POWER SOURCES OF THE FUTURE . . . Page 164

SCIENTIFIC AMERICAN

OCTOBER • 1942

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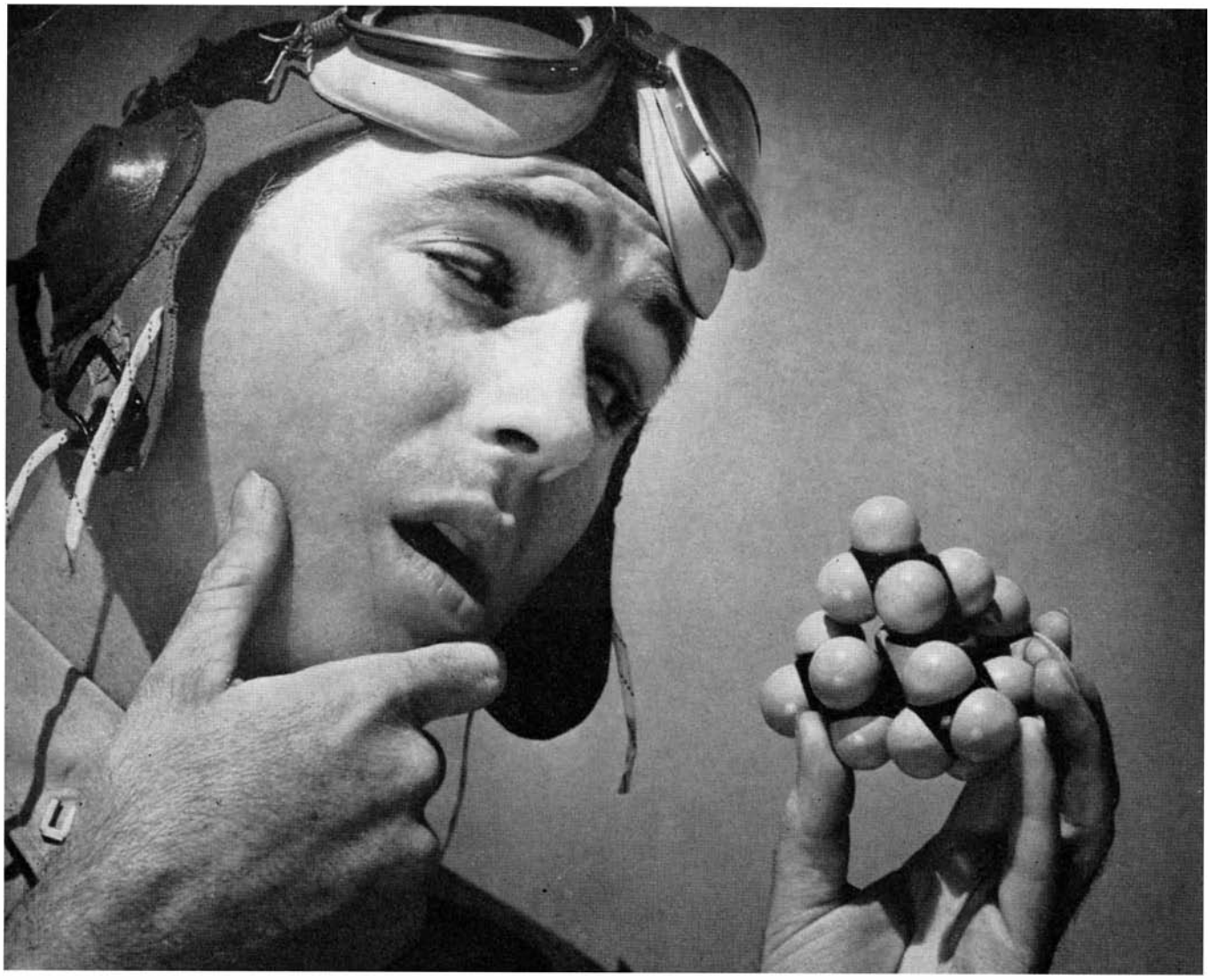
One-Man Parachute Boat for Fighter Pilots



"Do you mean to say I have these things in my gas tank?"

YES, Lieutenant. Millions of them are mixed with your gasoline to give your plane more speed and power. What you have in your hand is a chemist's model—100 million times life size—of a molecule of one of the ingredients of Ethyl fluid.

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FIGHTER pilots, forced down in water, may now have recourse to the fully equipped rubber boat shown under test in our front cover illustration. More details of this boat and of its life-saving features, will be found on page 178.

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SCIENTIFIC AMERICAN

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NINETY-EIGHTH YEAR **ORSON D. MUNN, Editor**

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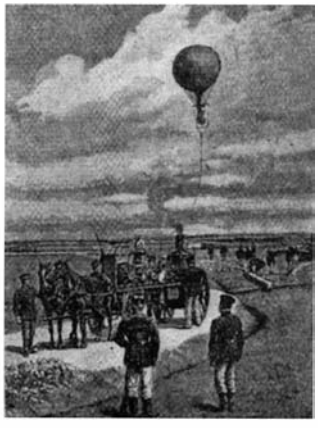
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of October, 1892)

TELEPHONE—"The perfection of the science of long distance telephony has been going on for the past five or six years, until an epoch of much interest has finally been reached; that is the perfect transmission of articulate speech for a distance of one thousand miles and over. . . An important element in the success of long distance telephony is the improved battery now used for energizing the transmitter, which has the merit of maintaining a nearly uniform electro-motive force of high tension for an extensive period of time. . . The long distance transmitter also has been improved by using in it one uniform size of carbon granules, obtained by passing them through a sieve of a certain mesh."

BALLOONS—"In Europe, the principal governments now have ballooning corps attached to their armies, by means of which observing balloons may be readily transported and quickly inflated on the field. . . The German military balloon car is suspended from a trapeze, which lessens its oscillation. . . The rope-winding mechanism, by which the height of the balloon is regulated, is arranged upon a strong wagon, and is operated by a steam engine, the whole presenting the general appearance of a steam fire engine. The hydrogen gas for inflating the balloon is carried to the field in highly condensed form in separate steel cylinders. In operation a central steel cylinder, of larger size than the others, is laid upon the ground and the smaller cylinders are then attached to its sides. A flexible pipe at one end of the large cylinder conducts the gas to the balloon."



CHOLERA—"In Asia and Russia the cholera has carried off many thousands of poor people, chiefly by reason of the filth in which the victims lived and the lack of proper medical treatment. In Europe the disease made no alarming progress, except in Hamburg, where it was brought from Russia, and, owing to the dirty condition of the town and the supineness of the authorities in adopting proper sanitary measures, the advance of the disease became rapid and ominous. . . Hamburg is notorious for its crowded and filthy tenements. . . It is a peculiarity of this disease that its spread may be readily checked and controlled by the early adoption of intelligent precautionary means and regulations."

BAKU—"The supply of crude petroleum at Baku, on the Caspian Sea, is apparently inexhaustible, but until within the last ten years the town has been practically isolated from the rest of Europe, a long and troublesome journey being required to get to it. This has now been changed, and Baku at present has steam communication with all parts of Europe. The Nobel brothers have borne a prominent part in developing the petroleum industry here, laying the first pipe lines, employing tank steamers for conveying the product, and taking the lead in employing petroleum as fuel for the steamers. There is now not a vessel on the Caspian using wood or coal, liquid fuel being employed exclusively."

AMPHIBIAN—"Seldom have land and water been laid under contribution by a single mechanical device. It remained for the genius of a citizen of Chicago to devise a machine for both use and pleasure, which should enable his fellows to traverse with great speed either land or water, proceeding readily from one on to the other. . . It consists of twin boats rigidly connected and a tricycle connected to said boats so ingeniously aranged that the machine is propelled and steered by the same mechanism. This machine has the most perfect stability in either element."

TRACTOR—"Peter Chalmers, a farmer, is a genius in his line. When anything new comes out he studies to see whether it cannot be adapted to use on his farm. . . All the plowing done on Chalmers' big ranch is done with a traction engine. . . Now the farmer is hauling wheat to town with his engine. He brought a load in recently and stored it at the Stockton Warehouse. There were nine wagons in the train, and each carried sixty-eight sacks of grain. Each sack weighs, on an average, 137 pounds, so each wagon load was 9,316 pounds, and the aggregate of all the wagon loads 83,844, or nearly forty-two tons. . . The engine can haul the train at the rate of four miles and a half an hour, but to prevent jolting the speed is regulated to about three miles an hour."

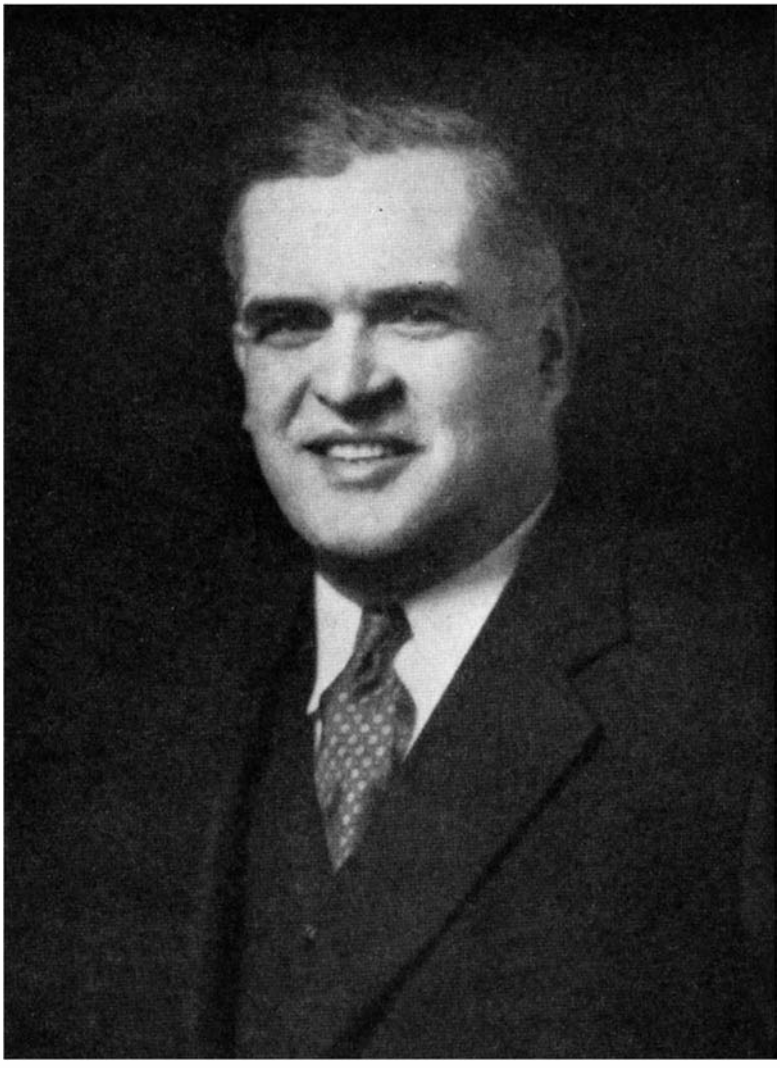
EDISON—"The village of Ogden, N. J., now known as Edison, has been built up within the last two years. . . When Mr. Edison invented the magnetic ore separator, he organized the New Jersey and Pennsylvania Concentration Company, and a plant was established at Ogden, the name of which was then changed to Edison. The ore as taken from the mine is run through enormous crushing machines, and then passed through the Edison separator, where powerful magnets attract all the metal, which is afterward run into pigs."

