbs. and is mounted on a concrete pier extending 12′ below ground level.

"Weight of the entire telescope is around 1000 lbs.; the tube assembly alone weighs about 150 lbs. Contained in the instrument are 32 castings, for which 19 patterns were made by myself."

Mr. Boehm's description of the electric drive of this big telescope, with its design, has been included in "A.T.M.," Vol. II, as an example of a drive for a telescope of larger size, such as more and more amateurs now aspire to make. He continues, with regard to his observatory building (Figure 8):

"The 12′ x 12′ building is mounted on six concrete posts, 10′ deep, due to the unsteady ground conditions. The sliding roof is split at the ridge, each half being counterweighted and sliding independently on rubber rollers. Only about half of the total roof area is movable. The roof 'overhangs,' as well as the lower one third of the roof, are stationary, the latter being depressed to allow the sliding portion to pass over it. This depressed portion also supports the sliding roof when in open position. This construction greatly reduces the weight of the sliding roof, requires no external roof supports, and helps to preserve the trim lines of the observatory building when the roof is open.

"When observing near the zenith, a cushion on the upper edge of one of the sliding sections of the roof makes a convenient observer's seat. The roof can easily be 'inched' to follow the telescope movement during use. Besides protecting the instrument and observer from wind, the building materially assists in preventing dewing troubles. Merely closing the roof will postpone dew-up for several hours."

PITCH testers again. F. C. Woods, 100 North Cherry St., Galesburg, Ill., has made two, and writes:

"Here is a picture of a pitch tester which I believe overcomes some of the difficulties which I encountered in using one I built after the illustration in the October, 1935, Scientific American. Of this type I built a rather elaborate one (Figure 9), only to discover that the pivots had to be quite tight to take care of the upward thrust given by the point as it enters the pitch. In the one I have devised (Figure 10) the only moving part is the central rod which carries the needle point (.0395″ diameter).

"The degree indicator can be quickly removed and the micrometer head put in its place, thereby enabling the hardness of the pitch to be measured in 1/1000″. Neither the degree indicator nor the micrometer head is necessary, as divisions could be made directly on the shaft and read from a pointer attached to the standard. The rulings should probably be in thousandths of an inch and read with a magnifying glass.

"In the operation of the machine the shaft is set so that the pointer is at zero, and the shaft is held stationary by the thumbscrew at the upper cross bar. The pitch is then brought firmly to the point and locked in position; then, with watch ready, the thumbscrew is loosened for the predetermined period and again the thumb nut is tightened, locking the shaft.

"If anyone should build a pitch tester after this design, it would be best to make the shaft that holds the point and weights ½″ in diameter if a micrometer is used. I have already redesigned it to prevent flexing of any part of it."

JUST as these pages are put together this scribe is down from Vermont, after the eleventh annual convention, get-together or powwow of amateur telescope enthusiasts held at *Stellafane*. This year the attendance was 248, considerably larger than ever before. The amateur astronomical and telescope making movement "marches on," and one wonders what and where it will be in another decade.

Persons who are in a good position to watch statistics note that there never has been a retreat since the movement began. Instead, there has been a steady growth all along: "one man tells another." It looks as if everybody and even his wife would ultimately be pushing glass.

No ballyhoo methods—none of the artificial inflation methods so dear to some public relations counsels and "builder-up men"—have ever been used. It was thought better from the first to give the hobby its head and let it develop naturally, going wherever it wished.

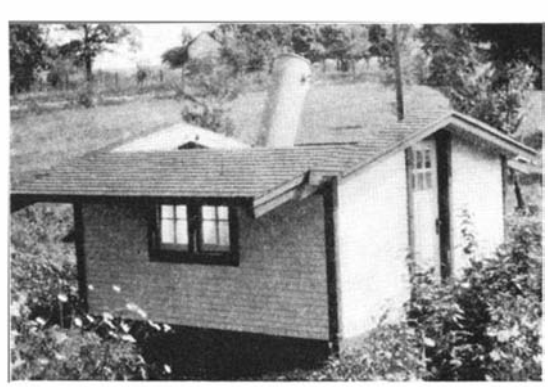


Figure 8: **An attractive observatory**

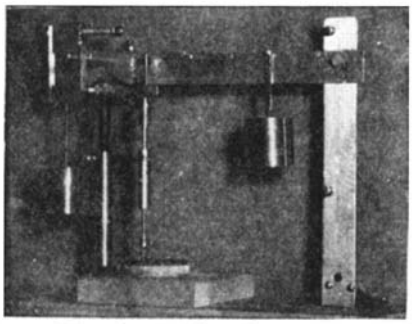


Figure 9: McCarrol type tester

We have even been reproached, in a few instances, for not "developing" it by various available high-pressure means. A really "live" organizer, we were told, would have blown the hobby up to much greater proportions in many fewer years. This is true—it could have been done. But then the bubble would have burst the sooner, leaving only that "morning after the night before" feeling. What such a thing really would have done is simply to inflate the hobby with a lot of people who lack sufficient carry-through to stick to telescope making more than three months or so. On the other hand, the hobby is its own quiet salesman to the right kind of folks—meaning by this, the kind of fellows who can handle the work and like it, and who don't peter out.

The *Stellafane* powwows are a lot of fun, chiefly, some think, for a reason which is of a piece with something mentioned above—folks come and are pretty generally left alone to do what they please. They add themselves to the crowd and begin chinning with the first telescope nut they see; and so it goes, all the (Saturday) afternoon and evening—all night for the owl fraction—and part of the next day, when the hold-overs drift away. The only semblance of a "session" is a group of informal "speeches" at dusk, mostly made in shirt sleeves.

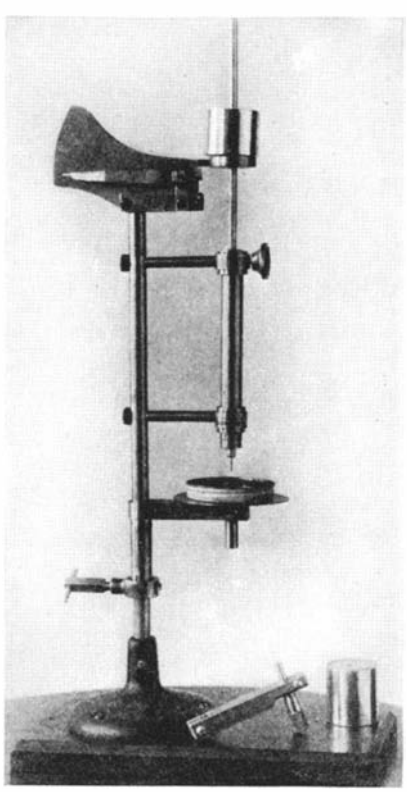
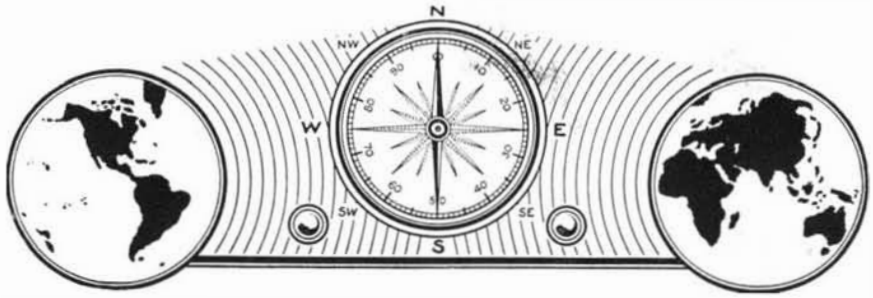


Figure 10: Another pitch tester



WORLD-WIDE RADIO

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

Amateur Phone Stations

MANY DX stations can be picked up in the amateur bands this time of year. There are two stations operating in Georgetown, British Guinea. They are VP3BG and VP3MR and operate on frequencies of 7.22 and 7.08 megacycles, respectively.

Captain Bob Bartlett's Schooner *Morrissey* is on another trip to Greenland. The phone transmitter is being operated by an amateur and has been heard on a frequency of 14.25 megacycles. The call is W10XDA.

A few of the other amateurs operating phone transmitters in the 20-meter or 14-megacycle band who may be heard almost nightly are: G5NI, England; LU8AB, Argentina; EA8AL, Canary Islands; SU8MA, Egypt; NY2AE, Panama Canal; PY2ET, Brazil; YV4AC, Venezuela; EI2J, Ireland; CO6OM, Cuba; HI5X, Dominica, etc. If the band remains open after midnight, there is a good opportunity of picking up some Australian amateurs.

New Custom Receiver

THE 1937 model Masterpiece Receiver, introduced by the McMurdo Silver Corporation, is a good example of the type of custom-built set produced these days for the discriminating all-wave listener. It also serves as an example of modern mechanical and electrical design trends in the radio field.

The receiver and its power supply-power amplifier unit use 20 tubes. The cone of the loudspeaker is 18 inches in diameter. The dial scale on the front panel of the receiver is nine inches in diameter. The pointer that traverses the scale has a knife edge that eliminates the parallax reading error often encountered.

The receiver has five tuning ranges, covering wavelengths from 2140 to 700 meters and 560 to 4 meters. A volume expander is used in conjunction with the audio amplifier for the purpose of increasing the dynamic range of orchestral music. Two of the new 6L6 beam-power tubes are used in the amplifier and these provide an audio output in the vicinity of 32 watts on volume peaks.

The audio-frequency range of the receiver is said to be from 20 to 9000 cycles, with facilities to cut down to 6000 cycles for reception from stations that do not cover such a wide tone range.

Chinese Station

WEST Coast listeners report hearing Chinese street songs over XGW, Shanghai, on 10.42 megacycles, between 4 A.M. and 1 P.M. Eastern Standard Time.

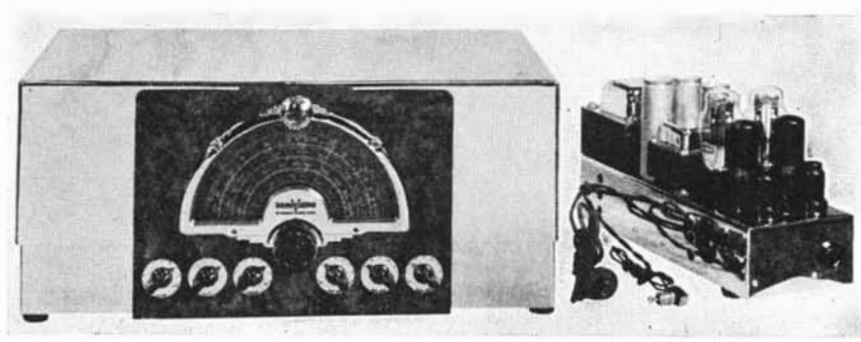
It should be possible to receive this station on the East Coast as well. The Japanese stations come through regularly and with good signal strength.

