SCIENTIFIC AMERICAN

DECEMBER · 1940

Photograph by Robert Yarnall Richie

Vol. 163 No. 6

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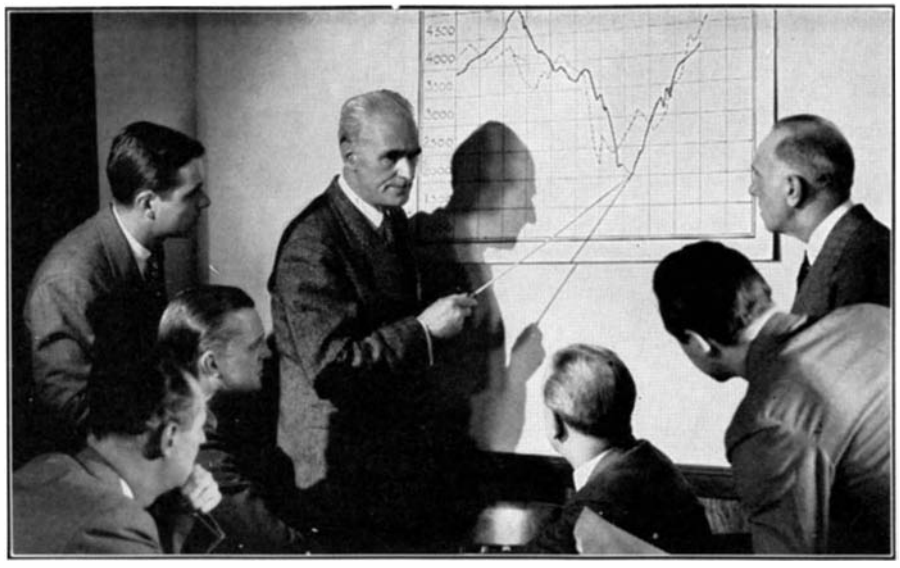
AIRCRAFT FOR DEFENSE



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Please mail me, free, a copy of "Forging Ahead in Business."

Modern Business

Name.....

Business Address.....

Position.....

ANTI-AIRCRAFT coördination with the air forces of the United States (see page 311) is essential to an adequate aerial defense program. This month's cover illustration shows, foreground, an aircraft range-finder that works in close co-operation with the anti-aircraft guns, background. Photograph by Robert Yarnall Richie, taken at Camp Buchanan, Puerto Rico.

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SCIENTIFIC AMERICAN

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

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PLASMA TO BRITAIN

THE wealth and ingenuity of America face no insurmountable difficulty in rendering enormous aid to the valiant British. Well and good! We all do what we can, and our cheers go up as we note with what spirit our kinsmen across the sea make use of the weapons of defense we send them.

Some emotion deep within us stirs, however, when we read of a particular gift made, at this writing by some 6000 New Yorkers, to the British cause. The weapons we've shipped, defensive though they are, have to do with death while these 6000 donors have given life—something of both body and spirit—for they have given their blood. Three thousand quarts of their blood have been processed, put into blood banks for transfusions, and probably much of it has been shipped to England by this time.

It is appropriate to recall here the fact that blood banks were conceived by an American surgeon, Dr. O. H. Robertson, in France during the World War. A little added sodium citrate prevented healthy blood—drawn from the veins of others—from clotting, and it could be kept in bottles in refrigerators. Two to four weeks was its keeping limit, however, and, in transfusions, the patient had to be given a type to match his own. The former limitation would give us insufficient time both to collect and then ship refrigerated blood overseas; and the second added the danger that the seriously wounded person might die while his blood was being typed. Happily, these limitations no longer exist. A research group of the Rockefeller Institute for Medical Research has developed a way to extract from blood both the red and white cells, leaving only the plasma. And the plasma which we are now sending to the fighting British will keep for years, and may be transfused into any patient regardless of which of the four blood types he has.

Murderers and megalomaniacs may pervert to inhuman use some of the products of science, but here is one that cannot be so perverted. It is a life-giver, not a death-dealer. The process itself marks a milestone in the advancement of man's knowledge. But when so many persons utilize it voluntarily—under no compulsion of patriotism or self-preservation—to render precious aid to a friend, then does our faith in humanity receive a heartening boost.—*F. D. M.*

WHOSE FAULT IS IT?

NO ONE today even thinks of asking whether concrete will prove to be permanently acceptable as a material of construction. Of course it will. It will, despite certain observable faults.

For the past weeks the writer has been taking note of each piece of concrete construction, large and small, seen in the course of ordinary life—factory buildings, bridges, railway platforms, sidewalks, posts—not in any special capacity but as anyone having an ordinary interest might observe. It turns out that the job which has stood up even for a few seasons without extensive cracks, chunks spalled off, unsightly patchings and other evidences of deterioration, is rather exceptional. What or who is to blame?

Easiest, of course, is to blame the constructor. Maybe he cheated. Probably he lacked pride of workmanship. Perhaps he was ignorant of best methods, though ignorance about concrete is less common today among its users than it once was, thanks to years of instructional hammering by the Portland Cement Association and others.

Economics and machinery have exerted an interesting kind of control over concrete for the past half century, divisible into three periods: First, in the last century most of the cement used was imported from Europe and was expensive, but labor was cheap. It paid, therefore, to mix the concrete stiff, with just enough water to wet it barely; which in turn required laboriously ramming the non-flowing mix into place by hand. Such concrete has maximum strength. Some of these old jobs are still giving fine service.

The second period came with relatively cheap American-made cement but expensive labor. Stiff mix and hand ramming then passed out and most work was poured—too much of it at the water-weakened consistency of soup. Much of that work deteriorated.

Today we are in the third period: Cement still inexpensive, labor quite high but better methods available for placing less soupy, hence stronger, concrete; also, vibrating machinery is available for ramming it inexpensively. Much better work is being done but, even so, much of it soon looks mangy.

It is believed that if the ultimate people, largely the public, who pay for concrete work, and not merely the engineer, clearly understood only a few basic facts about it, higher standards of workmanship would result, since these can be attained wherever they are appreciated, demanded, and willingly paid for. The cleanness of the materials is not, as is so commonly believed, the most important factor in obtaining sound, strong concrete, though it still is very important. There are two other big factors. One is the amount of water used—the more water the less ultimate strength, in a ratio as great as three to one between stiff and soupy mixing. This of course takes more time and costs more money. The other is curing, something too often dispensed with altogether. After the concrete has set enough to prevent it from washing away, the surface is kept wet for some days, preventing the escape of the correctly proportioned amount of water needed within to combine chemically and permanently with the cement.

Concrete is a coarse material but it pays to be fussy with it.

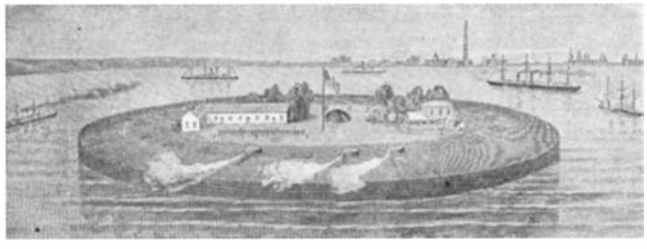
These points may seem elementary to engineers, yet, when it is realized that there still are many persons in other lines of work who think the setting of concrete consists of drying it out, they may not be altogether out of place.—*A. G. I.*

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of December, 1890)

DEFENSE—"It has for many years been patent to every one that New York City, with the great industrial forces and vast aggregate of wealth concentrated around what is known as the Port of New York, are entirely without defense against such an attack as might be made by the vessels of any first class power with but a few hours'



notice. . . A plan quite unlike anything heretofore attempted anywhere for the construction of forts for the defense of the ocean approach to the city . . . has been brought forward by Mr. John F. Anderson, a New York engineer, and consists in the construction, on artificial islands, of three forts, each with a diameter of 500 feet, between Rockaway Beach, on the Long Island shore, and Sandy Hook point . . . They would be about two miles apart, and the same distance from each shore, so as to command all the channels of approach, while being from twelve to fifteen miles distant from the city."

PIGEONS—"Efforts are now being made to introduce a carrier pigeon service into the United States Navy . . . War vessels employed in defending a coast are often without the means of transmitting information of the utmost importance to the mainland. By means of carrier pigeons they could send communications ashore over a distance of several hundred miles, signal the approach of the enemy's fleet, and report all his movements."

FIRELESS LOCOMOTIVE—"A fireless locomotive for use in mines . . . is provided with a tank that holds 0.550 cubic meter. The water is heated to 205° C. (or an absolute tension of 16 atmospheres) by a boiler placed on the surface; it is sufficient for a steady run of 3 to 4 kilometers."

ROPE—"Ropes sometimes wear out internally while apparently sound outside. This is caused by bending the rope over a sheave. In doing this the fibers slide a small distance upon each other and eventually wear out. In the best ropes this wearing out is prevented by lubricating the strand with plumbago, mixed with a small quantity of tallow, just sufficient to hold it in place."

LOG RAILS—"Mr. Angus McPherson of Cumberland County, Nova Scotia, has built 1¼ miles of railway into his lumber woods this summer and is now running a train on it. . . The rails he used are round spruce poles, six inches in diameter at the larger end, tapering down to half the size, and neatly joined at the ends. The sleepers are small round poles on which the rails are spiked. The rolling stock consists of a small upright engine, eight horse power, and two flat cars."

METER—"A new penny-in-the-slot contrivance has been adopted by the gas department of the corporation of Birmingham, for the benefit of small consumers. . . A sort of meter has been constructed, which, on dropping a penny in a slot, will deliver twenty-five cubic feet of gas."

BRIDGE—"The great steel bridge across the Columbia River, at Vancouver . . . will be 6,000 feet from the Washington to the Oregon shore. It will be double tracked, with a roadway on top for teams, and will be erected upon pneumatic piers. The pivoted pier, or draw pier, will support a draw which will give an opening of 200 feet space on either side for vessels to pass, and the span immediately south of the draw span will be 375 feet."

PATENT CENTENNIAL—"The wealth and economic prosperity of our country are so largely due to the system of patents, by which our inventors have been encouraged to pursue their unselfish labors, that among the many centennials which have been and are to be commemorated, the one hundredth anniversary of our patent system should not be overlooked."

BIG GUNS—"The chief of the bureau of ordnance, Gen. S. V. Benet, in his . . . annual report, notes that a twelve-inch breech-loading steel rifle is now nearing completion at the Watervliet Arsenal, and will probably be ready for trial in February. This is the largest size of modern gun we have yet attempted to manufacture, but the Watervliet plant is being put in shape by the government to turn out, also, sixteen-inch steel guns. These guns will be fifty feet long and weigh 125 tons each, requiring a full firing charge of 1,000 pounds of powder . . . and throwing a projectile over a ton in weight. It is expected that these guns will have a maximum range of about fifteen miles."

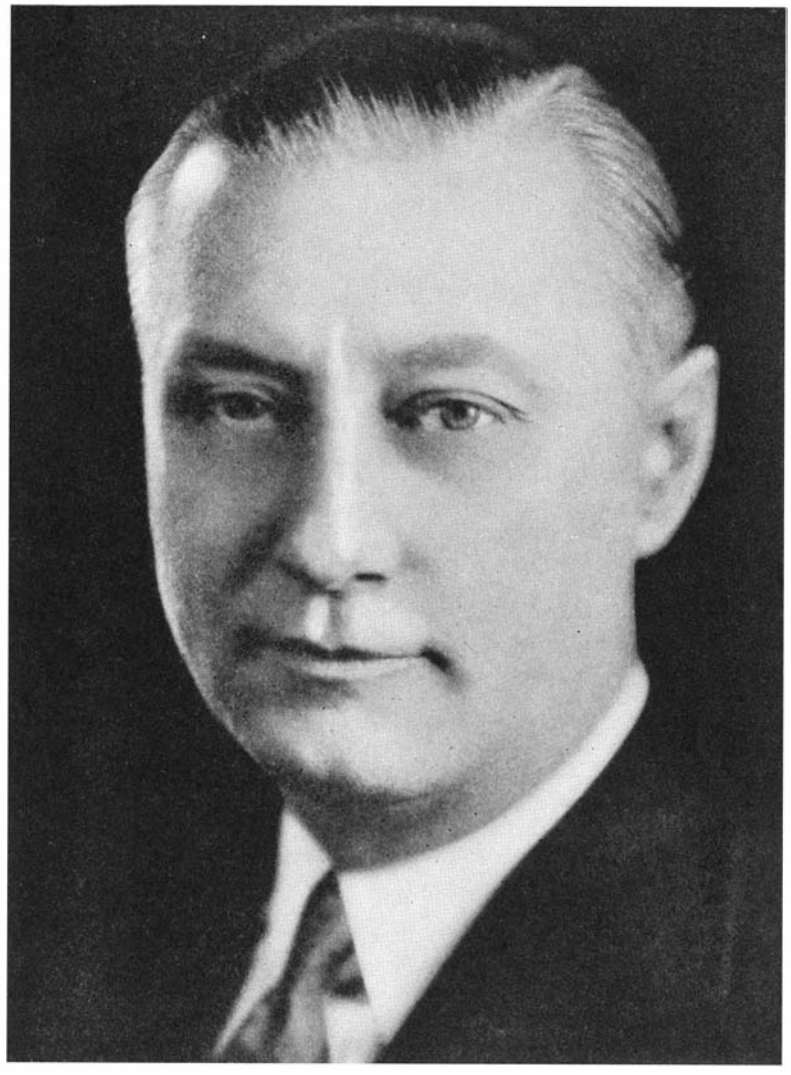
CHIMES—"Dr. Alva Owens, of Chicago, recently constructed . . . a set of chimes to be rung by electricity. . . Attached to each of the thirty bells hung on the rack above the key-board is an electro-magnet. The keys make the circuit from a battery in the base to the electro-magnets at the bells."

STEEL—"The Otis Steel Company, of Cleveland, which has the largest plate mill in the world, a few days ago rolled a 20 inch ingot of 8,500 pounds down to three-quarter inch plate with one heat."

BUILDING—"The new Masonic building now being erected in Chicago will be an architectural marvel. It is to have a frontage of 170 feet, a depth of 114 feet, and will be twenty stories high, and the roof will be nearly 300 feet from the level of the street. There are to be eighteen elevators, arranged in a semi-circle, having a total carrying capacity of 40,000 passengers daily."

SMOKELESS—"The basis of all the new kinds of smokeless gun-powder is cotton subjected to the action of nitric acid and the consequent formation of mono-, bi-, and tri-nitrocellulose according to the strength of acid employed. . . This new powder is said to be on the average three times as powerful as the old."

Personalities in Industry



MARTIN L. DAVEY

LONG before the poet wrote of trees, Martin L. Davey knew that they were creations to cherish —living things and, as such, amenable to curative processes. That knowledge led to the founding of an organization devoted to scientific shade-tree care that now does a business of nearly $3,000,000 annually.

Martin L. Davey was born July 25, 1884 in a small, rude home built with his father's own hands in Kent, Ohio. Young Martin started on his business career when he was six years old by peddling vegetables gathered from his father's truck garden. All through elementary school, he added to the family income and later financed his way through high school.

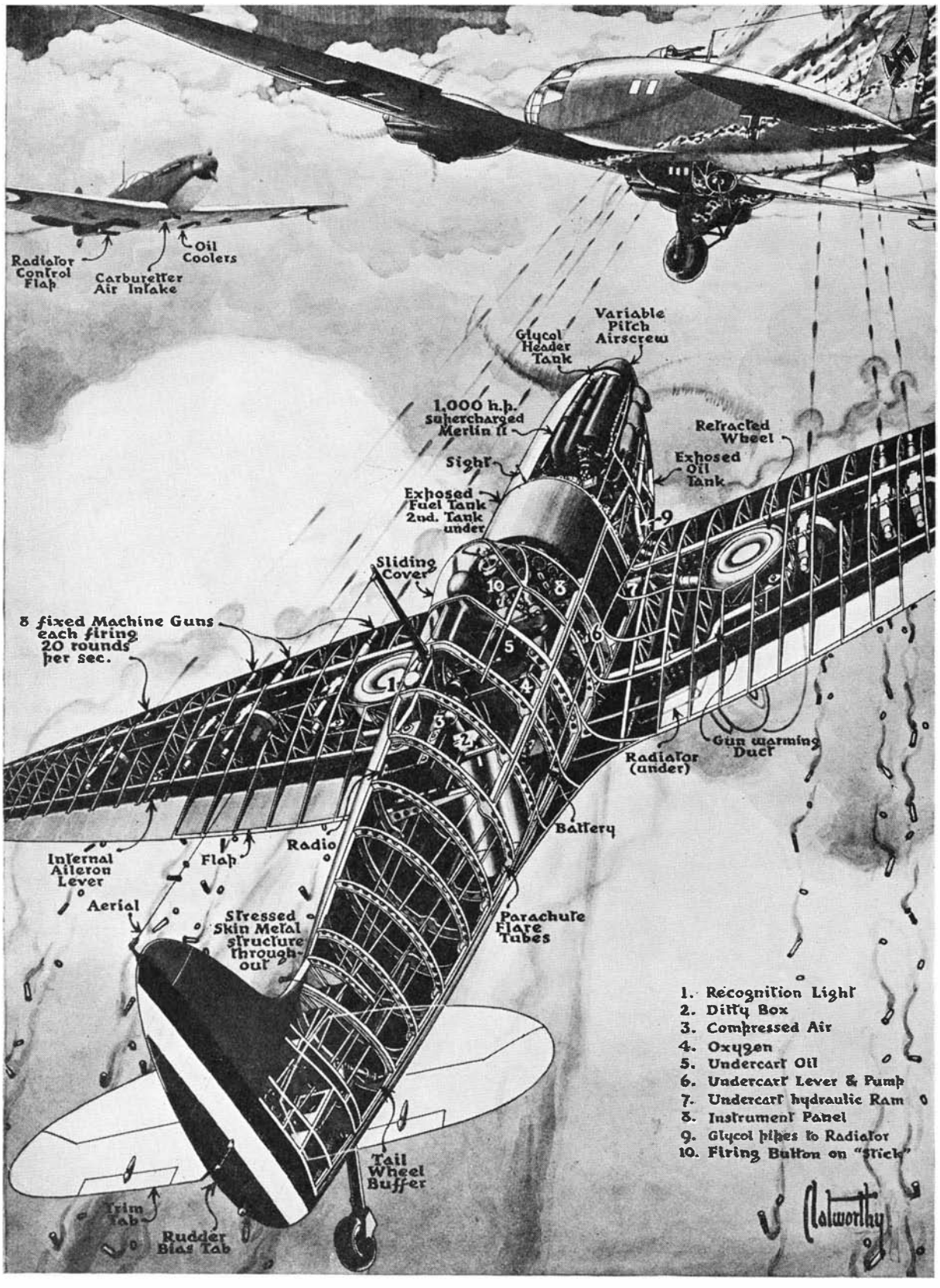
Martin had an exceptional father, John Davey, who has been called the "Father of Tree Surgery." His book, "The Tree Doctor," published in 1901, laid the foundation for the science of shade-tree care and awakened people to the fact that tree life could be preserved, nurtured, and maintained in healthy condition for the enjoyment of everyone. John Davey, the father, was something of a dreamer and idealist, and needed just the executive and administrative ability early displayed by his son, Martin. During Easter vacation in 1906, young Martin decided to join forces with his father, and left Oberlin College. At 22, he organized his father's affairs into an incorporated company and became general manager. He now is president of the Davey Tree Expert Company.

Though not a scientist, Mr. Davey has surrounded himself with a group of outstanding technical men. There has been constant improvement in technique, materials, and equipment. The moving of large trees has been one conspicuous development. Fifteen years ago, big trees were being moved on contraptions that resembled Spanish-American War artillery wagons. The Davey staff redesigned the equipment, using all modern aids to make it highly efficient: special metals added strength and reduced weights; a change was made from iron to pneumatic tires which cut into the ground less and have advantages of speed; the general mechanism was improved so that trees could be more readily and safely handled. A practical injection method for the successful treatment of chlorotic trees was developed, and, currently, injection experiments are being conducted with a view toward controlling serious tree diseases.

The battles Martin L. Davey has fought in behalf of shade-tree preservation have been waged not only for his own company, but indirectly for all other organizations in the same field, for his theme has always been: "Better and healthier trees kept in good condition by qualified experts." To give the best service to the public, Martin L. Davey started the Davey Institute of Tree Service in 1909. In its first year the school had a few students meeting in a hall over a store but developed into a three-winter course with a peak attendance of 447 employees. Most of the company's thousand field men and its 70 sales representatives are graduates of the school.

The company had little capital in its early days; no one cared to invest in such a "fool" enterprise as taking care of trees. There were scoffers aplenty but Martin L. Davey's faith in his father's ideas and in his own ability to translate them into actual practice for the benefit of tree life, admitted of no failure.

Politically, too, Martin L. Davey has had a successful career. At the age of 29 he was elected mayor of Kent, was twice re-elected, and at 34, while serving his third term, was appointed to fill the unexpired term of the Congressman for the 14th District of Ohio who had died in office. Twice nominated for Governor of Ohio, Martin L. Davey was elected on the second occasion in 1934 and was re-elected in 1936.



EIGHT STREAMS OF METAL STINGS

MANY times the British Spitfire has proved itself the deadliest fighter plane in general use during the present war. In this drawing, showing the plane cut away so that its equipment is visible, a Heinkel bomber is being slashed to pieces by a withering stream of bullets from the Spitfire's eight Browning (American) machine guns. Empty cartridges and links of the cartridge belts (which disintegrate on firing) stream behind from 160 shots per second. All eight guns are fired together by simple pressure of the pilot's thumb on a button on the "stick." Smaller, lighter, and slightly less maneuverable than the Hurricane, the Spitfire has a speed of 395 miles per hour. Some Spitfires have been mounted with shell guns, and all now have partial armor protection for pilots and tanks, such protection having been found on no crashed German planes. Super versions of both Spitfires and Hurricanes have recently been produced.

AIRPOWER FOR DEFENSE

Strategic Requirements of Aircraft in All Services

JAMES L. H. PECK

THE United States has been forced by world conditions to assume the defense of what is, to all strategic intents and purposes, half of the world. This involves the maintenance of strategic security of North and South America and, roughly speaking, the western half of the Atlantic and the eastern half of the Pacific—a tremendous task which even a two-ocean Navy and a 1,200,000-man Army could not accomplish without the aid of that greatest of modern weapons—airpower.

Our airpower is not made manifest by an independent air force, but by the Army Air Corps and the Naval Air Service; each of which employs particular types of planes that are best suited to naval and army operations. The Navy is immediately concerned with the control of the above-mentioned sea areas; it is our "first line of defense." Without such control, American commerce could be blockaded from points far removed from the coasts and beyond the range of shore-based aircraft. Our insular possessions, or those of friendly powers, could be occupied and used as enemy advance bases against us, and this could be followed up by the establishment of hemisphere bases from which the United States could be attacked by airpower assault and sea power "investment." Fortunately, the Navy in general and its air arm in particular are in a position to exercise control, in that they have immediate access to information concerning enemy activity in these sea areas and also the power to reduce such activity. Thus, the strategic requirements for our Naval Air Service craft are the ability to gain enemy information and the flexibility and striking power to counteract hostile operations.

The first assignment is delegated to the "big boats" — the huge, multi-motored flying boats known as patrol bombers—and the scouting squadrons of the Fleet's aircraft carriers. The Consolidated PB2Y-2 boats, 18 of which will shortly go into service to form a new patrol squadron, are our best type. Powered by four radial air-

NATIONAL DEFENSE

cooled motors, they have a range of more than 5000 miles carrying a nine-man crew and several tons of bombs. Their famous predecessor type, the Consolidated PBY boat, is the present first-line patrol bomber and has a range exceeding 3000 miles. Operating from the recently acquired Atlantic bases and those in Alaska and the Pacific, these long-range craft can effectively patrol our "half" of each ocean. On mission, the squadron planes fly in a fanned-out scouting line miles out of sight of each other but in a precise line maintained by radio contact and exact navigation. Even so small a number of craft can, in this manner, cover a remarkable amount of territory; they are in truth the "eyes of the fleet."

Not so far-sighted are those "eyes" represented by the carrier-based scouting squadrons, whose main purpose is to spy out advance units of the enemy fleet—submarines and cruisers or aircraft. The carrier's main function, however, is the fulfillment of the second Navy requirement—striking power, or the delivery of firepower —and to this end our floating airports accommodate Douglas TBD-1 torpedo bombers and Northrop BT-2 dive bombers. (Both scout bombers and patrol bombers live up to the second part of their designations once they spot the enemy, the big boats bombing from level keel at high altitudes while the scouts get right down to things by dive-bombing tactics.) The carrier fighter complement boasts such sterling combat planes as the Grumman F4F3 and the Brewster F2A-2 at present; a quantity of the sensational 450-mile per hour Grumman *Skyrockets* are on order.

The seaplanes carried aboard the Fleet's battleships and cruisers are employed for short-range scouting and range-correction; they are sent aloft from catapults, then land alongside to be hoisted aboard by cranes. Training planes of various types, and utility craft for the transport of personnel and matériel, are, of course, most essential. Marine Corps Aviation is an integral part of the Naval Air Service and operates therewith as well as in support of Marine ground units. It is of daily growing importance because of the apparent necessity of garrisoning both the new Atlantic bases and establishments in Central and South America.

WITHIN 100 miles of our coasts, the Army Air Corps takes over, and theirs is the big job of continental air defense, together with that of the Panama Canal Zone. Because of our long coastlines and the necessity for close co-operation with our neighbors to the north and south, it is vital that we have a powerful, highly mobile striking force that may, in whole or part, be shifted from one section of the country to another within a few hours. Such is the General Head-

Note the 37mm cannon in the propeller hub, and the teardrop cockpit of this Bell P-39 Airacobra

quarters Air Force, which may best be described as an air force within an air force, since it consists of all the combat squadrons within U. S. borders. The GHQ Air Force may operate in close support of ground forces in the United States, Canada, or Mexico, in joint Army-Navy operations, or completely independent of land or sea units. Supplementing this roving "big stick," are several Air Corps tactical units in strategic points of the country, in the Canal Zone and the Hawaiian Islands; new establishments are under construction in Alaska and Puerto Rico.

BOMBARDMENT is the mission of airpower, the fist of the air arm, even as infantry is the fist of the Army. The Air Corps egg-layers are divided into three groups: Heavy Bombardment, Medium Bombardment, and Attack Bombardment. The former include the "flying fortresses"—so-called because of the amount and disposition of their defensive armament—that are capable of carrying huge loads of bombs for great distances. Outstanding of these are the four-engined Consolidated B-24's which have a range of some 3000 miles with a nine-ton bomb load. On shorter missions, with less war load, they have a top speed in excess of 370 miles per hour, and climb to the pursuit-ship altitude of 36,000 feet. Planes of the Medium Bombardment group are smaller, faster, and operate over shorter distances. The twin-engined Douglas B-23 and the 400-mile per hour North American B-25 are the newest types. Attack bombers engage in short missions involving strafing and dive-bombing of troops and stationary objectives. Twin-engined types such as the almost-400-mile Douglas A-20A carry fairly large quantities of bombs and armament; single-motored craft such as the Vultee YA-19 and Republic *Guardsman* do the dive bombing.

Reconnaissance aviation is charged with the maintenance of strategic security over land, just as the scouting force guards against surprise at sea. Due to developments in Europe, the Air Corps has discontinued use of the observation plane of medium range, as is evidenced by the lack of orders for the robin-breasted North American 0-47 series, the finest line of planes of this type ever built by any country. For distant reconnaissance, it seems safer to send the heavier-armed bomber, most of which have provisions for installation of aerial cameras anyhow. Liaison missions—the purpose of which is to maintain contact with ground units, keep the divisional command informed as to his advance force's location, progress, and requirements, and "warn" these units of enemy movements which might jeopardize them—and artillery "spotting" are best carried out by relatively slow craft or autogiros that can land on a roadway or nearby cow pasture during operations in the field. Latest and best of these "puddle jumpers" are the Ryan YO-51, the Stinson O-49, and Curtiss O-48, all high-wing monoplanes powered by radial engines.

Pursuit is the Air Corps' fighting force, and our combat planes are known as pursuit-interceptors and convoy fighters. The former types would go up to engage enemy bombers or observation craft in defense of a city or area and the convoy fighters would accompany bombers or reconnaissance planes on a mission in order to protect them against enemy pursuit. By the time this is in print, the Air Corps will have taken delivery on quantities of Curtiss P-40's, Bell P-39 *Airacobras,* Bell SM-1 *Airacudas,* and Lockheed P-38's. The first two are single-engined ships, while the SM-1 and P-38 are powered by twin Allison motors.

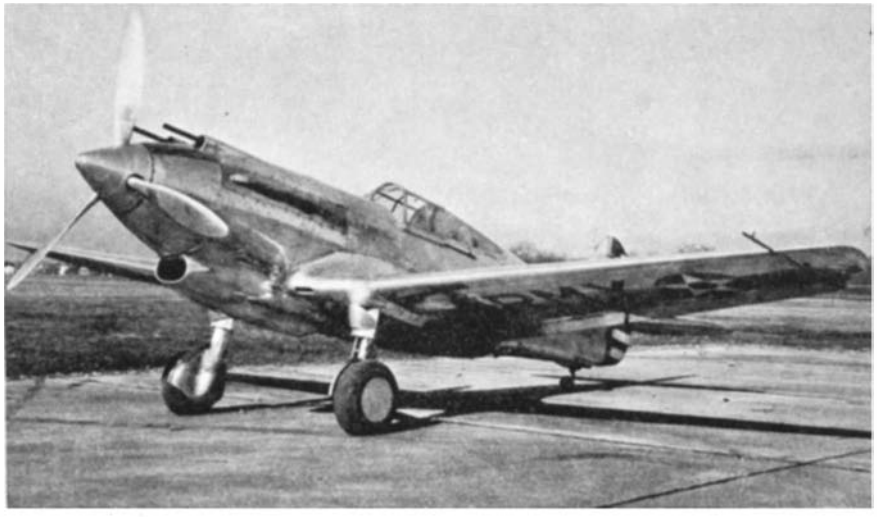
These Navy and Army aircraft are by far the finest in the world, but there are all too few of them. There are not enough pilots and ground personnel to fly and maintain the 25,000 Army and 10,000 Navy planes we hope to have by the end of the next fiscal year; nor are there adequate bases and airdromes on which to put them. Thus, the United States is concerned at the moment with the procurement of planes, engines, accessories and spares, and armament; pilots and combat crews—gunner-observers, bombardiers, navigators, and radiomen; mechanics, radio technicians, sheet metal workers and welders, armorers, parachute riggers, meteorologists, flight surgeons, and technicians and specialists of a dozen other callings—all of which are a pre-requisite of airpower. The

Planes and anti-aircraft must be coordi-

airport program is at last under way.