SOUND STEAMER—"The new twin-screw steamboat Richard Peck, built by the Narlan & Hollingsworth Company, at Wilmington, Del., for the New Haven steamboat line, made 20¼ miles an hour on her trial trip recently. The boat is 316 feet long over all, 48 feet beam over guards, and has a depth of hold of 18½ feet. Her horse power is 4,000 and her gross tonnage is 2,906."

FAN—"A fan attachment for rocking chairs is to be applied to a platform rocker, and, as one rocks backward and forward, a continuous rotary movement will be imparted to a fan held above the occupant of the chair, affording a constant and refreshing current of air."

COAST-WISE—"The proposal to establish an inland waterway between the Atlantic coast cities is once more under consideration. In its amplest form such a route would extend from Massachusetts Bay to Texas, making use of sounds and bayous as well as of existing canals as far as possible. This form of the enterprise contemplates the cutting of three new canals, through Cape Cod, Maryland, and the Florida peninsula; and as its expense would mount into the hundred millions, it is not likely to find favor at present."

Personalities in Industry



DR. CHARLES B. JOLLIFFE

AWARE that this is a "radio war" as much as it is a clash of mechanized forces, Dr. Charles Byron Jolliffe, Assistant to the President, Radio Corporation of America, and Chief Engineer, RCA Laboratories, is giving every ounce of his energy to furthering the all-important role of radio in supplying the "nervous system" for the nation's war machine.

"Radio provides the long-range eyes and ears of field troops, tanks, airplanes, and warships," says Dr. Jolliffe. "Therefore, it is up to the American radio industry to see to it that our armed forces are equipped with radio 'eyes and ears' that will out-perform anything that the Axis powers may devise."

Holding down a multi-phased job of liaison, technical counsel, and coordination between his company, all the activities of which are closely geared to the war effort, and various Government officials and agencies is Dr. Jolliffe's personal way of outdoing the enemy.

As Chief Engineer of RCA Laboratories—a post that includes direction of the RCA Frequency Bureau—Dr. Jolliffe directs and coordinates the broad engineering policies of RCA, represents the corporation, and directs its representation before public and governmental bodies.

As vice-chairman of Division C of the National Defense Research Committee, Office of Scientific Research and Development; as secretary of the Industry Advisory Committee of the Defense Communications Board; and as a member of the Engineers Defense Board, he contributes liberally of his broad knowledge of radio practices and potentialities.

In fact, Dr. Jolliffe is equipped by education, training, and experience as few other men are for his multiplicity of responsibilities. A big man physically, he has a big capacity for labor. Ask him how he is able to accomplish as much as he does, and he replies: "I just go ahead and do the job." There is more to it than that, however. Some of his associates say that he has been known to work twenty-four hours at a stretch. This doesn't mean that he works that way as a rule, but it does signify his willingness to keep going until the job at hand is completed.

Born in Mannington, West Virginia, November 13, 1894, he developed an early interest in physics and chemistry, concentrating on these two subjects at West Virginia University, from where he was graduated, with a bachelor's degree in science, in 1915.

During the years from 1915 to 1922, he continued his studies while serving as an instructor of physics at West Virginia University and Cornell University. He won his M.S. from West Virginia in 1920 and his Ph.D. from Cornell in 1922. Also in this period, from March, 1918, to February, 1919, he was attached to the United States Army Air Service, Science and Research Division. In May of this year, Dr. Jolliffe was awarded the honorary degree of LL.D. by West Virginia University.

From 1922 to 1930, Dr. Jolliffe was a physicist in the Radio Section of the U. S. Bureau of Standards, Washington, D. C., rising to the position of Assistant Chief of the Section. His research on radio-wave propagation and the development and maintenance of frequency standards resulted in several scientific publications and helped to form the basis for regulations which brought order out of the chaos into which broadcasting had fallen.

In March, 1930, Dr. Jolliffe was appointed Chief Engineer of the Federal Radio Commission, continuing in this capacity when the organization was changed to the Federal Communications Commission in July, 1934. He resigned from the FCC in November, 1935, to become Engineer-in-Charge of the RCA Frequency Bureau. He was appointed Chief Engineer, RCA Laboratories, in March, 1941, and Assistant to the President, RCA, in January, 1942.

98TH YEAR SCIENTIFIC AMERICAN OCTOBER 1942

SLENDER, SPEEDY, SCRAPPY

Destroyers Are Highly Important Factors in Naval Warfare

WALTON L. ROBINSON

OF THE various types of combatant ships in the world's navies the destroyer is, without doubt, the most versatile and hardest fighting. Armed with torpedoes, guns, and depth charges, she is a deadly menace to the enemy on, above, and beneath the sea. Long, slender, and speedy, she possesses great maneuverability and hence offers an exceptionally difficult target to hostile warships, aircraft, or submarines. But once hit by a torpedo, bomb, or heavy shell, the destroyer is in a serious plight, for her construction is very fragile and not intended to withstand any really hard blows. The experience last year, however, of the U.S.S. *Kearney*, one of our latest destroyers, is an excellent example of the severe punishment one of these boats can sometimes receive and yet reach port under her own power.

America and Britain urgently need more and more destroyers and other anti-submarine craft to combat the grave Axis U-boat threat in the North Atlantic. We must have as many destroyers and sub-chasers as possible in order to smash the enemy's U-boats faster than he can turn out new ones. Destroyers are, everything considered, the best all-'round anti-submarine type yet developed, especially for deep-sea convoy work. These remarkable boats can also perform several other important missions, among them torpedo attacks on hostile battleships, aircraft carriers, and cruisers in a major engagement. Their various functions were fully covered in an article which appeared in Scientific American for February, 1942.

The United States Navy is exceptionally well provided with destroyers. Our shipyards, furthermore, are turning out new ones at an astonishing rate. As of December 1, 1941—just a week before Pearl Harbor—we had 171 destroyers in commission and 191 others under construction or on order. Britain possessed some 230 in service and Japan about 125, of which at least 20 were small units (torpedo boats) of only 500 to 800 tons.

● Fourth analytical article of a series on ships of the United States Navy. The fifth, on submarines, is scheduled for publication in November. Previous articles were on battleships, carriers, and cruisers, published in May, August, and September of this year. —The Editor. ●

OUR destroyer strength included 72 boats of World War I vintage. With the exception of the 920-ton *Allen,* all of these old destroyers were of the well-known "flush deck" type. The *Allen,* completed in 1917, was of still earlier design and the sole survivor of her class. Her armament consists of four 4-inch, 50-caliber guns, two 3-inch, 23-caliber anti-aircraft weapons, and twelve torpedo tubes firing "tin fish" of 21-inch diameter. Designed speed is 29.5 knots, obtained by 17,000-horsepower geared turbine engines driving two propellers. Although having four funnels like the "flush deckers," the *Allen* can easily be distinguished from them by her raised or broken forecastle. Despite her 25 years, of which 18 were spent in reserve, she can still make things quite uncomfortable for Axis undersea raiders.

The "flush deckers," commissioned between 1918 and 1922, were the survivors of a class which at one time consisted of 273 units. Eleven had been lost by shipwreck or other accident, 93 stricken from the list and sold or scrapped, 50 traded to Britain for base rights, and one, the *Reuben James,* sunk by a Nazi U-boat (October 31, 1941). The remaining 46, their torpedo tubes and some of their guns removed, were serving in various auxiliary capacities: 16 as fast minesweepers, 14 as seaplane tenders, 8 as light minelayers, 6 as fast transports for Marine landing forces, and 2 as experimental vessels.

The 71 units still rated as destroyers ranged in displacement from 1060 to 1193 tons and were armed or had originally been armed with twelve 21-inch torpedo tubes in triple deck mountings, two on either beam. All of them carried four 4-inch guns except the *Brooks, Fox, Gilmer, Hatfield,* and *Kane,* which had four 5-inch, 51-caliber weapons.

ALL of these destroyers are now very nearly worn out, but, like the *Allen,* can still engage effectively in anti-submarine work. Most of them are believed to be on escort and patrol duty in the Atlantic. Others, presumably, were with the Asiatic Fleet when hostilities with Japan commenced. They acquitted themselves well, particularly in night torpedo attacks on heavily escorted Jap convoys in the Macassar, Lombak, and Bali Straits, and in the ill-starred cruiser action of the Java Sea. Eight of them were lost during the first six months of war: the *Pope, Stewart, Pillsbury, Edsall,* and *Peary* in the Far East and the *Jacob Jones, Truxton,* and *Sturtevant* in the Atlantic.