Foreign Broadcast Band

THE reception of distant stations is by no means confined to the short-wave bands. The standard broadcast band holds its share of foreign stations that may be heard in this country with good volume after the more powerful domestic stations shut down for the night.

There are, as a matter of fact, about as many foreign stations operating in the band of frequencies from approximately 550 to 1500 kilocycles, as there are operating in the numerous short-wave broadcasting channels. As a rule, however, it is not possible to intercept these stations until well after midnight due to the interference set up by the stations in the United States utilizing the same wave bands. Moreover, these foreign stations are difficult to pick up in the U. S. during the torrid months.

But, beginning about October 1, many of



Front view and chassis of the 1937 Masterpiece all-wave receiver

A verification card from a Mexican broadcaster

the foreign broadcasters will be laying down good signals over here, and such listeners who enjoy an occasional watch into the early hours of the morning are assured of at least a few good foreign catches.

Many foreign broadcasters have jacked up their transmitting power. England, Germany, and France, in particular, have had super-power stations under construction, and these transmitters will no doubt be placed into service in the very near future, if they are not already on the air.

Transmissions from these stations are particularly interesting since they are prepared for home consumption, or for the consumption of the natives of a neighboring country. Seldom are programs prepared with an eye to America, as is often the case with the programs transmitted from foreign short-wave stations.

Most of the foreign broadcast stations operate on even frequencies, with a 10-kilocycle spacing between stations, so that their signals fall in the same spectrum spaces as our own domestic broadcasters. A few of them, however, operate on split frequencies—such as 756 kilocycles—so that the signals appear between the signals of local stations. Therefore, if the receiver dial calibrations are fairly precise, it may be assumed that any signals heard on odd or split frequencies originated in a foreign country.

Signals from these stations reach their peak in midwinter, but now is the time to commence fishing for them.

1937 All-Wave Receivers

NOTABLE improvements have been made in the new crop of all-wave receivers now on the market. Self-seeking circuits are used in many of the 1937 sets, among the makes being Philco, Crosley, and General Electric. By means of this circuit the listener is not called upon to make delicate tuning adjustments; it is only necessary that the receiver be tuned to within five kilocycles of the desired station frequency at which point the self-seeking circuit comes into play and completes the tuning automatically. This scheme does away with the necessity of using a tuning meter or indicator to assure precise tuning.

The self-seeking circuit has made possible the practical application to a radio receiver of various systems of automatic tuning. Grunow is using an arrangement which operates somewhat like the dial on a telephone. Small tabs carrying the call letters of favorite stations are inserted behind a rotable face plate with circular apertures. By inserting a finger in the proper aperture and flipping the plate, the desired station is "dialed in."

Most of the new all-wave receivers have greater band spread, making it easier to tune in stations in the short-wave bands. By means of these band-spread arrangements, stations are well separated on the dial scale from each other. The result is that tuning in the short-wave stations is about as simple as tuning in stations in the standard broadcast band.

There is a distinct trend toward the use of air trimmers and iron-core intermediate-frequency transformers. The air trimmers insure permanent accuracy of circuit adjustment, while the iron-core I-F transformers provide greater sensitivity or gain in the intermediate-frequency stages. In some receivers the iron cores are made adjustable. They are set to resonance at the factory.

Frequency response has been greatly improved, although there is a hesitancy on the part of many manufacturers to carry the response too far into the upper registers where noise and station interference become problems. Nevertheless, the response has been carried far enough into the higher regions to provide quality of tone not approached by most of the earlier receivers. Moreover, the response has been extended into the lower frequency regions and the bass frequencies supported by much greater reserve power.

Time Signals

TIME signals from the United States Naval Observatory in Washington are broadcast daily on short waves through the naval radio station at Arlington, Virginia. The broadcasts occur at 11:58 A.M., E.S.T. and are on frequencies of 8150 kc, 12,225 kc, and 16,300 kc.

The broadcasts commence with a series of one-second signals preliminary to sending the noon signal, which lasts exactly three-tenths of a second, starting at noon sharp after ten seconds of silence.

CAMERA ANGLES

Conducted by JACOB DESCHIN

PHOTOMICROGRAPHY

TO the sum of pleasures that fill the leisure hours of the camera-hobbyist, add photomicrography. Its attractions are many-faceted and every camera user can find in it at least one good reason for taking it up as a pastime. Microscopy, the art of viewing microscopic objects enlarged to great proportions, has for a long time been the delight of hobby riders. But since the audience to which the marvels visible through the lens of a given microscope is necessarily limited to one, the camera-hobbyist finds in

Simplified set-up for photomicrography, described in text at right

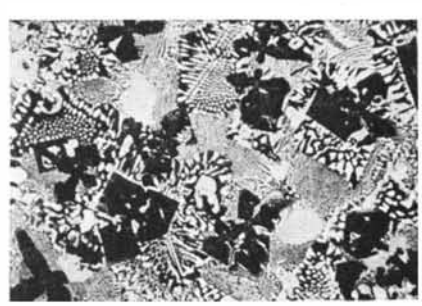
this fact a distinct drawback, accustomed as he is to exhibiting his handiwork to many. However, wider scope is given the hobby of microscopy by combining it with photography and in this way adding new zest to a branch of scientific work that never loses its interest to those of an exploratory turn of mind.

Photomicrography is no formidable undertaking that calls for vast scientific background, but may be practiced by any amateur who acquires a liking for this kind of work. Barring a few small adjustments, photomicrography resembles straight photography, and so far as developing the negative and making the print or enlargement is concerned, there is, of course, no difference. The same film you use for regular photography is employed here, too, and the same principles apply also with regard to the chromatic character of the emulsion, orthochromatic being used ordinarily and panchromatic for subjects containing red. To compensate, however, for the chromatic aberration (failure of different colors reflected to come to a single focal point) of the average microscope lens, it is recommended that a filter be used, the ideal all-around filter being a yellow green, one type of which is the Wratten "B." The filter is adjusted in a position between the source of light and the microscope mirror.

The set-up for photomicrography is a camera attached to a microscope outfit in such a way that the camera may be racked up and down for focusing and the lens of the microscope used for photographing as well as viewing the subject. A simple outfit, such as the one recently put out by Bausch & Lomb, offers an easy and inexpensive way to investigate the possibilities of photomicrography. Its low cost will permit the beginner to experiment with it to his heart's content without "plunging" on something that he may later find unsuited to his tastes. Should he take to it like the proverbial duck to water, as is altogether likely, there will be time enough later to decide on the purchase of a more advanced instrument.

The outfit includes a heavy, cast metal base, attached to which is a supporting rod on which the camera support is moved up and down. A focusing tube attached to the side of the camera has a frosted film disk in the upper end in exactly the same plane as the film in the camera. A short metal tube is mounted to the underside of the camera in the place ordinarily occupied by the camera lens, the tube's inside diameter being designed to fit snugly over the eyepiece of the microscope in order that a light-tight connection may be obtained between camera and microscope and to center the camera with the microscope automatically.

The light source for this outfit may be



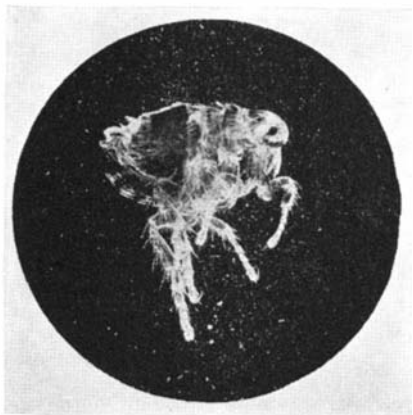
Photomicrograph of an alloy of the stellite type. Magnification 3000x

an ordinary 40-watt Mazda frosted bulb in a reflector, the common goose-neck type being considered ideal for the purpose. While the brighter the light the less exposure needed and therefore the less danger from slight vibration, too bright a light may bring the exposure time down so sharply that it will be difficult to control it accurately. Workers who have encountered trouble with excessive light in other

types of photography will recognize in this a familiar enemy.

Exposure time in photomicrography, as in ordinary photography, is determined by the amount of light reflected from the object as well as the filter factor, the speed of the film emulsion used, and the degree of magnification desired.

The interests that may be pursued through photomicrography take in the world's greatest sciences as well as the humblest, some idea of the scope being gained from the fact that not only may one delve into the mysteries of physics, chemistry, metallography, geology, microbiology, botany, and zoology, but also into those of household objects, textiles, and paper. One may observe and photograph the collection of dark dots and lighter spaces on a small piece of exposed photographic film; study rust on an old piece of steel or iron; explore the contents of a vacuum cleaner; examine pieces of fabrics or a slice of raw potato. In short, the world is your oyster and the joy of it is that if you like the hobby a pearl will be your reward every time.



A male dog flea, magnification of 40x; with dark field illumination

Very accurate focusing, proper placement of the light source so that the light is transmitted through a translucent subject or reflected from an opaque one as well as being adjusted to cover evenly the entire area of the slide visible through the lens, printing on glossy paper in order to show up every detail, are some of the chief factors involved in photomicrography. The experienced amateur photographer who has never attempted photomicrography will find in it so much that is true of ordinary photography that there will be little to learn except, of course, for those features which relate strictly to microscopy. However, knowledge is relatively cheap—costs no more, in fact, than the price of a book. In this connection, if you like, this department will be happy to send you a list of books on this subject.