We have mentioned the different types of craft used by both services to conform with the defense requirements of the Army and Navy. Fighters fight, and bombers bomb; but our warplanes are of diverse design and construction because of the difference in specifications and operating conditions. There are reasons, remediable and otherwise, why the services cannot seem to agree on a few basic designs. Standardization would, of course, greatly expedite production, and to this end the Aeronautical Board—a liaison agency headed by the chiefs of the Air Corps and Naval Air Service—is seeking to coördinate production methods, machine practice, aero research, and exchange of technical information. The principal difficulty arises from the "extras" which Navy planes must incorporate—"flotation gear"; specially treated, corrosion-resisting alloys; special radio equipment; nautical instruments and signalling devices; and personal essentials such as life jackets and emergency rations.

Carrier-borne aircraft are stressed to withstand the rigors of deck landings and arresting gear and the recoil shock of gunfire. These are "musts." An Army plane not so stressed, and unprotected against the deteriorating effect of salt water and spray would fall apart after a few months' carrier operations. Not so apparent are the reasons for different kinds of bolts and nuts on an otherwise identical pair of Wright Cyclone motors (differing hardware specifications), two inspection and testing routines, and separate sets of reamers, dies, collets, and so on for tooling. As if the machine-tooling bottleneck were not tight enough on general principles!



Powered by a 1200-horsepower Allison liquid-cooled engine, "several per day" of these Sterling-Curtiss P-40's are rolling off the production line

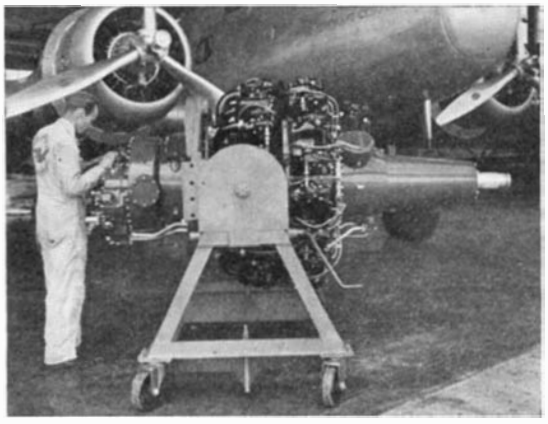
nated. This gun fires 25 shells per minute

SOMEWHAT less of a problem, but requiring more time per unit, is the training of air personnel. A swift fighter may be built in seven days; an embryo pilot must have that many months of training before he can safely fly this tricky, hot-to-handle ship. The Air Corps is well started on an ambitious program involving the training of 7000 pilots and 3000 bombardiers and navigators annually. Primary instruction will be continued at the nine Army-supervised commercial flying schools, some of which are opening branch schools to accommodate increasing quotas. Then aviation cadets will be sent to one of the three training centers for basic training, advanced and specialization work. Randolph Field, San Antonio, Texas, long known as the "West Point of the Air," is now called the Gulf Training Center; Maxwell Field, Montgomery, Alabama, formerly the home of the Air Corps Tactical School, is known as the Southeast Training Center; and the West Coast Center is located at Moffett Field, California. Cadets spend 10 weeks in the civilian school and 25 weeks at the training center, after which time they are sent to tactical units for active duty.

Navigators undergo three weeks of "elimination training" at one of the Naval Reserve Aviation Bases before they are sent to the Naval Air Station at Pensacola, Florida, to complete their aerial education. Because the Navy plans to train 10,000 pilots within the next two years, three air stations are under construction at Jacksonville and Opa-Locka, Florida, and Corpus Christi, Texas. Enlisted personnel and technicians receive their schooling at the Naval Establishment at Pensacola.

Air Corps mechanics, armorers, parachute riggers, instrument specialists, radio operators, and other enlisted men learn about maintenance of an air force at the Technical Schools at Chanute Field, Rantoul, Illinois, and Lowry Field, Denver, Colorado. Others are enrolled in seven Army-supervised civilian schools. These are the warbird's housekeepers. The Army's 3000 bombardiers and navigators will be tutored at the Pan American Airways school at Miami.

Neither Pan American nor the other airlines will step out of character further, because these carriers must bear the brunt of our stepped-up commerce if, and when, M-Day comes. Nearly as busy as the airlines are the service planes of the Utility branch. Cargo planes, transports for officers and enlisted personnel, and ambulance craft ply back and forth between bases and aircraft carriers on their errands of military mission and mercy. Newest of the transports is the Douglas C-47, of which a quantity have been ordered for the new parachute unit undergoing training in New Jersey.



Pratt & Whitney's 1850-horsepower engine. Extended nose facilitates streamlining

This 1940 has indeed been a momentous year, but within the coming year we shall witness even a more rapid march of aerial progress. Aeronautical research, genesis of airpower, in our N.A.C.A. laboratories, Naval Aircraft Factory, Wright Field, and that of the aircraft and engine manufacturers, is being extended in the quest of new aerial findings and methods for exploiting them. Most exhaustive of research is the actual war-testing of our various American prototypes; and we have already profited by experience. We have two types of leak-proof fuel tanks which are far superior to anything known to be in service abroad; we have the finest aerial armor plates, automatic shell cannon, and heavy caliber machine guns in the world; we have the only fool-proof bombing sight. America's warplanes, on which these accessories and armaments are being installed, out-perform by far any European War II craft of any type or model, and they are built to higher specifications standards and of materials that are vastly superior.

Anti-aircraft defenses, with which interceptor forces should be coördinated, are likewise improved; particularly the fire-control devices. Newest of these is the detector which utilizes the infra-red radiation given off by airplane engines, and concentrates this diffusion of rays into a visible image on a ground screen. The range-finder and Sperry-Wilson "predictor" automatically ascertain the altitude, speed, and course of the image—enemy plane—and the guns are fired accordingly. Experiments are being conducted with an infra-red ray searchlight, which may later be used in conjunction with this telescope detector. To assist further in aerial defense, the Aircraft Warning Service has been inaugurated to enlist civilian aid in the spotting of enemy planes.

It is highly probable that performance of our craft will be increased more than 10 percent during the coming year. Aerodynamical advances such as the remarkable Davis aerofoil —used to such advantage on the Consolidated B-24 heavy bomber—and engineering innovations should make this possible. The Lockheed P-38 is reported to have attained the long-sought 500-mile per hour mark at this writing, and the limit does not appear to be in sight.

It is not all sunshine, however. Productive industry is slow getting into high gear, perhaps through no particular fault of its own. The machine-tooling bottleneck is still seriously narrow, as is also the aircraft instrument situation. Skilled tradesmen are not plentiful. There is a surprising and unreasonable lack of Army-Navy air coördination, despite the efforts being made in certain quarters to alleviate this condition. There is far too much politics in defense in general and aviation in particular.

But we have surmounted higher obstacles. We inherit certain imponderable qualities with which America alone seems blessed these dark days. Spirit and morale which is inspired by the heart and feeling of a free people—not the sort born of extreme nationalism and propaganda ministries—and the mechanical heritage of the American youth supply him with the finest flying background obtainable; our excellent services furnish him with the finest training obtainable; our industry and engineering genius afford him the finest of equipment. This is the American Way. On land, sea, or in the air, it will be hard to beat.

• • •

RUBBER DIE

Pad Used With Single Forming Die

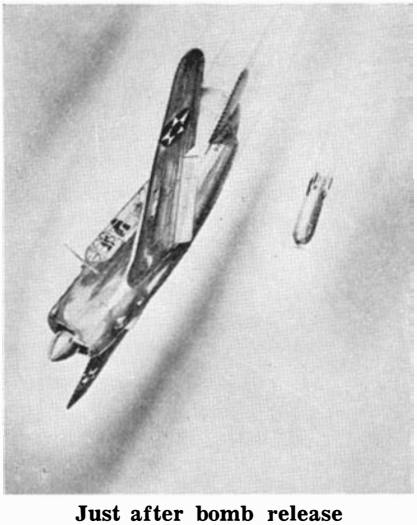
By using a flat, thick pad of rubber in the fabrication of airplane parts, the Douglas Aircraft Co., Inc., has been able to lower die cost and speed production in line with our needs for national defense. When operating with this rubber pad, only one die is used and tooling methods are simple. The slabs of rubber are the largest pieces ever designed for commercial application by the Goodyear Tire and Rubber Company, weighing approximately 4000 pounds and measuring 160 by 57 by 11 inches. This development was reported in a recent issue of *India Rubber World.*

In application, the rubber is confined within a steel container which descends on a lower press table where many types of dies may be operated simultaneously. When the sheet metal is laid upon the rubber slab and pressure is applied, the rubber conforms to the shape of the dies, thus forming and blanking metal sheets into their desired shapes.

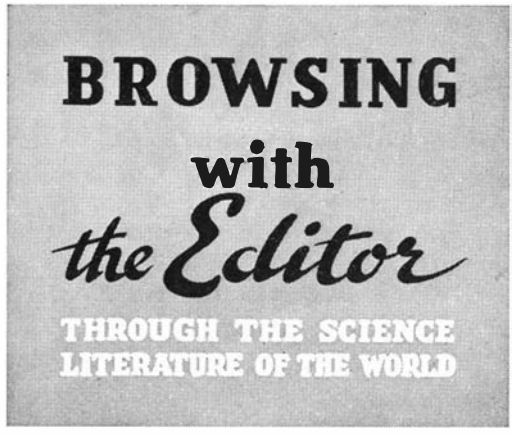
The Guerin process, as it is known, makes possible an exceptionally high strength-weight ratio by forming sheet metal quickly into a rigid structural part, eliminating the need of stiffening members.

DIVE-BOMBER

The United States Navy is testing out a new all-metal Curtiss-Wright dive-bomber, the XSB2C-1. Greater range, increased machine-gun fire, higher speed, heavier bombs, are all claimed for this machine, although beyond a statement that a 1700 horsepower double-row Cyclone is to be employed, no details are given. The artist's drawing hints at flaps to retard the dive, wheels completely retracted and drawn up and sideways into the wing, and bomb bays with bombs carried horizontally under the belly of the fuselage.—*A. K.*



Just after bomb release



NAZIS' POOR "GAS"—Gasoline used to power German airplanes in general is from 70 to 80 octane rating, equivalent to our standard grades of motor fuel, whereas the RAF has aviation grades of gasoline, thus in part accounting for the apparent superiority of the British fighters.—*Oil Weekly.*

UNBREAKABLE SPECS—Eye-glasses are worn by one football player, Thatcher Longstreth of Princeton. These are of the contact lens type.—*Visual Digest.*

TUNNEL MILEAGE—There are 1539 railroad tunnels in this country with an aggregate length of 320 miles—Notes, Association of American Railroads.

WE USE MORE SNUFF—The average person, thinking of snuff-taking as a rather ancient habit, will be surprised to learn that from a little less than 4,000,000 pounds in 1880, production jumped to 41,000,000 pounds in 1929. Nowadays, however, snuff is used generally like chewing tobacco.—U. S. Department of Agriculture.

QUIETER CARS—About 400 pounds of rubber, in 1009 rubber parts, are used in the modern streamlined trolley car which is built to the specifications of the President's Conference Committee of the street railway industry.—*India Rubber World,* September 1, 1940.

GELATIN ENERGY—There is no evidence that gelatin cocktails are harmful in themselves, but it is yet to be scientifically proved that they do us any good.—Dr. Iago Galdston, in *Hygeia,* October, 1940.

LIGHTNING STRIKES TWICE—Lightning struck the Empire State Building at least 20 times during the period between April and October, 1940. Because the building is properly grounded no damage resulted.—Notes, General Electric Company.

SMALLER THAN BACTERIA—It would take something more than 5,300,000,000,000,000 smallpox viruses to weigh one ounce.—Dr. Thomas M. Rivers, Rockefeller Institute for Medical Research.

ACRES OF RAILROADS—Approximately 4,000,000 acres of land, equal to about one sixth of the area of Indiana, are used by the American railroads for rights-of-way, yards, shops, station grounds, and other transportation purposes. —Notes, Association of American Railroads.

NITRATES—Preliminary results of an experiment at Woollongbar Experiment Farm have shown that, following a short fallow, the nitrate nitrogen content of the soil is considerably increased. Half of the experimental plots were fallowed for about two months, the other half remaining under pasture. Analysis at the end of the above period showed that the plots under pasture contained an average of 4.5 parts per million of nitrate nitrogen while the fallowed plots averaged 60 parts per million.—*The Agricultural Gazette of New South Wales.*

HIGHEST TEMPERATURE—The highest man-made temperature on record—18,000 degrees, Fahrenheit—has been produced by Dr. C. Guy Suits. This is twice the temperature of the Sun's surface.—Notes, General Electric Company.

PHYSICALLY UNFIT—Approximately one third of the men examined for World War service, reports Dr. W. S. Leathers of Vanderbilt University School of Medicine, were physically unfit for military duty.—*Science Service,* October 8, 1940.

HELIUM—More than 100,000,000 cubic feet of helium have been produced at the U. S. government's plant, only one in the world, in 11 years of operation. That quantity is sufficient to inflate nearly 20 monster airships, such as the ill-fated *Macon* and *Akron.*—Science Service.

FAST WINGS—Hummingbirds' wings beat 75 times a second in flying and 55 times a second when the bird is hovering. The bird's flight reaches a speed of nearly 50 miles an hour.—Dr. Winsor M. Tyler, Smithsonian Institution.

RESEARCH PAYS—A survey made by Dr. Karl Compton, Chairman of the Advisory Committee on Scientific Research of the National Association of Manufacturers, showed that out of 188 companies covered in the survey, 10 companies spend more than 10 percent of their gross income on research, while the average spent is about 2 percent. Leaders in research at the present time are manufacturers in the aviation industry.—*Journal of Applied Physics,* September, 1940.

1000 WELLS PER MONTH—More than 1000 wells are drilled each month in the United States in seeking oil. These are from a few hundred feet to more than two miles deep and run in cost up to $250,000.—*Oil and Gas Journal.*

TONS OF DUST—Dust storms carry tremendous amounts of material. It has been calculated that during some of these storms 126,000 tons of dust per cubic mile of air is lifted and carried by the wind.—Blackwelder and Barrows "Elements Of Geology."

RAYON TIRES—Rayon cord tires have given as much as 30 times the mileage of ordinary cotton cord tires in special tests under extreme conditions. In one overloaded, high-speed run in a hot country, rayon tires lasted 80,000 miles while ordinary tires wore out in 3000.—William H. Bradshaw, E. I. Du Pont de Nemours & Company, Inc.

INCUBATION—Both the Egyptians and the Chinese knew how to hatch chicks artificially more than two thousand years ago, using crude equipment and laborious methods. —Clip Sheet No. 1158, U. S. Department of Agriculture.

SILVER STERILIZES—Silver as a sterilizing agent for drinking water may be used in the ratio of one part of silver in 10 to 20 million parts of water to render the water safe for human consumption. The cost would be but $2 to $4 per million gallons of water.—Dr. Alexander Goetz, California Institute of Technology.

FOREST RED—Green fields and forests emit a ghostly red light. Though this is invisible to human eyes except with special instruments, it is of fundamental significance in the study of the basic physical process of life on earth.—Drs. E. D. McAlister and Jack Myers, Smithsonian Institution.

Government-Made Addicts

The Federal Alcohol Administration Still Follows an Ancient Tradition — Blindly

YANDELL HENDERSON, Ph.D.
Professor of Applied Physiology at Yale University

In the United States now the number of alcoholic addicts—the men each of whom consumes a quart bottle of whiskey, or more, every day—is quite constant; and quite constant, also, so far as can be estimated, is the number in each of our 48 states. In each the number of new addicts produced each year balances closely the number that die. In nearly every one of the 48 the system of liquor control differs in some details from that of every other state. Yet these 48 supposedly differing experiments produce no appreciable differences in results. Evidently, then, there is some fundamental factor that is the same in all these experiments, and that dominates the results in all: some factor that prevails throughout the entire nation, and reduces all the 48 experiments to one. That factor is the high "proof," or alcoholic content, of our distilled spirits, chiefly whiskey, which is the same throughout the nation. The Federal government alone controls that factor.

Under Prohibition even the weakest liquors were forbidden. Under the system to which we have reverted, and which is now maintained by the Federal government, distilled liquors of low or even moderate strength are virtually prohibited and only those of high alcoholic content are permitted to be labeled and sold as whiskey and other distilled liquors. The underlying idea is that it is the duty of the United States government, through its supervision of interstate commerce, to guarantee the quality and quantity of all foods and drugs. It is held that the American citizen should receive full value for his money, whether he spends it for a can of tomatoes, a bottle of medicine, or a bottle of whiskey. Accordingly, we have not only the Federal Food and Drugs Administration, but also the Federal Alcohol Administration; and under the regulations which this Administration is authorized to make and enforce, no liquor of a strength below 80 proof—or 40 percent of alcohol by volume—can be labeled or sold in the United States as whiskey, gin, rum, or brandy. In 48 states all kinds of experiments and efforts in endless variety are made to ameliorate what Lloyd George, its greatest ameliorator in England, called the "drink trouble;" and all are effectively counteracted by the Federal government, by its maintenance of this high proof requirement.

How this condition came about is briefly as follows: In Colonial days our ancestors on the Atlantic Coast drank rum made from East Indian sugar or molasses. But, when they moved west of the Allegheny Mountains, the difficulty and expense of transportation promoted the development of a local distilling industry that made use of grain—chiefly Indian corn. When President Washington appointed Alexander Hamilton as the first Secretary of the Treasury, and Hamilton began to repair the almost bankrupt treasury, he looked about for sources of federal revenue. He established a tariff on imports and by act of Congress laid a tax of 10 cents a gallon on whiskey. Thereupon the Whiskey Rebellion broke out in western Pennsylvania; and President Washington used the armed forces of the Government for the first time under the Constitution to suppress it.

The excise men then collected a part of the tax, but the distillers evaded a part. Alcohol costs little to make; but water is still cheaper, and two gallons of whiskey were easily diluted to three. There were few chemists to analyze the liquor and determine its concentration of alcohol. It was sufficient as a test of alcoholic content to moisten gun powder with the liquor, and try to light it. If the content of alcohol was high enough, and the content of water low enough, to permit the powder to burn, that was "proof," or "100 proof." If the moist powder would not burn, the liquor was "below proof."

To meet this practice, the Government applied a measure that stopped the loss of revenue due to watering, and made 100-proof whiskey—that is 50 percent of alcohol by volume—the standard American liquor. It thereby did more than any other factor in American life to maintain for 150 years a steady production and reproduction of alcoholic addicts. The law specified the same tax "on each proof gallon or wine gallon below proof." The distiller could dilute his liquor, but if he did he must pay the same tax on the water that he added to the barrel that he did on the original contents of the barrel.

Now the term "wine gallon" has nothing to do with wine. The first distillate from a primitive pot still was a liquor low in alcohol and was called "low wines." It was redistilled to produce a liquor higher in alcohol and called "high wines." Hence the expressions "wine gallon" and "proof gallon," which are both just a gallon in volume, but of different alcoholic content, and hence the practice of the Government of basing the federal excise on the "proof gallon" and taxing a "wine gallon" at the same rate, which has served effectively—and unfortunately—to hold American liquor up to high degrees of proof ever since. Even when it was allowed that, after the tax was paid, the liquor might be diluted to 80 proof—40 percent of alcohol—the idea persisted in the popular mind that whiskey, to be whiskey, must be of high proof—as it is to the present day.

History records several cases in which entire nations have within a few years developed a wide-spread addiction to extreme degrees of alcoholism. In all such cases the cause has been the introduction into popular consumption of high proof spirits with low taxes, or none. This occurred in England in the reign of Queen Anne. England was at war with France, and was allied with Holland. So French wines were so far as possible excluded, and "Hollands," or gin, was favored as a sign of patriotism. Even when a low tax was imposed, it was largely evaded by smuggling. As a result, habitual drunkenness be-

came appallingly general. The cause and condition were shown by a popular sign on an inn in a poor district: "Drunk for a penny; dead drunk for two pence; clean straw" (in which to sleep it off) "for nothing." And generations of higher taxation and strict control only gradually overcame the general intemperance of the English people: indeed, it lasted down to the War of 1914-1918.

If a low price and high alcoholic content tend to promote intemperance, there is equally strong evidence that high price and lower alcoholic content tend strongly to decrease intemperance. Lloyd-George, as Minister of Munitions, in 1915 found that heavy drinking by the workers interfered with the production of munitions. Accordingly, by act of Parliament, the distillers were allowed to dilute spirits much more than ever before; and the taxes were adjusted so as to make it profitable for them to do so. As an outcome, "The weekly average of convictions for drunkenness in England and Wales, which in 1913 were 3482, had, by the first part of 1917, fallen to 929." And the same general policy has been continued ever since, with the result, as Lloyd-George reports in his Memoirs and others confirm, "Britain today is a much more sober country than it has ever been in my memory." Government reports show that convictions for drunkenness per 10,000 of the population in 1938 were only 23 percent of those in 1913.

In recent years the tax on liquor for consumption in England has been about $13 per American proof gallon: contrasting with about $3 a gallon for federal and state taxes together in this country. But this high British tax has been compensated to some extent for both producer and consumer by the allowance of a degree of dilution that makes "Scotch" in England a milder drink than "Scotch" in America, where it must meet our taxes and required concentration. Under the British taxes and concentration the distillers make a satisfactory profit; the consumers are satisfied with their distinctly milder liquor; and the American visitor, finding that he can drink more than at home without serious effects, concludes that "it must be the climate." The benefit is further enhanced by the fact that "Scotch" is always further diluted with "soda" by the drinkers; it is almost never drunk "straight," as is often the case with those in America—especially automobilists—who drink American whiskey direct from the bottle.

Courtesy Calvert Distillers Corporation

Today, alcohol concentration in whiskies is proofed with a hydrometer as it leaves the still, not with gun powder

Thus in Britain a high tax rate and a large legal degree of dilution have made it to the interest of the distilling trade to decrease the intoxicating quality of their product and thereby to decrease to a more than proportional extent the evils associated with it. In America, on the contrary, the system has always been one of low taxes, cheap liquor, and high alcoholic content: a system under which the distilling industry has found little incentive to develop a market for lower proof liquors. Yet it is quite certain that, until the federal government adjusts its taxes upward and the permissible degree of concentration downward, so that it will be to the financial advantage of the industry to offer and advertise lower proof liquors at prices that will contrast favorably per gram of alcohol with those of higher proof, the production of alcoholic addicts and other evils will not be lessened: no matter what the 48 states may do.

Even this is not the whole story of American maladjustment in liquor control. There is another important item: the bootlegger. One of the arguments adduced in support of low taxes on proof spirits is that higher taxes have always tended to promote the manufacture and sale of illicit liquor. The government needs all the revenue it can get from the excise on spirits. It makes strenuous efforts to discover and suppress the moonshiner, the bootlegger, and the smuggler. Yet, at the same time, by its unwise system, it has promoted the very conditions that it wishes to suppress. It habitually penalizes the legal liquor industry in its competition with the bootleggers. It forbids the legal manufacturer and dealer to sell any liquor below 80 proof, while the illicit manufacturer and dealer can, and does, dilute his liquor to any extent that his market will tolerate, which is commonly between 60 and 70 proof: rarely higher. And the fact that illicit liquor is commonly diluted to 70 or below is decisive evidence that Americans are like Englishmen in that whiskey below 80 proof would be acceptable. What 70 proof is on the tongue is shown by comparing our 70 proof bootleg liquor with cocktails; for 35 percent of alcohol, or 70 proof, is the strength of a dry Martini; and this, by the way, is about the highest concentration that can be taken habitually without destroying the mucosa of the stomach. No one can fairly complain that he gets "no kick" from a 70 proof drink.

Editor's Note: *Professor Henderson's special competence to write on the subject dealt with above arises from the fact that he is an outstanding scientist and that one of his special fields of research long has been the physiological and social aspects of the liquor problem. Others are physiology of the circulation, bio-chemistry of respiration, and pharmacology of gases. He was one of the organizers of the Chemical Warfare Service, is the author of a book on industrial poisons, entitled "Noxious Gases," determined the standard of ventilation for the Holland Tunnels, and was the scientific authority on whose advice Congress legalized 3.2 beer as non-intoxicating under Prohibition.*

For a fuller discussion of the

subject of the above article see a paper by the same author, in the new Quarterly Journal of Studies in Alcohol, *Vol. 1, Page 1, Yale University Press, 1940.*

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RADIO KNIVES

War Casualties

May Benefit

MEDICAL science has made such great strides since the World War that already we hear of the use of new techniques in the treatment of wounded in the present war. Recently, at a meeting of the Military Surgeons of the United States, Col. Gustavus H. Blech suggested that American Army Surgeons will in future use radio-knives on army wounded instead of scissors and scalpel. This method is particularly advantageous for wounds of the extremities.

"I am sure," Col. Blech said, "that in the light of recent experience we should not only provide regimental surgeons with adequate surgical equipment but simplify the scheme of organization for field service by having fewer units but those to be staffed and equipped for all surgical operations permissible in the zones of combat."

NERVOUS

Faulty Sugar Chemistry

May Cause Mental Diseases

FAULTY sugar chemistry in the body may be one cause of mental and nervous diseases, Dr. G. Wilse Robinson, Jr., and Dr. Prior Shelton, of Kansas City, Missouri, recently reported in *The Journal of the American Medical Association.* Patients on the verge of a nervous or mental breakdown might, therefore, be helped by treatment of such a condition.

Signs of sugar disturbance that could be considered diabetes were discovered by these doctors in a high percentage of patients when first admitted to a hospital for mental disease. From one third to nearly two thirds of the patients appeared from the tests to have diabetes. The patients were suffering from all types of mental and nervous diseases, including alcoholism. Tests on these patients several weeks after they entered the hospital showed normal sugar chemistry in one fourth to one half of the group, although only one patient was given treatment for diabetes.

From their studies, the doctors conclude that faulty handling of sugars and starches is common in nervous and mental patients and that it may be a cause of the abnormal nervous and mental condition.

SIDE VISION

Eyesight Measuring Device

Detects Unsafe Motorists

A DEVICE developed by the American Optical Company detects faulty side vision. For safe driving, one should be able to see a moving ob-

ject at an angle of 90 degrees while his eyes are looking directly ahead. The perimeter instrument shown in our illustration measures accurately the entire field of vision. It also is used in the diagnosis of eye and brain diseases.

PINK ELEPHANTS

So It Wasn't Primarily

The Drinking

ALCOHOL is "not the principal factor in the production of delirium tremens," three Providence, R. I., physicians, Dr. Hugh E. Kiene, Dr. Robert J. Streitwieser, and Dr. Himon Miller, seem to have proved in experiments reported in *The Journal of the American Medical Association,* as reported by *Science Service.*

Vitamin B_1 banished the pink elephants in short order, twice as fast as usual, even though the patients in their experiment continued to drink a quart of whisky daily. These five patients were seeing every animal in the Barnum and Bailey outfit, according to one of them, when admitted to the hospital. They recovered, on the average, in 2.4 days on a treatment of large doses of vitamin B_1, plus a drink of four ounces of bonded rye whisky every three hours, day and night.

Signs of kidney irritation in two of the patients disappeared within three days under the vitamin treatment, even though the patients were continuing their daily quart of whisky—from which the physicians concluded that vitamin B_1 acted directly on the kidneys in such a way as to indicate probable curative powers.

The fact that recovery from acute symptoms of delirium tremens occurred practically twice as fast when vitamin B_1 was injected into the patients' veins, even in the presence of continuous drinking, indicates, the Providence physicians state, that the cause of the condition is primarily a deficiency of the vitamin in the presence of a deranged sugar-starch chemistry in the body.

Reason for the vitamin deficiency which brings on the pink elephants is the fact that the person who gets delirium tremens has a habit of failing to "stop for adequate dietary foods in his alcoholic meanderings after the first 12 hours."

PROMISE

New Synthetic Cleansing Agents

Threaten Germs

DISCOVERY of the germ-stopping power of modern synthetic soaps and shampoos may provide scientists with a new class of chemical weapons against disease, including tooth decay, according to *Science Service.* Experiments in this direction are now under way at the University of Chicago, by Dr. Benjamin F. Miller and Dr. Zelma Baker.

Three of the cleansing agents, with the trade names Damol, Emulsol-605, and Emulsol-606, are relatively non-poisonous and non-irritating to mice and rabbits. They stop the growth of germs in the test tube. Their protective action towards experimentally induced germ diseases is now being investigated.

One of the cleansing compounds, Zephiran, is being tried as an anti-tooth decay weapon. The germ-

killing power of this substance was announced by Prof. G. Domagk, of Germany, the man who gave sulfanilamide to the world. Trials of Zephiran by the Chicago scientists showed that it promises to fight tooth decay in two ways: by killing germs and by stopping production of lactic acid which, in high concentration, can destroy tooth enamel and thus give decay a chance to start.

The new cleansing agents were developed to meet various special demands of industry. More than 1000 of them have been patented within the past decade. They have long, chemical names. Zephiran, for example, is alkyl dimethyl benzyl ammonium chloride. Another, with the trade name of a much advertised shampoo [Drene. —*Ed.*] is triethanolamine lauryl sulfate. One of them is sulfonated castor oil.

RISK

Dangers From Hormones

In Some Cosmetics

DANGERS besides the possible development of cancer may result from indiscriminate use of sex hormones and vitamins in cosmetics, Dr. Joseph Eller and Shirley Wolff, of New York City, warn in a report in the *Journal of the American Medical Association.* Dr. Eller and associates point out that a commercial face cream containing a female sex hormone produced cancer in animals as well as other profound changes when applied on the skin in one fifth of the amount recommended for daily use by women.

SOFT CORNS

Operation on Toe May Be Needed

A BONE-CUTTING operation for relief of soft corns has been devised by Dr. H. B. Macey, of the Mayo Clinic. The anatomy of the fourth and fifth toes make ideal conditions for the development of pressure on a bony prominence which leads to callus formation, Dr. Macey explains. Soft corns, situated between the toes, generally between the fourth and fifth, are calluses. Their softness arises from their confinement between the toes and the associated moisture of the feet.