A decade passed between the commissioning of the last of the "flush deckers" and the laying down of the U.S.S. *Farragut*—the first of our rapidly expanding force of modern destroyers. Work on the *Farragut* was begun in September, 1932, by the Bethlehem Steel Company, Quincy, Massachusetts. Seven sister boats were laid down during the next year and a half. All eight units were completed in 1934-35 at an average cost of over

$3,500,000. Their displacements range from the 1345 tons of the *Dewey* to the 1410 tons of the *Worden*. They mount five 5-inch, 38-caliber "dual purpose" guns, four or more 1.1-inch anti-aircraft machine guns, and eight 21-inch torpedo tubes in quadruple mounts along the center-line. Geared turbine engines, developing 42,800 horsepower and driving two screws, give the *Farraguts* a designed speed of 36.5 knots. Trial speeds in excess of 41 knots have been reported. Four Yarrow high-pressure boilers provide steam for the turbines. Oil fuel capacity is 400 tons, sufficient for a cruising range of well over 6000 miles.

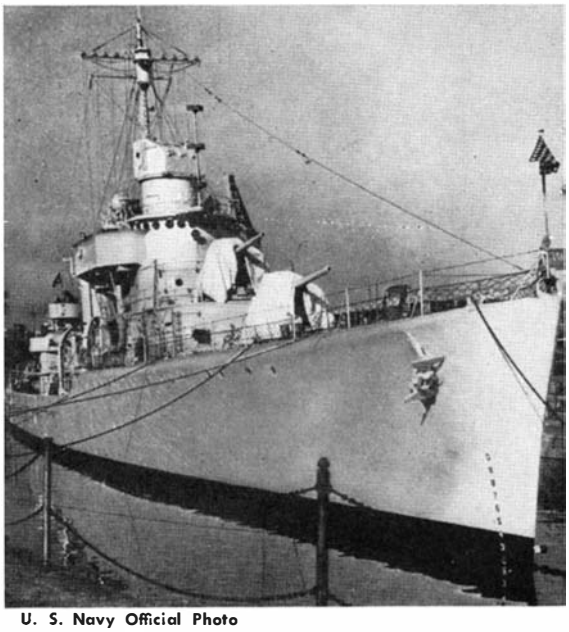
U. S. Navy Official Photo

***USS Anderson, Sims* class, combines many successful features**

THE *Farraguts* differ widely in appearance from the "flush deckers" and represent a considerable improvement over them. They have a raised forecastle and only two funnels instead of the flush deck and four funnels of the older boats. They are faster and better steamers, have a much steadier gun platform, and are not so wet forward in heavy seas. These superior nautical qualities obtain in all of our modern destroyers.

In 1933-34 twenty-four destroyers were laid down. Eight of them belonged to the *Porter* class and the remainder to the *Mahan* class. The former were large, powerfully armed boats of an entirely new design, intended to operate as squadron leaders. They displace 1805 tons and mount eight 5-inch guns, at least ten smaller anti-aircraft weapons, and eight 21-inch torpedo tubes. The 5-inch guns are paired in enclosed shields, superimposed, two forward and two aft, giving these boats an appearance very similar to a light cruiser's. This resemblance is increased by the heavy tripod masts with their searchlight platforms. The torpedo tubes are grouped in fours on high revolving mounts, one between the two funnels and one between the second funnel and the mainmast. Designed speed is 37 knots, obtained by 50,000-horsepower engines. On trials 39 knots were attained without difficulty. About 600 tons of fuel oil can be carried. Each boat cost about $4,000,000 to build.

The 16 units of the *Mahan* class, all completed in 1936-37, were an enlargement of the *Farragut* design. Two of them, the *Cassin* and *Downes,* sank under Jap air bombs at Pearl Harbor, while a third, the *Shaw,* had her whole forepart demolished. With a temporary bow fitted, however, she reached a West Coast port for permanent repairs.



U. S. Navy Official Photo

***USS Ellyson* carries 5-inch guns**

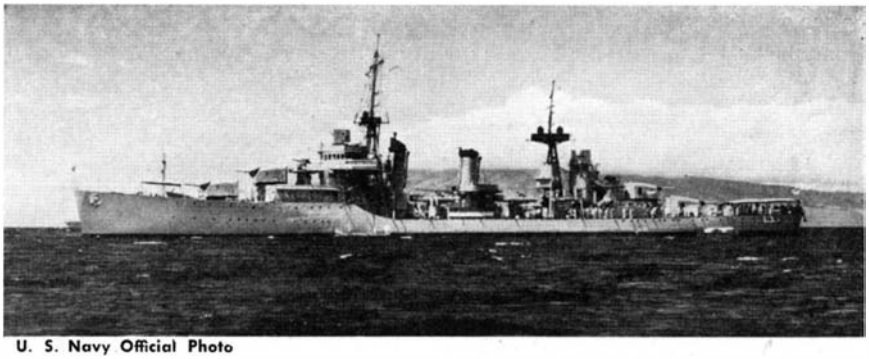
On displacements ranging from 1450 to 1500 tons, the *Mahans,* as compared with the *Farraguts,* carry four additional torpedo tubes and about 100 tons more fuel oil. The foremost set of tubes is on a high center-line mount between the funnels, while the remaining two sets, one on either beam, are mounted on the deck and abaft the second funnel. Originally these boats could be distinguished from the *Farraguts* by their tripod foremast, light mainmast stepped right behind the second stack, and No. 3 gun (5-inch) on the after shelter deck (instead of abaft the second funnel, as in the *Farraguts*). Recently, however, pole rig has replaced the tripods, and mainmasts have been removed from some units.

FOURTEEN destroyers, 10 of the *Craven* class, two of the *Dunlap* class, and two of the *Somers* class, were laid down in 1935. The *Cravens* are 1500-tonners with four 5-inch guns and sixteen torpedo tubes—the heaviest torpedo armament ever fitted in a destroyer and equalled only in the 7500-ton British cruisers *Emerald* and *Enterprise.* Their two forward 5-inch guns are mounted singly in enclosed shields, while their torpedo tubes are in quadruple mounts, two on either side of the deck. Designed horsepower and speed are the same as in the *Mahan* and *Farragut,* but fuel oil capacity has been increased to 600 tons, giving a range of more than 8000 miles at 15 knots. The *Cravens* can readily be distinguished from our earlier destroyers by their single, flat-sided funnel. In 1936-37 work on 12 additional boats, differing slightly in appearance and known as the *McCall* class, was commenced. In them the freeboard amidships, between the forecastle and the foremost sets of torpedo tubes, was raised several feet in order to keep out heavy seas. One unit of the group, the *Benham,* considerably exceeded 40 knots on her trial runs, thereby smashing all speed records for American destroyers.

The *Dunlap* and *Fanning,* commissioned in 1937, are generally similar to the *Mahans,* differing from them only in having their forward 5-inch gun in enclosed shields.

The 1850-ton *Somers* and *Warring-*

ton and three sister boats laid down in 1936 (*Sampson, Davis,* and *Jouett*) are logical developments of the *Porter* design. They have an extra set of torpedo tubes, slightly increased horsepower (52,000), a single funnel, and greatly reduced rig. Their 12 torpedo tubes, mounted quadruply on the center-line, enable them to fire the world's heaviest torpedo salvo. A pole foremast replaces the tripod of the *Porter,* while the mainmast is a mere stump, intended only as a flag-staff.



U. S. Navy Official Photo

***USS Clark, Porter* class: Powerfully armed, entirely new design**

Twelve 1570-ton *Sims* class boats, combining the most successful features of the *Dunlap* and *McCall* designs, were begun in 1937-38. Their armament was similar to the *Dunlap's,* while in general appearance they closely resembled the *McCall.* Under service conditions, however, serious defects in stability developed. These were remedied in the earlier units by adding 60 or more tons of steel to the keel as ballast, while in later boats weight was saved by reducing the thickness of the plating for decks and superstructure. As finally completed, therefore, the *Sims* class actually displaced from 1640 to 1670 tons and carried five 5-inch guns and eight or 12 torpedo tubes. Enclosed shields were provided for guns Numbers 1, 2, and 5, and light armor protected the bridges and control positions. Features of the design were the rounded lines of the forecastle and forward superstructure, which gave these boats a distinctly streamlined appearance. They were refitted last year and given additional anti-aircraft guns, and torpedo armament was reduced to eight tubes.

U. S. Navy Official Photo

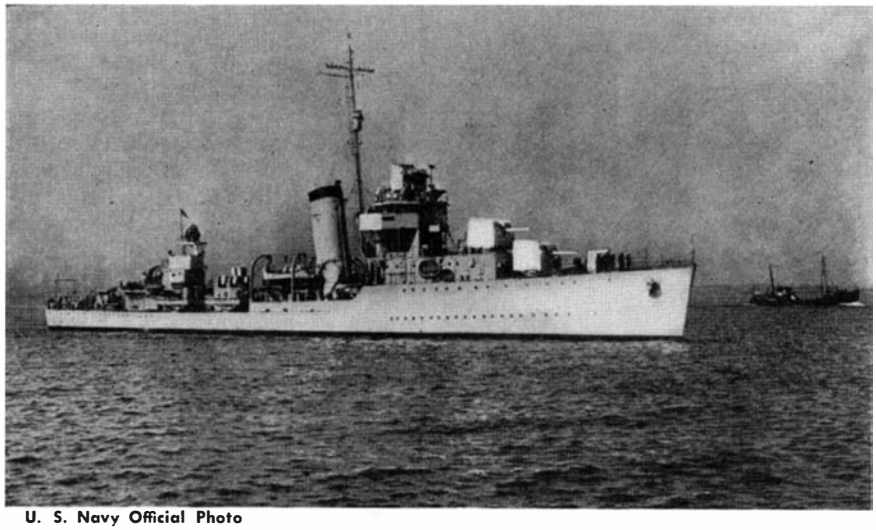
***USS Dewey, Farragut* class, has reported speed of 41 knots**

In 1938-39 twenty-four *Benson* class destroyers, two-funneled modifications of the *Sims* design, were laid down. They were the last of 97 destroyers built under the qualitative limitations of the 1936 London Naval Treaty. All entered service in 1940-41, the *Ingraham,* last of the group, being commissioned in July, 1941. On a displacement of at least 1630 tons they carried five 5-inch guns (now being reduced to four) and eight or 10 torpedo tubes.