Pictures by Moonlight

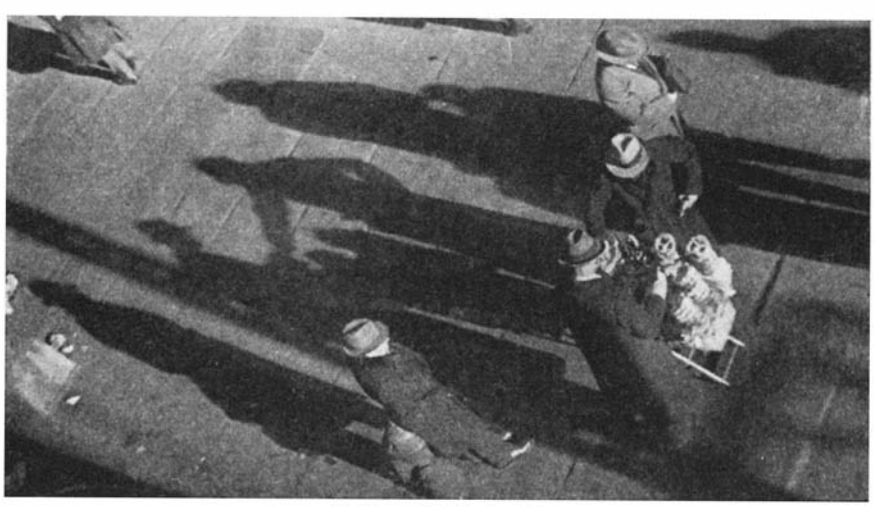
A METHOD of taking photographs by the light of the moon at relatively fast time exposures has recently been introduced abroad by the French astronomer, M. Lucien Rudaux. The fact that moonlight is said to be about 650,000 times weaker to the film emulsion than sunlight makes M. Rudaux's achievement stand out as a most remarkable feat. M. Rudeaux's objective was to find a means of cutting down the long exposure ordinarily required in moonlight photography in order to record such slow-moving objects as clouds. By employing a condenser used in a projection apparatus he obtained a lens of rather large aperture, obtaining definition by the usual procedure of stopping down considerably. He found that a 4-inch condenser stopped down to 2¾ inches gave him a lens of F:1 speed, which was fast enough to bring exposures down to under a minute by the light of a full moon.

Kodachrome for Stills

KODACHROME film, hitherto available only for motion picture cameras, is now announced for stills as well, the sizes for the time being limited to two, roll No. K828 (8 exposures) intended for use in the Kodak Bantam Special, and roll No. K135 (18 exposures) intended for cameras of the Kodak Retina type. The full color transparencies obtained with this film as easily as ordinary black and white exposures are viewed in their original size by transmitted light or projected on a screen in enlarged form.

Sidewalk Shadows

IN the lexicon of the photographer a shadow is one of God's greatest gifts to man. Picture a world without shadows and you see a world without contrast, dull, flat and unphotographable. And among its varied manifestations the shadows seen



"Sidewalk Shadows"

when the sun is low are the most beautiful and attractive. For long shadows it is generally best to get up high not only to include both subject and shadow in the picture but also to get the most interesting perspective.

Craft Pictures

EVER think of collecting photographs of people in various crafts at their work? If you haven't, here's a thought for you that should lead to interesting personal as well as photographic adventures. You will probably find such old crafts as

"The Puppeteer," a fine example of craft photography. A collection of characteristic poses is worth while

that of the blacksmith, the repairer of violins, the cabinet maker, most productive of pictorial material, and if you will direct your camera to include some such characteristic pose as that shown in the illustration of the puppeteer you will soon assemble a collection that will be worth all the pains involved in making it.

Automatic Enlarger Switch

MORE and more photographic darkroom routine is becoming less and less drudgery. The latest device designed to add to the comforts and conveniences already available for the darkroom worker is the so-called Automatic Enlarger Switch. This instrument, which is equipped with separate switches for time and focusing and powered with a synchronous electric motor, is handsomely encased in Bakelite. The device accurately times the exposure required, which is set by a dial, and automatically lights and turns off the enlarger light.

Toning Simplified

COLOR prints are all the rage these days—and it is conceded that a good color print will always be something to shout about—but direct color photography is still a rather complicated process and one which not all can tackle in the full confidence of achieving success. The toning and staining of prints, however, by which even two or three tones may be obtained, is a simple procedure which anyone can follow. Burroughs Wellcome & Company have been putting out their color producing tablets

for a long time to the great delight of amateurs everywhere, and their line of toners and stains should answer practically all amateur requirements.

A technically perfect chloride or bromide print, correctly exposed, fully developed, properly fixed and thoroughly washed, is essential. Sepia, blue, and green toners are three popular colors and the brown toner may be used to modify the color of a sepia-toned print. A versatile toner is the Copper Ferrocyanide Toner with which may be obtained a variety of colors ranging from warm black to red chalk, and including various shades of brown, red, and purple. The different colors are realized by varying the period of toning. For most of the toners only one bath and a short period of washing are all the work required.

The stains stain the paper and the emulsion, leaving the black image unaffected and are effectively combined with toners to produce unusual color results.

Projected Backgrounds

WHEN spotlighting the background in portraiture, interpose a cutout between the spotlight and the wall or whatever plain light-toned background you may be using and thereby considerably improve the resulting portrait. Generally, in this type of background, it will be necessary to so light the subject as not to show his or her shadow on the background. The possibilities in this connection, it is readily apparent, are limitless, for not only may one project a design on the background but a whole scene as well. A projected cutout is an excellent means of giving your portraits an individual twist.

Tray Cleaner

A TIP from the professional on how to clean those stained trays: Dissolve 4 ounces of potassium bichromate in 16 ounces of hot water and add 4 ounces of commercial sulphuric acid. After swishing this solution around in the dirty tray for a couple of minutes, rinse the tray with clean running water. This cleaning solution can be used a number of times.

Write Your Own Title

"SNAPSHOTTER Snapshot!" is this department's feeble first attempt. Or perhaps, since this department is written

"Snapshotter Snapshot!"

for photographers, you will prefer Burns'

Oh wad some pow'r the giftie gie us
To see oursel's as others see us!

Anyway, the next time you visit the zoo, why not train your camera eye on your fellow-hobbyists as a change from animal hunting?

Parades

PARADES sometimes offer unusual photographic opportunities and are always worth watching with pictures in mind. "On

"On Guard"

Guard" shows one way of converting an ordinary parade scene into something better. The large form of the police horse's head and neck in the foreground makes for effective pictorial balance, as well as contrasting mood—the ardor of the parade leader and the watchful impassivity of the horse's countenance.

Spraying Photographs on Walls

WORD comes from England of the development of a new type of wall decoration by which any wall surface may be sensitized by spraying it with a photographic emulsion, an image projected upon it by the usual enlarging method, and then the developer and fixing solution sprayed on the wall to complete the printing routine. The whole thing seems fantastic and to the cradle watchers of the last century, who nursed photography until it was well on the way to its present healthy and vigorous state, might have seemed an impossible day dream. But the fact remains that there is no if or maybe about the matter; it has been done and the inventors, Eugene Mollo and Paul Lamboit, are proving it every day.

Mr. Mollo, in describing the process, which, incidentally, is based on a patented formula, sees the new method "a practical and commercial proposition" for decorating large surfaces by means of photography and as greatly enlarging "the decorative possibilities of the photo-mural, for by means of it jointless photographs with a hard washable surface can be produced not only on a flat wall but also on any bas-relief, curved, corrugated, or fluted surfaces."

Making Haste Slowly

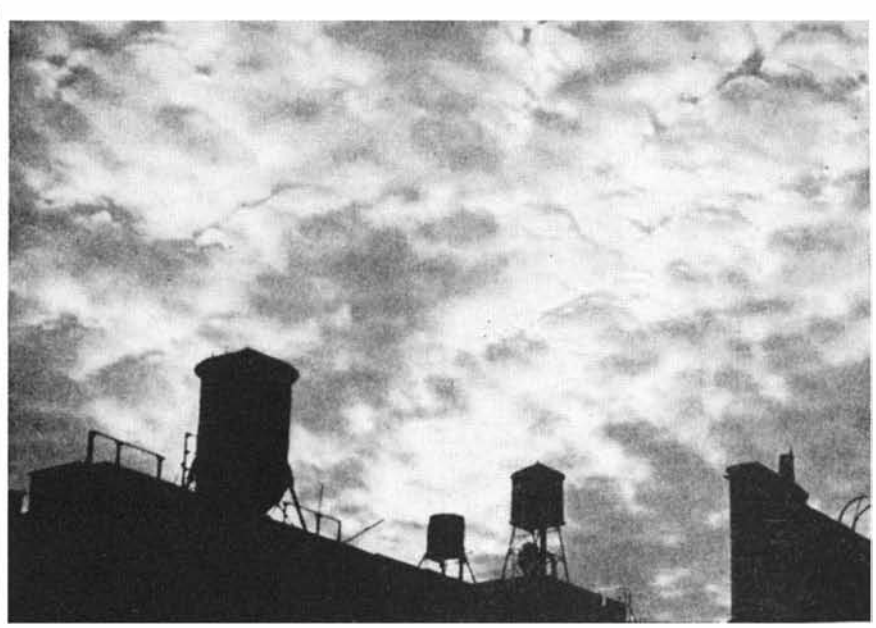
OWNERS of cameras equipped with F:4.5 lenses who have wished on certain occasions for speedier lenses may take comfort in the fact that some workers have been able to overcome the difficulty of "stopping" night action scenes by waiting for the "moment of suspended animation" when action stops for a brief interval. One man recently succeeded in "stopping" a trio of acrobats with a 1/5th of a second exposure at the full opening of his F:4.5 lens.

Carrying Cases

CAMERAS with exposed lenses and range-finders or view-finders should always be protected, when not in use, by a carrying case of some kind or other. Fine leather cases may be purchased, of course, or, with a little ingenuity, you can make your own to your own design and taste. Leather or heavy cloth are suitable materials.

Roof Pictures

MANY of us never get to see the roofs of the houses we live in. And that's a great pity, because there's many a good photographic shot available from a roof-top vantage point. With all proper modesty, this department submits the accompanying illustration as an example of the possibilities.



Silhouettes and clouds, from the roof-top

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 225)

cigar or cigarette butts on a rock or in mineral soil. He does not even throw "dead" butts into brush, leaves, or pine needles. He drops them into the dust of trail or road and tramples them, to be doubly sure they are dead.

The careful smoker not only observes these rules but while traveling through forest, brush, or grassy land smokes only in a safe place where there is no inflammable material, or inside a vehicle with an ash receptacle.

Shorter Syphilis Treatment

THREE Chicago scientists believe that they have succeeded in decreasing materially the long period of treatment necessary for persons who have syphilis in its early stages. They further feel that their methods bring the eradication of the disease in its early stages one step nearer realization.

Dr. Clarence A. Neymann, Dr. Theodore K. Lawless, and S. L. Osborne have merely combined the recognized fever and drug treatments of syphilis, and the results, reported in the *Journal of the American Medical Association*, have been highly satisfactory.

The average time consumed in this combined treatment is 42 days. An average of five sessions of fever were given each patient and an average of five injections of neoarsphenamine were given during the treatment period. A small amount of bismuth salicylate was also used.