One of the bones of the fourth toe often ends with a bony prominence or bump pointing toward the fifth toe. The opposite bone of this toe may also have a prominence. Short, narrow-toed, forward-pitching shoes may cause one if not both of these bony prominences to press on the flesh between, with a callus resulting.

To relieve the condition, the prominent portion of the bone of either toe may be removed by operation. The prominence must be removed smoothly and cleanly so that no sharp points are left to cause further trouble. — *Science Service.*

ARCH SUPPORTS

Scientifically Correct,

Made of Plastic

LIGHTWEIGHT and sanitary arch supports designed for foot comfort and scientific precision in correcting ailing feet won a major award in the Scientific group of the Fifth Annual Modern Plastics Competition sponsored by *Modern Plastics Magazine.*

Designed by S. Sydney of the National Foot Appliance Laboratory, New York, these arch supports are made from a plaster of Paris impression of the foot as taken in the practitioner's office of the physician or chiropodist (podiatrist). Sheets of Tenite II are molded by Insulation Manufacturing Company and from these sheets pieces are cut to size. Under heat and pressure they are shaped into supports that are odorless; low conductors of heat; resistant to discoloration, tarnish, stains, and moisture; and that do not warp. Any type of arch support can be made by this method.

Plastic arch supports, shaped over plaster of Paris impressions, can be made in any type, or with metatarsal combination

People allergic to steel or leather will find these plastic arch supports to be the solution to their problems of irritation and skin disorders. Smooth and pleasant to the touch, the surface will not tear sheer hose.

LOWER MORTALITY

From Intestinal

Ailment

INTESTINAL obstruction has long been one of the most serious disorders of the digestive organs, with a mortality rate which has remained at approximately 40 percent for more than 50 years. Today, however, says Dr. William Osler Abbott, of the University of Pennsylvania Medical School, marked success in treating this condition is being achieved through a variety of ingenious new methods, and mortality rates in several large hospitals have fallen to 7½ and 11 percent.

SURGICAL RAYS

Ultra-Violet Lamp

Aids in Cataract Surgery

HERE'S good news for persons slowly going blind from cataracts. Greater efficiency in cataract surgery has been made possible by the development of a new ultra-violet lamp for use in cataract cases where the diseased lens of the eye has to be removed by operation.

The new lamp, developed by the American Optical Company in collaboration with Dr. Eliott B. Hague, noted eye specialist, is the first one designed exclusively for cataract surgery. It provides the greatest source of fluorescing ultra-violet now available for cataract operations, which comprise approximately 25 percent of all eye operations.

The lamp projects a full beam of ultra-violet light of maximum intensity at 3650 Angstrom units. Directed into the eye, this light causes the crystalline lens to fluoresce. As a result, the lens becomes brilliantly visible, a distinct help in cataract surgery. Furthermore, the lamp insures total extraction of the lens as any remnants, which may later cause trouble, are easily located because of their fluorescence, and extracted.

What Is On Venus?

Newest Evidence Hints Venus is Clothed In Dense Clouds of Polyoxymethelene Hydrates

HENRY NORRIS RUSSELL, Ph.D.

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VENUS—the most conspicuous of the planets—is in many ways the most disappointing to the astronomer. The casual visitor to an observatory, enjoying a daytime telescopic view of the planet near the time of its greatest brightness, is likely to exclaim with delight at its brilliance, its whiteness, its crescent phase. If he is a little more sophisticated, he may notice the beautiful gradation of light between the limb and the terminator. The experienced planetary observer looks at the same view with something very like despair. The surface is white, smooth, and usually altogether featureless, except for the diminution in brightness resulting from the increasing obliquity of incidence of the Sun's rays.

Faint and fugitive markings have often been reported by visual observers. More contrast is shown on photographs made with ultra-violet light, as Ross showed in 1928, but, even then, the difference in brightness between the lightest and darkest spots is only about 25 percent. These markings change radically from one night to the next, and are obviously phenomena belonging to the planet's atmosphere, and not to a permanent surface.

When the planet is very nearly in line between us and the Sun, so that her apparent crescent is reduced to a mere hairline of light, a strange thing happens. We might expect this line to extend over a semi-circle, fading out to nothing at the ends; but, when the sky is clear, it has been seen many times to extend over more than a semi-circle. This obviously could not happen on a bare spherical body like the Moon. It must be due to twilight—the illuminated atmosphere visible beyond the place where the sunlight grazes the surface itself. Indeed, when Venus is within a degree or so of the Sun—which happens rarely—she has been observed on several occasions as a luminous ring—the sunlit atmosphere being in sight all around the dark face.

From the amount of the extension of the horns, it is possible to calculate the height above the planet's surface to which the visible sunlit atmosphere extends; and this comes out only a little more than one mile. This is, however, not the full height of the atmosphere, but that of a hazy layer, which is so brightly lighted by the Sun's rays that it can be seen through the brilliantly illuminated foreground of our own atmosphere, close to the Sun.

When Venus can be observed on a dark sky, 20 degrees or so from the Sun, and yet appears as a narrow crescent, we might expect the twilight effects to be more extensive. Something of the sort was recorded by Schroeter, an enthusiastic observer at the end of the 18th Century; and his observations appear never to have been repeated with modern telescopes. Here is a nice problem for an amateur—provided that he has an instrument of considerable size with a field free from scattered light, and lives where the air is, at least sometimes, transparently clear.

THE reflecting power of the surface is high—about 50 percent. When allowance is made for the changing distance from the Earth, it is found that the diminution of brightness with phase, from full to half to crescent, is much smaller than for the Moon. This shows that the surface is relatively smooth. A study by Gerasimovic shows that these two things can be satisfactorily explained if the surface is covered by clouds or fog—consisting (like terrestrial clouds) of particles larger than the wavelength of light, but can not be accounted for by reflection from a solid surface or from a thick layer of cloudless gas.

The rotation period of Venus is still unknown, except that we are sure that it must be long. The markings change so much from night to night that they can not be followed; and observations for radial velocity, which alone suffice to reveal rotation for all the planets from Mars to Neptune, show here only that the motion is too slow to measure. It appears certain, however, that Venus does not keep the same side turned permanently toward the Sun. Radiometric measures at Mt. Wilson and Flagstaff show that the dark side of the planet radiates considerable heat; but, if it was always dark, it would be very cold. It is probable that the planet's "day" is several weeks long by our reckoning.

Evidence regarding the composition of the atmosphere can be obtained only with the spectroscope—and our powers of analysis are seriously restricted in the case of a cool body like this. We must observe through our own atmosphere—which cuts off all the ultra-violet except a beggarly part near the visible region. All the really strong absorption bands of the familiar gases lie in the inaccessible part of the spectrum. For a few of these there are feebly absorbed bands in the observable part of the spectrum, demanding many thousands of times more material to produce than the others, but for many of the best-known gases—for example, hydrogen, nitrogen, carbon monoxide, helium, neon, and argon—there is no accessible absorption at all, and we cannot detect them. The exceptions fortunately include just the constituents which are of the most general interest—oxygen, water vapor, and carbon dioxide.

The first two of these are present in our own atmosphere, and disturb observations of the planets seriously; but the difficulties, though troublesome, can be surmounted. Venus, with her great surface brightness, is the most favorable of all the planets for such a test. Yet the observations of St. John and Nicholson, at Mt. Wilson, failed to detect any observable absorption by either. For oxygen, the test is sensitive, and the observers conclude that the amount above the surface of Venus must be less than a thousandth part of that in our atmosphere. The test for water vapor is much less delicate, and an

amount much less than a tenth of that on Earth (above a mile-high mountain in dry weather) would have escaped detection.

Carbon dioxide, however, gives bands in the infra-red, discovered by Adams and Dunham, which, though not very strong, indicate that the amount of this gas above the planet's surface is equivalent to a layer about a mile thick, at standard temperature and pressure—about 400 times more than here.

On Earth, however, carbon dioxide is continually being removed from the air by the growth of plants, which use the carbon in building their own substance, and turn back the oxygen. On a lifeless world, we might expect to find far more carbon dioxide, and little or no oxygen; so that this is no puzzle. But the absence of water is hard to account for. The sunlit side of Venus must be hot, especially as the carbon dioxide in the atmosphere must serve as a very efficient heat trap; and it appears probable that the temperature of the planet's visible surface is not far below the boiling point of water, or higher. The solid surface below the visible clouds or haze must be still hotter. If there were oceans on Venus, or any considerable, though smaller, quantity of water, its evaporation would saturate the atmosphere with moisture, and cause the appearance of water-vapor absorptions in the spectrum, much stronger than those produced by the Earth's atmosphere.

Venus is so nearly a twin of the Earth in size and mass that it is very hard to understand how she could have practically no water, while our planet is almost drowned in it. No satisfactory explanation has yet been suggested; yet the train of evidence which has just been sketched is so strong that we appear, at present, to have to accept it as a fact.

But if there is no water on Venus—or practically none—what produces the great veil of whitish clouds which covers her whole visible surface? A very interesting suggestion has just been made by Wildt, pointing out possibilities which would never have been thought of by astronomers less familiar with chemistry.

Start with the assumption that the atmosphere of Venus, long ago, contained a great deal of carbon dioxide (it is still there), a small amount of water vapor (for the reasons just stated), and little or no oxygen. The temperature of the surface was, and is, high enough to make the appearance of life very improbable. The surface of the planet, if of composition like terrestrial rocks, would contain partially oxidized (ferrous) compounds of iron, and these, if there was any water present, would undergo weathering and exhaust

A photograph of Venus, made by Harold A. Lower, using a small telescope as a camera. Many are surprised, on their first view of Venus through telescope or opera glass, to discover that its disk is not round but shows phases, as does the Moon. Indeed, there are persons who claim they can even see the half-moon appearance of Venus with the unaided eye (the smallest glass renders the phases clearly visible). Perhaps the fact that such persons know what to look for to some extent influences this belief. Galileo was the first of record, however, to have seen them, using his first telescope. Copernicus had predicted them

from the atmosphere what little oxygen remained, leaving the carbon dioxide and water vapor.

These gases, when exposed to short-wave ultra-violet light, enter into the reaction

$$CO_2 + H_2O = CH_2O + O_2$$

forming formaldehyde and free oxygen. The considerable amount of energy required is furnished by the light.

Formaldehyde, while reactive chemically in many ways, is highly resistant to attack by oxygen. Hence it is possible that, while the oxygen is used up by further rock weathering, the atmosphere may contain steadily increasing quantities of formaldehyde gas. If so, Venus would be a very poor place for men in some hypothetical "space ship" to land; they would be poisoned at once.

But a test of this hypothesis is available. Formaldehyde exerts a very powerful absorption upon ultra-violet light, producing a system of bands extending up to $\lambda 3600$ — that is, well into the spectral region which we can observe through our atmosphere. Dr. Wildt, during a recent stay at the McDonald Observatory, obtained a series of ultra-violet spectra of Venus, and of the Moon for comparison. Careful comparison of the two showed not the slightest difference in the spectra of the light reflected from the two bodies. If there had been an amount of formaldehyde in Venus' atmosphere enough to make a layer of the gas a quarter of an inch thick, under standard conditions, its absorption could have been observed.

One would think, then, that this theory must be abandoned; but here is where more chemistry comes in. Formaldehyde has unsaturated molecules, which have a strong tendency to link themselves up into long chains—indeed, this makes it an important raw material for the production of some commercial plastics. Even in the pure state, it condenses into a solid white mass—probably consisting of a complex mess of longer and shorter chains. Water-vapor catalyzes the reaction. If a small amount of it is injected into absolutely dry formaldehyde gas, the reaction vessel is instantly filled with a dense white cloud of finely divided solid particles. If heated hot enough these polymerized hydrates are dissociated into their constituents; but this requires a temperature of about 200 degrees Centigrade. At the temperature which probably prevails on Venus' surface, there would be little decomposition—which may account for the absence of the formaldehyde bands in the spectrum.

It seems, then, to be quite possible that the very absence of abundant water from the planet's surface—if in presence of abundant carbon dioxide—may lead to the production of white clouds on its atmosphere, and the precipitation of white polymeric compounds on its surface, and so account for its telescopic appearance.

Dr. Wildt presents this reasoning tentatively, as a possible explanation. It is very interesting to see how results obtained by chemists, with not the slightest thought of application outside their own science, and published in journals that not one astronomer in a hundred thinks of reading, may, years afterward, offer a clue to an outstanding astronomical puzzle. — *Princeton, October 2, 1940.*

Protecting Gasoline Tanks

Principles and Practice In Development of Bullet-Proof Tanks for Airplanes

ALEXANDER KLEMIN
Aviation Editor, Scientific American. In charge, Daniel Guggenheim School of Aeronautics, New York University.

WHEN the Army Air Corps announced a few months ago that it had secured a leak-proof or bullet-proof gasoline tank, old timers in aviation were astounded —because they had known and used protected tanks at least 15 years ago. Protection for tanks was news only to the younger personnel of the Air Corps. But if the protection of tanks is an old story, the scientific principles involved may not have been clearly understood hitherto. Accordingly, a paper by A. R. Weyl, in the *Journal of the Royal Aeronautical Society*, entitled "Fire Protection of Petrol Tanks," which does go thoroughly into principles, has been well received on both sides of the ocean. The Weyl paper is based on systematic research work with the aid of slow-motion cameras and other devices of modern ballistics.

Here are Mr. Weyl's general conclusions regarding tank design:

The entry hole made by a bullet is harmless, and no ignition is connected with the entry. It is quite easy to seal the entry hole made by a bullet. The exit hole or leak made by a bullet which has passed through a tank is much larger and is much more difficult to seal. The motion of the bullet inside the gasoline produces pressure waves and it is the pressure waves which are the cause of the exit leak and help to produce ignition. If the bullet can be made to stop within the tank no ignition may be expected. If the bullet can be separated from the gasoline while inside the tank, the exit leak will be small. If the bullet can be freed from gasoline at the moment when it is leaving the tank, no ignition should take place. Incendiary bullets designed to disintegrate inside a gasoline tank are unlikely to cause ignition.

These general principles are of real value but Mr. Weyl goes beyond principles and gives some thoroughly practical design suggestions.

It is important to concentrate the gasoline of an airplane in one very compact tank. Then there is less surface for bullets to strike, and the weight of tank protection is smaller because the compact tank has so much less surface in relation to its volume.

What metal should be used? There does not appear much reason to choose one metal over another. Brass offers slightly higher resistance to the impact of pressure waves because of its elasticity. Magnesium tanks suffer large holes, but their edges are not deformed. On the whole, one metal will do almost as well as another.

To restrict the pressure waves, it is important to have baffle plates. How can the baffle plates be arranged inside the tank so that all likely hits are faced by them? A star-shaped arrangement of baffles seems adequate but heavy.

Since pressure waves cause the dangerous exit leak, the tank mounting is important. If the mounting is too soft, resonance is to be feared. But above all, the support of the tank must be well distributed; the internal pressure waves are then less likely to cause trouble. Further, the tank should not be mounted in brackets, but in a cradle or straps.

Is it any help to use hollow containers or compartments within the tank? That might be helpful, since the pressure waves could destroy the internal compartment without the outside walls being affected. Filling of the protective compartments with inert gases was found to be useless, however.

Here, in general, is the proper way to protect the tank: Around the metal there is fitted a gasoline-tight fabric, treated skin, or parchment. Then a fairly thick layer of sealing compound which swells under the action of gasoline and fills the entry and exit holes. Since the sealing compounds have no strength, a sealing bandage must come outside of all this in the form of highly elastic vulcanized rubber. The compressing rubber cover helps to separate the bullet from the gasoline in accordance with one of the principles given above. The whole structure should be enclosed in a wire net of a large mesh which is electrically connected with other metallic parts of the aircraft to prevent electrical ignition effects.

Of course, superimposed upon all these requirements, will be the final requirement that the protection of the tank must not be so heavy as to impair the general load-carrying capacity of the airplane. Otherwise military authorities might decide that it was better to have a lighter, more maneuverable airplane and to take a chance on the bullets piercing the tank.

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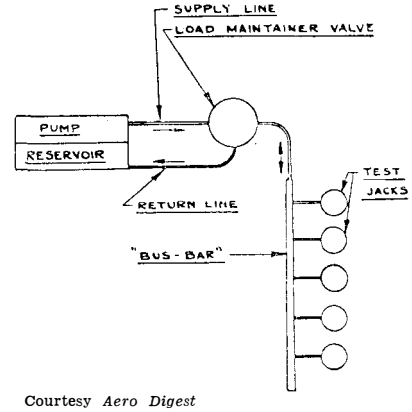
HYDRAULIC TESTING

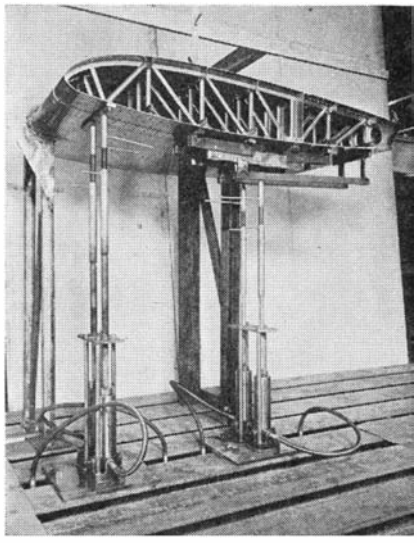
Destruction of Airplane Parts Reveals Defects

TESTING to destruction of the structure of airplanes dates well back in aviation; during the World War the Army Air Service, with the aid of French and British missions, converted into an art what used to be a crude shop test. Today, the structural testing of wings and fuselages is as useful as ever, and methods are highly refined.

Charles Tilgner, now Chief Aerodynamicist of Grumman Aircraft, has been responsible for great progress in "hydraulic testing." Loading sandbags or shot-bags weighing thousands of pounds on the wing is a painful, slow process, which may be dangerous when the structure suddenly lets go and



Courtesy *Aero Digest*
Diagram of the system of testing airplane parts hydraulically



Using hydraulic jacks to test the structure of a plane wing

heavy bags fly downward. Another drawback of the sand-bag or shot-bag is that if loads are not applied simultaneously, secondary stresses and inaccuracies may be introduced. Mr. Tilgner has developed a method which avoids all these drawbacks; loads are applied to the wing by suitably placed hydraulic jacks. The loads from some of the jacks are also applied through a leverage system, so that a single jack applies a predetermined load to various parts of the wing. The jacks are all connected to a single source of supply, as shown in the diagram, and between the pump and the jacks there is introduced a load-maintaining valve in which a weight on top of a piston is used to provide a constant pressure. With pump and valve under complete control, and a single source of pressure supply, the engineer can be quite certain that he is applying exactly the required load to each part of the structure. Further, the load can be applied and released with rapidity and ease.—*A. K.*

AIR TRAILERS

Possibility of Transporting Troops by Air

A CORRESPONDENT asks whether the idea that Germans will tow gliders behind airplanes to transport troops has any merit. In spite of all the discussion by "experts," no definite answer can be given. W. S. Shackleton, writing in *The Aeroplane,* gives as good an analysis of the problems involved as anyone. He believes that such a troop train will be practicable. This would consist of four large gliders, each about 82 feet in span and each carrying 20 troops, spaced 100 yards apart and towed behind a large twin-engined transport.

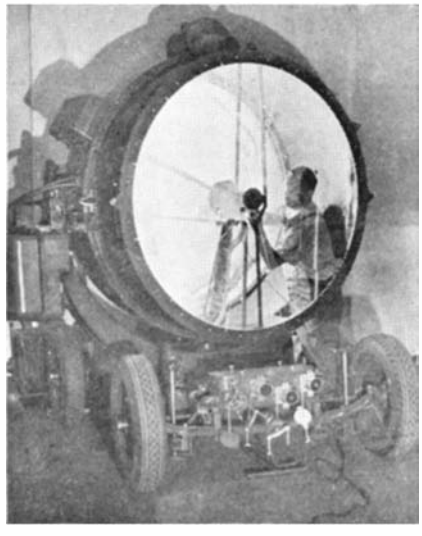
There are many difficulties, however. The glider train would be slow and vulnerable. It could not possibly defend itself with gun fire, and it certainly could not maneuver or conduct a dog fight in the sky. There is also some doubt as to what would happen to the glider train in rough weather.

We suggest a glider trailer flight as a spectacular feature for the next Soaring Meet at Elmira.—*A. K.*

SEARCHLIGHTS

IMMENSELY powerful anti-aircraft searchlights of the type being used by the British in defending London are being delivered to the United States Army by General Electric. Naturally, information is restricted, but we are free to say that the lights are 60 inches in diameter and of 800,000,000 candle-power. They are effective for at least 5½ miles in the air, which should be sufficient for spotting most bomber attacks.

The searchlight is not new in principle, since a powerful arc with



800,000,000 candle-power

concentrating mirrors has been customary for decades, but besides the extraordinary power of the new lights it has many valuable features. Thus, the beam may be directed from side to side or tilted up or down just as easily as a motor-car can be steered. Both the lights and the power plants which accompany them are mounted on rubber-tired wheels for easy towing into position or for transportation in trucks. The searchlights are, of course, used with an optical airplane finder. Our photographs illustrate several aspects of these lights. Even though the best anti-aircraft defense lies with interceptors or pursuits, good batteries, well directed, make life very unpleasant for the enemy bombers; these lights should be most valuable in our national defense.—*A. K.*

An airplane finder used in conjunction with powerful lights

OXYGEN BOOST

Increases Diesel Power for Take-Off

AIRPLANES require about one third more power in take-off than in flight, and airplane gasoline engines fortunately have higher rating at take-off than in normal operation. Against the airplane Diesel engine there has been raised the objection that its power cannot be boosted during take-off.

Professor P. H. Schweitzer, of Pennsylvania State College, writing in *Mechanical Engineering,* describes experiments intended to remove this criticism. He has tried to increase the power for short intervals by feeding pure oxygen to the cylinder and increasing the oxygen concentration from the normal 21 percent to 45 percent. So much extra power can be developed for take-off by this method that the size of the airplane Diesel could be reduced some 25 percent by the "boost." While the oxygen containers are heavy, they are not heavy enough to invalidate the possibilities of the system. Now that the laboratory experiments have proved satisfactory, it would be desirable to make an actual test in flight operation.—*A. K.*

Lightless Light

Black Light—Unseen Rays—Causes Many Materials to Glow, Has Practical Uses

PHILIP H. SMITH

IMAGINE a convoy of ammunition trucks speeding along a highway in pitch darkness, holding to the center of the road and following its contours with unerring accuracy, but using no headlamps. This isn't a Jules Verne dream. It is a possibility, thanks to black light.

If you don't care for the warlike, you can choose a peacetime scene. Imagine a motion-picture theater having its lobby illuminated entirely by the soft light of glowing walls and luminous statuettes. If you arrive late and the house is dark it is simple to find your seat because a luminous design in the carpet guides you down the aisle, and the seat number sparkles in the dark. This, too, is a possibility, and again, it is a black light phenomenon.

The paradoxical name "black light" is given to rays or certain wave bands in the ultra-violet end of the spectrum. Roughly speaking, these waves have lengths ranging from 3300 to 4000 angstroms (light measure), 4000 being the beginning of visible light. These invisible rays have the ability to make certain materials fluoresce, or glow, as though they were producing light. They don't tan skin or have germicidal properties as one might expect of ultra-violet rays, these properties being possessed by waves of shorter length. Fluorescence occurs only in the presence of the rays. It is unlike phosphorescence whereby light is stored and given forth after the light source is removed.

Black light is no recent discovery, but it has been used indifferently. Luminous costumes have been featured on the stage from time to time. Europeans, particularly the Dutch, have developed it to practical ends much more than we have and now the commonplace of blackouts has given it a great boost. Today we have available inexpensive black-light sources and a wide color range of paints, dyes, and inks which have been rendered durable through painstaking research.

There are three types of black-light lamps. The simplest type, suitable for amateur work, is a tungsten filament lamp with a black glass bulb. Its life is short because of the high temperatures required for ultra-violet radiation. The other types are high-intensity, mercury vapor lamps, one employing a black glass bulb; the other, a clear glass bulb with separate black glass filter. This last mentioned type is the most practical and widely used commercially, because the filter does not have to be replaced if the bulb goes. Mercury is used because its spectrum contains the richest emission of ultra-violet rays in the black-light zone.

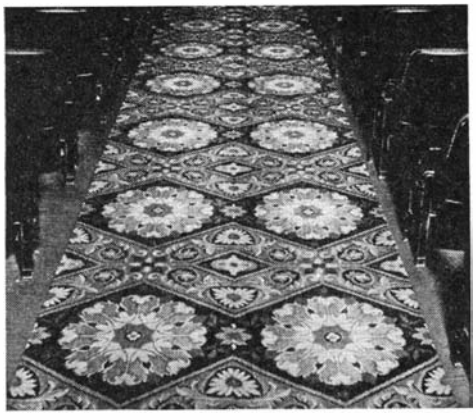
Look directly at a black-ray lamp and if you see anything it is a core glowing like the heating element of an electric toaster. You will notice that a haze comes before your eyes which is annoying but not dangerous. This sensation is caused by a slight fluorescing of the eyeball. If someone should look at you while you are standing in the rays, they would see your teeth glowing in the dark, provided they are your own teeth. Store teeth will not fluoresce. Your fingernails also glow, otherwise you would be practically invisible.

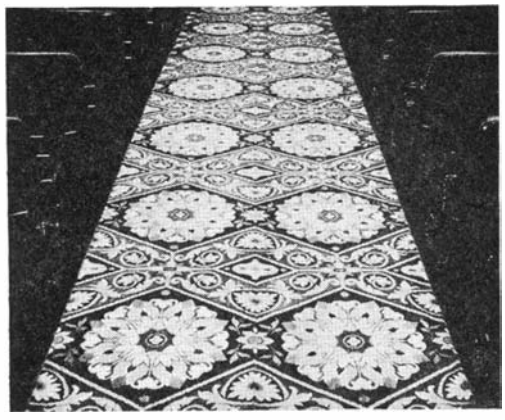
The materials used to make fluorescing paints, dyes, and inks, are more or less trade secrets. There are plenty of substances which fluoresce naturally but it has taken years of experimentation to select them for proper color and durability. Today, there is a fair range of colors to be had, and in Europe they go so far as to offer fluorescing materials in the form of plastics, make-up, chalk, and crayons.

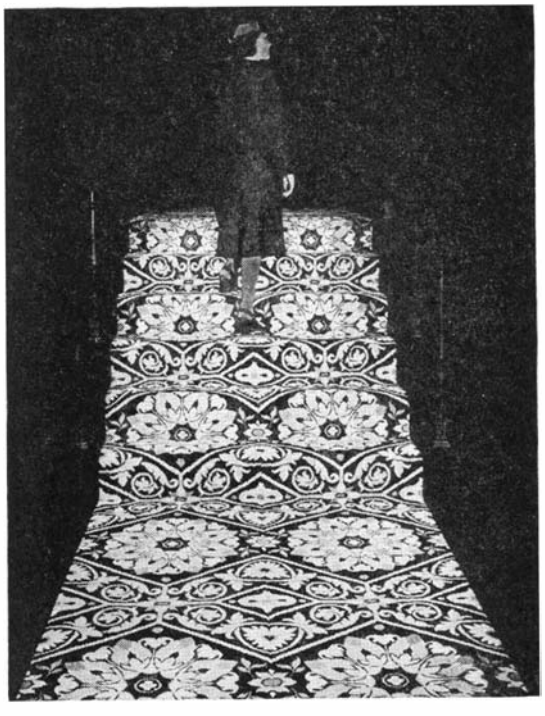
MOST visitors at the New York World's Fair were unaware that they saw a sort of dress rehearsal of black light. The night scene in the Perisphere's miniature city was created by coating windows with a fluorescent paint and turning on black light as the ordinary light was turned off. The luminous bathing caps of the swimmers in Billy Rose's Aquacade were simply colored with fluorescent materials so that they would glow in the rays

A possibility for fashion shows: An evening dress and wig under ordinary light and black light. The latter causes the dyed design to glow in colors

At right: **A carpet in a theater aisle as it appears when lights are on, and glowing under invisible ultra-violet rays.** *Below:* **In complete darkness, steps in another aisle are easily seen as black light makes the dyes of the carpet glow**







of concealed lamps. Both these spectacles demonstrated the possibilities for achieving dramatic light and color effects.

Fluorescent wall paints are now in commercial use. Common practice is to paint walls in designs which will look well under all lighting, but glow luminously in desired color combinations under black light and give sufficient light for seeing. It is particularly well suited for the soft lighting of cocktail bars and lobbies. There are paints which show only in daylight; others which respond to both daylight and black light, and a third type which has color only under black light. By a judicious use of these three types in combination, some striking effects can be produced. You'll soon see advertising displays which have a dual aspect created by the alternate flashing of ordinary light and black light. For the time being these will be used indoors or sheltered from direct sunlight because the fluorescent properties are impaired by the sun's rays.

As luck would have it, many inexpensive dyes are fluorescent. A ten cent handkerchief is very likely to become a thing of rarest beauty in the rays of black light. Dyed fabrics can be used for stage curtains and costumes and now there are carpets woven from materials given fluorescence with dyes. One wonders what the effect will be upon theater audiences if black light becomes common. Fluorescent carpets already are used in 25 theaters. Must the theater-goer of the future consider dressing for two lighting effects?

This is a fair question, because the practice of marking fine fabrics with invisible fluorescent inks is being carried on by some laundries and cleaners, and as a result Mrs. Jones is known to have been de-coded as she walked down a theater aisle—late to the performance. If this simple scheme to avoid ugly laundry marks leads to trouble, more can happen. We know that some rouges go dead black under the rays; we have yet to find out about hair dyes.

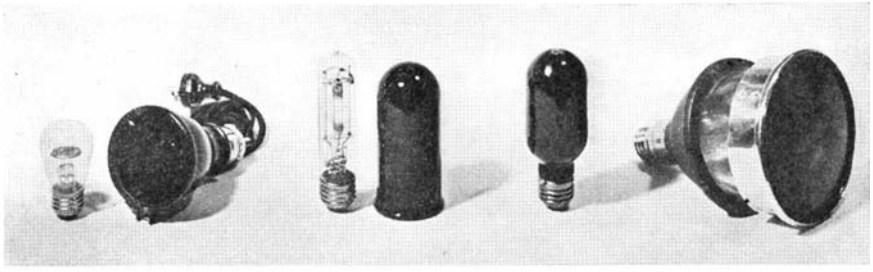
Circulars printed with fluorescent inks are being used to show prospects the possibilities of lighting equipment for advertising purposes. We see a building pictured under ordinary light and that's the daytime appearance; then, by switching on black light, the circular shows signs and building walls glowing with the effect of night reality. It is conceivable that books and magazines will be printed in such inks for those whose eyesight can be helped by illuminated lettering.