The 1940 program authorized the construction of 38 new destroyers. This was soon followed by a special emergency program providing for 155 additional boats. These 193 destroyers will be of three distinct types. The *Bristol* class, comprising 78 units, are 1700-ton improvements over the *Benson* design. Two of them, the *Bristol* and *Ellyson,* entered service just before we were attacked by Japan. Two others, *Emmons* and *Hambleton,* were commissioned soon afterwards. The *Bristols* carry four 5-inch guns and most of them have a torpedo armament of ten tubes, quintuply mounted.

Two 2100-ton destroyers, *Percival* and *Watson,* are listed as belonging to a "Special Type," concerning which all details are restricted. The remaining 115 new destroyers will be of the *Fletcher* class, 2100-tonners designed as "replies" to Japan's 2000-ton *Kagero* class boats, which mount six 5-inch guns and, according to some reports, eight tubes for discharging huge 24.5-inch torpedoes. No particulars concerning the *Fletchers* have been released.

The commissioning of these new destroyers should profoundly influence the course of the war at sea. Stronger anti-submarine and anti-aircraft protection can then be given to all of our convoys in the Atlantic and Pacific, while the U-boat threat off our East Coast can be greatly reduced if not entirely eliminated. The Navy Department is taking no chances, however, and since Pearl Harbor has asked for several hundred new destroyers and other escort types.



U. S. Navy Official Photo

***USS Mayrant, McCall* class, has higher freeboard amidships**

Day After Tomorrow

How the War-Time Workings of a Variety of Industries Will be Reflected in Peace-Time Operations

A. P. PECK

(In Two Parts—Part One)

To what extent are research, development, and invention, as prompted by war-time production, being correlated with plans for civilian production in post-war days? That question expresses the essence of SCIENTIFIC AMERICAN's industrial survey; the answers to it and other queries which would naturally arise in any ensuing discussion form the basis of the present article.

But before reporting the results of this survey in detail, it is desirable that certain things regarding it be fully understood. First, the survey itself is based entirely on the premise that the United Nations will win the war. At the time of writing and from this point of view there is no assurance that this will be the case, although an inborn faith in the ability of the United States as a nation to carry through with a given project, no matter how long it may take to complete, makes it almost impossible to think otherwise. Thus, while some may place the stamp of wishful thinking upon such a premise, the assumption that we will win the war—and then will have to win the peace—must be kept in mind when reading the following paragraphs.

Secondly, there may arise the argument that any thinking toward post-war production or post-war activities of any kind will of necessity detract just that much from the more important work of the moment—winning the war. This is necessarily a fallacious argument, since it must be based on the assumption that the human mind is a machine that can be directed at all times along a set path. Where is the business executive, the engineer, the production man, who, face to face with the shaving mirror, under the morning shower, dozing off to sleep at night, does not frequently find his mind toying more or less casually with some problem far afield from his immediate occupation? What is more natural, then, that these same men, even though engrossed with problems of war-time production, should visualize the effect that their present work will have on the future in the bright day after tomorrow when the war is over and the problems of peace-time operations once more arise?

That such visualizations will benefit the entire human race is obvious. That they can interfere in the smallest amount with the war effort is a thought that has no real basis in fact. That they can even serve to stimulate present production is an important possibility, acting, as they so frequently can, as a spur to mental and physical activity and as an incentive to get the present job done so that the war can be won and we can get back to more normal work.

Yet, despite all the things that are being done and have been accomplished for post-war operations, there are still those who feel that such planning is useless. True, the planning is all subject to change without notice and what may seem perfection today may be in the discard by tomorrow. Nevertheless, any planning, so long as it be based on sound reasoning, is better than none at all. There are many who will not agree with this. For example, there is the top executive of a huge plumbing manufacturing organization who, when asked the question in the first sentence of this article, replied: "Not at all." Then he spent an hour telling of his disapproval of many different governmental plans for many things. At least the government planning was an attempt to step forward and must be accepted as being more desirable that a "Not at all" attitude.

Mayor Fiorello H. La Guardia, of New York City, in a quoted statement, recently made himself representative of the confusion that exists in many minds regarding this matter of preparation for day after tomorrow. "Let's win this war first and discuss the after-war period later," said Mayor La Guardia. Later, but on the same occasion, he suggested that the government have a vast public works program "ready to roll into operation to prevent . . . serious dislocation after the war." How this program will grow to a point where it can be put into operation without planning is something that the Mayor did not explain.

There are, however, many outstanding industrialists who have given serious thought to the future, familiar as they are with the necessity of careful planning of all steps that involve the operation of a successful business. These same men know, also, that all plans are necessarily impermanent, that they must be laid with an eye to change, that the lessons learned from day to day may soon outmode operations that today seem basic in nature. Yet, in the light of such knowledge they are willing to voice opinions regarding the future, to place at the disposal of others their restrained optimism, their "know-how," gleaned through years of hard-won experience.

It should be noted that the basic question of this industrial survey limits it severely—and purposely—to technological developments of today which will affect our post-war world. No attempt has been made to assay or evaluate the psychological effect of World War II on the worker, to enquire into the sociological problems of the future, or to become concerned with any views of the future other than those which can be based on the practical industrial developments of the moment. Interesting though these other aspects may be, they have been purposely avoided and left to the tender mercies of other researchers. They, of course, will have their place in the future, but since experience has shown

• SITTING at an editor's desk during such times as these gives one a curious sense of detached attachment with the world of science and industry. The editor is part of it all, yet, so to speak, is on "detached service." Across his desk pour reports from all fronts—military, industrial, governmental, personnel. From these reports are sifted material for publication, leads for articles, waste paper for reclamation, all gradually working toward the finished magazine that you see each month. One of the leads so sifted resulted in the beginnings of an industrial survey upon which is based the accompanying article, compiled after personal interviews with leading industrialists, extensive correspondence, and mulling over of voluminous published material.

The present article, therefore, may be considered as a compendium of several minds, brought together and woven into one running story. All that the story tells, however, is not in the written word. Between the lines there is to be found a grim determination on the part of American industry that, come what may, the American way of free enterprise will not be relinquished without a fight, that industry will, after the war is won, demonstrate once more that it is capable of giving to the people of this nation and of the world those benefits that can be provided only under the proved system of democracy.—*The Author.* •

the vast importance of technology in the development of our industrial civilization, it seems only right that at this critical moment in history due attention should be paid to it and to the part which it will play in the coming days of peace.

THE first organization to be approached in the development of this survey was Westinghouse Electric and Manufacturing Company. This company, like many others, is so far con-

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G. H. Bucher, Westinghouse: "Our development and research programs are larger than ever before . . ."

verted to war-time production that its out-put for civilian consumption is now an almost non-existent part of operations. Yet "planning for post-war operations is very definitely a part of the Westinghouse program today," said G. H. Bucher, President of Westinghouse. "However, because the future is still obscured by clouds of war, the planning must necessarily be subject to workable flexibility. Executive meetings, held every two weeks, almost invariably involve discussions of such plans. Frequently, these plans take immediate form in a step forward in our war-time production processes; sometimes they must be shelved for the duration. And when a step is taken it may not necessarily appear to be in the direction of peace-time operations, yet it is invariably along the industrial path to future developments.

"Probably the best way to summarize our present position as regards 'Day After Tomorrow' is to say that our development and research programs are larger than ever before. This does not involve our consumer-goods production program which, of course, has been severely curtailed in many fields to meet the increasing demands for military production.

"Because of the need for military secrecy about many of the activities of Westinghouse, it is virtually impossible to give exact statements on correlation of war-time production with possible civilian production in post-war days. We are learning many things in a wide variety of fields, however, and every assurance can be given that lessons from our war-time activities will have many applications later on."

Westinghouse is known to be engaged in the manufacture of many kinds of war apparatus that will possibly lead to new developments for peace. For example, some time ago when Army officials wanted to find means of improving the gunners' marksmanship in tanks, they came to Westinghouse with the problem. When a tank is speeding over rough ground, the gunner's task of hitting a given target may be likened to an attempt to thread a needle while galloping on horseback. Westinghouse research engineers produced fire-control equipment that resulted in considerable improvement. This fire-control equipment probably can be adapted to post-war uses, with great advantages over the peace-time mechanism that gave it birth—advantages that might never have been realized but for the impetus of war-time demands.

Another war-time development that may have wide uses in peace-time is a radio panel consisting of a layer of spun-glass cloth sandwiched between layers of fireproof, strong plastic. Westinghouse engineers developed the combination to resist the stresses that are set up on board a battleship when a broadside is fired. Under these conditions, there is a sudden compression of air in below-deck compartments—often sufficiently severe to shatter the brittle panels ordinarily used in radio and control instruments.

Use of radio communication between ships in war-time convoys is restricted, lest the signals give information to the enemy. Westinghouse illumination engineers have designed a lamp by which code signals can be transmitted in a horizontal, narrow beam not visible from altitudes that enemy aircraft must fly.

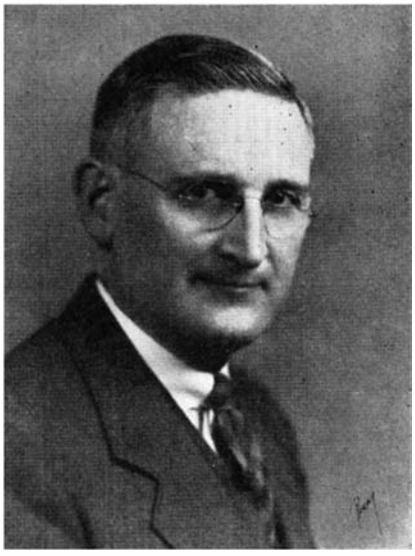
In much of the war production of Westinghouse, of which the preceding paragraphs give but a sketchy idea, engineers have had to call on all of their skill and ingenuity, particularly in making up for the loss of materials on the priority list. Substitutes have been devised for long-accepted materials and, often, substitutes have had to be devised for substitutes. In practically every case, however, the substitutes have been so efficient that in only a few applications has performance or quality suffered; frequently the changes have been for the better.