Fourteen cases of early syphilis were treated with hyperpyrexia; that is, the patients were given a high fever. Half of them simultaneously were given arsphenamine and bismuth compounds.

The seven treated by fever therapy alone developed further signs of the disease. The seven given the combined treatment have shown no clinical signs of syphilis for periods ranging between five and eighteen months.

"This entire treatment presupposes an organized expert medical and nursing staff trained in giving hyperpyrexia treatments and the hospitalization of the patient during 24 hours for each session of hyperpyrexia," the three medical scientists state.—*Science Service.*

Soybean Adhesives

SOYBEAN meal, after the extraction of the oil used in paint and as a food, contains a large proportion (41 percent) of a protein resembling the casein of milk. This protein is used in making glues for manufacture of plywood; as much soybean glue is used in the United States as of all other plywood glues combined.—*D. H. K.*

Perfect White Impossible

PERFECT white exists only as an unattainable scientific standard. All substances filling the layman's conception of whiteness are actually darker, grayer than the perfect white. The nearest colors to the perfect white are those of the purest chalk or a very thick layer of new-fallen snow. But even these fall short of science's rigid standard. The increasingly wide use of the word white in connection with commercial articles, however, especially in advertising, made scientific recognition imperative.

Research to determine a method of grading these varying shades of white was undertaken in the Massachusetts Institute of Technology color laboratory. The results, which constitute the basis of all modern discussions of whiteness, have been explained by Dr. David L. Mac Adam, of M.I.T., who conducted much of the research.

All substances which are ordinarily called white, he told the conference, differ from the perfect white in one of two ways. All are darker, grayer than the perfect white. Some may show no other difference, and these are scientifically regarded as grays of differing degrees of brightness. They are commonly called whites, however, the brighter substances being regarded as whiter than the others.—*Science Service.*

Canada Produces Most Platinum

PLATINUM first became known to Europeans early in the 16th Century when it was discovered with gold in the river beds of what is now Colombia, South America. Later the important deposits in the Ural Mountains were discovered. Then its existence in the copper-nickel ores of the Sudbury district in Ontario, Canada, was noted, and finally it was found that the gold ores of South Africa contained substantial amounts of the metal. Today Canada is the most important platinum-producing country and Russia is second.

More Research— Less Unemployment

LESS unemployment and perhaps no jobless at all would be the state of the nation if industrial research were done by more and better people. This is held to be "perfectly obvious" by Dr. Willis R. Whitney, General Electric's vice president in charge of research, quoted in a *Science Service* report.

Always there is an increasing circumference of untested assets about us and an infinitely fertile area for progress just adjacent to the known. New industries may be put into action at any instant, Dr. Whitney said, by the maturing of some new crop of facts, materializing into gadgets.

Dr. Whitney is himself a leader in applied physics and he was for many years director in the General Electric Research laboratories.

"Is it enough in a research laboratory to tackle known difficulties, to improve output and to analyze competitors' methods and products?" Dr. Whitney said in a Sigma Xi address. "The answer is, no! And this leads to asking how far afield should a research laboratory go. The aims of the research group should include protection of the industry against the sure obsolescence due to new discoveries by someone. Discoveries made entirely outside an industry may disconcert and injure it. They may stop the

earning power of conservatively invested capital. The harness men and carriage builders of the early days were more or less embarrassed by the oncoming automobile makers, because there was little in the harness or wagon business to anticipate the gasoline engine. Research on the old ground is not enough. One must assume that advances will be continually made in all industry, and try to be party to it . . .

"Research is the result of child-like inquisitiveness, and we are likely to check that inquisitiveness, as we do a child's, because we are lazy. It is easier to plan experimental work close to the old home acre, so we do. In electricity, for example, I can think only in terms of wires, magnetic fields, and wavelengths, so I lazily encourage inquisitiveness only about adjacent areas. So much has been accomplished with 25 and 60 cycles and a few selected high frequencies in radio, and even with zero frequency itself, that wavelengths between zero and infinity are subjects for research—simply adjoining fields. But this, too, discloses laziness, ignorance, and conservatism, because I have thought only of the obvious. I may have actually forgotten that I never knew what electricity is, and am ignorant of what it might do if freed from the shackles which limited knowledge has forged. We almost need to provide more 'accidents,' for it is frequently the unexpected effect which drives a researcher into a new and productive field."

A Visit to the "Hindenburg"

WE delayed our visit to the *Hindenburg* until its third trip to Lakehurst so as to avoid crowds. Thanks to the courtesy of Captain Anton Heinen (one of the constructors of the *Shenandoah*, now back in service with the Navy), we were privileged to visit not only the passenger and navigation quarters but to walk along the interior keel through every part of the huge ship.

The *Hindenburg* is just as advertised. It is a marvellous piece of engineering in conception and detail. Notes in previous issues have covered the airship rather fully, but we cannot resist setting down some personal impressions.

Seen from below, the engine gondolas look tiny and difficult of access. But when reached through the keel and commodious side walks and gangways, they are found to be roomy and comfortable. The mechanic who is constantly on watch in these gondolas should have little difficulty in his task of maintenance and minor adjustment. It seems a pity that because there is no helium in Europe, the engines have to be placed outboard. In the United States, with our large supplies of helium, we can house the engines inside the hull with much aerodynamic saving.

The *Hindenburg* must navigate with exceeding smoothness since no provision is made for securing crockery, flower vases, or even bottles from sliding or shaking off the tables. A small vessel on the high seas gives the diner infinitely more trouble. The crew eats very well, which is a good omen for the passengers.

When a passenger wishes to leave the smoking room, a bell rings and warns the steward who alone can open the airtight double door. A lighted cigarette near escaping hydrogen is so great a hazard that no passenger can complain of this precaution.

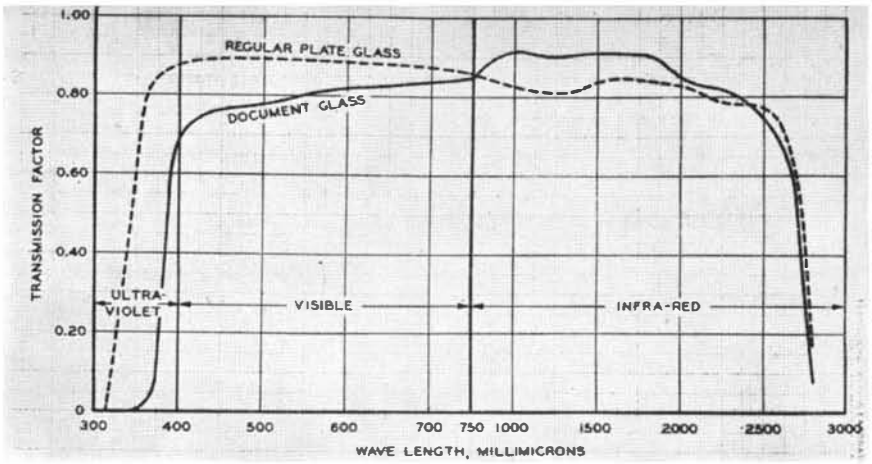
The noise level of the *Hindenburg* is so low that passengers can hear the shouts of people on the ground 500 feet below.

The man who operates the elevator controls in the navigation cabin stands sidewise to the direction of travel; therefore he feels the pitching of the ship and does not have to observe his inclinometer so closely. Elevator man and the steersman are normally relieved of strenuous effort by the interposition of an auxiliary engine, but in rough weather the auxiliary engine is cut out, because manual control is so much more rapid, and because the steersman should "feel" the ship.

Men and officers have the same stamp as men and officers in the merchant marine. Are seamen and airshipmen selected for their steadiness of character, or does steadiness of character develop at sea and in the air?

On the third trip back every imaginable small article was carried on the ship besides mail. But there was one large object. This was the Wright Whirlwind powered Beechcraft biplane, which Mr. and Mrs. James Haizlip, two famous racing pilots, and their son James, Jr. were taking with them to Europe. Mr. Haizlip is the former holder of the transcontinental speed record

Loading a light plane on the *Hindenburg*



Document glass passes but little of the ultra-violet

of 10 hours, 19 minutes. One of our photographs shows the first airplane to be ferried to Europe by airship, while it is being loaded into the hull.—*A. K.*

Soviets Fight Religion With Chemistry

IN the effort of the Soviet government to destroy religion in Russia, many of the experiments familiar to the users of toy chemical sets are being employed, according to Rudolph Seiden writing in *Industrial and Engineering Chemistry*.

Among the experiments shown to young people by the anti-religious lecturers are: turning of water to "blood" by mixing solutions of ferric chloride and ammonium thiocyanate; the transformation of water to "milk" by mixing barium chloride and sodium sulfate; making "wine" from water with phenolphthalein and an alkali; and production of a pillar of cloud with hydrochloric acid and ammonia. Miraculous pictures are made to appear by exposing a cloth or paper previously treated with cadmium, bismuth, manganese, and lead salts to hydrogen sulfide. Fires are made to light themselves by dropping alcohol onto potassium permanganate moistened with sulfuric acid. These and numerous other simple chemical reactions are explained, according to Mr. Seiden, as the way in which the miracles of religion were produced. In America children play with chemical sets and perform similar experiments, but without injury to their religion.—*D. H. K.*

Document Glass

THE production of "document glass," which is designed to protect valuable manuscripts from the deterioration caused by harmful light rays, is announced by the Pittsburgh Plate Glass Company. Developed to meet a growing demand by museum directors and curators of collections of rare manuscripts, document glass filters out the ultra-violet portion of the spectrum, exposure to which causes discoloration of paper and fading of ink, at the same time giving complete visibility by transmitting the visible light rays.

Development of document glass was based on the fact that the ultra-violet portion of the spectrum is most destructive to paper stocks and inks of various kinds, as established in research activities carried out at the Swedish National Testing Institute in Stockholm. The most active light rays are those beyond the range of the visible spectrum in the short-wave region of ultra-violet (shorter than 400 millimicrons).

After considerable experimentation with chemical ingredients designed to transmit the visible light rays and filter out the ultra-violet, document glass was perfected. Comprehensive tests reveal that it transmits only 3 percent of the invisible radiation just out of the visible range, yet has a relatively very high transmission within the visible portion of the spectrum. The chemical elements which give the glass its non-actinic quality impart to it a very faint pink tinge, which in no way interferes with visibility.