Black light has moved into the field of fraud detection. It can be used to reveal alteration of documents either by showing the work of ink eradicators or differences in inks. Still in its infancy is the detection of frauds in antiques. Suppose, for example, you possess a pair of glass candlesticks with dangling prisms. If the two are not contemporary or some of the prisms have been lost and replaced, the substitution is easily detected. Glass is fluorescent—particularly cheap, modern glass which contains uranium salts—and glass from different sections of the country and of different manufacturing eras, rarely if ever fluoresce with identical color.

OLD tapestries and fabrics lend themselves to black-light check. If there has been mending it will be revealed, because old and modern dyes are readily distinguished in black light. Even furniture can be examined for antiquity because old-fashioned glues fluoresce quite differently from modern ones.

Sam Hibben, one of the fathers of black light, tells of purchasing a sandstone fossil of a crustacean while traveling as a boy in Austria, and of proving its genuineness with black light many years after. The fossil came under the rays quite by accident and to his surprise it glowed brilliantly. The explanation is not hard to find. Fluorescence had not diminished with age and this crustacean displayed it just as do the skin and bones of fish.

Before black light becomes a reliable tool for testing antiques, standards will have to be established. Your candlesticks, for example, may not be a matched pair, but which is new, which is old—which is the fake and which the genuine? Perhaps both are genuine, differing only as to place and



Several types of black light lamps. Two, of clear glass, stand beside reflector and hood of black glass. A self-contained lamp, at right of center

time of manufacture. Repairs to glass, furniture, and fabrics can be ascertained, but experts will have to struggle long before they are able to place an object definitely within a given period.

In Holland, black light is used for sorting diamonds. It reveals source of origin rather than quality. Some diamonds fluoresce brightly, others only very little. If you should examine a bracelet of diamonds under black light you would find few of the gems glowing alike. Some other odd but practical uses to which the Europeans have put black light are to ascertain adulterations and food quality. Butter can be distinguished from margarine because the former fluoresces yellow, the latter pale mauve; fresh eggs fluoresce red while stale ones are brown.

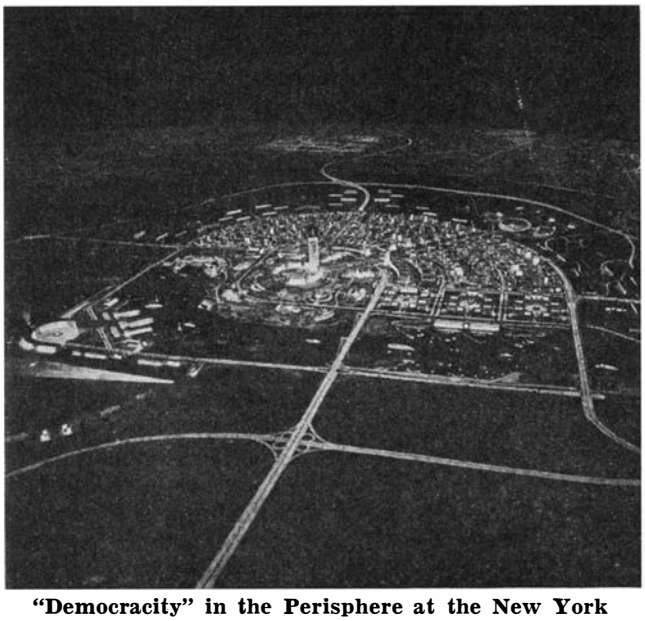
There is a very broad field in mineralogy. One can distinguish many minerals in mines under black light, and companies are already using it to search out zinc and tungsten deposits— to find the richest ores and to examine scrap piles for valuable minerals discarded in error. By pure chance, most of the really valuable minerals and metals fluoresce. It is possible to distinguish genuine sapphires, pearls, and ivory from the artificial, to tell new cut jade from old, and to spot rubies from Siam as contrasted with those from Burma or the synthetics.

A VERY simple application of black light has recently been placed on the market. It calls for coating reflectors with a substance which fluoresces red, and when used in combination with mercury lamps, a pink tint is added to make up partially for the red-ray deficiency characteristic of the mercury spectrum. Even more ingenious is the weaving of a fluorescent strand into rope, as now practiced by one manufacturer. This simple trick makes possible checking up rope which fails in use to see whose product is at fault—the ingenious manufacturer's or a competitor's.

Experimenters have been trying a variety of stunts to test out black-light possibilities. One of the most novel has been to play cards with no illumination other than that furnished by a tablecloth of fluorescent dyed fabric and cards printed in fluorescent inks. It is significant only in demonstrating how objects themselves can be made a source of light—an idea very likely to be capitalized upon. Now that fluorescent substances can be incorporated in plastics, the idea gets a real boost. The plastics can be formed into figurines and statuettes, into artificial flowers, and into threads for weaving into fabrics, and all these supply what might be termed artistic, indirect lighting fixtures, though the light is only a glow.

Of military uses for black light, little can be said because nothing is known officially. But one can hardly mull over the great advantage of invisible light under wartime conditions without having some uses come to mind. The convoy described at the beginning of this article finds its way by flashing black light on fluorescent painted markers lining the roadway, and that's just one step ahead of the present practice of using prismatic buttons. Gages and controls of artillery and aircraft can be illuminated in such a manner as to be invisible to the enemy. And perhaps this is being done. The Germans must know plenty about black light because they control the Netherlands, the seat of black-light development.

Both fluorescence and phosphorescence are being used in England. The London bobbies have crossed suspenders which show up in the darkness of blackout traffic. The entrances to air raid shelters are indicated by fluorescent mark-



"Democracity" in the Perisphere at the New York World's Fair. The effect above at left was achieved wholly by use of fluorescent paints on the city and black lights overhead, not a single inch of wiring being in the city itself. Above, at right, the tiny city and surrounding country under ordinary light

ings, or with phosphorescent paint.

Black light sounds like the light the little man who wasn't there reads by, but for all its paradoxical nature it has a valuable role to play in the future. First and foremost, it affords an opportunity to achieve color and light effects by illumination which cannot be obtained by any other means. In time, decorators may have to think in terms of two lighting effects. It already serves industry, but here the possibilities have no more than been scratched. The lamps and fluorescent materials are available and practical and it remains only for man's ingenuity to put them to varied esthetic and commercial uses.

Photographs courtesy of Calco Chemical Co.; Alexander Smith & Sons Carpet Co.; Stroblite Co.; Westinghouse Elec. & Mfg. Co.

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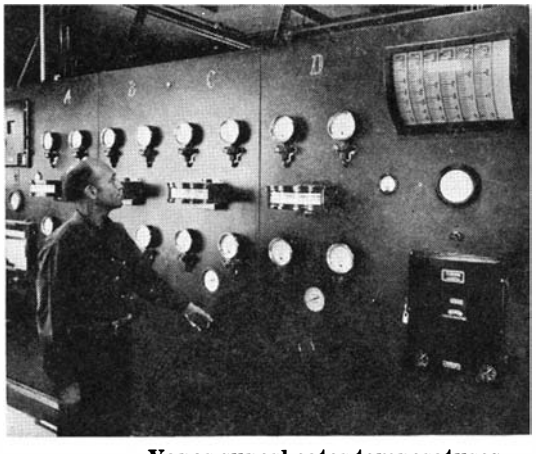
Carbolic From Gases

World's Largest Synthetic Phenol Plant Is Operated By Only Six Men

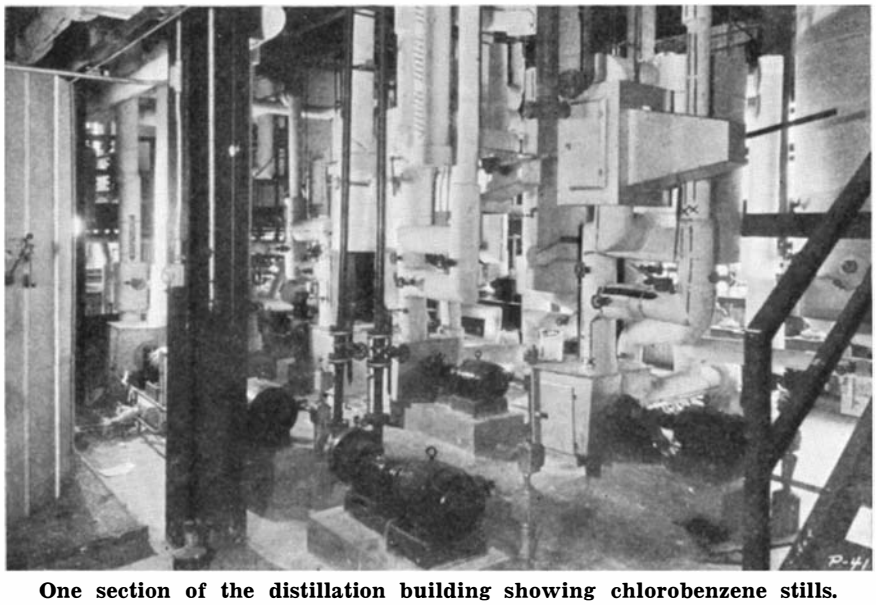
MANY plastics employ phenol, better known to the layman as carbolic acid, as one important constituent. Since the year 1834, phenol has been made from coal, an enormous amount of by-product being produced for every pound of phenol. The plastics industry has grown so fast, however—from a production of 2,000,000 pounds in 1921 to more than 200,000,000 pounds in 1939—that it has become necessary to synthesize the basic materials used in their manufacture.

Of great interest, therefore, is the new $2,000,000 plant built at North Tonawanda, New York, by Durez Plastics & Chemicals, Inc., for the production of synthetic phenol from several common chemicals. When the acid is made by the new Raschig process, the by-products amount to less than one-tenth of a pound for each pound of phenol. The plant, the largest of its kind in the world and the only one in the United States, is one of the most amazing chemical units in the world. In spite of its size and the intricate processes involved, it can be operated at full capacity by a force of six men and a supervisor for each shift. Operations are controlled automatically by these men at master control panels. In case of motor trouble anywhere, automatic signal divisions warn the operators who can then cut in duplicate equipment from their control stations.

Peep holes enable operators to observe first stage of process



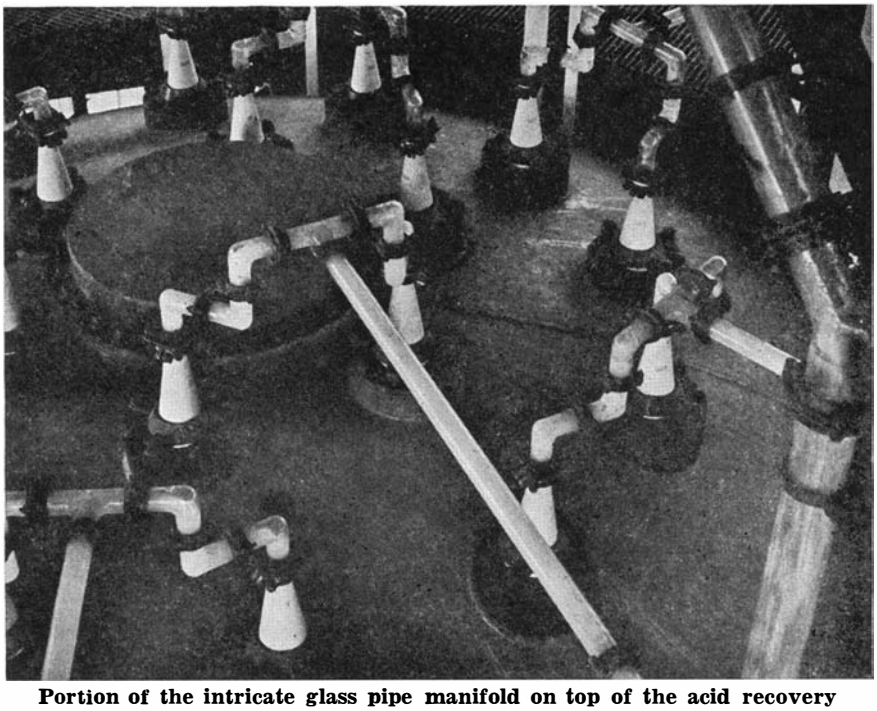
Vapor superheater temperatures are controlled at this station



One section of the distillation building showing chlorobenzene stills. Duplicate pumps assure continuous operation regardless of breakdowns

There are several large buildings, towers, and distillation units, all joined with 40 lines of pipe, three miles of which is made of glass, porcelain, or rubber, to withstand the action of acids at high temperatures. Duplicate equipment has been installed at every stage for use in case of trouble.

The process itself is so intricate that many leading chemical engineers in this country refused to consider it when it was first offered here a few years ago. Briefly, it consists, first, in passing a vapor mixture of benzene, hydrochloric acid, and air through a catalyst. This produces a mixture of chlorinated benzenes from which mono-



Portion of the intricate glass pipe manifold on top of the acid recovery tower. Here the Raschig carbolic acid process starts in the second stage

chlor-benzene is distilled in the pure state for use in the second step. In the second step, a vapor mixture of mono-chlor-benzene and steam is passed through a catalyst which produces phenol and regenerates the hydrochloric acid. These two stages actually form a completely continuous process, and during the process most of the materials formed, and the catalysts, are recovered for re-use. The process can be likened to a game of ring-around-a-rosie, the process making a continuous circle with the phenol being extracted or drawn off as it is formed, and new materials and new catalysts added as the original ones wear out or become used up.

Assuring an independent and controlled source of the purest phenol obtainable in this country (above U. S. P. standards) this new plant not only makes possible improved plastics but also is a definite aid in national defense, for phenol is used in some explosives.

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NATURAL GAS STORAGE

Changed To Liquid, Stored in Smaller Tanks

THE dream of J. A. Clark and R. W. Miller, of Pittsburgh, engineers of the Hope Natural Gas Company, of reducing natural gas to the liquid state and then storing it at 250 degrees below zero, has come true in a new plant now being erected at Cleveland for The East Ohio Gas Company. The tanks holding the liquid gas are of special nickel steel and are insulated by walls of cork three feet thick.

Even metals lose their strength at sub-Arctic temperatures. The problem of storing liquid natural gas, therefore, involved research and experiment to find materials which would withstand the harrowing cold of the liquefied fuel.

The reason for this interest in liquid natural gas is not hard to find because natural gas companies have experienced considerable difficulty in solving the problem of varying gas demands by consumers. Generally, the natural gas supply and the consuming center are miles apart, joined by a pipe line. Economic reasons dictate the size of such lines, and they are used only at part of their capacity in the summer time, at best.

Sometimes gas companies solve their storage problem by raising the pressure of gas in the pipe line, making this a natural storage reservoir, but it is a limited one. Other companies have used high-pressure storage tanks, but these are expensive and rather uneconomical ways of storing large volumes of gas.

One cubic foot of liquid natural gas would make 600 cubic feet of ordinary natural gas if allowed to return to its natural state, and all of this would take place without any change in the gas. Thus, a big gas holder can store 15,000,000 cubic feet of gas but it would take a holder of only 25,000 cubic feet capacity to store the same amount of gas in the liquid state. This saving in storage space had such great appeal that Mr. Clark and Mr. Miller began extensive experiments as far back as August, 1937, to solve the many problems of economically liquefying and storing natural gas.

These experiments revealed that the most practical method of liquefying the gas was by the so-called "cascade" system in which the gas is cooled to the liquefying temperature by passing it through four stages, each one of which is surrounded by a closed circuit containing liquids having successively lower and lower boiling points.

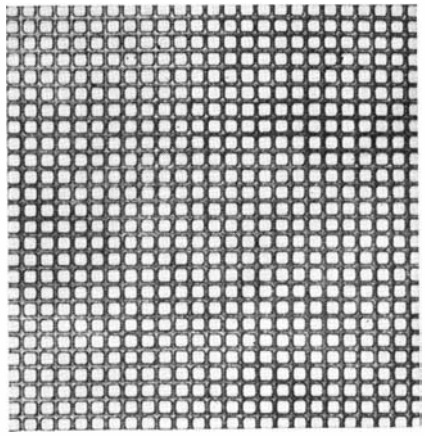
The Cleveland plant will be able to liquefy 4,000,000 cubic feet of natural gas each day and will have three storage tanks, each holding 600,000 gallons of liquid natural gas, which will be equal to a total storage of 150 million cubic feet.

Not least in interest is the way in which this liquid is reconverted into gas. This requires steam heat, and the natural gas is boiled at a speed fast enough to produce 3,000,000 cubic feet of natural gas per hour, enough to supply cooking needs of 100,000 families.

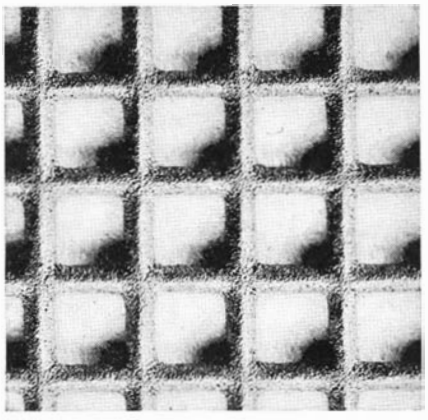
POWDER SCREEN

No Wires, No Weaving in Powder Metallurgy Product

POWER metallurgy, which was discussed in length a few months ago in Scientific American, has solved many industrial production problems. It has now been adapted



Powder screen, natural size



Powder screen, 6x

by the Chrysler Corporation to the production of fine bronze screens. The resulting screen, shown in the accompanying illustrations, is, as yet, only a laboratory curiosity. It is, however, practical from the standpoint of both use and manufacture.

This screen was made of finely powdered copper and tin, processed and molded into finished form without the necessity of first making wire and then weaving it into the required pattern.

ANOTHER SYNTHETIC

"Rubber" Made From Waste Gases

BY MAKING it as a chain of molecules to which only a very limited number of additional links can be added, American chemists have been able to produce from oil refinery gases, formerly wasted, a synthetic rubber-like substance with many advantages over imported natural rubber.

Dr. Per K. Frolich, director of the chemical division of the Esso Laboratories, recently gave the first technical report of the new "butyl rubber," developed by Standard Oil chemists. It is colorless, odorless, tasteless, and more stretchable than rubber from trees.

—*Science Service.*

COLD-SET GLUE

Easy to Use, Water-Proof, Strong

WHAT is said to be the first cold-setting resin adhesive ever produced in the United States has been announced by the United States Plywood Corporation. Called Weldwood plastic resin waterproof glue, the product is bacteria-proof, rot-proof, stain-free, and economical, as well as water-proof and enduring. It is made under Plaskon patents.

The new glue can be used by professional or amateur. It comes as a finely divided powder which dissolves instantly in cold water and is ready to use immediately after mixing. Jobs can be handled within two hours after gluing and can be worked after four hours. Since it sets by chemical action instead of evaporation, continuous submersion of the glued part results in no deterioration. It dissolves only in the presence of alkalis or acids that are strong enough to eat away the wood itself, or under heat above 160 degrees, Fahrenheit.

The manufacturers claim great economy in the use of this glue, as they advise the thinnest possible coat on the surface to be joined, the coating being applied by a spray or by a brush and then squeegeed. Because of the small quantity of water used, shrinkage of dowels or close joints is minimized.

Rock maple, joined with cold-set glue, broke; the joint held

SMOKE ROUTER

Reduces Air Pollution By Smoke Stacks

A QUEER device that bombards smoke with high-frequency sound waves, thereby causing the smoke to lie down and play dead, is being developed by the United States Bureau of Mines. The idea is to attach one of these units to every chimney and stack, and prevent the smoke from getting out and spreading around the countryside.

Inside a piece of pipe is an aluminum cylinder which is connected at one end to a loud speaker and special radio set. The radio sets up a magnetic field which causes the aluminum cylinder to vibrate, producing powerful high frequency waves. These waves are directed at the smoke and cause the particles in the smoke to coagulate into relatively large pieces of soot which fall out of the air stream by gravity.

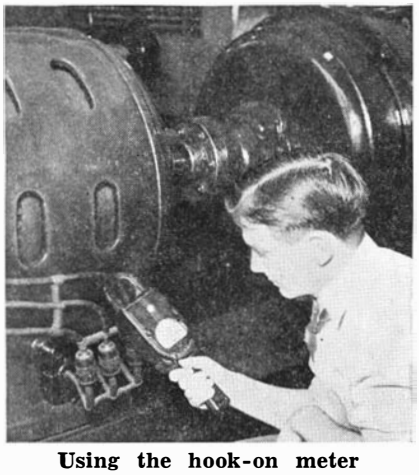
It's still an experiment, but has possibilities of doing much to reduce air pollution by smoke, if it can be applied to large-scale service.—*Aluminum News-Letter.*

HOOK-ON METER

Volt-Ammeter Snaps Over Wire

A VERSATILE, portable instrument, a hook-on volt-ammeter for measuring alternating current and voltage, has been introduced by the General Electric Company. With it, alternating current can be read instantaneously on both insulated and non-insulated conductors simply by hooking the instrument around the line. For voltage readings, it is necessary only to connect two leads furnished with the instrument and then flip the thumb-manipulated selector switch to the desired voltage position on the scale.

Designed for use on conductors of 2-inch maximum diameter, the new volt-ammeter is small enough to get into tight places, light enough to be hung from a lineman's belt, and sufficiently accurate for a great variety of measuring jobs. Weighing only 3½ pounds, it is designed for easy, one-hand operation. Four current



Using the hook-on meter

ranges—0-15/60/150/600 amperes —and two voltage ranges—0-150/600 volts—are available at the setting of a convenient six-position snap switch. Its accuracy is within 3 percent.

An integral part of the instrument is a C-shaped, split-core current transformer so designed that it can be operated without a trigger. To make measurements, the transformer is simply pulled open and placed against the conductor.

A slight push on the handle snaps the transformer shut. The measurement completed, a gentle pull springs open the dovetail joint of the transformer and releases the conductor. The dovetail joint assures that particles of dirt, which would cause large errors in the ordinary butt joint, have almost negligible effects on the indication.

CIRCUIT BREAKER

Small, But Does

A Big Job

A SIX-OUNCE electric "safety valve" was recently announced by Westinghouse. Not only does this hard-boiled midget switch stop a force equivalent to 230 horsepower, but it does it in a way that is entirely new. Representing an adaptation of principles involved in the design of a superior type of circuit breaker for airplanes, this device is intended to guard the lighting and appliance circuits of homes and industry.

Although it is not much larger than a woman's compact, the device is able to interrupt a short-circuit current as great as 5000 amperes, shutting off the flow of electricity through it in less than one sixtieth of a second.

Midget circuit breakers and woman's compact; compare sizes

Paradoxically, this unique circuit breaker permits the passage of momentary "overloads" of electric current, which normally occur when motor-driven appliances are started; but it also operates instantly to shut off the current if the overloads become dangerous.

This dual personality is due to the use of both heat and magnetism to operate the breaker. When lights or appliances are switched on, the flow of current through the contacts of the breaker gradually heats a bimetallic strip inside the unit. Since one of the metals in the strip expands faster than the other, the unit eventually bends, releases a latch, and breaks the circuit.

The bimetallic strip has been designed to permit a safe amount of "overload" to pass through it before opening the breaker. However, if the current increases beyond a safe margin, it not only causes the bimetal unit to trip but causes a magnet to help release the spring-latch and open the breaker instantly. In less than a sixtieth of a second, the electric arc is drawn through a half-inch gap between three tiny steel plates, cut into four smaller arcs, and quenched in air.

MIRACLE MEASURE

Finds Thickness of Paint

To Hundred-Thousandth of Inch

MEASUREMENTS to less than one-hundred thousandth of an inch can now be made of the thickness of non-magnetic films such as paint, paper, and even rust or weathering on sheets of iron, reports the *Telephone News Bulletin.* It is done without disturbing the coating.

A short iron rod with two coils of wire on it is pressed, end on, against each side of the coated iron sheet. Both rods are magnetized by passing an alternating current through one of the coils on each rod. This induces voltage in the other two coils. The coating, which is non-magnetic, decreases the voltage on its side of the sheet by an amount which depends on the thickness of the coating.

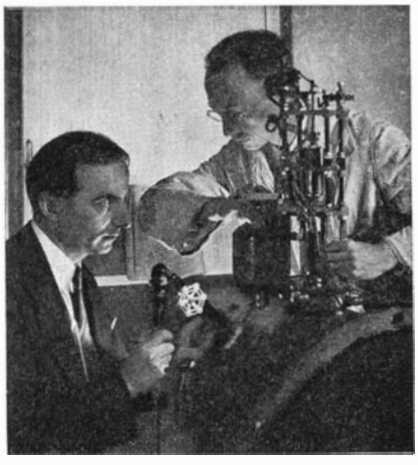
This method, developed recently by the Bell Telephone Laboratories in New York, has many uses in the telephone industry, where tests of the condition and wear of a vast amount of indoor and outdoor equipment are being made constantly to improve the service.

BUBBLE DANCE

In Oil Circuit Breaker

Aids in Design

MOVING pictures have revealed to engineers of the Westinghouse Research Laboratories a "bubble dance" of elusive electric arcs. Drs. Joseph Slepian and Thomas E. Browne, Jr., were seeking ways to improve the design of oil circuit



With this equipment engineers searched for data on circuit breakers, found bubble dance

breakers and discovered that the gas bubble, formed by decomposition of the oil surrounding the contacts, appears to dance as it oscillates from large to small size several hundred times a second. The pictures indicate, according to Dr. Slepian, that the quenching of an arc in one of these switching devices takes place entirely within a bubble of gas the size of a teacup or smaller.

This discovery of the "bubble dance" is significant for it gives the engineers a suggestion as to the direction the design of oil circuit breakers should take. Indeed, Dr. Slepian believes that emphasis should be placed on the de-ionizing (removing of electrification) of the gas within the bubbles.

To carry out the advanced studies necessary in this research, Dr. Browne built an experimental circuit breaker with thick plate glass windows opposite the point where the contacts separate. Using a high-speed movie camera which carried the film forward at a speed of 50 feet a second, he used a revolving glass prism to move the image at the same speed. The prism acted as a shutter, revolving 60,000 times a minute, or about 30 times the speed of an airplane propeller during normal flight.

INDUSTRIAL TRENDS

INDIUM

ONE of the metals about which you have heard little but which is destined to play an increasingly important role in industry is indium. Broadly speaking it does for non-ferrous metals what chrome does for ferrous ones. It is attractive at this very moment because it has been proved that a very small amount added to bearings composed of alloys of cadmium, silver, tin, or lead, inhibits corrosion due to the organic acids present in the lubricating oils. Indium can be made to diffuse through these bearing alloys by simply coating them and heat treating, and there is no ill effect upon the bond between the alloy and the steel backing. Given the severe conditions under which the modern automobile and aircraft engine operates, indium makes a real contribution and it is no wonder that it has been seized upon to do its bit.

The earliest use of indium was to improve the quality of gold alloy castings in dental work. Another use is to lower the melting point of alloys. There are indications that casting alloys can be developed which will soften in hot water, thereby giving the medical profession something for molds. The metal added to tin seems to inhibit the phenomenon of "tin pest."

Like many of the other lesser known metals—beryllium, tantalum, molybdenum—indium was extremely costly at the outset of its use. From $300 an ounce, it has dropped to $30 for the electrolytically pure and $15 for other grades. Since a pinch of it goes a long way to produce valuable results it cannot be called a prohibitively priced metal. Furthermore, there's plenty of it in the country.

MORE MILES PER GALLON

There's an added significance given to work to improve bearings when one hears what the engine and fuel people plan for the future. Not content to have improved these two factors in transportation to an extraordinary degree, they want to jump farther. T. A. Boyd, of General Motors, declares that the use of a 100-octane number gasoline instead of 70 in experimentation has given a 55 percent increase in miles per gallon at 20 miles per hour and more than 40 percent increase at higher speeds. He points out that with an absolutely knock-free fuel one can get double the power or nearly double the mileage, but not both at once. Thus far the public has demanded the added power, but in the future it may favor greater economy and that would bring about smaller displacement engines than those in use today.

There hasn't been much said about a motor fuel famine in late years for the very patent reason that research has made possible extraction of double the amount of gasoline from the crude oil and thus upset all the sound calculations of those who "viewed with alarm." Given fuels that will deliver the power and engines that will take it, focus attention on the merit of economy now that excellent performance is commonplace, and the net result would be more inexpensive motoring and a conservation of our petroleum resources to postpone still further the day when motor fuel must be obtained from other sources.

TRANSPARENT FILM

Ethylcellulose cast in brilliantly clear transparent film is coming into commercial prominence for modern packaging. Under the trade name of Ethofoil, it is getting into large-scale production now that users have given it an extensive tryout.

The properties which recommend this newer among the packaging materials are many. It is easily fabricated by light or deep drawing, much in the manner of metals, to make objects which have definite form while retaining their flexibility under long aging and high temperatures. It can be produced in opaque, translucent, or transparent colors; it can be sealed with adhesives, stapled, or rivetted; and it is readily printed. Ethofoil is not flammable but will burn with a slow flame. It is not affected by alkalis and is resistant to dilute acids. It transmits about 90 percent of visible light and a large proportion of ultra violet. The rays absorbed by window glass pass through the foil.

MORE NYLON

There's no gainsaying that nylon is a "natural" in the commercial world. With the announcement of the building of a new plant to raise the aggregate production to 16,000,000 pounds, Du Pont declares that this total is five times what was contemplated when the first plant was authorized in 1938. It is a snowball rolling up to huge proportions and it is a safe guess that world conditions are giving some of the shove.

The United States takes about 78 percent of Japan's silk output. If we take last year's consumption of 50,000,000 pounds, we see that nylon will be ready to fill one third of silk requirements by 1942, and that will mean a beating of all records—even those made by the fast growth of Cellophane.

ADMIRALTY METAL

Adding a small amount of antimony to the formula for the well-known admiralty metal gives a product which resists dezincification, sulfur corrosion, and inter-crystalline corrosion.