An important part of the equipment which the company has installed for war production will be available, with little or no change, for post-war operations, Mr. Bucher believes.

"An example of this is found in the manufacture of ship propulsion motors," he explained. "If the end of the war ends the demand for these motors, the same production facilities can be turned over to the manufacture of generators for peace-time use.

"In spite of all the extra engineering effort going into our work to meet war requirements, some improvement is necessarily continuing in transformers, generators, motors, and lighting equipment, as well as in household appliances and the multitude of other things, counting all the variations of each, that add up to the grand total of over 100,000 products made by Westinghouse. We feel that all of this gives assurance that, after the present world debacle is over, living standards can again resume their upward climb."

FAR different in scope from the electrical industry are those organizations devoted to the production of metals. Some of the steel producers did not feel that they could co-operate in this survey, apparently because their operations are so basic in nature that war production means simply an all-around speed-up rather than any change in principles. The aluminum industry, however, represented in this case by the Aluminum Company of America,



Dr. Francis C. Frary, Aluminum Company: "One of the most fertile fields for aluminum in the future" is in the manufacture of textiles

had much to say about the present and future.

"Right now, of course," stated Dr. Francis C. Frary, Director of Research at the Aluminum Research Laboratories, "we are confining all our efforts to the production of aluminum for military purposes. There are items, however, which were just barely under way at the time of Pearl Harbor which had to be shelved for the duration, despite their tremendous possibilities. These are the items which should be stressed, principally because they have already been proved and are not merely idle fancies that come under the head of wishful thinking.

"Wide aluminum applications in architecture are about 12 years old, yet this field has barely been touched. There were a number of dramatic installations, such as the spandrels on a number of modern skyscrapers, the use of aluminum in decorative statuary, and in molding and trim; but, on the whole, there are many applications of aluminum in architecture which need developing. One of these is the aluminum window frame for residential construction. We feel that here aluminum has a very bright future, because these frames are efficient, permanent, easy to handle, and present no problems of maintenance. The frames which have been installed in large skyscrapers in the past 12 years have given no trouble, and we feel that the same condition will prevail when aluminum window frames are adapted for home construction.

"The first aluminum streamlined train made its debut in February, 1934," continued Dr. Frary. "Since that time, about a dozen such trains have been built and are now in service. Their performance made a tremendous impression upon railroad officials, and they will no doubt be the forerunners of a great number of other aluminum trains. In addition, more aluminum will be used on freight equipment. Some very thorough tests were made with hopper cars for coal and sulfur transportation. Sulfur attacks steel rather rapidly, but has no effect on aluminum. All coal contains a certain amount of sulfur, and this chemical in the past has been a problem to railroad officials. The elimination of this problem by the use of aluminum-bodied hopper cars with aluminum facings may well be considered at the time when aluminum will be again available for civilian needs."

The sinking of hundreds of merchant ships during the past two and a half years means that there is bound to be great and continuing activity in marine construction at the conclusion of the war. The world is and will be greatly in need of ships to carry on its commerce, and the number of these ships must be adequate to take care of world trade. Aluminum long ago had been found to be a desirable metal in marine construction. The use of aluminum for entire superstructures, boats, davits, fittings, bulkheads for passenger quarters, and for numerous other applications allows a redistribution of weight in such a manner that the ship will function as a more efficient unit. It will either be lightened to such an extent that smaller engines will be needed to propel the boat at a given speed, thus saving fuel costs; or, with the same type of engines as formerly used, the boat, being so much lighter, can be propelled faster and reach its destination sooner, thus saving time.

Life boats also hold interest as a future development. As far as is known, there are about 70 all-aluminum life boats in service at the present time. A number of these are on European ships; the United Fruit Company has had a number of aluminum life boats in service for several years and is quite enthusiastic about them. The *Nieuw Amsterdam,* flagship of the Holland-America Line placed in service about 1937, had 22 aluminum life boats. Aluminum life boats are not only free from maintenance troubles, but they also serve to lessen the weight of the ship at a point where weight is not desirable; namely, near the top deck. The lesser weight, therefore, increases the stability of the ship, and is more practical, according to Dr. Frary.

"Aluminum has been used in the textile field for some time," continued Dr. Frary, "but its applications there can be widely increased. In our opinion it is one of the most fertile fields for aluminum in the immediate future, particularly since rayon and nylon are enjoying an ever-increasing popularity. Aluminum is widely used in the manufacture of these textiles."

The art of brazing aluminum has been developed to a commercial degree within the past year or so. Unfortunately, activities in aluminum brazing have had to be heavily curtailed because of the war effort, but this will no doubt be a method of joining aluminum to be seriously considered in the future.

Mr. John O. Chesley, Manager of the Development Division of the Aluminum Company of America, had this to say: "The aluminum beer barrel had a very interesting history, and we feel confident that it will be in great demand when aluminum is again available for civilian purposes. The beer barrel got under way very slowly at first, but it was found to be so excellent a package for beer that brewers had begun to buy it in large quantities when the metal was withdrawn from the civilian market. A typical aluminum half-barrel weighs only 18

John O. Chesley, Aluminum: "Just to show that we are trying not to miss any bets in the world to come . . ."

pounds, whereas a wooden barrel of the same dimension weighs 65 pounds. The aluminum barrel does not have to be pitched, since aluminum does not affect the taste, odor, color, clarity, or limpidity of beer. There are no maintenance problems to speak of with the aluminum barrel. All these advantages combined to make this barrel a very desirable commodity.

"Just to show that we are trying not to miss any bets in the aluminum world to come, we might cite one commodity which was ready for marketing when the war broke out and priorities put a stop to this type of product. That is the aluminum plate used by artists for making etchings and dry-points. Copper had been the traditional medium for more than 400 years, but copper had certain disadvantages which have been overcome by a special aluminum plate. In the case of copper, an artist could only make about 75 good prints from an etched plate before the plate would begin to break down. He could only make about 15 good prints from a dry-point. In aluminum, an edition of 250 prints is generally possible, and in many cases, the edition far exceeds this figure. This holds for both etchings and dry-points on aluminum. The metal, furthermore, is light in color and, therefore, easy on the eyes. It has only one disadvantage: once a line is cut, this line cannot be eradicated

by the methods used with copper. The line is there to stay and cannot be changed."

Add to all this the new know-how in aluminum manufacture and fabrication that is being acquired, the development of centrifugal casting of the light metal, the possibilities of aluminization of steel to replace tin plate, and so on, and it becomes obvious that the civilian of the future will think of more than pots and pans when aluminum is mentioned.

WELDING of metals of all kinds has come so rapidly to the fore in so many war-production operations that Mr. James F. Lincoln, President of the Lincoln Electric Company, was consulted regarding his views of the future. "The problems which I believe we are going to meet after this war is over," said Mr. Lincoln, "are two-fold:

"First of all, there will be great unemployment because even if the call for goods after the war is so great to keep all men employed, the reshuffling of these men from the war industries to peace-time work will take some time. We are, therefore, planning on cushioning this shock to these men by present-day savings.

"The second thing that will occur is that competition will have changed to a very great extent due to the existence of a great many government financed organizations which will have much less overhead than those who have financed their own expansions.

"Because of those two things it is our policy," continued Mr. Lincoln, "to now develop the new machinery or present-day production methods which will be more efficient and which can be used in the post-war period, and to get now the higher efficiencies from this machinery and, therefore, the lower cost. It is our policy also to develop the end product to the maximum degree possible under present conditions.

"We are in the very fortunate situation of having a product which now is the same as it was before; the war effort is not changing the character of our product, so that the development of the product and the manufacture of it is continuing for the war effort just as it will for the peace-time effort after the war is over.

"Therefore, we are also bending our energies toward a reduction in cost of the application of the process, and to the elimination of a great many of the abuses which now exist because of ignorance in the field about the application of the process, so that the actual cost of doing the work will be cut to a minimum.

James F. Lincoln, Lincoln Electric Company: "There is nothing that can keep us from hoping, which is also part of our post-war program"

"Of course," concluded Mr. Lincoln, "there are a great many unknown features facing us. For instance, there is no way of knowing what kind of government we will have when this is over. It is rather obvious from previous history that it will be totalitarian. No bankrupt nation ever escaped totalitarianism. Under those conditions perhaps all of our planning will go for naught because we will be told by bureaucrats what to do and how to do it, but there is nothing that can keep us from still hoping, which is also part of our post-war program."

DESPITE the somewhat pessimistic note on which Mr. Lincoln ends his contribution to this survey, it is obvious from even the few views expressed here that American industry is fully alive to the responsibilities which it faces in the day after tomorrow. In our next issue will be continued our report on the unearthing of these encouraging views.

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CORK SUBSTITUTE

Found in Product of Sugar Cane

SUGAR cane from Louisiana has been called upon to take the place of cork from war-encircled Spain to help protect the nation's supply of perishable foodstuffs. From the fibers remaining after the sugar juices have been squeezed from the cane stalks, a new kind of cold-storage insulation has been developed by The Celotex Corporation. Its ability to keep out heat is said to be equal to corkboard's. It is cheaper, stronger, and the supply of raw material far exceeds all possible needs of the United States and its allies.

More than a year ago, as the war gradually strangled the flow of cork bark from Spain's trees to industry in the United States, research men began seeking a satisfactory substitute for corkboard insulation. In the Celotex company's big plant and research laboratories at Marrero, Louisiana, across the Mississippi from New Orleans, they developed a product with all of cork's useful insulating qualities.

To match cork's ability to slow down the passage of heat, the research men mixed the cane fibers in selected lengths and thicknesses, then wove and felted them into half-inch insulating boards of a low density.

To equal cork's resistance to moisture, the individual fibers, before being felted into boards, are sterilized, waterproofed, and then protected from dry rot and fungus growths by the patented Ferox process.

To provide further resistance against moisture, the half-inch boards are laminated together with weather-resistant special asphalts between layers. An additional coating of asphalt is then applied to the outer surfaces. Thus, a two-inch thickness of insulation has five moisture-resistant asphalt membranes, one on each outer surface and three between the boards.