With the extremely low ultra-violet transmission effected by document glass—by far the lowest obtainable with any glass of comparable visible transmission—the fading of even the most delicately colored ink and the deterioration of the paper should be almost wholly prevented.

Mothers' Milk for Premature Babies

A NEW process of quickly freezing mothers' milk, thereby preserving it in perfect condition indefinitely until it is needed by prematurely born or seriously ill babies, was recently demonstrated by the Children's Welfare Federation at its offices, 325 East 38th Street, New York City.

The process, invented by Washington Platt, a scientist in the research laboratory of The Borden Company, and worked out in conjunction with Dr. Paul W. Emerson of Boston, makes it possible for the first time to freeze and keep mothers' milk for several months or more, transport it, and feed it to prematurely born or ill babies without the necessity of any subsequent action other than thawing and warming. The process has been licensed to the Federation, without charge, by The Borden Company.

Mothers' milk is regarded by doctors as an absolute necessity for premature babies but their mothers generally are unable to nurse them. This creates a demand which the Mothers' Milk Bureau strives to fill.

Mr. Platt, in explaining the process, said: "Human milk is a much less stable emulsion than cow's milk and therefore the former is more difficult to freeze in such a way that the emulsion will be preserved and the milk remain digestible by infants. It is common knowledge that milk frozen in the ordinary manner, comparatively slowly, has the emulsion partially broken. And it is

widely recognized by the medical profession that frozen milk may be the cause of digestive disturbances in infants.

"However, numerous clinical tests, particularly by Dr. Paul W. Emerson of Boston, have definitely established the fact that human milk frozen by the new process is entirely suitable for young infants. Our process provides for the freezing of mothers' milk under such conditions that upon thawing the natural emulsion will remain substantially unbroken and the other characteristics will remain sufficiently unchanged so that the thawed product will be suitable for infant feeding."

A study made by Dr. Walter H. Eddy of Teachers College, Columbia University, showed that frozen human milk as compared with unfrozen milk has lost none of its vitamin content. Moreover, frozen human milk does not differ from fresh milk in total solids, fats, carbohydrates, or proteins.

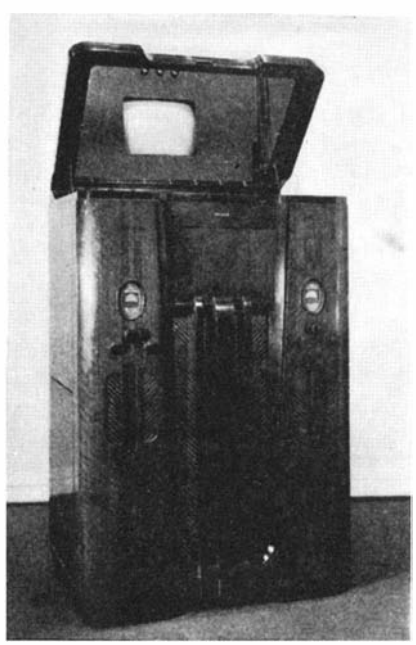
More Television

TELEVISION engineers are constantly studying the problems of cathode ray transmitting and receiving equipment. One of the latest demonstrations—in the nature of a progress report—was staged by the Philco Radio and Television Corporation. Using a 345-line picture, they were able to show a reproduced image approximately nine by eight inches in size that gave fairly good definition of the transmitted objects. Indoor scenes under artificial light and exteriors with natural lighting were satisfactorily transmitted by radio over a distance of approximately seven miles.

Although receiving equipment is not as yet available for the general public, the engineers have designed their apparatus along the lines of a standard home sound broadcasting receiver. The images are viewed by reflection in a mirror located in the slanting top of the console cabinet. These receivers are designed for reception of both sound and television signals and contain 36 tubes exclusive of the cathode ray tubes. It is estimated that if and when such receivers appear on the market, they will retail for approximately 500 dollars. This, however, cannot take place until satisfactory transmission facilities are made available and programs have been worked out.

Much of the experimental work being conducted today is directed toward the solution of problems of transmission and toward a study of reception under varying topographical conditions. Because of the extremely short wavelengths used for transmission, it is necessary that everything possible be found out about the actions of these waves in cities, towns, and country, before definite plans can be made for the erection of permanent transmitting stations.

In spite of the development work being done, it appears that the statements made in the editorial on page 9 of the July 1936 issue of Scientific American still hold good.



Above: **Front view of an experimental television receiver.** ***Right:*** **Rear view, showing self-contained equipment.** ***Upper right:*** **Television image (reduced) as seen in mirror**

Ephebogenesis

THE discovery that ephebogenesis—reproduction with only male cells present—is perfectly possible in nature, has recently been demonstrated by Dr. E. Newton Harvey, Princeton biologist. Parts of the eggs of sea urchins which contained no female nuclei were found to be capable of development by whirling into living organ-

Centrifuge-microscope that proved ephebogenesis possible in nature

isms in a new centrifuge microscope developed in the laboratories of Bausch & Lomb Optical Co.

This "cell carousel" is a rotor mounted on the shaft of a fast electric motor. Inside the rotor a system of microscope optics and prisms has been built to reflect light up into the eyepiece. At 10,000 revolutions per minute the light impulses reaching the eye are of the order of 1/300,000 of one second, but repeated 10,000 times a minute the impulses give the impression of a continuous image.

The force developed by this centrifuge is 12,000 times that of gravity. In other words, one ounce placed at the location of the specimen slide on the periphery of the rotor and traveling with a speed of four miles a minute produces an outward pull of 12,000 ounces, or 750 pounds. As the cell is whirled, the molecular particles are separated according to their specific gravity. The action on the cell results in an acceleration of the process of sedimentation.

Sets Type on Film

A MACHINE which will produce automatically photographed lines and columns of reading matter on film, for printing by lithography or rotogravure, without the intermediate use of type, has just been patented.

Commercial lithography and rotogravure are processes which employ metal plates on which the text matter had previously been photographed. In order to obtain such a plate the required reading matter must first be set up, or cast, in type and a proof pulled to obtain a copy on paper. This copy is then photographed on a film and the film transferred to the zinc plate.

To set up type for the purpose of printing a single copy—which is all that is required—is costly and time-consuming and is an item of major expense in lithographic and gravure printing. The new machine entirely eliminates type and type-casting from the process and produces directly, by photographic means, justified lines or columns of text without the need of a "first copy" printed from type. It accomplishes this by using some of the principles of the linotype machine invented by Mergenthaler, the 50th anniversary of which invention is being marked during the current year.

In the Mergenthaler linotype a line of individual molds or matrices bearing engraved type-characters is assembled and the recesses filled with liquid metal. The metal is allowed to cool, the matrices removed and the result is a "line o' type" composed of the characters engraved on the matrices. In the new machine, the photo-linotype, the engraved matrices are replaced by matrices bearing type-characters suitable for photographic reproduction and a camera device is substituted for the metal-casting mechanism.

In operation, the machine, instead of producing cast lines of metal type-characters on bars or slugs, produces photographed lines of type-images on a roll of film. Because the operations of the machine are automatic and the film may be of any length desired, it is possible to set up, if necessary, the composition of an entire book on a continuous roll. The film, which carries the photographed type-text, takes the place of the "first copy" which heretofore had to be printed.

The photo-linotype offers many other advantages to lithography and rotogravure, such as the ability to obtain many sizes from one size of matrix and various designs of type-faces by the use of screenings. It is believed that the machine will reduce materially the cost of these processes of printing.

The photo-linotype is the invention of Samu-El Ish-Shalom, a typographic engineer, and Dr. Otto I. Bloom, a New York physician.

The Science of Breath

WHEN Dr. J. McKeen Cattell became professor of psychology at the University of Pennsylvania in 1888, he was the first occupant of the first chair of psychology in any university.

The word psychology, of Greek origin, means literally "science of the breath," and was given that meaning because the Greeks associated the breath with life itself. When they observed the breath leaving the body of a dying person, they felt that with it went the soul. So the science of breath meant the science of the soul.

Later when the soul came to have a different and more specifically religious meaning, psychology was called the science of the mind. Still later it became known as the science of consciousness. Much more recently it has been proposed that it should be called the science of behavior.

This development of the term psychology suggested the following witticism quoted by Dr. Samuel W. Fernberger, of the University of Pennsylvania, in his new book on "Elementary General Psychology."

"Psychologists first lost their breath, then they lost their soul, then their mind and now, with the developing interest in reactions, they are rapidly losing consciousness."—*Science Service.*

Accurate Naming of Colors

USING the Munsell system of color description by cable, a week is saved to American fashion designers in duplicating the latest colors of Paris fashions. Colors can be more accurately described for commercial purposes by those characteristics which the human eye recognizes than by the more exact methods of spectrophotometry, according to Walter M. Scott of Gustavus J. Esselen, Inc. The eye readily differentiates

hue (the position of a color in the spectrum), value (the net relative reflective power of the color as compared with mixtures of pure white and pure black), and chroma (the strength or depth of the particular hue). The system of color specification or description developed by Munsell defines these three characteristics by simple numerals and letters in such a way that anyone with a little experience can readily duplicate any color from its Munsell value. Pink may be accurately described for purposes of duplication by the symbols 5R8/2, indicating that its hue is 5R, its value 8, and its chroma 2. These symbols, widely used in the textile and printing industries, specify an exact color and only one. —*D. H. K.*

Rodent and Bug Chiselers

IRON bars may imprison a tiger and a screen may stop a fly, but some insects and animals are equipped with chisel-like jaws and teeth which can cut through metal.

California lead-cable borers, for example, often damage aerial telephone and high-tension lines in or near forests by boring holes in the lead sheathing. They do not eat the lead. They bore holes in it to establish new homes. Then moisture usually short-circuits the electric current. Linesmen for telephone and power companies call the borer "the short-circuit beetle."

Many other wood-boring insects easily chisel their way through lead and tin signs which block their passageways and exist on trees, according to entomologists of the Department of Agriculture. Hickory bark, which is even harder than most lead and will often deflect the blow of a sharp ax, isn't too tough for hickory-bark beetles. They bore through the bark rather readily. The sharp jaws of Lyctus beetles, often found in seasoned hardwood lumber, enable them to eat through certain kinds of tin and lead which block their passageways. Termites, in biting wood, grind it into a powder.

Rodents occasionally use their hard, sharp teeth on metal. Curious squirrels sometimes gnaw aluminum identification tags off trees. The ground mole sometimes gnaws into concrete, and cases of rats cutting lead pipes in buildings are not uncommon.