Antimonial admiralty is particularly suited for heat exchangers, condenser and evaporator tubes, offering as it does resistance to corrosive water conditions as well as sulfur corrosive conditions. It is not without wartime significance now that the Navy has embarked on an expansion program.

PHOSPHORESCENCE

You've read elsewhere in this issue that black light is going to town very largely from the boost given it by blackouts. Paralleling the rise of black light is the use of phosphorescent materials. Just around the corner is a phosphorescent wallpaper with no war implications. It will be produced primarily for use in un-modernized hotels and boarding houses lacking bedside light switches. On switching off the light, the wall paper will glow for a sufficient time to enable the occupant to reach the bed without colliding with the rocker. Why not for nurseries of children afraid of the dark?

— *Philip H. Smith*

Four Centuries Late

Science and Society Begins to Recognize a Great Inventor, Engineer, and Scientist

ALBERT G. INGALLS

ALONG in the 'twenties and 'thirties a good many Americans came to the realization that many of us had been too emotional and some of us even hysterical in some of our attitudes connected with World War I. In our rage against our opponents many of us also condemned his literature, art, and music, not alone contemporary but past. For example, many would not play Beethoven's music because Beethoven was a German, though he had been dead 90 years and had nothing to do with the events that led up to that war. Today, the great majority feel strongly about events political and military in the Old World, but it is pleasing to note that many have vowed they will not this time let their emotions run entirely away with their common sense, at least where things like art and music and science are concerned—things that belong to the whole world and to the ages.

When, some weeks ago, the New York Museum of Science and Industry obtained from Italy a collection of 275 working models of the inventions of the Renaissance Italian inventor, engineer, physicist, biologist, architect, and artist, Leonardo da Vinci, and put them on exhibition after they had similarly been on recent exhibition in Milan, nothing untoward happened. Nobody planted a time bomb or even thumbed his nose. Of course, the Italians, in willingly lending these models to the American institution, aimed without much doubt to enhance Italian prestige, but New Yorkers and others have flocked to see them, and still are flocking, probably because they simply wanted to see them. All this shows that, since 1914-1918, the nation may have to an extent grown up.

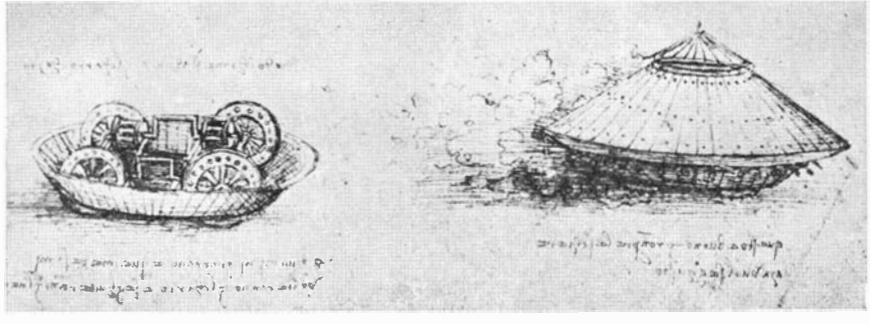
Perhaps the reader has noted that, in referring to Leonardo above, the word "artist" was mentioned last, "inventor" first, reversing the customary sequence, Leonardo usually being thought of primarily as an artist. The motive is not to belittle art, which could not be done, but to help redress a bad balance of long standing. If, a generation or more ago, one had asked the first 100 persons whom he encountered who Leonardo da Vinci was, it is believed that at least 90 might have replied simply, "A very great artist." Perhaps nine more might have been aware that Leonardo also dabbled in science, and maybe one out of the hundred, fully aware of his greatness in realms scientific, would have said that Leonardo was so able in that realm that a time would come when his abilities in it would be recognized as the equal of those in art. That time has begun to arrive.

IT is now approximately 450 years since this "tremendous universal genius" was doing his best life work, yet, even this long afterward, we know a very great deal about that work, also about the man himself. For example, we know from contemporary record what manner of man he was personally. The rather cantankerous disposition traditionally associated with great genius appears to have been no attribute of Leonardo's. His was a warm, sunny personality; he made many friends and kept them. Physically, he was not a latin type; he is spoken of by contemporaries as golden haired.

We also have, in different large libraries, the actual originals, well preserved, of the 7000 pages of notes which Leonardo penned throughout his lifetime, in which he preserved his thoughts and conceptions in the realms of aeronautics, anatomy, architecture, astronomy, botany, engineering, geology, mathematics, medicine, optics, physics, and other corners of science; for he took the whole universe as his scope. All this and other available first-hand material affords us what might be called an "in-focus" picture of the man, rather than the somewhat fuzzy, blurred, out-of-focus picture we have of many great men who lived at even later periods—Shakespeare, for example, who lived a century later.

No man of Leonardo's artistic and mechanical flair would be likely to write out 7000 pages of notes without also drawing some pictures, and thus it is that very many of these manuscripts are copiously illustrated by clear, definitive sketches, not alone of things he had seen but of things he had invented—machine designs. It is from these original notes and sketches that the modern Italians made their 275 working models, many of them full-scale, of Leonardo's inventions, a few of which are shown on these pages.

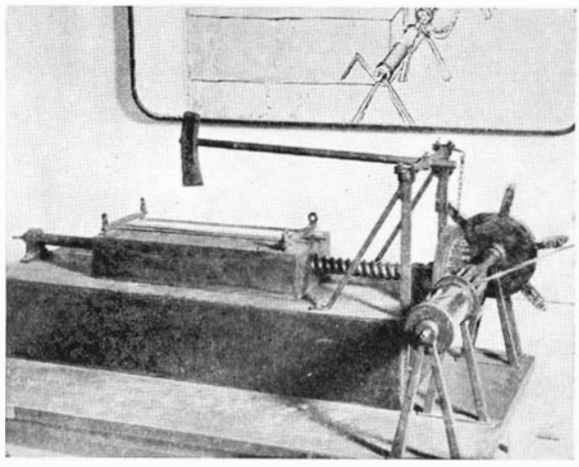
Here one might be pardoned if the suspicion rose in his mind that the modern Italian model makers might perhaps have improved on them a bit while they were at it—people often do this, unconsciously, when their heroes are involved. In the present instance there was, however, no need to do so. It is true, Leonardo did not leave dimensioned blueprints, whether of a screw-threading machine design or that of an airplane, but his sketches are as clear and definite as an engineer's notebook sketch would be if made in 1940. Thus, in judging Leonardo's abilities, little "courtesy allowance" need be made for the man's times. You get the impression, after studying his con-



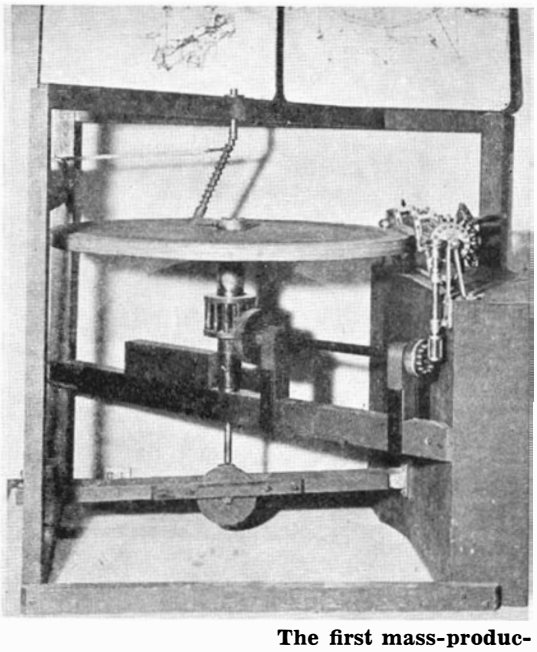
Leonardo's design for an engine of war—a tank; also his script, written from right to left, a natural, logical direction for a left-handed writer

ceptions, that this was an artist who also felt as fully at home in the world of mechanics as our engineers do today. He quite obviously had a modern mind. In fact, it does not seem exaggerated to inquire whether, had the man been born in 1847, as Edison was, instead of 1452, he would not have equalled Edison as a conceiver of inventions, not to mention his far greater versatility in other fields than invention. He invented a helicopter, the double-hulled ship, a pile driver that looks remarkably modern, the power-driven band saw, a cannon actuated by steam, the rolling mill, pumps, lens grinding machines—many other practical things.

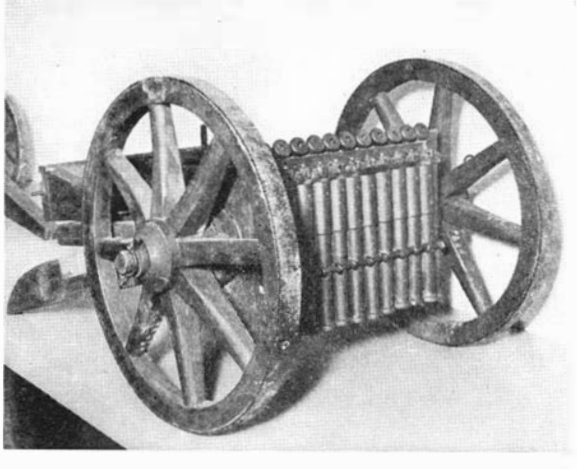
Beyond invention, Leonardo went far, for his time, into physics. He determined coefficients of friction, hinted at the principle of virtual work, studied out the principles of the composition of forces, and discovered the fallacy of perpetual motion. He also foreshadowed the principle of inertia which Galileo demonstrated a century later, and clearly defined what still later became Newton's Second Law of Matter (Galileo and Newton had no access to Leonardo's writings and probably did not know that they existed).



A file shaper built from Leonardo's design (*right*). The file blank was to be clamped on the bed-plate moved by the lead-screw, while the cold-chisel on the tilt-hammer indented the teeth serially in it



The first mass-production machine. Designed to point a number of needles simultaneously, against its horizontal, rotating abrasive wheel



This multiple cannon was not a "machine gun," as is sometimes stated, yet it is based on the mass-production principle of one. While top bank of barrels was being fired, the bank in front was cooling and the one behind was being loaded

There are at least three reasons why Leonardo's great work did not have the expectable impress on scientific advance.

First, he did not publish it.

Second, in his time no organized, far-seeing industry existed to take up discoveries and inventions, as exists in ours. Not alone this but in that age people in general were not prepared to see the value of science. Leonardo's contemporaries, for example, regarded his mechanical and similar activities merely as whims and notions, in which he was good-naturedly indulged by them because of his worth-while artistic activities.

Third, Leonardo himself lacked persistence and the businesslike, promotional type of enterprising makeup. When contemporaries failed to grasp the significance of a given idea or invention, he did not try hard to convince them or to push it himself but simply returned to his sport of thinking up more ideas. Moreover, he was inclined to lose some of his own eager interest in these ideas as soon as he had set them down on paper where they could not get away; probably this signified mainly that more ideas were pressing hard from behind.

Can it not therefore well be that the price paid by the world for Leonardo's sunny, extraverted, sociable, but perhaps insufficiently pushful, personality was just about a solid century of delay in the arrival of our Age of Science on the world stage? If he had found a way to set his conceptions in actual movement it is altogether likely that we might be, today, where we now expect to be by 2040.

• • •

SAVING SNOW

Plowed into Rows, It Prevents Later Drifting

You'd think there was enough snow in Canada without hoarding any—but the Department of Agriculture in Saskatchewan has announced the development of a new technique for snow conservation, reports *Ethyl News*. In many parts of the country, farmers look to the melting snows of spring to do the work of early showers in wetting and softening the soil for plowing and planting. And since it is important to keep the snow right on the land where it will be needed

later, many experimental methods have been tried to prevent it from migrating.

The latest and simplest — and perhaps most successful — way of "tying down" the mantle of Jack Frost has been evolved by G. E. Matthews, superintendent of the Experimental School run by Saskatchewan in the town of Scott. He drags a pair of especially constructed snowplows behind a tractor, lays each level field out in ridge-rows, and the problem is solved. The ridges anchor succeeding drifts.

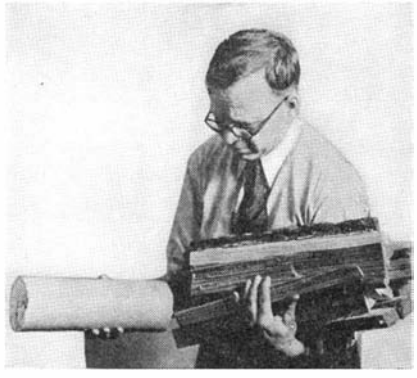
Canadian farmers and scientists alike have long tried to make an ally of the winter snows — getting them to wet the soil instead of running off in streams that cut gashes through the fields and leave other spots so dry that wind erosion carries away the good topsoil. Many a farmer has had to re-seed, not once but twice, while his seeded and cultivated soil has blown across the road to bury another crop.

WOOD BRIQUETTES

IN the larger cities of the West—Los Angeles, San Francisco, Portland, Seattle, and Spokane—housewives can buy a new type of fireplace log in grocery or neighborhood stores, service stations, or from the ice man. These neat, clean, and uniform cylindrical logs are pressed from sawdust and shavings from sawmills. The magazine *American Forests* reports the ever widening use of this product which provides a method of salvaging great piles of sawdust formerly wasted, or, at best, inefficiently burned in saw mill furnaces.

One of the logs weighs eight pounds and is the equivalent in fuel value of an armload of ordinary wood or a bushel basket of waste shavings. Three times the specific gravity of the original wood, these logs will not float on water.

The process of making cylindrical fuel briquettes is not exactly new, as the machine was first developed some years ago. That machine has, however, been so improved that production on a large



One log equals an armful

scale is possible. The sawdust holds together in briquette form solely through materials it originally contained — no string, wire, or sticky binders being used. The secret of its success is enormous pressure under which it is compressed—around 165,000 pounds.

HINGED BUS

Threads Traffic, Carries More Passengers

THERE recently appeared on the streets of New York a unique vehicle in the form of a bus, longer than usual, and hinged just past its mid-section. This is a new departure in surface transportation for cities of dense traffic. The articulation of the two sections permits a shorter turn than would be possible with a rigid bus of such length.

The new coach is 47 feet in overall length, 96 inches in overall width and seats 58 passengers, which is the capacity of the ordinary street car. Each of its two sections consists of the usual all-metal body construction riveted and gusseted to a steel underframing. The two sections are joined at the center on a horizontal plane by means of a hinged section in the underframing, permitting front and rear sections to move up and down irrespective of each other. A prestretched rubberized covering provides flexibility at the joint. Reverse steering on the front and rear axles gives the unit a smaller turning radius than an ordinary 40-passenger bus. Hence, it may thread its way through heavy traffic with ease.

This Super-Twin coach, made by the Twin Coach Company, is propelled by a Diesel engine of 175 horsepower, or it may be used as a trolley coach, obtaining the electricity from overhead high-voltage wires.

"MAILED"

Time Capsule Sealed In

THAT 800-pound "letter to the future," the Time Capsule, which was buried in an open pipe before the Westinghouse exhibit building at the New York World's Fair, has now been finally "mailed." During the first season of the Fair, and until late in September of the second season, millions of Fair visitors inspected the Time Capsule as it rested at the bottom of its open

Exterior and interior of the hinged bus that will reduce traffic difficulties

pipe container. On September 23, 1940, it was finally sealed off by Dr. Clark Wissler, archeologist of the American Museum of Natural History. Dr. Wissler turned a crank which emptied from a large cauldron 500 pounds of a compound made of pitch and other chemicals —a special compound concocted for long keeping qualities.

The site of the Time Capsule will be marked by a monument. It is firmly believed that no human eyes will again see it until archeological ages have passed.

Mobile unit salvages ties from an abandoned railroad

TWO-WAY TELEVISION

Demonstrated By Amateurs: Low Cost Equipment

RECENTLY announced was the opening of a two-way television circuit, operated by radio amateurs, the distance between the two ends of the aerial line being approximately eight miles.

Mr. George Bailey, President of the American Radio Relay League, the nation-wide organization of radio amateurs, who flew from Boston to dedicate the new circuit, said: "The American Radio Relay League is indeed proud to have a part in this latest indication of the thorough-going, practical-mindedness of the American radio amateur. The conception of having two complete duplications of equipment, for a two-way demonstration and then arranging for simultaneous voice transmission is one of the things we would expect from Arthur Lynch, whose interest in all amateur radio activities is well-known. We are confident that this exhibition will be another link in the chain which is binding the amateur radio man closer and closer to the average radio listener.

In commenting on the circuit, Mr. Lynch said: "The picture circuit is operating in the 112-116 megacycle amateur band—having one transmitter near the lower end, the other near the upper end. This band, if expressed in the more commonly used terms, would be said to be on two and one half meters.

"The system which we are using can never be made to compare in clarity with commercial television. We use a system which gives us but 120 lines, while the commercial standards are in the vicinity of five hundred lines. Then, too, the amount of power we use at our transmitters is only a very small fraction of the power used by the commercials. The cost of our equipment is extremely low, in comparison. A complete transmitter and receiver, of the type we are using on each end of our circuit, can be duplicated by any amateur for less than three hundred dollars. That includes all the tubes, but it does not take the voice channel into consideration.

"Our voice circuit operates on two frequencies in the 56-60 megacycle band, which is the equivalent of approximately five meters. The transmitter is equipped with several crystals, so that one of several voice channels may be selected at will, while the receiver is made with an automatic noise-gate, which prevents any sound coming from the loudspeaker until the voice of the operator on the other end of the circuit is heard.

Two-way amateur television set-up. Camera at left, receiver tube at right

UPROOTER

Abandoned Railroad Beds Quickly Cleaned Up

A MACHINE which eliminates the tedious job of tearing up old cross ties from abandoned railroad beds and hand-loading them on trucks has been developed by the Athey Truss Wheel Company. Mounted on a Caterpillar tractor, this mobile loader pries up the old cross ties, swings them overhead, and slides them down a chute in the rear so that they are loaded onto the body of a truck.

As shown in the accompanying illustration, swinging arms are mounted on an axle near the rear axle of the tractor. Meeting in front of the machine, the two arms terminate in a two-prong, wedge-shaped fork which gouges under the old cross ties as the tractor is

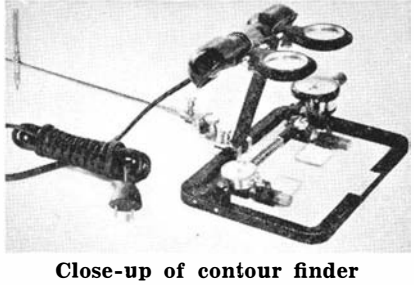
moved forward. The prong holds several of these cross ties as the arm swings up on the framework mounted over the tractor and drops its load when almost directly over the tractor driver. The cross ties slide down a flat chute to the truck. The truck is coupled to the tractor so that as the tractor moves the truck always follows.

This machine will dig up and load an average of 10 ties every 20 seconds, and with it a contractor is able to clear a mile of right-of-way per day.

CONTOUR FINDER

ENGINEERS of the immediate future won't be forced to await the findings of ground survey crews; with the advent of the compact little "contour-finder" developed by the Abrams Aerial Survey Corporation the situation is changed.

The contour-finder, adapting a principle used by our grandparents —the stereoptican—measures elevations of trees, hills, and buildings directly from a set of two aerial photographs. The drawing attachment accurately describes minute measurements, enabling engineers to run profile lines along rights of way, locate and draw contour lines around dam sites and drainage areas and obstructions in engineering work. Tedious ground-crew survey work is thus done away with, engineers being able



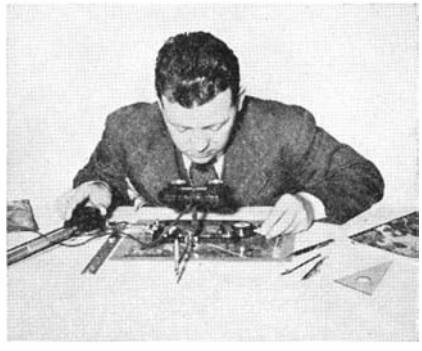
Close-up of contour finder

to locate "control points" in a short space of days.

The contour-finder was designed to complement the work of aerial survey crews mapping projects from high altitudes.

The instrument is a compact one equipped with a drawing attachment for obtaining topographic information from vertical aerial photographs or from oblique photographs which have been accurately rectified. It consists of six parts: stereoscope, parallax measuring unit, drawing attachment, lighting unit, carrying case, and, optionally, an alignment mechanism.

In operating the device, a pair of stereoscopic aerial photographs are placed under the instrument in such a way that two indicating dots cover the same point in both photographs. The dial gages are set at the mid-point of their range. The photographs must be at right angles to the instrument and the dots in direct line with the line of flight or base line of the photographs. They are then fastened securely to the



Contour finder in use

table. If the hand on the large dial is turned clockwise, the dot will appear to rise in the stereoscopic model and vice versa.

By keeping the instrument in alignment with the pictures and moving the instrument with the floating dot always in apparent contact with the ground, a contour line can be traced on to another map of equal scale. Higher or lower contour lines can be traced by raising or lowering the floating dot the desired vertical distance and then tracing out the constant elevation. The heights of buildings, trees, and ground elevations can be measured quickly.

FOLSOM MAN

His Actual Bones Never Found

DR. FRANK H. H. ROBERTS, JR., Smithsonian Institution archeologist, last summer continued excavations for the fifth season at the oldest known inhabited site in North America—the Lindenmeier site in northeastern Colorado.

This apparently was a summer hunting camp of the wraith-like makers of the peculiar type of spearhead known as the "Folsom point" which is found associated with the bones of extinct animals and in geologic strata dating from the closing centuries of the last great ice age.

Dr. Roberts has obtained not only a large number of Folsom points, and bones of animals eaten by the hunters, but also many artifacts used in their domestic life, such as stone scrapers and knives. Thus far he has been unable to find any human bones.

There is still hope, Dr. Roberts believes, of finding a skull of one of these Americans of 15,000 years ago. It is possible that the dead were not buried but were left exposed on the surface to be devoured by the vultures. The bodies may have been burned or there may have been a special burial site which has not yet been uncovered.

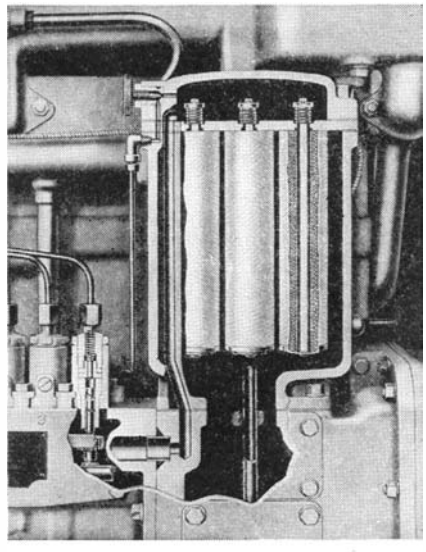
DIESEL FILTER

Cheap, Easily Removable, Protects Engine

AN ingenious and highly effective filter has been developed by the Caterpillar Tractor Company for use in that company's Diesel engines. So efficient has this comparatively simple innovation proved that laboratory tests show the new filters increase the life of Diesel injection pumps and injection valves by as much as 75 percent as compared with the usual edge-type metallic filters.

The filter elements consist of a high quality, highly absorbent type of cotton yarn, wound on an inner metallic screen, which is wrapped with a filter paper. Winding of the yarn is done in a cellular pattern, with accurate spacings which are controlled in such a way as to provide increasing density toward the center. Thus finer and finer particles are removed as the fuel approaches the center. In case an extremely fine dirt particle passes through the main elements, it is stopped by the filter paper.

The elements are easily remov-



Sectional view of Diesel filter

able and are so inexpensive that they are simply thrown away when dirty, and quickly replaced. There is a gage, mounted on the engine, which shows the operator when replacement is necessary. Elements may be removed by simply removing the cover on the centrally located filter housing, and lifting them out.

FOR WINTER

Permanent Type Anti-Freeze

"STET," a new ethylene glycol anti-freeze, has been added to the product line of the automotive accessories division of The B. F. Goodrich Company.

The anti-freeze, the first ever offered under the Goodrich name, is of the permanent type, one filling furnishing radiator protection against freezing all winter.

Odorless, the new compound will not evaporate or boil away; rust inhibitors prevent rusting. The new product will not damage car finish, mixes readily with other ethylene glycol anti-freezes, and can be tested with the standard hydrometers for such fluids.

MINIATURE ROOMS

Observer Sees Self In Them

A MAGIC MIRROR that projects the observer into a series of miniature rooms is the feature of the new Alexander Smith Colorama Exhibit at Rockefeller Home Center at New York's Radio City. An involved optical system actually lets you see yourself, reduced to one eighth actual size, standing in the middle of a perfectly proportioned little living room less than eighteen inches long. Most remarkable of all is the fact that you see a side view of yourself, full length, exactly as others see you and as you have never before seen yourself except, perhaps, in motion pictures.

While you have been admiring yourself in miniature, a recorded voice has been patiently explaining the theory behind the Colorama Exhibit — that women should choose color schemes for their homes that flatter their particular type of beauty. The first room, the voice explains, is for a blonde. At this point a curtain descends over the aperture through which you have been looking and when

it goes up again you find your image in another room identical to the first except for the color scheme. This goes on until you have seen yourself in five little rooms.

The optical system that reduces you to one eighth your size and projects you into the miniature rooms is not quite as complicated as might appear at first blush. A full length mirror well to one side of where you stand picks up your image, and lenses focus it on a "transparent mirror" behind which is one of the miniature rooms. The "transparent mirror" can function either as a mirror or as a piece of clear glass depending on whether the light in front of it is greater than that behind or vice-versa. As you stand looking into the aperture, a brilliant light illuminates your figure and thus when your reflection in the full length mirror is focused on the "transparent mirror," the part of the latter that receives the image acts as a mirror, whereas the rest, because the lighting in the little room is less intense, is perfectly transparent and allows you to see through the glass to the miniature room behind. The illusion that you are actually standing in the room is complete.

BRIGHTEST FLASHLIGHT

Small Light Throws Powerful Beam

WHAT is believed to be the brightest portable battery light in the world, smaller than a man's head but so powerful that it is possible to read a newspaper by its light half a mile away, has been developed by Mr. Jackson Burgess of the Burgess Laboratories.

The new portable lantern, with 180,000 maximum beam candlepower, is 180 times as powerful as the best two-cell flashlight on the market.

180,000 beam candlepower

The spot of light cast by the lantern at arm's length is 45,000 foot-candles, which, by mathematical calculation, is four and one half times as bright as sunlight on a spot of the same size. Theoretically, at 100 feet it has 180 foot-candles which is equal to the average office illumination. The light output of the new lantern far exceeds that of an automobile spotlight or two automobile headlights.

The new light may be used by fire and police departments as emergency standby lights; and as an emergency landing light for airplanes. It may also be carried in planes to be used in emergencies as protection insurance, similar to the way in which modern air transports carry battery-operated radio transceivers.

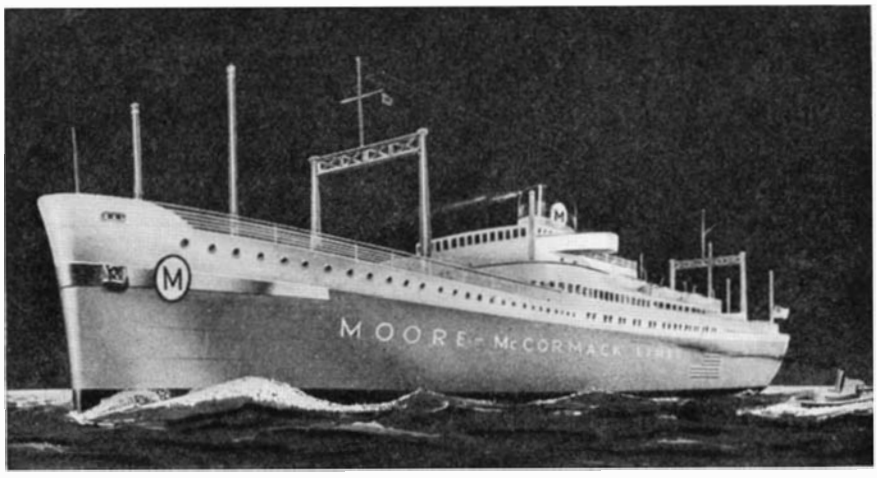
COOL SHIPS

First to Air-Condition All Staterooms

SOMETHING new in hand-made weather for tropical waters will be introduced in 1941 when Moore-McCormack's American Republics Line supplements its regular services to the east coast of South America with four new combination passenger and freight liners.

The new liners will go in for air conditioning in a big way. They'll feature it not only in public rooms —as the newer ships are doing— but for the first time will also install it in each and every stateroom.

Pioneer vessels to be thus equipped, the new liners will accommodate 196 passengers and are being built because of the greatly increased interest of Americans in touring South America. Of 17,500 tons displacement, the ships will be 492 feet overall and will have a molded beam of 69 feet six inches. Their two Diesel engines will develop 9000 horsepower and give them a speed of 17½ knots.



For the tropics: 17,500 tons, all staterooms air-conditioned

AUTOMATIC COFFEE

TO the automatic toaster, which has graced many breakfast tables for years, may now be added an equally automatic coffee maker. Embodying all the features of existing glass coffee makers—clean glass bowls, fascinating operation,

Better coffee—automatically

and ease in making good coffee—the new device eliminates certain disadvantages which have been experienced by coffee makers.

The Alnico magnet, versatile General Electric product, is the key to this new appliance. A small cylindrically-shaped Alnico magnet, coupled by suitable levers to a pair of contacts, is held in its upper position by a small stainless steel keeper located on the lower end of the lower bowl tube. As the last of the water is forced into the upper bowl, excessive turbulence in the tube breaks the circuit, allowing the magnet to drop and turning off the unit. As the brew returns to the lower bowl, a thermostat turns on

a separate warming element which maintains the coffee at a temperature of approximately 185 degrees for an indefinite period.

INSECTS

Follow Armies of The World

IF HISTORY is allowed to repeat, say officials of the Bureau of Entomology and Plant Quarantine, the present war may add to the insect pests that have invaded new territory because of armed conflict among men. The Hessian fly, which each year destroys wheat with an estimated value of $13,000,000, came here with the German troops hired by George III to suppress the rebellion. Turning the tables, the Colorado potato beetle crossed the ocean in 1917 with the American army and settled in France, subsequently spreading to Germany where it is a serious threat to an important food crop. During World War I, Australian wheat replaced American wheat which had been shipped to Europe. Some believe these importations introduced flag smut in America.