WAR PLANTS

Being Built of Wood and Concrete

TWO new buildings for the manufacture of airplane engines under mass-production conditions have recently been announced as being designed to make use of readily available material and to conserve steel for other war purposes.

One of these new plants is being erected "somewhere in Michigan," the other "somewhere in New Jersey." The first, being built by Continental Aviation & Engineering Corporation and designed by the Russell Engineering Corporation, is being built of wood and other substitutes for critical materials throughout. Exterior walls and piers will be of brick, and interior columns, trusses, and sash will be of wood. Mass concrete footings without reinforcement will be used.

The main building, the largest wood-truss structure built in Michigan in many years, will be of one-story construction, except for a mezzanine 40 feet deep across the front, housing the drafting room. Offices will occupy the

space below the mezzanine and will be 80 feet in depth.

The New Jersey plant of the Wright Aeronautical Corporation is being constructed of concrete by what is known as the "warspeed" process. It is claimed, that, using this process, factories can not only be built more rapidly than of wood or steel, but that, in the construction of a building with 2,000,000 square feet of floor space, there is a saving of enough steel to build a Navy cruiser.

This concrete building, designed by the Wright company in co-operation with Albert Kahn, architect, is literally being built from the roof down, the floors and walls being the final units to be completed. The building is a single-story structure with reinforced concrete columns and roof and unreinforced concrete floor. The design is such that the building may be easily camouflaged and is well suited to production-line operations.

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GLUED—Spars for new minesweepers being constructed for the United States Navy are hand-turned of selected spruce and are glued with a synthetic resin glue.

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GLASS BEARINGS

Replace Sapphires For Use In Instruments

SYNTHETIC sapphires, used for years as pivot bearings in small electric meters, are now virtually unobtainable from Switzerland, former main source of supply. Hence there has been developed in the General Electric Laboratories a new type of high-alumina content glass which can be hot-formed into tiny bearings which satisfactorily replace the synthetic sapphires. Engineers say that, from a performance standpoint, there is little to choose between the new glass jewel and the sapphire for small instrument applications.

FIRE HOSE

Now Made With Minimum of Rubber

WHEN a War Production Board order, earlier this year, cut the amount of new rubber which could be used in fire hose from about 17 to a maximum of seven pounds per hundred feet in the 2½-inch size, and correspondingly in other sizes, it had the immediate effect of making it impossible for manufacturers to supply hose meeting the standard of Underwriters' Laboratories and the specifications under which thousands of cities have been ordering such hose.

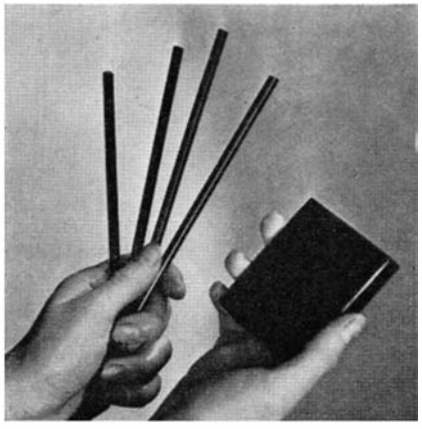
To help remedy this situation, Underwriters' Laboratories, after considerable experimentation and research, developed an emergency alternate specification for fire hose and manufacturers are now supplying hose built to the new specifications.

This new hose will handle equally as well as hose meeting Underwriters' Laboratories' regular specifications, the main difference between the new and the old hose being that the new hose will probably not last as long. Otherwise the performance characteristics remain much the same.

HARD RUBBER

Will Stand Relatively High Temperatures

DEVELOPMENT by its research laboratories of a superior type of hard rubber made from Ameripol, the synthetic rubber which its chemists created, is announced by The B. F. Goodrich



Synthetic: extruded, molded

Company. According to a report just issued, the new synthetic hard rubber, before softening, will stand temperatures 100 degrees, Farenheit, higher than the best hard rubber made from natural crude. It is expected that the new development will extend the field of hard rubber, since it overcomes many of the limitations which had restricted the service of this type of rubber under extremely severe conditions.

LACQUER CONTAINERS

Protected by Addition of Organic Chemical

THE tendency of clear lacquers, alcoholic shellacs, and nitrocellulose solutions to corrode plain steel containers can be overcome by the addition of small quantities of a new organic chemical. This suggests interesting possibilities for lacquer packaging during the current limitations on tin supplies. Because of the relatively low cost of the new chemical, it is believed that its use may continue after the tin shortage is relieved.

The chemical, it is explained, reacts with the metal surface of the container to form an insoluble film, which, though of microscopic thickness, is sufficient to afford the necessary protection. Because of the nature of its formation, the film is self-mending in case of breaks. In normal clear lacquers, about one-half ounce of the chemical per gallon of lacquer is sufficient to produce the desired effect.

SILVER USES

Being Increased in Electrical Equipment

JUST as Pizarro, conqueror of Peru, once shod his horses with silver in an emergency, engineers are now using the precious metal instead of tin, copper, and other scarce materials in electrical apparatus.

There is at least a little silver now, according to Harry A. Winne, Vice President of General Electric Company, in almost every motor, generator, transformer, or other piece of apparatus made by the company for the war.

"In many cases the use of silver adds to the cost, a consideration secondary to production at the moment," explains Mr. Winne, who is in charge of apparatus design engineering. "In such instances, its use is probably temporary.

"On the other hand, the use of silver in current-carrying contacts and in brazing alloys frequently results in an improvement in quality sufficient to justify the greater cost, and so for these purposes its use will not only continue after the war but probably will increase."

Silver is replacing tin in soft solders, alloys which require comparatively low temperatures in joining metals. In the past, these alloys have had a relatively high tin content, ranging from almost pure tin to a very common composition of 40 percent tin and 60 percent lead. Today, however, solders in wide use range from 20 percent tin, 1 percent silver and 79 percent lead, to 97.50 percent lead and 2.50 percent silver.

Substitutions of silver for copper are being made in brazing alloys, which require high temperatures for joining metals. One type of brazing alloy, widely used before the war, was

composed mainly of copper, the remainder being silver and phosphorus. Now alloys with copper content as low as 16 percent are in general use. A typical alloy consists of 50 percent silver, 16 percent zinc, 18 percent cadmium, and only 16 percent copper.

Aside from saving tin by reducing the tin content of solders, brazing technique is now widely replacing soft soldering to conserve tin and copper. Brazing also, chiefly because of the silver present, is often quicker, more reliable, and produces stronger joints.

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LAMPS—The ordinary small Westinghouse Mazda lamp owes much of its lighting efficiency to the exactness of the diameter of its tungsten filament wire. This wire is so thin it is measured by weighing it on scales accurate to within 40 billionths of a pound. These scales are sensitive enough to weigh a penciled signature.

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FREEZING

Of Machine-Tool Parts

Has Many Advantages

OF INTEREST and importance to science, industry, and business is the development and perfection of the new Deepfreeze Santocel extreme low temperature metal chiller, manufactured by Motor Products Corporation.

Among the numerous applications of the metal chiller, made in portable form for ease and economy in use, is contraction in compound fitting of metal parts. This facilitates slide fits in assembly operation, relieves strain and possible fractures. Exhaustive tests by competent authorities also indicate that sub-zero tempering and stabilization of high-speed tool steel will produce a combination of hardening, strength, and ductility unobtainable by ordinary hardening or tempering. Therefore, the freezing system should have extensive use in the aircraft industry and by machinery builders, tool makers, automotive manufacturers, and so on.

In one of our illustrations is shown a freezing installation in a large machine-tool plant doing extensive war work. The operator is inserting a machine-tool spindle in the unit. This is done so that costly anti-friction precision bearings can be assembled easily and permanently without damage. This is of particular importance today because machine-tool manufacturers have been forced to employ some unskilled help; in assembling bearings with a drive-fit to shafts, care must be taken not to damage the bearing which is both costly and difficult to replace.

The bearing shoulder of the shaft shown is approximately two inches in diameter and can be shrunk .001 to .0015 of an inch in 40 minutes at 50 degrees below zero.

Another use for the portable unit in this large machine-tool plant is shrinking steel sleeve type bearings used in cast-iron fixture housings for supporting and guiding precision boring

Freezing a spindle

spindles for airplane boring machines. The bearings are usually made .0005 of an inch oversize, or are longer than the bore in the cast-iron housing. The bearings are frozen to shrink sufficiently so that they can be placed in the housing with ease. When room temperature is again reached, the bearings will have expanded to an accurate and tight fit.

LEAD BEARINGS

May Prove to be Superior to Tin Alloys

A WAY to meet the tin shortage as it threatens one of the most important applications of this highly strategic metal is being investigated by engineers who believe they have now found ways to produce alloys of lead to take the place of tin alloys in bearings.

One of the most gruelling trials of these new lead alloys for bearings is being conducted at The Cooper-Bessemer Corporation, according to Ralph Boyer, chief engineer.

"Alloys with lead as the base metal have been put into bearings of the corporation's Diesel engines and air compressors, and from all indications they are doing very well," the engineer said. "About a year of testing will be required, however, to prove conclusively that lead is an adequate substitute. We have run our tests for the last several weeks.

"We have been forced to turn to lead as a base metal in place of tin, and now there is every indication that lead will produce better bearings than we have ever had before."

The present importance of tin in this application is brought out by the fact that bearings in every automobile being driven in the United States contain on an average about 7½ pounds of this metal, the bearings containing between 88 and 90 percent tin.

SUPERSEDED

Riveting Machines Replaced by New Welders

EVIDENCE of how rapidly production techniques on war jobs are changing is given in the story of the giant riveters, only a year old, which soon will have outlived their usefulness in tank work.

Developed and built last year by one automotive company for its tank job, these giant machines are being laid aside because of the Army's recent decision to switch from the riveted to the all-welded tank.

To employ in tank production the cold-riveting process that had previously proved successful in automobile-body riveting, this company designed huge horseshoe-shaped riveters to do the job. Some stationary and others brought into position by overhead cranes, these machines exerted as much as 100 tons of pressure in squeezing rivets into place.

Frictional heat induced by this tremendous pressure expanded the nickel steel rivets and improved their strength, whereas in the previous method of heating and hammering, some of these qualities were lost.