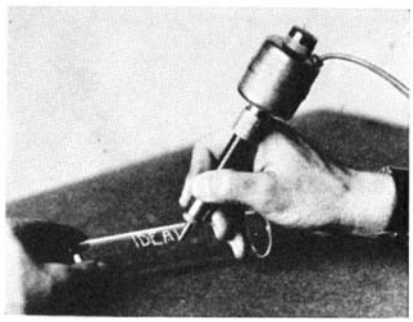
CORN NEEDS MAN

MAIZE, or Indian corn, is the most completely domesticated grain in the world as it is quite incapable of maintaining itself except through man's cultivation. Furthermore, the oldest corn of primitive man was as highly developed botanically as any corn known today.

Electrical Pencil Marks Metals

A NEW and inexpensive portable tool for marking on practically any material, whether metal or non-conductor, is announced by the Ideal Commutator Dresser Company. Legible and permanent records can be quickly, easily, and safely made on all metals and their alloys; on dies, tools, plates, sheets, shapes, rods, forgings, castings, pipes, equipment; and also on glass. pottery, ceramics, hard rubber, Bakelite, plastics, fiber, and similar materials.

The Ideal Electric Marker is 6¾ inches overall, weighs two pounds, and is as easily handled as a pencil or crayon. In fact it resembles an enlarged pencil with a small



Writing on metal with new "pencil"

motor where the eraser should be. It requires no cabinet, auxiliary controls, rheostats, or transformer for operation. The point does not stick in the marking surface. It makes permanent lines, cut into the surface, that can not be removed by ordinary wear and tear of handling.

This new marker operates on 110 volt, 60 cycle current, and consumes approximately 75 watts. It can be furnished for other standard voltages and frequencies.

Continuous Production of Mirrors

AS a result of the application of a new continuous process to the silvering of mirrors, many parts of the operation are shortened and better mirrors produced. The old process of hand-leveling the glass to receive the solution from which silver is deposited has been eliminated by the use of a carefully leveled conveyor belt. Backing of the deposited silver layer with shellac and quick drying paint has been replaced by a method of mechanically depositing copper directly on the silver. The whole operation requires about half an hour and handling of the plates has been reduced to a minimum to prevent scratching.—*D. H. K.*

Sun Lamps

IN 1927, the National Bureau of Standards published the statement that, of all the artificial illuminants tested, the carbon arc is the nearest approach to sunlight in spectral-energy distribution.

This statement of an observation that was already known in a general way is, of course, not an endorsement of any make of lamp by the National Bureau of Standards, yet this brief and incomplete item was seized upon for sales promotion of carbon-arc lamps. The Bureau, therefore, in Technical News Bulletin 140 (December 1928) issued a supplementary statement on "*The carbon arc versus sunlight*," in which it is pointed out that while it is true that, of all the artificial sources available, the spectral radiation from the carbon arc is the closest approach to sunlight, even this source is far from being an exact match of sunlight in spectral intensity. It contains ultra-violet radiation of very short wavelengths and infra-red rays of long wavelengths which are not found in sunlight.

By covering the carbon arc with a screen

of special glass it is possible to shut out the ultra-violet of short wavelengths and infra-red rays of long wavelengths. Nevertheless, there remains a selective emission band of ultra-violet radiation (the "cyanogen band"), the intensity of which is far in excess of that observed in sunlight.

For some years sales-promotion literature containing quotations from the 1927 statement has been in abeyance. Recently this incomplete statement from it, with no reference to Technical News Bulletin 140, has been revived in advertisements of "health lamps" and "sun lamps," with the inevitable result that the Bureau receives repeated requests regarding the reliability of the claims made for such lamps—including carbon-arc and tungsten-filament lamps.

The Bureau wishes, once more, to call attention to the fact that without an elaborate combination of filters no artificial source of radiation has yet been devised, and there is, consequently, no lamp on the market that has a spectral-energy distribution identical with that of sunlight. Moreover, in purchasing any lamp, its spectral-energy-distribution curve is not the only thing to be considered. Hazard from fire and from burns, which may result from contact with the housing of the lamp, as well as the possibility of generating disagreeable odors should all be carefully investigated.—Abstracted from the *Technical News Bulletin* of the National Bureau of Standards.

Better Hectographs

GELATINOUS plates or rolls used in the hectographic copying process are made by a new method patented by Erik R. Nielsen of the Miner Laboratories, Chicago, to meet service requirements better than has been possible in the past. The mass, which is made of glue, glycerol, and water, is made alkaline before the addition of small amounts of formalin which harden the mass. Accurate adjustment of the alkalinity and the amount of formalin introduced enables the maker to provide a mass of high melting point for summer use or greater softness for use in winter. The character of the mass determines the number of copies that can be made from it. Longer life and copies of any degree of brightness are realized by using the new method.—*D. H. K.*

Pillow-Block In Rubber Housing

THE latest step in conquering friction and vibration in shaft bearings is a "floating" pillow block. A molded housing

Rubber cushions a shaft bearing

of solid rubber supports a standard ball-bearing unit in which shafts turn smoothly at high speeds. The bearing itself is of the sealed pre-lubricated type. After it is pressed into the rubber housing, a rubber washer and thrust collar hold it tightly and permanently in place. On the outside, a special lacquer protects the surface of the rubber from deterioration.

The new construction is said to provide quieter and more shock-proof operation than is obtained with the ordinary cast iron housing, for the same reason that rubber mountings for automobile engines have achieved success. In addition, it is reported to be less expensive. Its initial application has been to fans used in domestic heating units of the forced air type, but numerous other possibilities exist for supporting high-speed shafts where loads are light but noise and vibration are a problem.

SIX—COUNT 'EM

NOW on the market are six so-called synthetic rubbers, most of which have certain characteristics making them superior to natural rubber. They are: Thiokol, Koroseal, AXF, DuPrene, Plioform, and Tornesit. The last two are rubber derivatives.

Safety in Using Carbon Tetrachloride

INCREASING use of non-flammable synthetic solvents in the dry-cleaning industry has suggested fears that workmen may be endangered by exposure to vapors of the solvents used. One of the most important of these solvents is carbon tetrachloride, familiar through its use in fire extinguishers.

An investigation conducted by the Laboratory of Hygiene, Philadelphia, under the sponsorship of five leading manufacturers of carbon tetrachloride, has recently been reported to show little reason to fear poisoning of workers if simple precautions are taken. Some 96 men working in contact with the vapors of carbon tetrachloride showed no serious or unmistakable injury traceable to the exposure. Further extensive investigations with guinea pigs, white rats, and monkeys showed that no injury is caused by concentrations that can be readily smelled and that there is some doubt about the injury caused by concentrations even ten times as great.

The recommendations based on the results of this study state that standard dry-cleaning units now on the market for use with chlorinated solvents are safe and that it is possible in practically any industrial use of carbon tetrachloride to keep its concentration in the air below the safe level of 100 parts per million. Ventilation can readily keep concentrations within safe limits. No cumulative effects from the vapors were found but the report points out that some rare individuals may be found whose resistance is less than normal and who should not expose themselves to carbon tetrachloride vapors.—*D. H. K.*

Rescue 230,000 Fish

WHEN the Sinking Pond near Muscle Shoals City, Alabama, recently staged the disappearing act, for which it has become famous and by which it earned its name, nearly a million fish were left strand-

ed, according to a bulletin of the American Wildlife Institute, Washington, D. C. But the energetic work of Commissioner Quinn's cohorts, reinforced by local sportsmen, saved over 230,000 of them.

It has been three years since the last retirement of this strange body of water. At that time, 165,000 fish were reclaimed. But the water came back and so did more fish, apparently from the depths of the ground. Geological experts believe the water comes from a subterranean arm of the nearby Tennessee River which is approximately 100 feet lower than the pond level. Authorities of the Geological Survey state that this is a limestone region which is relatively porous and subject to peculiar reaction to underground water levels. In wet weather the water level rises and the pond is probably formed at that time. In dry summers, with the lowering of the water table, the pond sinks into oblivion almost overnight.

But come and go it does, and so do the fish, as Game Warden W. M. George will attest. Watching and worrying about this has grayed his hair. If it would only give him a little more notice it wouldn't be so bad. But it takes its departure quickly, quietly, with little ado and never an "adieu".

This year Warden George and his men started on Sunday and worked all week hauling out 175,000 crappie, 40,000 bream, and 15,000 bass ranging from one inch in length to three pounds in weight. There ought to be medals for everybody who worked on the project.

Without Soil

CALIFORNIA nurserymen are growing vegetables and berries in chemically treated water heated by electricity. The idea has been taken from the laboratory at the University of California where Dr. W. F. Gericke has pioneered and developed nutrient plant solution agriculture. Commercial growers in Capitola, Los Angeles, Watsonville, and Richmond, California, are using the water basin method for raising tomatoes, sweet peas, and strawberries.

Water-filled vats, on the bottom of which are electric heating cables, are covered with mesh chicken wire. Excelsior, sawdust, or suitable litter spread on the wire serves as seedbed and insulation against heat loss. Plants or seeds are placed on the bedding, kept moist by water in the basins. As the plants grow, the roots enter the water. Then necessary chemicals are added as fertilizing units supplying the elements, each in proper form and concentration, for the use of plants. The chemically treated water is kept at the proper temperature by the heating cable.

Dr. Gericke is continuing his experimental work in growing tobacco, cucumbers, papaya, and floral crops in chemically treated water.

General Electric engineers, called in when Dr. Gericke needed a controllable heat source, supplied heating cable for the doctor's work and also for commercial installations under his supervision, which have sprung up in California as a result of the new method of controlled crop production.

According to Dr. Gericke, nurserymen have put tomatoes of unusually high quality on the market ahead of their competitors, who used soil to grow their crops. The yield, he said, was large and commanded a decided premium on the market.

The California installations are operating at present under Dr. Gericke's supervision, because cultural technique must be adjusted to meet climatic conditions.

GETTING THE BIG FELLOWS OVERBOARD

(*Continued from page* 194)

out with large centrifugal pumps. The ship is left standing on blocking which has been arranged to receive her. It is naturally possible to build a ship in such a dock and to float her by the simple expedient of flooding the dock, opening the gate, and towing her out. The objection to the method is purely economic. Dry docks are expensive to build and maintain. Interest and depreciation charges on a dock utilized for shipbuilding normally become part of the cost of the ship. In many cases, these charges would exceed the considerable cost of launching the ship, plus interest and depreciation charges for building ways.