CHRISTMAS TREES

Fireproofed by Simple Treatment

MANY people preserve their Christmas trees for long periods by inserting the butt in a container of water. The live tree absorbs water, sending it through all branches and leaves so that the decorated tree may stand for many days.

This ability of the tree to send water throughout its structure may be made use of to fireproof the tree. According to *American Forests* magazine, Dr. Martin Leatherman, associate chemist in the United States Department of Agriculture, has found that fairly concentrated solutions of ammonium sulfate or calcium chloride will usually do this job effectively. Dr. Leatherman says that the trees to be so treated should be as fresh as possible. Before treatment, an earthen crock, glass jar, or a galvanized pail should be available. Then the base of the tree should be cut on a long diagonal slant or in the form of a narrow V. The chemical preferred is ammonium sulfate, because it is cheap, effective, and easily obtained. The quantity to use should

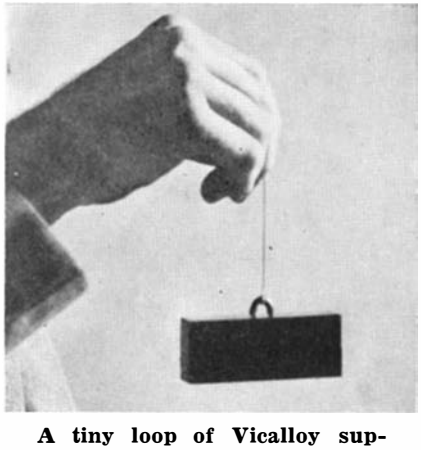
be one fourth the weight of the tree. It is dissolved in the ratio of one and one half pints of water for each pound of chemical. The tree is then set in the solution and away from direct sunlight until most of the solution is absorbed. Dr. Leatherman obtained best results when the surrounding temperature ranged between 55 and 65 degrees, Fahrenheit. The solution absorbed more readily at this temperature and the foliage retained its green color longer than when treated in a warm room.

Treatment of trees in this manner does not mean that all fire hazard has been eliminated but only that the tree itself will not readily catch fire. Other decorations used with it should, therefore, be of fireproof quality.

MAGNETIC ALLOY

Holds More Permanent Magnetism Than Any Other

A NEW magnetic alloy of remarkable qualities, "Vicalloy," was announced recently to the American Physical Society by E. A. Nesbitt and G. A. Kelsall of Bell Telephone Laboratories of New York. Composed of cobalt, vanadium, and iron, the alloy can be made to hold more permanent magnetism than any other commercial material. In addition, it can be drawn and rolled—a property of advantage in many applications, and not possessed by other permanent magnet materials of importance in the art. For example, it has been rolled into tape 1/500 of an inch thick and 1/20 of an inch wide. Several thousand feet of this tape were used for sound-recording at the New York World's Fair, while shorter lengths are running constantly as endless loops in the Bell Telephone weather-announcing systems.



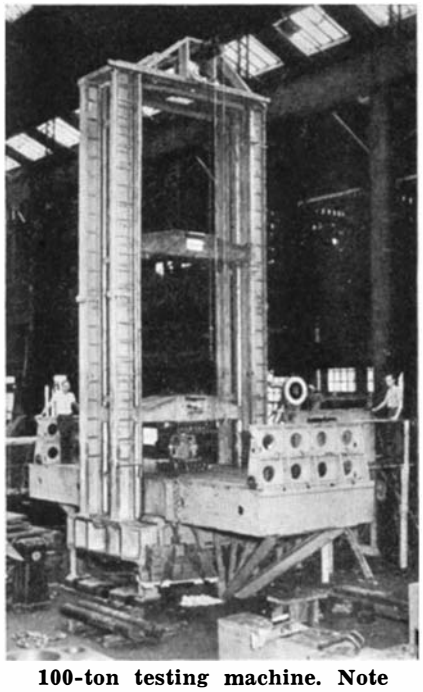
A tiny loop of Vicalloy supports several pounds of iron

Taking its name from the initial letters of its three components, the new material is composed of 6 to 16 percent vanadium, 30 to 52 percent iron, and 36 to 62 percent cobalt. From the molten state, it is cast into an ingot, which is hot-swaged to ¼ of an inch diameter. It is then drawn into wire or rolled into tape, as desired. When in final form, it is heat-treated to develop its magnetic qualities. It is permissible to use a heat treatment that will not be harmful to most high-permeability materials. Thus it is possible to weld such pieces to the magnet and heat-treat them both together.

GIANT TESTER

Materials Testing Machine Very Accurate

A 100-TON materials testing machine, so powerful that it can bend two parallel, 12-inch, steel I-beams, yet so accurately controlled that it can crack a nut without crushing the kernel, has been built by the Riehle Testing Machine Division, American Machine and Metals, Inc. Riehle directing designers have released the following specifications: 34 feet high, 21 feet wide and 24½ feet from front to back. The transverse table, one of the largest ever built, is 8 feet wide.



100-ton testing machine. Note the man on the transverse table

Not only is the machine one of the largest ever built in the United States, as well as the world; it is also among the most accurate. Though it can exert a maximum of 700,000 pounds pressure, the mechanism has recorded a maximum error of 0.06 percent, making it one of the most sensitive machines of this type ever built. German technicians refuse to build machines more accurate than 1 percent — sixteen times greater error than this machine.

In routine tests the machine snapped 12 by 12-inch wooden timbers with a pressure of 500,000 pounds. Steel tubes three inches in diameter were crushed at 600,000 pounds pressure.

When finally set up, this machine will be used for routine testing and as a primary standard for the verification of calibrating instruments. It required eight months to build; two months were spent in design alone.

WEATHER NERVES

Basis Found for Effect Ridiculed as "Just Imagination"

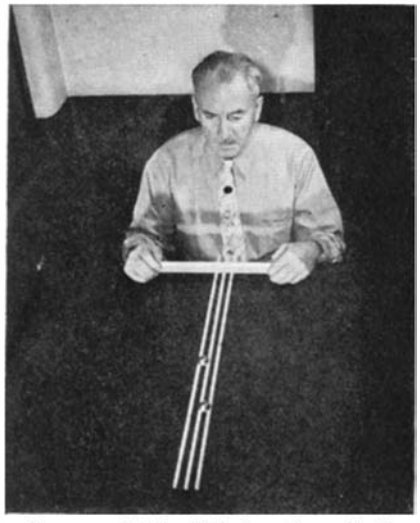
IF YOUR temper and nerves get more edgy when a storm is approaching, it is probably because the water balance in tissues of your body actually is disturbed due to falling barometric pressure outside. Advancing this likelihood, Dr. C. A. Mills, of the University of Cincinnati College of Medicine, advocates that scientists should closely investigate body changes thus involved when stormy weather brews.

Suicides are more likely to occur when a storm center approaches, Dr. Mills stated. Domestic troubles flare up most readily. It is harder to think clearly. Even animals become more inclined to fight, and less reliable. "With declining outside pressure," he explained, "tissues take up water and swell, much as does a sponge, while with rising pressure they give up water and shrink." In girth measurements of his own leg just below the knee, he observed changes of half an inch or more with major weather changes, and some people changed several pounds in weight.

OUTWITTING GRAVITY

Of Two Identical Balls, One Is Lazy

Two steel balls of identical weight and size recently disproved one of the rules of gravitation by rolling



Same weight, differing "gravity"

at different speeds down an incline. Dr. Phillips Thomas, Westinghouse research engineer, performed the experiment to demonstrate how the friction of tiny particles of loosely packed powdered tungsten inside one of the balls made it lazy by absorbing part of its energy.

Westinghouse engineers, Dr. Thomas explained, have used this same principle of energy absorption to prevent electrical relay contacts from bouncing apart when they are closed, thus eliminating sparking and reducing wear on electrical control equipment.

MILDEW PROOFING

Simple Home Treatment For Fabrics

MILDEW can be prevented. This is the conclusion reached by Margaret Furry, Helen Robinson, and Harry Humfeld of the U. S. Department of Agriculture after studying 135 recommended treatments. Of these, 35 were effective, about 10 practical for home and farm use. Tests are continuing in the home economics laboratories.

Use of such finishes will save money, these investigators point out. Mildew proofing will help preserve tents, tarpaulins, sails, sandbags, and other pieces of canvas equipment often stored in moist or poorly ventilated places. In the home, shower curtains, awnings, and canvas on porch furniture may need treatment. Untreated cotton fabrics are likely to mildew—then develop discolored and musty-smelling spots. They may be attacked so severely that they rot and fall to pieces.

Directions for treating an average-size shower curtain illustrate

one of the simplest methods and call only for a good laundry soap and crystals of cadmium chloride, available at drug stores. Have the cloth thoroughly clean. Heat it in a solution of one to two ounces of soap to the gallon of water. About one and one half gallons will cover a shower curtain. Heat 20 minutes, remove the cloth, and squeeze out excess soap. Put the wet cloth into a second solution of cadmium chloride crystals, three ounces to the gallon of water, about one and one half gallons required. Heat for about 30 minutes, wring out, and dry without rinsing. Hang to dry on a twine line (a metal line may stain the fabric). This treatment does not affect the color of the curtain, which will be resistant to mildew until laundered again.

PLAINS PREHISTORY

Five Stages of 10,000 Years

LONG before covered wagons of white settlers jogged toward the West, at least two great migrations of red men, their wives, and children plodded westward on foot to possess the Great Plains.

New chapters of the central Great Plains prehistory, reconstructed by Dr. Waldo R. Wedel of the Smithsonian Institution from archeologists' burrowing into Indian ruins and searching Plains terrain, can be briefed as follows:

1. About 10,000 years ago, the first men and women peopled the Great Plains, roving eastward from the Rockies. Nomad bison hunters, they were some of the early Americans identified by the distinctive stone dart points known today as Folsom and Yuma weapons.

2. Then came a blank chapter, enormously long, when the Plains were apparently abandoned by man.

3. The first easterners re-discovered the Plains. They moved cautiously, were not numerous, and were peaceful Indian settlers, not wandering hunters.

4. Later a second migration of different, more progressive Indians arrived. Also peaceable, these easterners brought the gift of corn, made better pottery. They were mound building tribes. Mysteriously, these best settlers abandoned their homes and vanished, before white men saw the Plains.

5. The Spanish conqueror, Coronado, seeking non-existent golden cities, marched from Mexico as far as Kansas in 1541, and was the first white discoverer to view Plains tribes. Nomad hunters were on the rise, harrying Indian settlers. Provided in time with white men's firearms and horses, the Indian hunter became ruler of the Plains, ending Indian dominance with a brief bison-hunting era—as bison hunters had begun the conquest.

—*Science Service.*

LUMINOUS BRICKS

GLASS bricks have been used more and more widely, because of several advantageous features, during recent years. Soon it should be possible to erect walls of glass bricks which admit daylight during the day and are luminous at night. This glowing light from the bricks at night would be so well distributed that there would be no bright spots.

Electricity is passed through these bricks, which are coated inside with fluorescent material similar to that used in the widely-known fluorescent tubes. If ultra-violet light is needed in a room, the bricks can be made of materials which transmit these rays, while a small amount of mercury inside each brick would be used as the source of the ultra-violet.

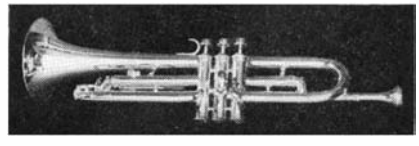
Rights to this invention have been assigned to the General Electric Company.

NEW CORNET

Design Changes Improve Playing, Tone

SLANTED pistons and a new tone spiral are features of a cornet and trumpet recently developed by a leading American manufacturer. Tests indicate unusual playing ease, substantial power, and added high tones for the new designs.

While the conventional horn is built in an oval spiral, with the mouthpiece at the level of the bell, the new models provide an ever-rising air flow. The mouthpiece, at which the tone column originates, is the lowest point of the tubing when held in playing position. This



"... ever-rising air flow"

Piston valves on an angle

feature, the makers believe, may account in part for the ease and flexibility of tone production.

By installing the piston valves on an angle, a more natural and relaxed position of the hand and fore-arm is permitted, which in turn leads to improved muscular control and facility.

DANGER UNIT

Degree of Danger In Driving Cars

TO MEASURE the hazard involved in driving at various speeds, the Travelers Insurance Company has developed the "danger unit" which is defined in stopping distance, roll over, vertical fall, and turning radius, reports the *Stone & Webster Bulletin.*

Under average conditions the distance an automobile moves after its driver has decided to make an immediate stop varies as the square of its speed. A "danger unit" equals 35 to 40 feet of stopping distance. A car traveling at 25 miles per hour can be stopped in this distance, while in stopping from 50 miles per hour it will travel between 140 and 160 feet, the equivalent of four "danger units." Nearly one full "danger unit" is added when the speed of a car is increased from 45 miles per hour to 50.

In case of too sharp a turn, a car will sometimes roll over once for each "danger unit" it carries. Thus it may roll over once at 25 miles per hour, twice at 35, and perhaps nine times at 75. It is well to remember that only in the luckiest accident can the driver cling to the inside of the rolling car as it does its three turns at 45.

Striking a solid object at 25 will do a car about the same damage as if it had been driven off a two-story building. Encountering a stone wall at 50 will be just as serious as if it dropped from four times two stories, or eight stories. When Captain George Eyston was doing 300 miles per hour and more on the dry salt beds of Utah, his big engine was packing energy into his car with such industry that it was adding one "danger unit" for each mile of increased speed. Had he hit a solid stone wall he and his machine would have been smashed as completely as if he had driven off a 3000 foot ledge into Grand Canyon.

Each added "danger unit" causes the car to require a longer turning radius. Thus a car can make only one fourth as sharp a turn at 50 as at 25; one ninth as sharp a turn at 75 as at 25.

RUBBER GLUE

Non-Flammable, No Odor, Keeps Well

A NEW cement, Texglue, with a latex or rubber base, and compounded to afford exceptional adhesive properties and resistance to aging has been announced by The B. F. Goodrich Company. It contains no flammable solvents.

The new product is of special interest to upholsterers, awning manufacturers, and leather fabricators as well as to anyone having any requirement of adhesion of fabrics, paper, leather, or other porous materials. Texglue also will attach fabrics, paper, and other materials to non-porous surfaces, and can be easily cleaned from these surfaces when its mission is accomplished.

There are many non-industrial uses for Texglue: as an office paste, easily removed, leaving clean paper surfaces; for sealing packages; applying labels; posting bulletins. It also can be applied as an anti-skid coating for rug bases, used to repair clothing and household furnishings, and to stop runs in hosiery.

Non-flammable, with no objectionable odor, the cement can be stored in normal atmospheric temperatures, with avoidance of freezing temperatures or heat above 90 degrees.

HI-JACKING THE ANT

Farmers Get Ants' Collection of Grass Seed

BY hi-jacking the harvest of buffalo-grass seed which red ants accumulate—probably as a source of winter feed—southern farmers and ranchers can sometimes gather a supply of seed at slight cost. One farmer in Bell County (Texas) got about 200 pounds of clean seed in

two days from ant hills in a pasture of native buffalo grass, says W. J. Neumann, in charge of a soil conservation project of the U. S. Department of Agriculture, near Temple, Texas.

Soil Conservation Service men, who noticed that red ants collect buffalo-grass seeds and pile them around ant hills, were able to tell the farmer how to get seed for planting. The seed material was swept together with a stiff push broom and then run through a commercial cleaner to separate the seed from soil, trash, and weed seeds.

STEEL EATERS

Bacteria Thrive on Iron and Steel

THE discovery that certain bacteria living underground thrive on iron and steel pipes, causing annual rust and corrosion damages running into the millions, was announced at the convention of the American Gas Association by Raymond F. Hadley of Philadelphia, electrical engineer of the Susquehanna Pipe Line Co.

Known as anærobic bacteria because they live in an atmosphere devoid of oxygen, it has been found that they can survive for long periods of time when brought to the surface. When magnified 850 times under the microscope, they appear in the shapes of coil spirals or curved rods. They are particularly hardy. Cultures have been grown from soil water taken from under ice. They also have withstood temperatures as high as 176 degrees.

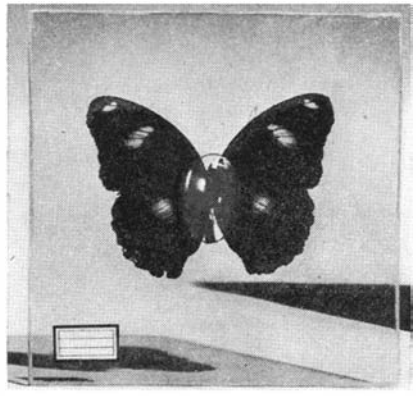
Once the bacteria have taken hold, the maximum life of a pipe is approximately seven to ten years. The rate of corrosion under their attack is nearly three times that of other types, with the exception of carbon contact, stray electric currents, and concentrated acid.

There are 450,000 miles of gas, oil, and water distribution systems in the United States, all of them susceptible to attack by the bacteria.

BUGS IN PLASTICS

Transparent Sheets for New Mounting Method

FOR schools, laboratories, and camps, a new method for mounting biological specimens has recently been worked out, utilizing Monsanto cellulose acetate. The mounts consist of two flat sheets with a hollow in the center of each. The specimen—butterfly, beetle, or other insect—is laid flat on one sheet with the body of the insect resting in the hollow. Another sheet of the same size is placed over this. Wings and limbs are between the sheets while the body rests in its cavity. The two sheets are then



Oval center holds the body

cemented together. The mount is now complete in a permanent, fully visible, and insect-proof arrangement.

The mounts, known as the Schwarz Transparent Mounts, are being manufactured by the Frank Schwarz Studio, of St. Louis, and distributed through the Central Scientific Company.

APPLE JUICE

"Flash" Pasteurization Product Resembles Fresh Juice

THE "flash" pasteurization for preserving apple juice, developed by specialists at the State Experiment Station at Geneva, New York, provides a reliable and relatively simple method for use on the farm which will insure a product that is being well received by the public because of its close resemblance to freshly pressed apple juice.

The essential features of the method include straining the juice carefully, heating it quickly to 170 degrees, Fahrenheit, and then putting the hot juice into bottles or cans without further treatment. After standing for a few moments, the containers are quickly cooled. The resulting product possesses much of the flavor and aroma of the freshly pressed juice and will keep indefinitely.

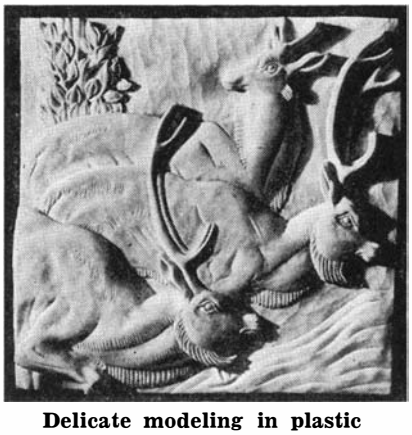
"Until recently the only juice which could be prepared and preserved in the kitchen was tomato juice," say the Station specialists. Now, however, "apple, cherry, grape, and many other fruit juices are used daily in the home. Im-

proved quality of preserved fruit juices has been made possible by development of methods of processing within the last few years. These improved methods include continuous flash pasteurization with little or no loss of flavor, methods to exclude air from juices which formerly caused changes of flavor and deposit of undue amounts of sediment, and perfection of containers, both bottles and cans."

ART IN PLASTICS

Cold-Molding Material Makes Plaques

PLASTICS have found their way into art many times, yet usually there is some difficulty in handling them. A new cold-molding plastic, made by the Monsanto Chemical Company, Plastics Division, obviates one of the most troublesome factors



Delicate modeling in plastic

in plastics molding—the use of heat. Consequently, attractive, decorative plaques are now being cast from this material by W. L. Stensgaard & Associates. An accompanying illustration indicates the delicate modeling that is possible when using the material for casting in this manner.

The cold-molding plastic is originally in the form of a liquid. When this fluid is mixed with another and poured into molds, it hardens without heat into a durable, rigid plastic of warm color and pleasant texture.

SAWDUST STOVE

ON the West Coast there is being produced a new sawdust burner which reduces the sawdust to a gas which in turn is burned in the combustion chamber to give efficient heating. The sawdust is loaded into a hopper beside the stove. Heated by the flame above, the sawdust is converted into gas and a small amount of exhausted ash. The sawdust smoulders on the grate, does not backfire, forms no creosote, and burns continuously so long as the hopper is kept filled. Users have reported a fuel cost of 75 cents to $1.50 per month.

GEOLOGIC MUD

New Technique Verifies Geologists' Claims

MUD deposits, 500 feet thick, on the deeper parts of the ocean floor, represent the accumulation of all geologic time, some 2,000,000,000 years. Deep ocean deposits grow in thickness at the rate of two or three centimeters in from 5000 to 10,000 years. A layer of sediment ten feet thick may represent a time interval of from 100,000 to 200,000 years.

Dr. Joseph A. Cushman, director of the Cushman Research Laboratory at Sharon, Massachusetts, and a noted authority in marine geology, recently emphasized these facts as being of extreme importance in interpreting the geologic history of ocean muds, because wide ranges in geologic time are thus preserved in core samples of only a few feet in length.

Vertical core samples 10 to 12 feet long have recently been collected from the deeper parts of the North Atlantic by the Piggot "gun," invented by Dr. C. S. Piggot, of the Geophysical Laboratory of the Carnegie Institute of Washington. Core samples obtained along the line of the Atlantic cable, from Newfoundland to Ireland, contained abundant fossil remains of tiny life forms, diatoms, and the snail-like foraminifera, which reflect climatic conditions prevalent at the time of deposition. Warm water foraminifera, such as live now in the Gulf Stream, alternate with types characteristic of the Arctic. These alternations of cold and warm types of foraminifera probably correspond to the known advances and retreats of the great ice sheet that once covered half of the North American continent.

Even mud samples taken from the deepest portion of the Caribbean reflect the thickness of the great ice cap once lying far to the north. Cores from the Caribbean were described as showing definite zones of concentration of warm water foraminifera separated by zones in which they were absent.

CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

All Contrasts In One Paper

CHANGES in the color of the printing light when teamed with a suitably coated printing paper will afford a variety of tone contrasts in the one paper. With this as a basis, the Defender people went to work to produce the paper and the method by which "complete contrast control" could be had in one grade of paper. The result is Varigam (varied gamma), and the tests we have given it indicate the method to be both successful and useful.

We made three separate tests on different occasions under the following conditions: Darkroom illumination was by red safe-light, Varigam being sensitive to the ordinary printing safelights but not to red. A negative of rather stronger than normal density was used in two of the tests and a normal strength negative in the other. Development was in D-72 diluted 1 to 2 for two of the tests and in the Defender recommended 55-D in the third. In the first two tests the bath was made up as usual and the whole batch run through in the one bath. In the last test, with the 55-D, a separate, new bath was made up for *each* print to assure like developer conditions for each of the prints. The temperature for each bath was held at 70 degrees and development was for 1½ minutes. The enlarger light source was the popular "211."

With each package of Varigam paper, Defender supplies a yellow and a blue gelatin filter, together with a cardboard filter holder between which the filters are sandwiched by binding the edges with lantern-slide binding tape. These filters are held under the enlarger lens or attached to the lens barrel with tape. By varying the proportionate length of time during which each of the filters is held under the lens, thus coloring the light yellow or blue, as the case may be, different grades of contrasts are obtained on the one paper, blue light providing contrast—yellow light, softness.

A test strip is made in the usual way. For this purpose the manufacturers recommend making a test with all blue light, but we have found it easier to judge proper printing time by cutting the exposure time in two, exposing half the time through the blue, half the time through the yellow filter. The exposure learned through this test will be the same for all other combinations of the two filters. In our test, the total exposure time was 14 seconds, and this remained the same for all the prints made from the same negative, the timing being distributed as follows: 2 seconds for the blue, 12 seconds for the yellow; 4 seconds for the blue, 10 seconds for the yellow, and so on, plus 14-second exposures made entirely with yellow light and entirely with blue light.

The resulting print contrasts gave a range from very soft gradation to very hard, with prints of distinctly different contrasts in between the two extremes, *from the same negative.*

A more convenient method of altering the color of the light is the use of the Duraline Print-Control Filter Set prepared especially for Varigam paper by Harrison & Harrison, of Hollywood, California. These are available in either the Standard Set, which contains ten filters with varying mixtures of the yellow and blue filters, or the Special Set, containing five filters. The first provides ten degrees of contrast from YB1 (very soft) to

YB1

YB5

YB10 (extra hard), while the smaller set includes YB1, YB3, YB5, YB8, and YB10. The latter is quite satisfactory and if an additional filter may be required later on, it can be purchased separately. With the set comes a dual snap holder, fitting a designated lens diameter. The filters are easily snapped in and out. In addition, a lock ring may be had for permanent attachment to the lens barrel.

The other two tests were made with the Duraline filter set, and provided an amazing range of contrasts in the same printing time for each of the prints. YB5 was used for making the test strip, after which all prints were made for the same time, the filters being snapped in and out successively in easy, routine fashion, except that in the 55-D tests, a new bath was made up for each print. This was for test purposes only, however, and is not necessary in normal working practice. An indication of the range may be seen in the reproductions made, respectively, through the YB1, YB5, YB8, and YB10 Duraline filters. If the engravings do justice to the originals, you will be able to judge of the results for yourself.

We believe that in actual use, the average worker will eventually settle down to two or three, perhaps four filters or filter combinations. (Incidentally, the Duraline filters must be used separately and not in combination with each other, since the varying combinations of blue and yellow are already incorporated in each of the filters.) The other filters will be used for those special negatives requiring other than routine treatment.

In actual use, the Varigam worker will forget all about the usual contrast designations and refer to them as YB contrasts instead. In the beginning, he will make up a panel of prints from a negative of normal contrast and bind them into a folder or mount them over his printing table. This panel he will use as a guide in selecting the proper filter to use with a particular negative. If the negative is softer or harder than normal, he will make the proper allowance, just as he would with different grades of paper. The advantage with Varigam, however, will be that a change in the filter rather than the paper is all that will be called for. After the worker has become accustomed to processing Varigam, he will refer to contrasts not as normal or medium or hard, but as YB5, YB8, and so on. And this, we feel, is a very definite and helpful advance in the art of printing.

Movie-Making With a Purpose

If you make a plan and try to stick to it, your movie-making activities will be the more valuable because they will build up to a definite goal rather than a miscellany of disconnected short lengths. Moviemaker George Post, of New York City, who, incidentally, has been shooting Kodachrome exclusively ever since it appeared on the market, has a scheme that, to our mind, is worth imitating. George has a rather wide range of interests, finding pleasure in shooting either flower closeups or the Cuban dancers at the World's Fair, scenic effects in the country or subjects in the intimacy of his own home. But one thing he abhors, and that is mixing his interests on any one reel. The plan he follows is this: Whenever he comes across a subject he likes, he shoots as much film as he thinks necessary and spools it onto an empty 400-foot reel. If his next subject is in another category, he spools it onto still another reel even though the first has only 50 feet on it. When he has occasion to shoot another aspect of the first subject, he adds this footage onto that reel. And thus he proceeds until the 400-foot reel of the *one subject* has been filled. In this way he edits as he goes along, cutting off what he does not want before splicing it. He tries when possible to get at

YB8

YB10

Fifth Annual Scientific American
AMATEUR PHOTOGRAPHY CONTEST

[For Complete Contest Rules, See Page 286, November 1940 Scientific American]

OVER $1200 IN PRIZES

36 PRIZES *PLUS* Three Special Awards

IN this year's contest, prints may be entered in any or all of the three groups listed below, in accordance with the rules. In addition to the seven major prizes and five honorable mentions, there will be three SPECIAL AWARDS that will be accorded to the three outstanding photographs among the 36 prize winners. *These special awards will be given in addition to the regular prizes that the pictures win.*

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

Division 1. Human interest, including camera studies of people, animals, and so on. Portraits will be grouped in this division.

Division 2. Landscapes, including all scenic views, seascapes, and so on.

Division 3. Action, including all types of photographs in which action is the predominating feature.

THE PRIZES

1st. Three $125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.

2nd. Three $85 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three FEDERAL No. 246 Photo Enlargers (List Price $49.50).

4th. Three FEDERAL No. 345 Photo Enlargers (List Price $42.50).

5th. Three PIERCE CHRONOGRAPH Men's Wrist Watches (List Price $19.75).

6th. Three BERMAN-MEYERS Flash Guns complete with case (List price $15).

7th. Three FINK-ROSELIEVE Vaporators (List price $12.50)

HONORABLE MENTION

1st. Three Fink-Roselieve "Hi-Spot" Hollywood type spotlights.

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

5th. Three Fink-Roselieve Satin-Chrome Range Finders.

THREE SPECIAL AWARDS!

Winning pictures in the three divisions will be grouped and judged further to determine which three of them shall be considered as the best in the entire contest. To the contestants who entered these three photographs will be presented the following special awards:

1st. One No. 715 Weston Exposure Meter (List price $24.)
2nd. One No. 650 Weston Exposure Meter (List price $19.95.)
3rd. One No. 850 Weston Exposure Meter (List price $15.50.)

THE JUDGES:

McClelland Barclay, artist
Ivan Dmitri, artist and photographer
T. J. Maloney, editor of U. S. Camera
Robert Yarnall Richie, photographer

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street **New York, N. Y.**

least 400 feet of any one subject he tackles, though the period between the first shooting and the last may be a year.

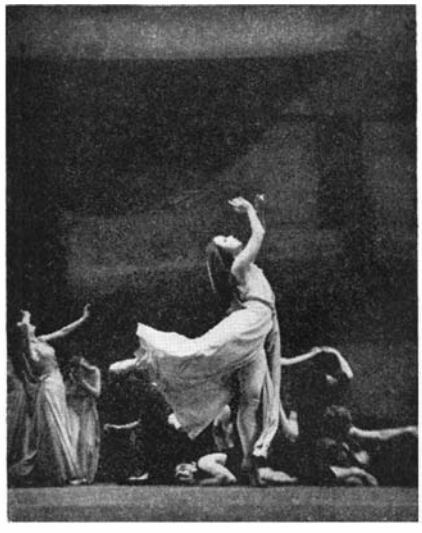
Spiral Binding

You can now bind your own pictures in the same way the big annuals do. Select a group of your best shots, preferably centering around a single subject—the baby, for example—mount them on thin cardboards or use double-weight prints unmounted, and send them along to a firm that makes a specialty of this service. You must also provide a front and a back cover, which may be heavy cardboard of a desired color. It is recommended that 25 double-weight prints should be the maximum selected for any one book; otherwise, the books become too bulky and awkward to use. Prints should not be larger than 8 by 10 inches. The charge is only 15 cents for each book. The firm is Spiral Bindings, 148 Lafayette Street, New York City, New York. Mailing charges are extra.