This method was so successful that more than 95 percent of the rivets used in the tank hull were inserted by cold riveting. Hot rivets were used only in the tight spots that would not allow entry of the large machines.

Yet, experience gained from major tank battles such as took place in the Libyan desert last year prompted Army officials to switch from the riveted to all-welded tanks. One of the major advantages of the new model tank will be the ability of the all-welded hull's curved surfaces to deflect projectiles more readily.

Thus the giant riveters, which cost thousands of dollars to build, must be laid aside. They will, however, be made available for other war work.—*Automotive War Production.*

INDUSTRIAL TRENDS

TOWARD BETTER NUTRITION

THE food that people all over the world eat, and the important industries which produce that food and make it available to the general public, are, without a doubt, going to be greatly and favorably influenced by a development that is largely an outgrowth of the present war. This development, the dehydration of a large variety of foods, was dealt with in its technical aspects in our issue of July, 1942. In even the short space of time that has elapsed since that article appeared, the industry has advanced measurably in its endeavor to provide greater quantities and a wider variety of foods than ever before.

When you think of dehydrated foods, don't think of them as being in the class of dried peas and beans, prunes, and similar staples of long familiarity. The dehydrated foods of today are as different from these old standbys as jerked beef is from a fine porterhouse. Not only are they different in their advantages but also in their qualities that show up in the final test of eating. Obviously, the main points that are aimed at in dehydration are the elimination of bulk and weight, the retention of all possible food values, and reduction of spoilage. In the older methods of drying foods, only some 50 percent of the water was driven out and spoilage was merely retarded; by modern methods it is possible to eliminate as high as 90 percent of the water or more and to so arrest the factors which induce spoilage that the foods so processed can be kept under almost any climatic conditions for months.

Our former article on this same subject told of cabbages that were dehydrated and compressed to small disks which, upon soaking and heating, resumed the appearance of the original, with all the aroma and flavor so appealing to the healthy appetite; of carrots, peas, and beans about which the same thing can be said. By now the list has been expanded to include almost every vegetable and fruit in common demand, plus eggs, butter, some meats, and even clams and oysters.

Some processes of producing modern dehydrated foods depend on dividing the food into small particles and submitting these to heat and controlled atmospheres by one means or another. Thus the natural moisture in the cells of the foods is quickly and almost completely driven off, yet the cellular structure of the materials is not affected. Herein seems to lie the secret of retaining the food value and flavor so highly important to the ultimate consumer. It appears that the rapidity of driving out the moisture also seals in those elements in the foods that furnish such factors as vitamins and essential oils, and excludes the bacteria which contribute to spoilage.

All this is not quite so simple as it may seem, yet to date many of the problems involved have been solved. Each species of fruit and vegetable requires different handling during the drying process, and even different methods of applying the heat to obtain the best result. In some cases the finely divided material is placed on trays in ovens, in others it is applied to the outside of heated revolving drums. Some foods dehydrate best when they are placed in small trays that, hooked together like a train of cars, are hauled through hot tunnels.

So much for the technical side of the increasingly important dehydrated food situation; what about the industrial side? It took the war to bring the industry to its feet and start it ahead. Our armed forces require tremendous quantities of food, quantities which, in many cases, have to be shipped long distances with assurance that they will reach their destination without spoiling. Weight and bulk, also, have to be reduced to a minimum to conserve valuable cargo space. Into this niche fell dehydrated foods. They fulfilled every physical requirement in a highly satisfactory manner.

Despite all the advantages that dehydrated foods offer, the industry itself is still relatively small, largely because it lacked public acceptance until the circumstance of war forced recognition of it. Thus, at the time of writing, there are reported to be only 25 active producers of dehydrated foods of all kinds on a commercial scale although it is said that 132 concerns are in the process of getting ready for production. Membership in the National Dehydrators Association is now 40 as compared with only 12 in January, 1942. Then, too, there are the concerns which are now producing or planning to produce the equipment used by the dehydrators, container and packaging manufacturers, and the various suppliers, all of whom form a necessary part of the whole industrial picture.

It is impossible to be too definite today about production figures of any type, yet it can be revealed that total business in the dehydrating field was only $10,000,000 in 1941. In 1942 it is estimated that this will increase 10-fold and that 1943 will see still greater increases.

What this means for the future is not difficult to visualize. After the industry has served the armed forces through to the days of peace, its products will be used to feed the millions in devastated countries, its methods will be applied to smooth out the peaks and valleys of crop production throughout the world, and it will contribute largely to the abolition of the under-nourishment that is so prevalent in this country and abroad. This means of preserving foods, now being brought to a fine point of perfection, will indeed be the basis of an industry that can go far to remove the blight of hunger from every land and to solve many of the problems that have faced every phase of the food industry in the past.

WHAT ABOUT THE AIRLINES?

RECENT announcement by the War Department that the airlines of the United States will continue under private ownership settles, for the time being, an important question about our air-transport industry. As is well known, of course, many passenger transport planes have been taken over for military use, leaving the airlines as a whole with only sufficient equipment with which, when operated on a faster turn-around basis, to continue operations on an air-milage reduction of 45 percent.

What, then, is the trend of an industry that is so important to business travel, yet is of even greater importance from the standpoint of military operations both here and abroad? Present indications are that the airlines may regain some of their equipment. This will become possible as plane production for military purposes steps up still further and current demands are satisfied. With more planes available, it is entirely possible that schedules on commercial lines may be restored to their previous condition, or even expanded to greater proportions than ever before. When this comes about, the airlines, with knowledge recently gained of improved maintenance procedure, and efficient utilization of equipment, will be in a better position than ever to provide the fastest possible means of transportation to all of our industrial fronts.

—The Editors

Cometary Tails

Added Light on an Old Perplexity: The Force Which Drives the Gases from the Nuclei

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

A FEW months ago (January 1942) we had occasion to speak of some recent results which had been derived by the spectroscopic study of molecules in astronomical bodies—comets among them. Some of the problems which were then puzzling have since been cleared up, and the story is worth telling.

First, as regards the composition of cometary gases: Dr. Swings, the Belgian astrophysicist now at the Yerkes Observatory, has identified three emission lines in cometary spectra, at 4231, 4238, and 4254, with strong lines in the principal band of the ionized molecule CH^+, which was detected last year in interstellar space. Some fainter lines in the ultra-violet are probably due to another ionized molecule, OH^+, while good arguments can be advanced for attributing the fairly conspicuous unidentified lines near 4050 to NH^+. This last interpretation can be verified only by production of the spectrum of this molecule in the laboratory—which presents a challenge to experimenters that, in normal times, would not long go without notice.

The list of molecules so far observed spectroscopically in comets looks very queer to the student of chemistry. It includes CH, NH, OH, CN, C_2, and also CH^+, CO^+, N_2^+, and probably OH^+ and NH^+. None of these ten "molecules" is what the chemist would ordinarily call by that name. They are all fragments of molecules of the familiar kind and in an ordinary book on chemistry the first five would be called "free radicals" and the others "ions." In the laboratory, they are all "unsaturated"—eager to combine with anything available that comes near, and so form stable molecules of the common sort.

Dr. Swings points out that, though they are not chemically stable in the sense that they can persist in an environment full of other molecules and atoms, they are physically stable—that is, they have no tendency to break up of their own accord into separate atoms. On the contrary, the atoms which compose them are firmly bound together. They are still very ready to pick up other atoms or molecules—if they get a chance. But the gaseous parts of a comet are of such exceedingly low density that collisions of one molecule with another must be almost completely absent. The unsaturated molecules remain as they are, not because they won't combine with others, but because they don't get a chance.

THERE may be plenty of molecules of the familiar types, such as H_2O, CH_4, and NH_3, on comets, but we could not detect them if they were there, for the spectral bands which they would emit lie well out in the ultra-violet and are hopelessly concealed from us by the opacity of the Earth's atmosphere for such short wavelengths.

In fact, it appears necessary to assume the existence of these familiar gases in comets in order to explain that of the observed molecular fragments. The latter, as Swings points out, cannot exist in the solid particles which compose the main portion of the comet. If these particles are heated, when they come near the Sun, occluded gases may escape from them; but these will have saturated molecules of the familiar kind. Something else is needed to break them up, and this is almost certainly shortwave ultra-violet light emitted by the Sun. In many cases the absorption of such light may raise a molecule into an unstable state which automatically breaks in two. The fragments sometimes fly apart at high velocities with energy derived from the absorbed light.

Swings uses this to explain the long-known and perplexing phenomenon that the gases which form a comet's head sometimes escape from the nucleus with high velocity. No pressure sufficient to produce such speeds could conceivably occur in so rarefied a medium, but dissociation of the sort just described would account for it fully. The effect might be expected to be different for different molecules. In fact, CN is driven to a considerable distance from the nucleus, while CO^+ stays close to it until light-pressure drives it off into the tail. This suggests that the dissociation process which forms the first is much more violent than for the second.

Once formed, these fragments find themselves in a region of such low density that they have very little chance of meeting any others. They are exposed only to the stream of radiation from the Sun, which fills all interplanetary space in its vicinity. If the molecules were capable of further dissociation by such radiation, it would not last long; but a molecule which escapes further breaking up may nevertheless absorb sunlight, get into a state loaded with energy and emit this again either as light of exactly the same wavelength, or as a closely associated line in the same band. This resonance process does not wear out the molecule and may be repeated indefinitely. There has been little doubt that the emission lines in cometary spectra are produced in this way; and now Swings presents a very conclusive proof. The emission of any particular bright line—say in one of the cyanogen bands—by gas in a comet means that cyanogen molecules had absorbed from sunlight, but a minute fraction of a second earlier, either this line or the closely associated one. The amount of light thus abstracted from the Sun, though enough to make the comet visible or even conspicuous on a dark sky, is too small to produce perceptible dark lines in the solar spectrum if the comet should pass between us and the Sun (as Halley's comet did in 1910).