The launching of a ship built in a dry dock is a singularly unimpressive ceremony. Water is admitted to the dock and when the ship floats, or when she starts out of the open dock gate, the sponsor christens her. That's all there is to it.

The custom of ceremoniously christening a ship at the time of her launching is a very old one. An Assyrian tablet found some years ago gives an account of the building of the Ark and describes the religious ceremony, including the sacrifice of oxen, which marked the completion of the vessel. Some form of blood sacrifice usually marked the launching ceremonies of the vessels built by the savage inhabitants of the Pacific Islands, the Chinese, the Phoenicians, and the Egyptians. With the advancement of civilization, the blood sacrifice was abandoned in favor of pouring a libation of wine on the vessel.

In England, where most of our naval and maritime customs originated, ships of the ancient Royal Navy were christened by a prince of the ruling house who was stationed on the poop and poured wine on the deck and named the ship as she entered the water. Not until the Nineteenth Century did a woman christen a British man-of-war. Nowadays the sponsor is usually, but not always, a woman. A notable exception was the christening of the Canadian Pacific liner *Empress of Britain*, the Prince of Wales, now Edward VIII, being the sponsor.

It is well known that an old nautical superstition attributes bad luck to any vessel not properly christened. For this reason, considerable care is taken to insure the wine bottle breaking when it hits the bow of the ship. In spite of all the last minute lectures delivered to nervous sponsors on the strength of wine bottles, it is occasionally necessary for someone to lend a hand to insure the bottle actually being broken.

The battleship *New York* almost got away unchristened at the New York Navy Yard when launched in 1912, and only a short time ago at the same yard, the bottle failed to break the first time it was swung against the stem of the gunboat *Erie*. Incidentally

the determination of one sponsor to *break that bottle* had an amusing result. The girl had been so impressed with the necessity of hitting the bow a mighty swat that she literally thought of nothing else. The triggers were released, the ship began to move, down came the sponsor's good right arm and smash went the bottle into a thousand fragments. She broke the bottle all right, but she never said a word!

Anything can happen at a christening! At the launching of a small yacht at a southern yard a good many years ago, I well remember seeing the sponsor run down the ways after the boat belaboring the bow with a champagne bottle. She finally hit the iron stem band with the bottle and broke it, but we told her afterwards that the name she gave the boat was the "Oh! My Lord, it won't break!"

CURRENT BULLETIN BRIEFS

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

COPPER WIRE TABLES, Circular C31, National Bureau of Standards, is a reprint of a publication which has not been available for several years. It deals with such things as electrical resistivity, temperature coefficient, and density of copper, as well as wire gages. *Superintendent of Documents, Government Printing Office, Washington, D. C.—20 cents.*

AUTOMOBILE FACTS AND FIGURES, 1936 Edition, is of particular interest to any one connected with the automotive industry. It gives statistics regarding such phases as production value, gasoline tax receipts, registration tax receipts, raw materials, state highway expenditures, and so on. *Automobile Manufacturers Association, Inc., 366 Madison Avenue, New York City. —Gratis.*

SILTING OF RESERVOIRS, Technical Bulletin 524, Department of Agriculture, emphasises the fact that cleaning of water and power reservoirs is too expensive a proposition and the only solution is to stop erosion and keep out the mud. The bulletin tells of work that has been done in attempts to make this possible. *Superintendent of Documents, Washington, D. C.—40 cents.*

29 WAYS TO PLAN A BASEMENT gives this number of basement plans as well as perspective drawings, predicated upon the use of a heating plant that makes cellar areas available for recreational and similar purposes. *Write for Bulletin 1036A, Scientific American, 24 West 40th, New York, N. Y.—3-cent stamp.*

THE PHOTOPLAY AS LITERARY ART by Walter Barnes, Ph.D., is a 40-page pamphlet particularly concerned with the promotion of an appreciation of the work of the motion picture. It also makes a strong plea for a continued trend toward better photoplays. *Educational and Recreational Guides, Inc., 125 Lincoln Ave., Newark, N. J. Single copies 50c; quantity prices on application.*

PLASTICS, National Bureau of Standards Circular 411, describes four principal types of organic plastics—synthetic resins, natural resins, cellulose derivatives, and protein plastics. *Superintendent of Documents, Government Printing Office, Washington, D. C.—5c.*

THE GOLD MINING INDUSTRY is a 20-page booklet reviewing gold mines as an investment. *E. F. Hutton & Company, 61 Broadway, New York City.—Gratis.*

THE TOWNSEND CRUSADE, by the Committee on Old Age Security of the Twentieth Century Fund, Inc. (which includes Newton D. Baker). A calm, rational analysis which refutes the Townsend Plan without the usual superheated "fireworks" or self-defeating evidences of animus. *Committee on Old Age Security, 330 West 42nd St., New York, N. Y.—25 cents.*

ARCHEOLOGY OF SOUTH AMERICA, by J. Eric Thompson. A 152-page study of the environment and genesis of South American civilization, and the religion and customs of ancient Peru, Ecuador, and Colombia. *Field Museum of Natural History, Chicago, Ill.—75 cents.*

CONCENTRATION OF COPPER ORES IN NORTH AMERICA, by Thomas G. Chapman, Bulletin 392, United States Bureau of Mines, summarizes and discusses copper-concentrator methods, results, and costs from 1929 to 1931, and includes an account of trends and developments in the industry. 169 pages, 26 illustrations. *Superintendent of Documents, Government Printing Office, Washington, D. C.—15c.*

OUTLINE OF THE HISTORY OF THE UNITED STATES PATENT OFFICE is a special number of the Journal of the Patent Office Society published in commemoration of the 100th Anniversary of the Patent Act of 1836. The book, 234 pages, covers the "Origin and Early History of Patents," "Colonial Monopolies and Patents," the Patent Acts of 1790 and 1793, the Act of 1836, and legislative changes since that time. It also deals historically with the Patent Office itself, and with the Commissioners of Patents. *Journal of the Patent Office Society, United States Patent Office, Washington, D. C.—$1.00.*

THE COLORADO DELTA, by Chas. Kirby Fox, Am. Soc. C. E. The author fears that the accumulating silt behind Boulder Dam will load the earth's crust and act as a trigger effect to set off serious earthquakes. *Chas. Kirby Fox, 1314 Washington Bldg., Los Angeles, Calif.—Gratis.*

LOANS UP TO $50,000 for the modernization of apartments, multiple family dwellings, hotels, schools, manufacturing plants, and so on, are described in this pamphlet. *Federal Housing Administration, Washington, D. C.—Gratis.*

HOW MUCH LIGHT FOR READING?, by Matthew Luckiesh and Frank K. Moss, is a careful analysis of lighting conditions desirable for efficiency, safety, and comfort. It includes a valuable series of references on the same subject. *Lighting Research Laboratory, General Electric Company, Nela Park, Cleveland, Ohio.—Gratis.*

Books SELECTED BY THE EDITORS

AN AMERICAN DOCTOR'S ODYSSEY

By Victor Heiser, M.D.

"ADVENTURES in Forty-Five Countries" is the sub-title of this book which narrates the life and very human activities of a noted public health doctor whose assignments and enthusiasms took him all over the world, always in the interests of cleaning up both peoples and places. It makes 535 pages of bang-up good reading, and long before he has put it down the reader will have absorbed, without sensing it, a vast amount of background concerning the science of public health and the dramas that go on behind the stage when cleaning up clashes with local inertia. The doctor knows how to tell a story and has a lot of good ones to tell.—$3.65 postpaid.—*A. G. I.*

ELECTRONIC TELEVISION

By George H. Eckhardt

WHAT the ultimate method of television transmission and reception will be is still a matter of considerable discussion. The success of electronic television—generally referred to as the "cathode ray" system—sets it forth as a likely contender for final honors. This book, therefore, has been confined solely to a consideration of the principles underlying electronic television and to a discussion of the methods which have been developed. It is thoroughly up-to-date in every respect and constitutes a noteworthy contribution to the scanty literature covering this up-and-coming art.—$2.65 postpaid.—*A. P. P.*

HOW ENGLAND GOT ITS MERCHANT MARINE

By Henry C. Hunter

THE author gives an extremely interesting and clear historical picture of the beginning and gradual growth of the English Merchant Marine covering the period from 1066 to 1776. Each step, the origin of each navigation principle, and how it was affected by subsequent legislation is described in detail. Between the lines one can trace in its development the reasons for England becoming one of the foremost powers in the world. Many curious old laws of the sea add considerable color and charm to the "meat" of the book, and the increasingly great part which the American colonies played in the development of England's Merchant Marine policy is emphasized and traced up to the very point where they challenged England for the supremacy of the seas. The legal and economic aspects as well as the historical side are all brought out and go to make "How England Got Its Merchant Marine" a truly colorfully interesting book and one well worth a reading if not an intimate study.—$3.70 postpaid.—*P. B.*

MEMOIRS OF SIR ISAAC NEWTON'S LIFE

By William Stukeley, M.D., F.R.S.