Local Boy Makes Good

A BORROWED camera, much enthusiasm and first-hand knowledge of the terpsichorean art, started 27-year-old Constantine, New York City dancer (he prefers to use this name just as he has done in his dance work), off in photography a little less than a year ago. Unaccustomed as he was to the vagaries of the camera shutter and finder, he cut off heads, legs, et cetera, and wept afterwards at what he called his stupidity, although, as everybody knows, the name for that is inexperience.

In time, however, he was able to get the dancing figures intact on the film and to make creditable prints. As he gained proficiency, confidence came along too, until the day came when he felt he was good enough to deserve a camera of his own. To make a long story short, he now has professional equipment, including a



7th Symphony of Beethoven

From the prompter's box

miniature camera and the Speed Graphic, using the latter for flash work almost exclusively, and has assumed the mantle of dance photographer.

The best part of our story is that Constantine did so well that the Ballet Russe dancers permitted him to come backstage for posed flash shots and work from the prompter's box with a miniature camera during the performance. He used the Contax in the latter vantage point and was able to get very good stills of action at 1/50 second with the *f*/1.2 Sonnar lens wide open. The pictures he made on these occasions turned out so successfully that the Kamin Gallery in New York City staged a one-man public exhibition of a selection of his best pictures. Specialization in the one field he knew particularly well is undoubtedly the reason for Constantine's sudden rise to fame.

Printing-In Clouds

WE recently had occasion to print clouds into a bald sky, yet retain a sharp outline of a projecting figure in the foreground. The job was accomplished in a rather simple manner. Instead of the usual procedure of making an exact outline of the foreground and keeping it shaded with painstaking exactness while the clouds were being printed in, a rough outline was made for the foreground. The sky being dense, a straight projection of the negative provided the foreground subject image, with nothing but white paper where the clouds were to be.

This print was then placed in the developer. As soon as the image had come up very lightly, the print was removed from the developer bath and placed in the stop bath. It was then swabbed with cotton and placed on the easel again, with a blotter underneath to protect the easel. The cloud negative, which was previously strip-tested, was then projected while the foreground was shaded roughly with the rough outline mentioned. The exposure complete, the paper was re-

CAMERA ANGLES

placed in the developer and left there for the full time, after which it was placed in the stop bath as usual, fixed and washed. The result showed sharp image outlines with clouds printed into the bald sky, the whole giving the effect of having been made from a single negative—no break was to be seen anywhere.

Light Makes the Picture

WITH great economy of light reflections, with only the salient points high-lighted and the rest in semi or complete darkness, the accompanying illustration of the outdoor musician was made at night outdoors by the light of a few small ceiling

"Night Concert"

bulbs. Shooting from street level up to the band-stand, the exposure was 1/10 second at the full opening of the Tessar *f*/3.5. The light outlines the instrument in just the right places, providing just enough high-lighting for the purpose and no more. Vibration of the instrument is apparent in the outline high-lights, thus affording an impression of a tuba (or whaddya call it) in full blast.

Touring Exhibit Proposed

FEELING that some method is in order for giving impetus and assistance to local photographic contests, Albert Greenfield made the following proposal in a recent issue of the *New York World-Telegram* ". . . to formulate plans for a traveling exhibit of photographic equipment, combined with local photographic contests under the auspices of a grand council comprised of representatives of every organized trade association in the photographic field."

"Why forget about the amateur photographers?" asks Mr. Greenfield. "They are the ones to see and inform about new equipment, and in their interest lies the market of the photographic industry.

"The traveling exhibit that I have in mind could start in New York City, go to Philadelphia, then to Boston and

——CAMERA ANGLES——

to every important city in the East. This exhibit would then cover every important city in the South and Midwest, and eventually reach the West Coast. After a complete tour of the country has been made, a new revised show would be organized again to tour the country."

Sounds swell, Al. When do we start?

For Ferrotypers

IF you have been having trouble ferrotyping your glossy prints on chrome-plated tins, check over your procedure and see if the following may help you to get better results. After the prints have been washed, rinse them in warm water before laying them down on the warm-water washed tin. Pass a rubber squeegee over the backs several times, lengthwise and cross-wise. Then sponge over the back with a squeezed viscose sponge, making particularly sure that all water has been forced out at the edges of the print, as well as from the entire surface. Incidentally, single-weight glossy prints are easier to ferrotype than double-weight paper.

• • •

WHAT'S NEW

In Photographic Equipment

SOLAR COPYING STAND ($17.50): For use with any type camera with suitable bellows extension or supplementary copying lens. Adjustable camera supporting arm permits camera to be brought down within eight to ten inches from baseboard, depending upon size of camera used. At top distance camera is about three feet from board. Sliding rod, hexagonal shape, permits in-and-out adjustment over eight-inch range, making possible to set camera at any of six different angles. Complete assembly includes standard Solar baseboard, upright standard, and adjustable camera supporting arm.

F-R ADJUSTO PRINT PRESS ($3.95): Accommodates 100 prints between blotters. Heavy, all-steel construction designed to eliminate warping. Dimensions 12 by 15 inches; takes prints up to and including 11 by 14. Top section of press fastened to bottom section with two locking lugs. Four rubber snubbers on base prevent scratching of any surface where press may be placed.

AGFA VIKING CAMERAS ($13.75 to $18.75): Equipped with *f*/6.3 or *f*/7.7 anastigmat lens. Take eight pictures 2¼ by 3¼ or 2½ by 4¼ inches. Standard equipment includes built-in, body shutter release; optical eye-level and reflecting, waist-level finders; hinged back and easy-loading spool carriers; self-

—CAMERA ANGLES—

erecting front. Both models focus from 5 feet to infinity; shutter speeds, 1/25, 1/50, and 1/100 second, bulb and time exposures.

TIMETER ($24.85): Synchronized exposure meter and automatic timer for use in enlarging. Electric-controlled light measurement eliminates use of test strips, providing indication for correct grade of paper to use for given negative. Timeter provides precision control, accurate readings,

synchronous calibration, automatic timing, complete paper speed chart of all papers. Exposure time range 3 to 120 seconds. Light meter range 1/100 to 4 foot candles. Paper speed range 0 to 100 Timeter rating. Plug meter into 110 volts, 60 cycles AC electric socket.

GEM KOLOR CHROME: ($1.25) Developer-toner permitting toning simultaneously with development. Available in five essential colors: sepia, blue, green, magenta, yellow. Kit includes three units: developer, toner, fixer. Many shades and hues possible by mixing colors in various combinations. Any print already made in black-and-white may also be toned. Can be used for toning various portions of print in different colors. Colors controlled locally on finished print. Permits making color transparencies from regular black-and-white negatives.

FOTOFOAM ($.75): Cleansing agent for photographic use. Cleans films and plates. Drying time speeded 25% to 40%. Aid in retouching, reducing, intensifying, toning. May be used to clean tanks, trays, glassware.

FLUOR-O-PHOTO ($102.50 for light and stand, less tubes): Bardwell & McAlister eight-tube fluorescent light, Type 15. Tubes 24" by 1½", 20-watt, either white or daylight type. Individual starting switches replaceable by using small friction socket furnished with each light. Normal height range 5 feet to 9 feet. Special counterbalance stand permits easy raising or lowering. Accessories available for unit include low arm adapter called "Knee Bracket." With this, light may be operated from as low as two feet to height of five feet. Wing shades, mounted on sides, also available.

AGFA INFRA-RED FILM: Now available, in addition to 35mm, in three popular roll-film sizes—A8 (same as 127) $.40; PB20 (same as 620) $.45; B2

(same as 120) $.45. With suitable filter is specially sensitive to deep red and infra-red regions of spectrum, recording blue skies in dark tones, and green foliage, light-colored buildings, white clouds and similar subject-matter in various tones from light gray to clean white. Requirements: bright sunlight and red or other blue-extinction filter for exposures, which average, with filter, 1/25 second at *f*/5.6 to *f*/6.3. Film is fine grain, has moderately brilliant gradation and effective type of anti-halo protection.

KODAK ELECTRIC TIMER ($9.50): Sixty-minute timer for A.C. only. Neatly designed die-cast case finished in smooth gray. Large dial with easy-to-read figures; minute and second hands.

FILMO FADER: Designed for professional effects with amateur movie cameras. Adjustable indicator visible in camera viewfinder shows when fades and wipes are completed. Fader said to be automatic; fits all makes of 8 and 16mm cameras and makes fade-ins, fade-outs, wipe-ons, wipe-offs, and, where camera is equipped to rewind film, transitional lap-dissolves. Fader can be mounted at any angle to permit wipes to appear or disappear from any direction. Fades made with rotating disk graduated from opaque black to clear sector, and back again to opaqueness.

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. Can you supply a formula for writing over the numbers on glass graduates to make them more visible? —L. K.

A. An effective "ink" for writing on glass so that no matter how much water is passed over it, it will not be washed off, is the following:

Shellac, unbleached	4 drams
Alcohol (95%)	4 ounces
Borax	7 drams
Water	6 ounces

Then add 12 grains aniline (adding any desired color).

Q. I don't understand why it should be necessary to make the labels referred to in your item on "Labels on Bottles," issue of August, 1940, out of photographic paper instead of ordinary paper of corresponding quality—for instance, high-grade bond writing paper.—H. Y.

A. Fixed-out photographic paper is recommended in order to prevent streaking when the varnish is applied. Photographic papers are coated, or sized, with baryta in order to provide a hard surface for the emulsion to be spread upon evenly and without streakiness. The baryta fills the pores of the paper, like a sizing, and keeps the emulsion (or varnish, in the present instance) from sinking into the paper. The baryta coating stays in the paper whether a photographic image is made or not; as a result, it provides a useful surface for the labeling method described.

Q. On occasion, I like to take portraits at home or in the homes of friends, but almost invariably run across the problem of what to do for a plain background, which seems to be ideal. What is your suggestion for a good all-around portable background that can be rolled up and put away when not wanted?—N. L.

A. A sheet of white muslin or other white cloth will provide the greatest utility inasmuch as a varied range of background tones can be provided by the way the light source is arranged. Get some half-round molding and cut it the width of your background (four feet to six feet). Cut four lengths the same size. Sandwich one end of the cloth between two of the half-round strips, nailing them together; then do the same for the other end. In use, the background is hung by a hook on a wall or tall piece of furniture, the molding at the lower end providing the weight to keep the background stretched taut, thus preventing folds and creases.

Q. What is the adhesive used for binding together two sheets of mounting board to prevent curling or to give increased thickness or weight?—D. M.

A. A stock batch of the following adhesive is made up for use as wanted. Fourteen ounces of any good quality glue is dissolved in 26 ounces of water. To this is added 1 ounce of a solution composed of one part of shellac in seven parts alcohol. Keep stirring until the solution cools. One-half ounce of dextrine is now dissolved in 7 ounces of alcohol and 3 1/3 ounces of water. Stir and place the vessel in warm water until the solution is complete. The two solutions are then mixed and cooled. For use, a small piece is cut off as wanted and liquefied by warming.

Q. I find that in using the dry mounting method, my prints start peeling off not long afterwards. Is there any cure-all for this situation? —F. N. H.

A. First of all, as you probably know, the tissue must be tacked to the back of the print, and print and tissue trimmed together. Tacking should be done from the center outwards and not from the corners inwards. That is, run the iron in cross lines from top to bottom and across the back of the print, leaving the corners free. Lay the print in the appropriate position on the mount, overlay a sheet of paper and apply the iron from the center out. Move the iron very slowly, giving what experience must teach you is about the right timing to do the job effectively.

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers.*

For "Defense"!

"A WELL-REGULATED militia being necessary to the security of a free State, the right of the people to keep and bear arms shall not be infringed."—Article II of the 10 original amendments to the Constitution of the United States of America. These first 10 amendments, known collectively as "The Bill of Rights," were proposed at the first session of the First Congress, meeting in New York City, September 25, 1789. After ratification by 10 of the 13 states, they were declared in force December 15, 1791.

The exploration, settlement, and growth of the United States from the wilderness it was in 1791 to the nation it is in 1940 owes so much to "the right of the people to keep and bear arms" that the statement of that obligation needs no amplification. Today, privately owned guns of that era of personal and territorial protection have been almost entirely replaced by what are known as "sporting arms." The nearly 7,000,000 American owners of these guns annually pay about $12,000,000 for hunting licenses and fees; close to $3,000,000 in Federal excise taxes on sporting arms and ammunition; better than $2,500,000 for Federal Migratory Bird Hunting stamps. Practically every one of these dollars in this 15-million-dollar-a-year business is spent by Federal or State agencies for rehabilitation of American wildlife, which, despite misconception to the contrary, was eliminated, depleted, or endangered not by hunters, but by economic forces and activities that deprived wildlife of natural breeding and feeding grounds.

As pointed out editorially on page 243 of the November issue, proponents of anti-firearms legislation have for years tried to curb "the right of the people to keep and bear arms," annually originating as many as 100 bills in state legislatures. Had the last Congressional proposal passed, seven million licensed sportsmen and other private owners of arms would have (1) registered and paid a dollar fee for each gun owned or bought in the future; (2) been "mugged" and fingerprinted; (3) paid a transfer fee if a gun was sold. Now, once again, this old bogey threatens, but behind its mask of "national defense" we find the same glaring and idiotic fallacy of expecting subversively-minded people to step forward and register guns held for lawless purposes.

Registration of guns owned by citizens of the United States is unnecessary as a national defense measure. It cannot conceivably achieve the purpose claimed by its sponsors, because banditry and homicide, Naziism and Communism are practiced not by the gun, but by the man behind it. As he is notoriously known to have no use for this country's laws as they exist today, why should we believe he would respect a new one? To attempt to eliminate military weapons from subversive elements through registration of all arms, including your own sporting rifle and shotgun, would be silly, impracticable, and impossible on the face of it, but such action might result in untold injury to national defense. If, as a further "defense" measure, all registered guns were to be impounded—far from an hysterical thought—we would have the ridiculous and pitiable picture of a nation that had disarmed its law-abiding citizens and which had left the lawless ones in our communities fully equipped with weapons.

If, as is generally agreed, the recent Federalizing of the National Guard, and the conscription and calling of men into training indicates "A well-regulated militia being necessary to the security of a free state," then the rest of those priceless words are as applicable and as potent today as they were when written into our Constitution 150 years ago, and, if straight-thinking people have their way, "the right of the people to keep and bear arms shall not be infringed."

On The Solunar Theory

LAST summer we fished a certain lake carefully and consistently from August 21 to September 1. On the 21st we were throwing back small-mouth black bass because they were too plentiful. From August 28 to September 1, we frequently repeated that process, but from the 21st to the 28th we had very little action, and now, perhaps, we've found out why. We've just read John Alden Knight's newest book, "The Theory and Technique of Fresh Water Angling," and have not only found it packed with sound knowledge of the elements of angling, but, what is more pertinent to our spotty fishing experience, the book also contains chapters on "Habits of Fresh Water Fish" and "The Solunar Theory," the latter having been advanced by Mr. Knight some years ago.

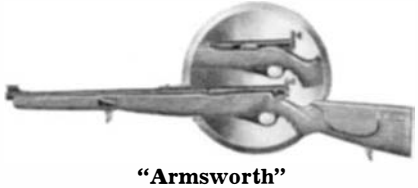
Whether you attempt to prognosti-

cate angling luck by the tides, wind direction, moon phase, color of sunset, leaf action, bird songs, or other pet theories, or just "go fishin' " you will be interested in Knight's statement that, "unquestionably the phases of the moon affect the lives and habits of all living things." Testing this thought in practice, the author established a system which worked quite well for several days each month, but the occurrence of regular lapses led him to investigate further. Following the theory of ocean fishermen that tides bring food to fish, thus establishing feeding periods, Knight felt there might be connection between feeding cycles of fresh and salt water fish. This brought him to causes of the tides and consideration of sun as well as moon phases. "Finally," he writes, "by discarding the tide tables and doing my own calculation of the actuating force by charting the resultant of the solar and lunar forces as applied to the earth, I found the schedule could be made fairly accurate. In so doing, the name 'Solunar' was coined —purely as a convenient term for describing the force in question. Thus was the Solunar Theory born."

Perhaps you've seen or used Knight's Solunar Tables, first published in 1935, and if so, you've formed your own conclusions. Possibly you've said, "Pooey!" to the whole thing. The fact remains that on checking this year's Solunar Tables, which we did *not* have along last August, with the meticulous record of wind, weather, water and air temperatures, and time of fishing, which we did keep, we found that the Solunar periods had closely coincided with our moments of best fishing. Perhaps it's still "Pooey!" in your estimation, but the constant application of science to the unknown in angling is slowly teaching us more about fish propagation, culture and habits, fishing tackle and how to use it to best advantage. Surely, we'd all be Methuselahs if we lived long enough to know all there is to know about fishing!

They Won Guns

FROM the amazing number of 18,000 entries in the O. F. Mossberg & Sons, Inc., "Rifle Name Contest," (May, 1940, Scientific American) the judges selected "Armsworth," submitted by Albert Campbell, of Richardson Park, Delaware, as prize-



"Armsworth"

winning name for the new Mossberg "M" model rifles. Second prize was awarded to Emery R. Fry, Oregon, Illinois, for submission of "Moss-K-Teer," and third award went to George H. Webster, Sheffield, Alabama, for suggestion of "Carbineer," a name also sent in by other entrants. Decision in the last instance was based on the best 20-word statement submitted with the entry. Each winner was awarded a cash prize and his choice of the three "M" rifles, and each chose the automatic, Model 51 M. Consolation prizes were given to 15 other contestants, and after it was all over, Iver Mossberg was so gratified at the wide-spread interest shown that he remarked: "Makes you want to work even harder to give 'em the biggest gun value in the world." We still have a few catalogs showing the "M" models and other Mossberg products. Want one?

"Fender Hunters' " Delight

WE once knew an old-time Michigan woodsman who had his own term for fireside hunters. He called them "fender hunters" because they never took their feet off the fireplace fender and spent most of the day and night arguing about whether wolves really attack people, how high and how fast do ducks and geese fly, are white-tailed deer frightened by a hunter's campfire, and a lot of other problematic things in woodcraft. The answers to these and other famous questions will be found in a colorful, informative booklet by Goodrich Division of Hood Rubber Company. It is called "Campfire Debates" and has a companion publication entitled "How Smart Are Dumb Animals?" We've a supply of each and will be glad to send them to you.

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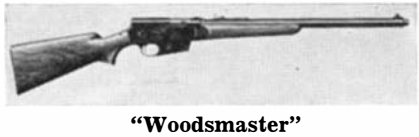
POT SHOTS

At Things New

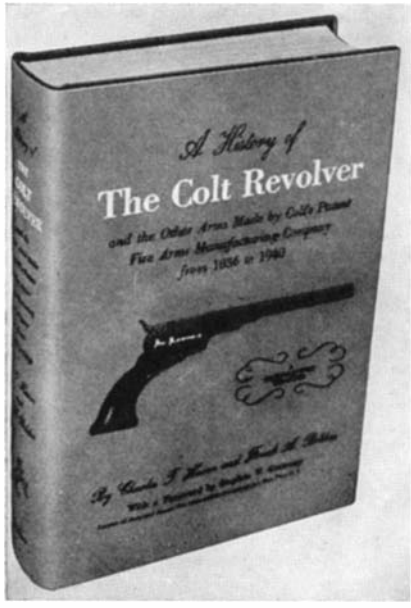
REMINGTON ARMS COMPANY answers demands of increasing army of big game hunters for autoloading rifle in caliber approaching ballistics of popular .30 Springfield '06 by producing modernized Model 81 "Woodsmaster" in .300 Savage caliber. This combination of recent type, rapid firing



"Woodsmaster"

rifle with cartridge of 2660 fps velocity, low trajectory—three inches at 200 yards—is highly effective, produces splendid accuracy and is under shooter's control at all times because trigger must be pulled and released for each shot. In addition to .300 Savage caliber, "Woodsmaster" is available in .30 Rem., .32 Rem., and .35 Rem. calibers.

MERSHON COMPANY, INC., formerly Fray-Mershon, Inc., depicts scores of gunner and angler necessities in their new 1941 catalog. In addition to an excellent line of firearms and accessories, equipment for archery,



Here it is! We termed it a "magnificent publication." (See article on page 284, November)

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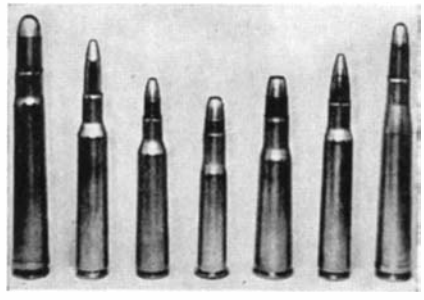
camping, and winter sports is shown. Of special interest to fishermen will be Mershon's "Reel-Fold" line dryer, which conveniently clamps anywhere, dries two or more lines simultaneously, reverses lines end for end, coils them to any desired circumference, is rust-proof and packs into a 1½ by 10½-inch unit for tackle box storage.

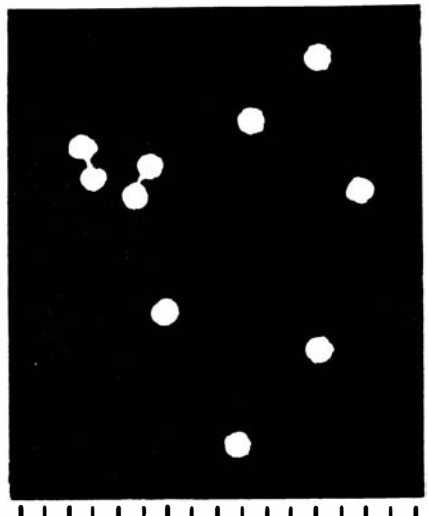
ABERCROMBIE & FITCH, in presenting their newest and customarily "tops" catalog, perfectly express our feelings about guns when they inscribe the first page: "We like to believe that a fine sporting gun does more for a man than merely bring game to bag. A gun is the link between men and the out-of-doors. It is the lodestone that draws sportsmen together. It is a symbol of the woods, of relaxation around campfires, of companions who have shared adventures. A good and well-used gun stands for the finest moments in a sportsman's life." The book's 136 pages are attractively covered, profusely illustrated, completely indexed, and contain every conceivable need for the gunner.

J. STEVENS ARMS COMPANY'S newest shotgun innovation is Model 240, a .410 bore over-under, with 26-inch close-choked barrels, weighing 6½ pounds, chambered for the 3-inch .410 shell and selling at astonishingly low price of $15.10. Like Stevens' extremely popular model 530M side-by-side double gun, which came out a year ago, the new over-under has stock and fore-end of Tenite, that hard, tough plastic which will not swell, split, warp, or crack and which so perfectly resembles knurled walnut.

WESTERN CARTRIDGE COMPANY'S recently announced Silvertip bullets, made in 18 calibers, establishes new high in hunting ammunition accuracy. Target shown was made with .30-'06, 180 grain Silvertip fired from machine rest under normal outdoor conditions. New principle of scientific construction produces remarkable accuracy at all hunting ranges. The Silvertip has a double jacket, the outer Lubaloy metal protecting the rifle bore, the inner of nickel silver encasing the point and soft lead core nearly to the base. Differing from ordinary soft nose or hollow point bullet which spreads on contact, Silvertip's light casing delays expansion, permitting bullet to penetrate hair, hide, tough tissue without loss of bullet weight. After penetration, bullet rapidly expands to about twice original diameter, Lubaloy jacket then curls back, forming supporting shoulder for expanded core. Careful determination of proper thickness of tip casing and amount of exposure of tip result in correct penetration and expansion at all ranges.



The Silvertip cartridges . . .



. . . a 300-yard target . . .

. . . and bullet expansion

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

THE BIRTH AND DEATH OF THE SUN

By George Gamow, Professor Theoretical Physics, George Washington University

DEDICATED to Professor Henry Norris Russell, this book is a popularization, as far as its abstruse subjects can be popularized, of the study of subatomic energy and stellar evolution. Astrophysics being an extension of physics beyond the laboratory (the two in actual fact are one), a large part of this book deals with the anatomy of atoms as such, the transmutation of elements, and sub-atomic energy. The remainder—130 pages—might almost be called a popular astrophysics but it isn't "fluffy stuff," for all its popularization, nor yet is it "deep stuff." A serious book. (238 pages, 4¾ by 8¼ inches, 76 illustrations.)—$3.10 postpaid.—*A. G. I.*

THE THEORY AND TECHNIQUE OF FRESH WATER ANGLING

By John Alden Knight

IF all anglers of this generation could have had the advantage of reading this book before beginning to take their trout and bass fishing seriously, they would have been saved much time, money, and grief. If they, together with prospective anglers, will read it now, they will find a mine of valuable knowledge, enjoyably presented by the Instructor of Fly Fishing at Columbia University, the unique position held by the author of this and other angling volumes, as well as of the famous Solunar Tables. (223 pages, 7 by 9¼ inches, 18 illustrations, 4 color plates of lures.)—$3.85 postpaid.—*A. D. R., IV.*

HOW TO GET INTO AVIATION

By John B. Walker

INNUMERABLE young men throughout the country are seeking to enter aviation. Whereas aviation at one time may have meant flying and flying only, at the present time aviation subdivides itself into innumerable activities. Therefore, any young man who wishes to enter aviation must determine carefully in what branch of aviation he is mostly interested, then determine the best way to get into the particular activity that has struck his fancy. Mr. Walker's book, which carries the sub-title "On the Ground and in the Air," is a sound guide to all those interested. It lists opportunities in aviation as well as schools and other methods of entering this particular activity, wages to be earned in various occupations, and manufacturers, followed by a very useful directory. We thoroughly recommend this to anyone who says to himself "I would like to make aviation my life's work". (126 pages.)—$1.10 postpaid.—*A. K.*

THE MARCH OF MEDICINE

By Doctors Goodridge, Alvarez, Larkey, Drinker, Heyd, Hoskins and Menninger

LAITY lectures delivered at the New York Academy of Medicine—medically informative, though a bit on the fluffy side. Most fascinating lecture is Dr. Drinker's, on the "sanitation" of a typical American city (Philadelphia) 150 years ago; a savage community is as sanitary today. A lady of substance writes in her diary, on July 1, 1799, "went into the shower bath. I bore it better than I expected, not having been wet all over at once for 28 years past." By 1850, however, there was a bathtub even in the White House! (168 pages, 5¼ by 8 inches, one illustration.)—$2.10 postpaid.—*A. G. I.*

CONVERSION OF PETROLEUM

By A. N. Sachanen, D.Sc.

A TECHNICAL book for technical men covering the full range of oil chemistry—cracking, hydrogenation, treatment of cracked gasolines, cracked products other than gasoline, and other phases of the subject. Each chapter is followed by a lengthy bibliography. (252 pages, 6½ by 9 inches, illustrated.)—$6.10 postpaid.—*F. D. M.*

THE ART OF BEING A PERSON

By George Ross Wells, Professor of Psychology, Hartford Seminary Foundation

ESSENTIALLY, or mainly, this is a treatise on understanding human nature, including one's own—in fact, after reading it, your reviewer's face is red! However, cantankerous kinks in personality make-up is not the book's only theme; life's big problems is another—problems concerning the people around one—connected with fear, anger, grief, fatigue, men and women, marriage, parents and chil-

——OUR BOOK CORNER——

dren, schools and children. Defensive dynamisms observed in people, unsuccessful adjustment in life, and neurosis and insanity, also are dealt with pointedly and penetratively. This is a sound, calmly written book embodying the newer understandings of human motivations but not the more radical interpretations. (300 pages, 5½ by 8 inches, unillustrated.) —$2.60 postpaid.—*A. G. I.*

A DICTIONARY OF CLICHÉS

By Eric Partridge

"CLICHÉ" is now a cliché. So are all those apt phrases every man Jack of us (!) uses day in and day out (!), for the word cliché means stereotyped, and a large proportion of the phrases we use daily are taken up so avidly by every scribbler in creation (!) that it soon becomes worn out, threadbare (!). This dictionary will help us mend our ways (!). Furthermore, it is actually interesting to all that tribe of humans who like to play with words. (259 pages, 5 by 7½ inches.)—$2.10 postpaid.—*F. D. M.*

MASTERING THE PISTOL

By Morris Fisher

TOGETHER with its companion volume, "Mastering The Rifle," (Page 248, April, 1940) this book by an expert marksman will prove invaluable not only for devotees of the sport of target shooting, but also from the standpoint of national defense. Carefully planned to lead the beginner step by step from the first elements to the refinements of handgun shooting, each chapter is a complete, self-explanatory lesson, free from confusing technical terminology. (158 pages, 5¼ by 8 inches, 15 plates, 11 line drawings.)—$2.35 postpaid.—*A. D. R., IV.*

MAKING MODELS OF FAMOUS SHIPS

By Ray J. Marran

INSTRUCTIONS for whittling out softwood models of war galleys, junks, the *Mayflower*, clippers, and many others, using a jack-knife and other simple tools. Suitable work for a handy boy of 12 or 14 or a not highly exacting man. That is, this is not a book on really high, wide, and handsome ship model work for the expert, but a medium type of work for the average person. (151 pages, 5½ by 8 inches, 41 dimensioned drawings, numerous photographs.)—$2.10 postpaid.—*A. G. I.*

PRINCIPLES OF ANIMAL BIOLOGY

By Lancelot Hogben

THE second and revised edition of a text-book essentially of zoology. (The author's "Mathematics for the Millions," famous best-seller, did not represent his main work, this book being closer to it.) (415 pages, 5¼ by 8 inches, 149 illustrations.)—$3.85 postpaid.—*A. G. I.*

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

BOSTON, traditional home of the bean and the cod, is said to have slipped somewhat in beans, but in telescope making it has come up a long way since the organization, some years ago, of the enterprising Amateur Telescope Makers of Boston. Leading spirit and first president of this organization has been W. H. Hargbol, 600 Beech St., Roslindale, Mass., (a postal station in Boston), and this column has too long been remiss about describing Hargbol's telescopes, three of which are shown in Figures 1, 2, and 3.

Hargbol began, some years ago, the same as any typical amateur, by making a modest first telescope, and the rest simply followed as usual by a kind of internal compulsion: he has now worked, he says when questioned, on 125 to 200 telescopes for himself and others, and he instructs in formal university extension classes at Harvard and at the Franklin Union Technical Institute. He does all his mirror work by hand.

Figure 1 is an 8", *f*/6.5 portable, with brass-covered galvanized tube.

Figure 2 is a 10", *f*/6.2 portable, with a tube of 3/32" Bakelite. This is attached to the declination axis spider casting by means of two long rails. These in turn are attached to two end brackets screwed respectively to the cell and to the central tube ring, so that the tube itself does not touch any of these except the ring and cell.

As Figure 2 shows, nearly half of the total tube length lies above the central ring, and this part may be rotated, the ring shown being divided in two parts. Hargbol was warned in advance that such a long rotated tube end usually is difficult to maintain in accurate geometrical relation to the lower end, and causes adjustment troubles. He therefore saw to it that the rings received very fine machine work, and found that the extra pains taken paid well, since the arrangement has proved good. Both rings are essentially L-shaped in cross-section, the lower one having an inner, upward projection. In addition, there are six external clamps, held on by screws into the lower ring, and, between the retaining projection and the clamps, the tube end does stay where it is told to stay.

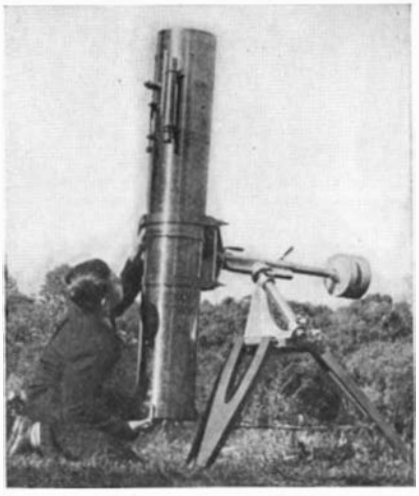

Figure 1: **Hargbol I, 8"**

The polar axis is a solid piece of 1¾" steel, the declination axis 1½". Both have thrust ball bearings.

Figure 3 is a 12½" reflector with an *f*/5 Pyrex mirror. Figure 4 is its focogram with very good shadows—for a short focal-ratio mirror. Since there is perennial evidence that, despite warnings in the handbook, "Amateur Telescope Making," many beginners, not to speak of some who are not beginners, are satisfied to judge a mirror merely by visual inspection of the shadows, without actually measuring zones; and since this practice is very likely to lead to the production of over-corrected mirrors, some of them grossly so, readers are warned not to take away with them as a mental standard of shadow *density*, for application to the average mirror, the shadows of this focogram. The shadows are right for this *f*/5 mirror but would be wrong for the average mirror with medium focal ratio. Ellison emphatically points this out in "ATM," page 96. The mere *distribution* of lights and shadows on a mirror is not an adequate criterion of the radii of its respective parts. This point is twice labored here for the benefit of the increased number of younger men — 18 to 22 — who are known to be taking up telescope making today. We have evidence that good mirrors are becoming fewer and farther between, and some think the two facts are related. Middle-aged men are more tenacious and patient, and less inclined to be in a big hurry, and therefore they turn out better jobs. Hence, measure zones—don't merely hope, even if the shadow map looks right. Looks are deceptive; mirrors, too, wear make-up. And refigure, even if it hurts, when the map looks fine but the curve proves to be too deep. On an *f*/8 the shadows will be much greyer and thinner than those of Figure 4.

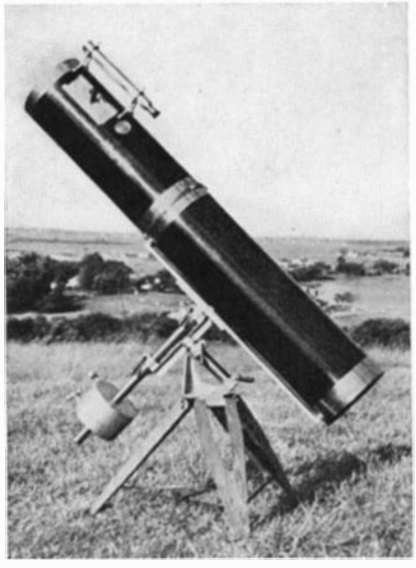

Figure 2: **Hargbol II, 10"**

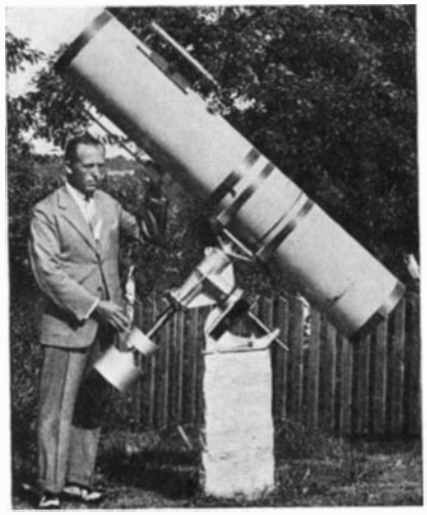

Figure 3: **Hargbol and III, 12"**

The 2" polar axis shaft of Hargbol's 12" telescope is mounted on a tapered roller bearing at top and a ball bearing at bottom, the bearings packed in grease and provided with dust covers. The photograph shows the wide, thin fins cast integral with the declination axis casting, making it very stiff—practically as stiff as it would be if the entire envelope were solid, yet much lighter. Hargbol made the patterns and core box and will be glad to pass along to any interested amateur the experience he gained in doing this part of the job.

The triangular spider at top of the

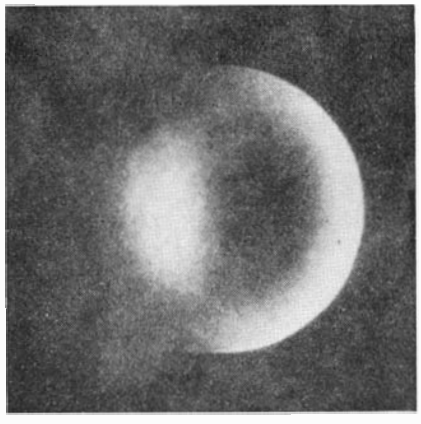

Figure 4: **Focogram of III**

declination axis appears in Figure 3 to have an open center, which would mean weakness, but actually it is a casting having a strong central web.

The base casting of this telescope weighs 40 pounds, the declination casting 25 pounds, the tube base weighs 15 pounds, and the counterweight 56 pounds.

TRAUB, not Pope, as stated, was the maker of the observatory dome shown in the October number on page 234. Pope writes to say that he doesn't want credit for another man's work. Ours was the error.

TED WATTERSON, official photographer at Palomar Observatory, Palomar Mt. (Yes, it's now a United States post office), Calif., made the two photographs of the 200" telescope shown in Figures 5 and 6.

Figure 5 shows the upper end of the tube, 20'3" in diameter, cuddled down into the big horseshoe, 46' in diameter, which constitutes the north bearing, and pointing toward the celestial pole. The two oil pads on which the horseshoe floats as it rotates show at left and right. Figure 6 is a

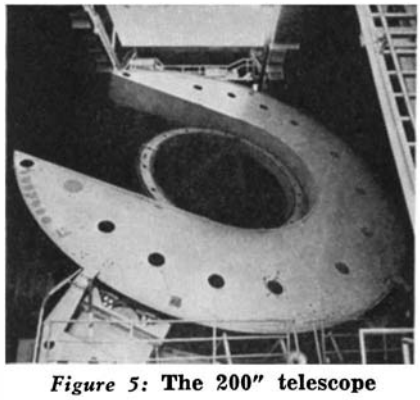

Figure 5: **The 200" telescope**

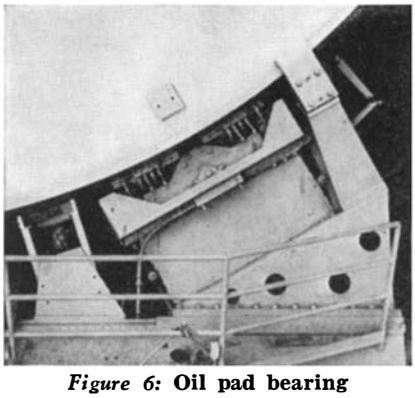

Figure 6: **Oil pad bearing**

close-up of one of these unique pads.

Oil is constantly pumped into these pads under pressure. This cuts the torque required to rotate the telescope from 22,000 pound-feet as calculated for roller bearings, to 50 pound-feet. The oil comes up through holes. The pads are covered with babbit metal. The entire pad rests on a knife-edge and each half rests on a spherical seat.

The horseshoe (split ring) bearing is a Porter contribution.

BUBBLES in Pyrex mirror disks cannot be entirely avoided, because Pyrex remains so viscous at temperatures to which it can be raised in melting (about 2800° F.) that the smaller ones haven't enough flotation power to push upward to the top and escape. The manufacturers therefore have to cull the disks over, throwing out the more bubbley ones. Recently, we learn, they have been culling these disks more closely.

If, when the disk is ground, the grinding intersects bubbles, a thin edge is usually created and any fragments breaking loose may scratch the glass. Different amateurs have used various methods of anticipating these troubles and heading them off in time (when the first break-through occurs) by reaming them out. Our file on this subject shows that M. J. Ireland, Dearborn, Mich., used a twist drill and abrasive grains. Edward P. Woodcock, Long Beach, Calif., used the rear end of a twist drill or a rat-tail file with abrasive grains. Lew Lojas, New York, put a round-head screw in a drill brace and similarly used abrasive grains. Woodcock further commented: "Because the bubbles do not materially affect the surface optically, they can do little harm if left alone, provided the edge looks safe from chipping, as in cases where they lie perpendicular to the face."

H. H. Selby, of California, after having some perplexing difficulty with mysterious scratches, found bubbles to be the cause. "After each wet," he says, therefore, "I dried the surface, scrubbed the bubbles hard with a toothbrush and shellac and, after ten minutes, scraped off the excess. During this scrubbing, the brush broke the thin edges of the glass and the shellac sealed in the fragments."

INVENTION of the telescope is generally credited to Jan Lippershay, who in 1608 arranged a convex lens in front of a concave. Bell, in "The Telescope," says Lippershay's telescope was far, however, from being an astronomical instrument. In the following spring Galileo heard rumor of this instrument that made distant objects seem near, sat down and, in one evening, independently figured out an arrangement of lenses which would accomplish this end and it magnified three diameters. Galileo, as Bell states, soon developed this crude beginning into a real instrument of research, magnifying 32 diameters. This telescope is on display in a museum in Florence, behind glass, and your scribe in 1928 slipped the guard there 50 cents to open the case and place a step-ladder before it, so he could climb up close for a little veneration at this fane. Main credit for the invention of the astronomical telescope rightly goes to Galileo; he (1) really made something of it and (2) did important research with it. Moreover, Galileo, not a meek man, fought for his discoveries and gave them publicity, when he could have kept out of hot water merely by being tactful and agreeable. This probably had very much to do with their survival.

While visiting the exhibition of the scientific achievements of Leonardo da Vinci, described on page 332, with Russell Porter, your scribe stumbled on the two grinding machines shown in Figures 7 and 8. If Galileo, who lived from 1564 to 1642, gave us the first astronomical telescope, what was Leonardo da Vinci, who lived from 1452 to 1519, or roughly a whole century earlier, doing with these designs? Porter and Ingalls looked at one another and remarked, "What does it mean?" Were the histories of science then all mistaken? "Better look into that," said Porter, and took a train for California.

The machine in Figure 7 was accompanied by a label stating that it was "a model of a hand-operated machine for grinding a concave lens for a telescope or other instruments." The radius beam on the one in Figure 8 bore the label, in Italian, "Leonardo made this up to 12 meters long." The first machine has a stub lever beneath the bed-plate, with a notch on which a weight could be hung to hold the disk against the grinding wheel, just as it is shown in the photograph. The remainder of the mechanism is obvious. (While the lantern gear may look antique, be it remembered that

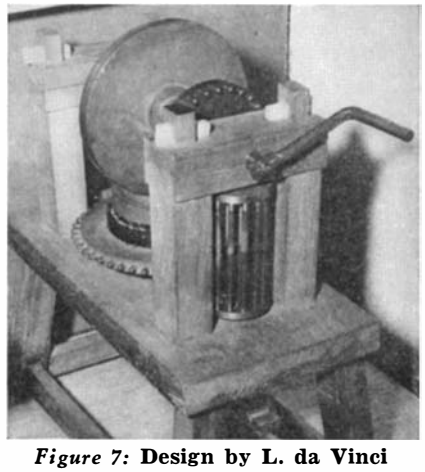

Figure 7: **Design by L. da Vinci**

in Leonardo's time a man couldn't simply turn to the Chicago or Boston Gear Works catalog and select a gear; he had to make his own. Moreover, some of these old gears were not so inefficient as one might think.) The machine in Figure 8 is crank-operated (crank at right-hand end removed in photo) and causes the convex metal sector on the nearer end of the long radius beam to traverse the disk. Evidently the crank man must go into reverse after each two or three turns.

At the offices of the New York Museum of Science and Industry, it was learned that Prof. Georgio Nicodemi, Director of the Department of Fine Arts of the Common of Milan, also Director of Museums in Sforza Castle and an outstanding authority and

writer on Leonardo, had accompanied the exhibition to New York. When hunted up and questioned, through an interpreter, he said that the question of Leonardo's possible priority of invention of the telescope had been the subject of recent discussion in Italy, and he kindly offered to prepare a note summarizing these discussions.

It appears that Prof. Claudio Argentieri has discovered some pages of Leonardo's original notes which have not yet been published. "The most surprising of Argentieri's observations," Prof. Nicodemi writes, "are those concerning the telescope. On folio 25*r*, of Codice F, which is now in the Institute of France, in Paris, Argentieri noticed, under a figure of a large tube mounted on a stand, the

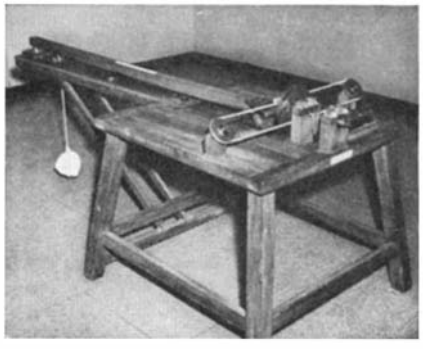

Figure 8: **Another L. da V. design**

words, 'This eyeglass of crystal must be flawless and very clear, and is to be thin in the center.' The note obviously refers to a negative lens. Other notes on the same sheet leave no doubt that Leonardo wished to design a magnifying instrument, and still others explain that one lens was to be plano-convex. Brief writings in Codex E and Codex A [exact references available to any interested reader.—Ed.] indicate that Leonardo intended his telescope for astronomical applications."

Prof. Nicodemi goes on to state that Leonardo improved his telescope by using a concave mirror with a catacaustic curve but without an eyepiece. The machines shown in Figure 8 might have been used for roughing out such a mirror.

Since Leonardo couldn't have used a concave lens alone as a telescope, though he could use a convex, it seems possible that he had used the two in combination—that is, the arrangement now known as "Galilean;" apparently he also used a concave mirror without eyepiece. But in any case, he omitted to publish an account of his telescopes, thus losing credit if this were his due; incidentally, delaying availability of the telescope to the world for about a century.

Whether this would have opened up man's cramped horizons in Leonardo's times, as it later did in Galileo's, and accelerated the Age of Science as much, is, of course, a question. Our guess is that, today, the 200" telescope would be a back number.

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Labor Labels

JUDGE THOMAS GLYNN WALKER of the Federal Court in New Jersey, in a decision of unusual interest, has restrained the imitation of the label of a labor union.

The suit was filed by a printing-trade union against a corporation bearing the words "Printers Union" in its corporate name. The Court found that the plaintiff was a voluntary association of working men; that it had adopted a distinctive label which was registered as a trade mark for stationery and that it permitted printing establishments employing members of the union to place the union trade mark or label upon its products.

The Court also found that the defendant, despite the fact that its corporate name included the words "Printers Union," was organized and supported by non-union printing establishments; that it had adopted a label which simulated in many respects the union label, and that in one instance the label of the defendant had been mistaken for the label of the printing trade union. The Court found that the simulation of the label constituted trade-mark infringement and that the defendant's entire course of conduct constituted unfair competition.

In reaching its decision the Court pointed out that the defendant had evidenced bad faith by seeking to represent itself as a trade union when, as a matter of fact, it was an organization supported by non-union printing establishments. The Court then pointed out that the defendant, having represented itself as a trade union, "then went a step further and sought to convey the impression that its label was in fact the label of" the plaintiff. It concluded that the use of the word "Union" in the defendant's corporate title, the use of a union label, the use of the words "Union label" and the use of a label deceptively similar to the plaintiff's label, "are with many of the other things herein shown by the record, the parts which, when put together, form the finished mosaic whereby the fraudulent design of the defendant is clearly spelled out."

Non-Exclusive

A NON-EXCLUSIVE licensee under a patent cannot bring suit for infringement of the patent.

This question arose in a rather unusual manner in a Federal Court suit for patent infringement. After the suit was filed, the plaintiff discovered that he did not own the patent but merely held a non-exclusive license under the patent and made a motion to dismiss the suit.

The defendant had filed a counter claim in the suit asking for a declaratory judgment, finding the patent invalid and not infringed, and sought to prevent the dismissal of the suit for the reason that he had incurred a great deal of expense in preparing for the defense thereof.

The Court found, however, that since the plaintiff was merely a non-exclusive licensee, there was no legal controversy between the parties and dismissed the suit.

Technical

WE have previously pointed out that our copyright law is highly technical and requires literal compliance therewith. No portion of the law is more technical than that dealing with the notice of copyright which must be affixed to the copyrighted work. This is exemplified in a recent suit involving copyrighted advertisements.

An advertising agency prepared a series of advertisements to be used by banks. The agency sold the advertisements to subscribing banks who reproduced the advertisements in newspapers and other periodicals. The agency had bound the advertisements in a volume which was copyrighted as a book. Thereafter a bank reproduced several of the advertisements without license or permission of the agency and suit was brought against the bank for copyright infringement.

One of the defenses raised by the bank was that the agency had failed to affix to each copy of the advertisements, which were reproduced and sold, the proper copyright notice required by law.

The copyright law provides in part that every copy of the copyrighted work must contain the required notice and failure to include the notice results in abandonment of the copyright. The law also provides that in the case of a book the required notice shall consist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor.

In the case of certain works such as prints and pictorial illustrations the law provides that the notice may consist of the letter "C" enclosed within a circle and followed by the initials of the copyright proprietor.

——LEGAL HIGH-LIGHTS——

The Court found that the bound volume of advertisements contained the proper notice required by the copyright law for books. However, in actual practice, the advertisements were not published in a volume as a unit, but were separately reproduced and published. The only notice appearing on the individual advertisement was the letter "C" enclosed within a circle together with the abbreviation of the advertising agency and this was so small as not to be legible without the aid of a microscope or glass.

The Court held that this notice did not comply with the requirements of the statute and concluded that the copyright had been abandoned. It was pointed out by the Court that the individual advertisements might well be considered as prints or pictorial illustrations and could have been copyrighted as such. If they had been so copyrighted, the form of the notice would have been proper. Since, however, they had been bound together in a volume and had been copyrighted as a book, compliance with the statute required that the notice should consist of the word "copyright" or the abbreviation "copr" followed by the date and the name of the copyright proprietor.

Rubber Sandpaper

A FLEXIBLE abrasive article similar to sandpaper, comprising abrasive grits or particles, held in a bond of a rubber isomer, was held to be patentable by a Federal Court.

The inventor of the article had applied for a patent and the Patent Office had refused to grant the patent on the grounds that there was no invention involved because prior patents showed it to be old to hold abrasive grits in a bond of raw or vulcanized rubber. The substitution of a rubber isomer bond for the rubber bonds shown in the prior patents, was not considered by the Patent Office to be patentable.

The inventor filed suit in a Federal Court against the Commissioner of Patents and the Court held that the invention was patentable and ordered the granting of a patent. In its decision the Court pointed out that the advantage of using a flexible rubber bond in an abrasive article such as sandpaper had long been recognized. However, prior to the invention under consideration, no satisfactory rubber bond had been developed. Some of the difficulties encountered were that a sufficient bond between the rubber and abrasive particles could not be obtained, and ordinary rubber had a tendency to clog or to become gummy in use.

The Court found that the use of a bond made of a rubber isomer overcame these difficulties and for the first time solved the problem of providing an abrasive article similar to sandpaper in which the abrasive particles were held in position by a satisfactory rubber bond.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

HOW TO MAKE TALKING PICTURES AT HOME is a completely illustrated description of the Presto Syncro-Sound recorder and its operation. With the equipment described, any amateur movie photographer can produce high-quality talking movies. All accessories are listed and prices are given. *Presto Recording Corporation, 242 West 55th Street, New York City.—Gratis.*

ELECTRICITY AND WHEELS is a 32-page illustrated booklet that presents the fundamentals of electricity and magnetism as applied particularly to the modern automobile. The explanations are given in simple language accompanied by interesting and instructive drawings. *Department of Public Relations, General Motors Corporation, Detroit, Michigan.—Gratis.*

LEAD-TIN-ARSENIC WIPING SOLDER is a five-page discussion of solders and their application to wipe joints which are used in the installation of lead-sheathed telephone cable.—*Bell Telephone Laboratories, Inc., 463 West Street, New York City.—Limited free distribution.*

THE STORY OF SUPERFINISH is a 670-page completely illustrated book, bound with hard covers, that tells the story of this new finishing method for moving parts of machinery. Superfinish, briefly stated, is a method of producing machinery bearing surfaces which will give maximum wearing qualities under heavy-load conditions. *Lynn Publishing Company, 5106 Buckingham Avenue, Detroit, Michigan.—$5.00.*

PLEXIGLAS is a 44-page illustrated booklet that covers the principal properties and more important applications of cast Plexiglas sheet and Crystalite molding powder. Both of these materials are crystal-clear plastics that are finding wide use in a broad range of industries. *Rohm & Haas Company, Inc., Washington Square, Philadelphia, Pennsylvania. —Gratis.*

HYGRADE MIRALUME is a 24-page catalog illustrated in two colors showing a complete range of fluorescent lighting units for business and industry. *Hygrade Sylvania Corp., Ipswich, Massachusetts.—Gratis.*

GE PHOTO DATA BOOK is a 110-page booklet, 3 by 5 inches in size, edited by Karl A. Barleben, F.R.P.S. Packed with technical data of all sorts, including film speed values, flash and flood data, filter data, together with various formulas, the book makes a handy reference that fits nicely into the vest pocket. One of the features of the booklet is an article by Mr. Barleben on "Why and How I Use the G-E Exposure Meter." It also contains a personal exposure record and calendars. *General Electric Co., Schenectady, New York—Free to purchasers of General Electric exposure meter, 50 cents to others.*

SKF SPHERICAL ROLLER BEARINGS is a 36-page catalog that describes and illustrates roller bearing applications in mining, steel, paper, oil, railroad, and allied fields. It also presents information on bearing selection, bearing computations, and various types of roller-bearing design. *SKF Industries, Inc., Front Street and Erie Avenue, Philadelphia, Pennsylvania. —Gratis.*

THE RADIO CONTROL INSTRUCTION MANUAL gives complete data on circuits, systems, and equipment for radio control of models, particularly as applied to gasoline-powered model airplanes. *Radio Control Headquarters, Inc., Granby, Connecticut.—10 cents.*

WHO PAYS THE COST OF HIGHWAYS? is an illustrated booklet that briefly answers pertinent questions regarding highway transportation. It gives direct comparisons with costs in rail transportation. *Association of American Railroads, Transportation Building, Washington, D. C.—Gratis.*

STEEL MAKES THE HOME is a 32-page fully illustrated booklet showing various applications of steel in modern home construction. *American Iron and Steel Institute, 350 Fifth Avenue, New York City.—Gratis.*

GIBSILOY ELECTRICAL CONTACTS is a 16-page catalog which describes a complete line of electrical contacts made from ductile powdered metals. Numerous photographs illustrate various contacts and contact assemblies. Technical data are included. Request catalog C-10 on your business letterhead. *Gibson Electric Company, 8362 Frankstown Ave., Pittsburgh (21), Pennsylvania.—Gratis.*

DEVELOCHROME is an 18-page pocket-size booklet specifically concerned with a new toning developer for use by amateur as well as professional photographers. Using this method it is possible to produce, by direct development, prints in practically any color. *Fink-Roselieve Co., Inc., 109 West 64th Street, New York City.— Gratis.*

THE INSTALLATION AND USE OF ATTIC FANS, by W. H. Badgett, is a 46-page booklet that has been prepared for the use of architects, builders, and home owners. Its scope is limited primarily to residential applications. Profusely illustrated with photographs and detailed drawings, and written in non-technical style. Bulletin No. 52. *School of Engineering, Texas Engineering Experiment Station, College Station, Texas.*

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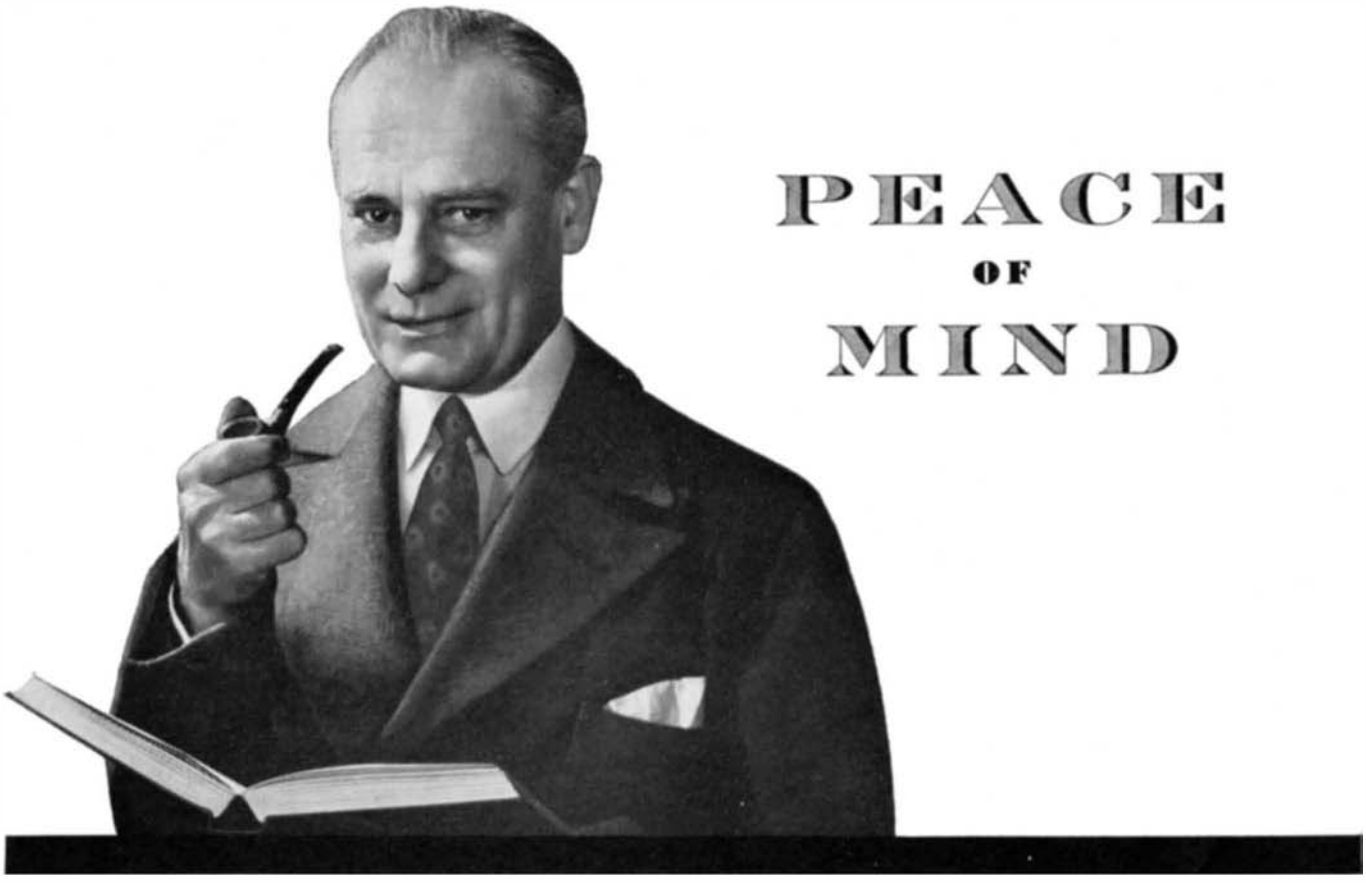

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THE RADIO INDUSTRY has answered the call to national defense with an "all out" acceleration of creative activities. In research, in operation, in production—from blueprint to wavelength—the watchword is Service for the Needs of Uncle Sam!

For radio today has attained front-line rank in the national defense program. Its magic voice keeps our citizens informed, unites our nation as a vast community for free discussion. It links together the 21 republics of our hemisphere in bonds of friendship and mutual interest. It enables us to communicate around the world, to reach out to ships at sea, and to guide our aviators through fog and night.

Whole-hearted Response

As a leader in radio research, as the only company that makes and does everything in radio, the Radio Corporation of America is proud of its call to duty. It eagerly enlists its facilities and personnel in the service of the American people.

The emergency finds RCA fully prepared. Months ago the "must" orders went to every subsidiary of the company, with the result that at the present moment it is making daily contributions through its great laboratories, ceaselessly active in research—through its manufacturing company, in the production of radio apparatus—through communications, flashing message traffic around the earth—through radiomarine, in all-round communication service at sea—and through the National Broadcasting Company, in nation-wide, world-wide broadcasting. To fill the need for men with technical skill, RCA Institutes is training radio operators.

Accepting the Challenge

Using all the resources at its command, the Radio Corporation of America is meeting every demand for service—with expanded facilities, increased production, with smooth functioning speed.

In assuming its vital share in national defense, RCA realizes its opportunity to help preserve the unity and integrity of our national life. Each of its thousands of employees pledges his energies and enthusiasm to producing all needed equipment on schedule, to making America's radio communication system the most efficient on earth.

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