A CONTEMPORANEOUS account of Newton's life, written by a friend, which has at last been put in type through the Royal Society. According to it the famous apple did fall, after all, but it did not hit Newton on the head, but met the earth instead, as the two fell together.—$2.00 postpaid.—*A. G. I.*

SENSE AND SAFETY ON THE ROAD

By Robbins Battell Stoeckel, Mark Arthur May, and Richard Shelton Kirby

THE authors of this book, which should be required reading for every motor car driver, have considered the subject of their title from every conceivable viewpoint. They have taken the trio often mentioned editorially in Scientific American—the car, the driver, the road—and considered each part of it from every angle. As a result of their study of this highly important subject, they have reduced the principles of safe driving to a code of twenty rules which, if heeded by every motorist, would result in an immediate and marked reduction in our accident rate. We cannot resist the temptation to quote one short paragraph regarding the subject of taking chances: "I never take a 50-50 chance. Before I will take a chance odds must be at least 9 to 1 in my favor. I prefer 100 to 1."—$1.65 postpaid.—*A. P. P.*

THE PILOTS' BOOK OF EVEREST

By Squadron Leader The Marquess of Douglas and Clydesdale, A. F. C., M. P. and Flight Lieutenant D. R. M'Intyre

ON April 3, 1933, man first conquered Everest from the air. This famous flight has now passed into aviation history but there still remained much to be told. This book does the job and does it well. It is essentially a story of the flights —preparations, disappointments, final achievement—as told by the pilots responsible for the success. Written as a running story so that it will appeal to the layman who is particularly interested in anything pertaining to aviation, it is well illustrated with excellent photographs, many of them double the size of the book and inserted on folded sheets. —$2.90 postpaid.—*A. P. P.*

FRONTIERS OF SCIENCE

By Carl T. Chase

MONTH after month new popular books appear, covering the same ground—time and space, atomic physics, quantum theory, cosmic rays, biology; in short, the substance of modern science. What excuse has anyone for adding still another? Book publishers know their public, and doubtless these books sell—the public evidently wants the books. The present book, covering essentially the same old ground, is up to the standards of the others and is a science-book-of-the-month-club book, but in future this reviewer may concoct a formula for all these books of a similar nature and, unless the book is really outstanding, simply write $X=a+b+c+d+\ldots$ or "see reviews of a dozen previous books." Probably more of a similar sort are being written at the present moment, and readers of reviews written by reviewers whose repertoire of kind adjectives is milked dry must be exhausted and becoming cynical. However, this is a good book.—$3.90 postpaid.—*A. G. I.*

RADIO SERVICE BUSINESS METHODS

By John F. Rider and John Van Newenhizen

RADIO service has gradually evolved from a part-time job done by the local radio amateur to a thriving business conducted by trained technicians. With this evolution has come the necessity for the application of up-to-date business methods and bookkeeping which take into consideration the peculiarities of the profession. Therefore this book, written by two men well-known in the service field, covering the entire subject from A to Z. Paper covers, 218 pages, illustrated.—$3.00 postpaid.—*A. P. P.*

SCIENTIFIC AMERICAN ADVERTISERS

OCTOBER · 1936

Advertising Manager
CHARLES H. STEINHART
E. H. KRAEMER, Eastern Territory
24 West 40th Street, New York, N. Y.
Advertising Representatives

EWING HUTCHISON COMPANY
35 East Wacker Drive, Chicago, Ill.

BLANCHARD-NICHOLS-COLEMAN
Los Angeles, San Francisco, Seattle and Atlanta

Published by MUNN & COMPANY, INC.
24-26 West 40th Street, New York

ORSON D. MUNN, President JOHN P. DAVIS, Treasurer I. SHELDON TILNEY, Secretary

Vol. 155, No. 4. 35 cents a copy. $4.00 a year, postpaid in United States and possessions. Canada, $4.50; other foreign countries, $5.00, postpaid.

Printed at The Condé Nast Press, Greenwich, Conn., U. S. A.

Is YOUR HOUSE Also a Museum Specimen?

NOT from the outside, perhaps—but what of the inside? You would not drive a 1920 automobile; it would be obsolete and inadequate for modern service. Houses become obsolete too. Your house, if it is more than 15 years old, is probably almost as inconvenient inside, compared with "New American" standards, as this outmoded museum specimen.

Now, in 1936, your family should be living in a truly modern, a "New American," home. Scientific planning of rooms saves steps and lightens housework. Electric servants work for better health and greater comfort for the whole family. "New American" living costs are even lower than in your present home. This is not a dream house, but a home you can own—one to be proud of. General Electric, by fostering the "New American" Home, opens the door to new living comforts for you.

"New American" is not an architectural style—it is a new conception of living. For information on how to obtain "New American" comfort, convenience, and economy—in your present home or in a new house—write to the General Electric Home Bureau, 570 Lexington Avenue, New York, N. Y.

Labor-saving appliances, developed by General Electric research and engineering, are brightening the home life of America

GENERAL ELECTRIC

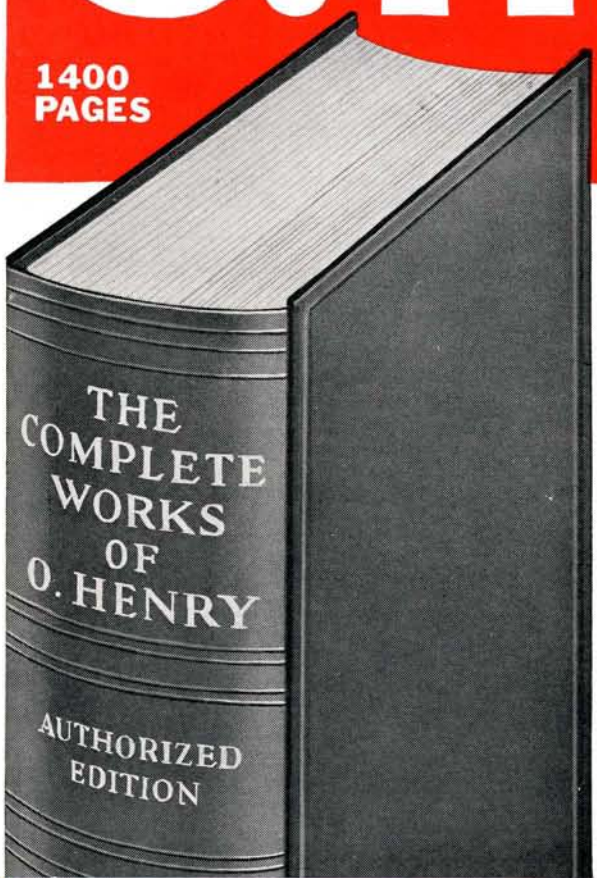
YOURS TO READ FREE!

O. HENRY

COMPLETE IN ONE VOLUME

273 THRILLING STORIES

1400 PAGES



READ THESE FAMOUS STORIES BY AMERICA'S FAVORITE STORY-TELLER

The Skylight Room	The Caliph and the Cad	Cherchez la Femme
Lost on Dress Parade	The Enchanted Kiss	Handbook of Hymen
A Blackjack Bargainer	A Harlem Tragedy	The Brief Debut of Tildy
The Ransom of Red Chief	The Fool Killer	Transients in Arcadia
The Green Door	A Sacrifice Hit	The Shocks of Doom
The Cop and the Anthem	Past One at Rooney's	Man About Town
A Lickpenny Lover	A Philistine in Bohemia	From the Cabby's Seat
Tamales	*and 251 More!*	

When the Rattlesnake Struck

"Judge: When you sent me up for four years you called me a rattlesnake. Maybe I am one—anyhow you hear me rattling now. One year after I got to the pen, my daughter died of—well they said it was poverty and the disgrace together. You've got a daughter, Judge, and I'm going to make you know how it feels to lose one. I'm free now, and I guess I've turned rattlesnake all right. Look out when I strike!"

What a beginning for a story—and what a STORY! DON'T miss it!

IF YOU LIKE IT KEEP THIS GREAT $5.00 BOOK for only $1.00

A GENUINE $5.00 VOLUME

Begin any O. Henry story and you will read it through to the end! He captures your imagination at the start, sweeps you on through one exciting adventure after another, and leaves you breathless with astonishment and delight.

Think of getting EVERY ONE of the stories ever written by the greatest story-teller in American literature! You get all the romance and pathos of "A Service of Love," all the humor of "The Rubaiyat of a Scotch Highball," all the drama of "The Furnished Room," all the sheer enjoyment of 273 immortal tales—hours and hours of delightful reading.

Formerly published in a many-volume edition at a good high price, ALL of O. Henry's stories, his poems and essays, with biographical information about the author, can now be yours in ONE exquisite volume of 1400 pages. Clearly printed and beautifully bound in rich deep blue cloth artistically stamped in gold, regular value $5.00. But our special offer gives you this great book for only $1.00 if you act promptly! You send no money now and none at all if after FREE EXAMINATION you don't think this is even more of a book bargain than we say it is.

DOLLAR BOOK CLUB MEMBERSHIP IS *FREE*

. . . and it brings you **AMAZING BARGAINS LIKE THIS**

The plan of the Club is simply this: upon receipt of the attached coupon you will be sent The Complete Works of O. Henry. With this book will be the current issue of the free monthly magazine called "The Bulletin," which is sent exclusively to members of the Club. This Bulletin describes the next month's selection and reviews about thirty other books available to members only for $1.00 each. If, after reading the description of next month's selection, the member does not wish to purchase the book for $1.00 two weeks' time is given in which to write the Club so that the book will not be included in the automatic monthly shipment and to request an alternate selection if it is desired. Thus members are privileged to purchase as many or as few books as they wish at the special price of $1.00 each.

Dollar Book Club Books are selected from the best modern books—the best fiction, biography, travel, etc., by the best authors. In past months the Club has offered books by Sinclair Lewis, Edna Ferber, W. Somerset Maugham, William McFee, H. G. Wells, Ellen Glasgow, Hugh Walpole, and many other great writers. The Dollar Book Club books are always in the "original format" which sold for 2½ to 5 times as much.

70,000 discriminating readers have enthusiastically accepted free membership in this money-saving Club. This huge membership of men and women enables the Club to offer book values unequaled by any other method of book buying. And the membership which brings you these bargains is FREE.

DOUBLEDAY ONE DOLLAR BOOK CLUB

Dept. 10SA, Garden City, New York

Please enroll me free for one year as a Dollar Book Club member and send me at once The Complete Works of O. Henry which I will examine and read free for three days. With this book will come my first issue of the free monthly Club magazine called "The Bulletin" describing the one dollar bargain book for the following month and several other alternate bargains. Each month I am to have the privilege of notifying you in advance if I do not wish the following month's selection and whether or not I wish to purchase any of the alternate bargains at the special Club price of $1. each.

If I keep The Complete Works of O. Henry, I will send you $1. plus a few cents handling and shipping charges as full payment. The purchase of books is entirely voluntary on my part. I do not have to accept a book every month or a minimum during my year's membership. And I pay nothing except $1.00 for each selection received plus a few cents handling and shipping costs.

Name.....

Street and No.....

City.....State.....

Occupation.....

GET $2.50 TO $5.00 BOOKS for only $1

TAKE THEM ONLY *IF* AND *WHEN* YOU WISH

This Coupon Brings O. HENRY to Read FREE

SEND NO MONEY

Just Mail the Coupon

May we *prove* to you that Dollar Book Club values are really amazing? Let us send you for free examination the great $5.00 value O. HENRY COMPLETE. When you see this splendid book and think of owning it for only $1.00 you will realize the value of free membership in this popular Club. This is a demonstration at *our risk and expense.* If you are not delighted with the book and surprised at this sensational bargain you may return the book and owe nothing. Don't miss this opportunity to get a FREE MEMBERSHIP in this money-saving Club. Mail the coupon now.

DOUBLEDAY ONE DOLLAR BOOK CLUB, Dept. 10SA, Garden City, New York