NOW these lines of the cyanogen band fall in a region of the solar spectrum which is full of wide and strong dark lines—produced by absorption in the Sun's atmosphere by iron and other elements. A cyanogen molecule in a given state of rotation has two absorption lines. If both of these fall within wide dark solar lines, very little energy will be fed into this particular molecular state from the sunlight, and the corresponding emission lines in the comet's spectrum will be faint. But if one or both of the absorption lines fall in bright regions of the solar spectrum, the

emission lines from this state will be strong. In this way it is found that the apparent division of the cyanogen bands into two parts, one emitted by very slowly rotating molecules and another by those rotating much faster (of which we spoke last January) can be explained by the fact that molecules rotating at intermediate rates have their absorption lines falling on wide dark lines in the solar spectrum, while the others do not (at least to the same degree). The hypothesis that there are really two groups of molecules, one rotating fast and one slow, can now be abandoned.

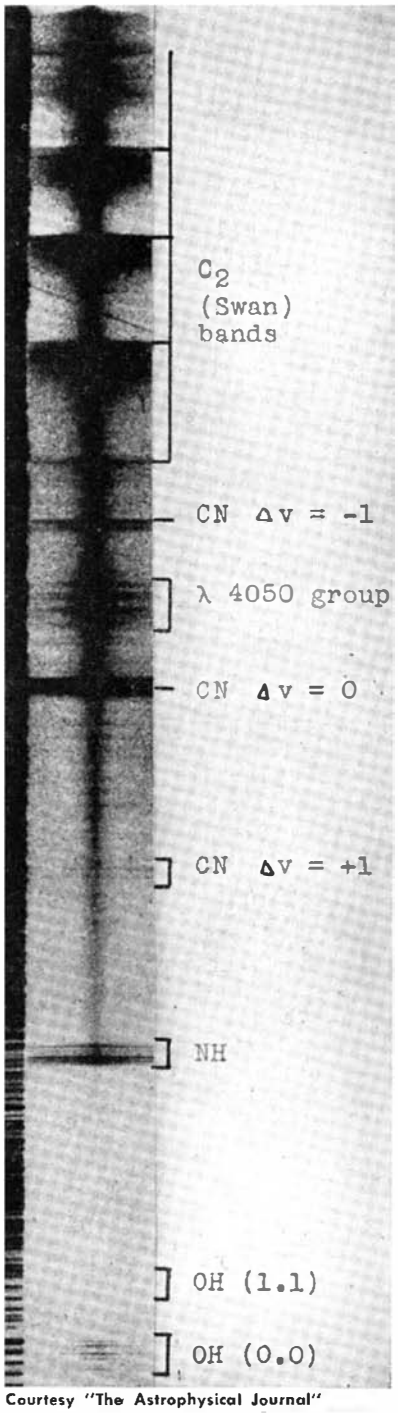
Just what the average rate of rotation of a molecule—and hence the temperature of the cometary gas—may be is harder than ever to determine, but it is little, if any, above 300° K—that is, "room temperature."

When a comet is rapidly approaching the Sun, or receding from it, the positions of its absorption lines are shifted relative to the solar spectrum. In some cases this changes the intensity of the sunlight available to excite the resonance lines. Differences have been observed in the intensities of details of the cyanogen bands in different comets which are fully explained by this. No more satisfactory proof that the radiation of comets is excited by the absorption of light from the Sun could be desired.

BAND-SPECTRA, as is well known, enable us to distinguish between the different isotopes of the same element. Carbon, for example, has an abundant isotope of mass 12 and a rarer one of mass 13. The molecule $C^{12}C^{12}$ is responsible for very strong bands in comets. Three bands of $C^{12}C^{13}$ lie clear of these stronger ones, and have been observed, though faint. The heavier isotope is therefore the less abundant in comets, as it is on earth and in the red carbon stars.

These carbon bands do not show the remarkable gaps, or faint regions, which the cyanogen bands do. They fall in a region where the solar spectrum has only weak lines (compared with the ultra-violet where the cyanogen bands lie) so that this is as might be expected. It appears, however, that the faint bands of OH^+, which fall in a region full of strong solar lines, are subject to irregularities of intensity.

All the cometary gases which have so far been observed are composed of four elements—hydrogen, carbon, nitrogen, and oxygen. In some comets which have come near the Sun, and been more strongly heated, the sodium lines have appeared. One of the tragedies of spectroscopy is that the great Comet of 1882 appeared before modern methods of photographing the spectrum existed. It came within a million miles of the Sun, and must have been hot enough to volatilize anything. Its spectrum at that time was examined by one or two visual observers, and seen to be full of bright lines, but no more is known. It was bright enough to have been observable with the most powerful spectographs. Ten minutes with a modern instrument might have given us information for which we may now have to wait till this comet returns, after some 600 years. Most of the other



Courtesy "The Astrophysical Journal"

Comet band spectrum, 3000—6400

elements which are known to be abundant in the Sun and stars have a very poor chance, if any of showing up in the spectra of comets at ordinary distances from the Sun. The metals and their silicates are not vaporized or even melted. Helium and neon are very abundant, but their resonance lines are in the extreme ultra-violet and unobservable. It is probable that their atoms, if present near a comet, would be subject to very little light-pressure, as the solar spectrum is weak in these regions, so that they would not go into the tail, though they would diffuse away into space from the head.

Sulfur forms compounds which, like those of oxygen, have bands in the accessible region of the spectrum. When these have been well enough observed in the laboratory, it would be interesting to look for them in comets, though they might be very faint.

IT is hardly practicable at present even to estimate the quantitative abundance of the elements in the cometary gases. Apart from the question of the intensity of the solar spectrum in the region where absorption occurs, we would need to know the absolute absorbing power of the molecule for each line before we could calculate how strong they ought to look. An interesting example of this is found in interstellar absorption. The lines of neutral iron, recently detected, are even fainter than the strongest line of neutral calcium. But it is known that the absorbing power of a calcium atom for this line is very much greater than for all the other lines put together, which it absorbs when in its normal state. For iron, however, laboratory measures show that the absorbing power for the observable lines is less than two percent, on the same scale. As regards detection by interstellar lines, iron is therefore at a disadvantage of 50 to one, compared with calcium. Not much is yet known about the absorbing powers of molecules, but there is good reason to believe that it is much greater for the CN molecule than for OH—at least, for the observable bands. The fact that the hydroxyl bands are weak in comet-spectra compared with the cyanogen bands does not prove that cyanogen is more abundant.

A great deal of very interesting and probably remunerative work remains to be done on the spectra of comets. Unfortunately, it is only for a small part of the time that comets bright enough to be observable with high dispersion are visible.

Refrigeration For Insanity

Hibernation at Lowered Temperatures Promises Value as a Treatment . . . Delayed by the War

BARCLAY MOON NEWMAN

THE most promising of all the researches that have been undertaken in the clinics that use refrigeration of the whole body as a medical measure has, unfortunately, been temporarily postponed by the war. For the first time this new therapy, popularly known as human hibernation and technically as hypothermia, has apparently found a definite, valuable application—in treating insanity, particularly schizophrenia or dementia praecox. Results in the cases studied have been remarkable, so that more extensive investigation of the possibilities and limitations of this treatment will surely be forthcoming at the war's end, if not before.

Decidedly a milder and less risky procedure than insulin shock, a treatment for insanity that was developed several years ago, hypothermia gives evidence of being more effective. Cases that did not respond to shock therapy have been markedly benefited by the hibernation treatment.

The modern psychiatrist already has been able to prove a great point: that mental illness need no longer be regarded as hopeless. Succeeding to an inspiring degree where centuries of effort went for nought, the new psychiatry has improved the mental conditions of thousands, and has effected some actual cures. Through insulin or metrazol shock, many schizophrenics have been restored to a practically normal state—though, too, there have been many failures and relapses. Hope for restoration under these treatments is generally limited to the first years of illness, presumably before the course of the disease has brought about irreparable degeneration and actual structural changes in the brain. On the other hand, there have been too many accidents—fractured vertebrae—during the violent convulsions occasioned by the treatment. Both insulin and the other commonly used drug, metrazol, notoriously often damage the brain tissue—though the very effectiveness of the treatment may be the result of structural changes that cut the activity of overactive centers. To many psychiatrists this is a dubious procedure. Dubious for a similar reason is the actual removal of cores of tissue from the brain, an operation now being tried here and there in "hopeless" cases and overenthusiastically described in popular articles despite the protests of the American Medical Association. Insulin or metrazol shock for schizophrenia, and fever therapy for brain syphilis, have never-

Courtesy Therm-o-Right Products Co.

Instead of a bed of cracked ice a thermostatically controlled electric refrigerator may be used

theless more advantages than disadvantages, and have justifiably been established in medicine. If, however, discovery of equally effective but milder, safer therapy can be made . . . .

So ran the train of thought in the minds of two Harvard Medical School psychiatrists, John H. Talbott and Kenneth J. Tillotson. Well up the temperature scale, Talbott had made important researches on heat cramps and the scientific evaluation of the ill effects of heat upon workmen. He and Tillotson, like every alert medical scientist, had been struck by the recent bold venture of Dr. Temple Fay into the strange world of refrigerated life in the treatment of cancer. Though beneficial in a limited number of cases, human hibernation as a treatment for this disease was not winning extensive application. Obviously, judgment of its value in cancer must await decades of further study. Also, just as with insulin shock and with metrazol therapy, both of which were first used on drug addicts, human hibernation could be applied in the treatment of morphine fiends. A few addicts painlessly hibernated through the first, usually dreadful, days of deprivation of their narcotics. Here, again, some additional alteration in the nervous system is induced by the treatment. The addict loses his craving, at least for a long period after refrigeration. Similarly, in tests with cancer patients who were suffering intense pain, a mysterious nervous change is brought about by hypothermia. Though no drug is administered, the patient often is free of all pain, sometimes for months after the stay of a few days in cold storage.

Talbott and Tillotson looked up the published records of Fay and his Temple University associate, Lawrence W. Smith, professor of pathology, who summarized the effects of prolonged hypothermia on normal tissues, including brain cells, as follows:

"Only rarely are significant structural changes observed in normal tissues even when subjected to prolonged local refrigeration for as much as five and one half months. Under general refrigeration such changes as do occur are insignificant."

HYPOTHERMIA, concluded Talbott and Tillotson, acts like an anesthetic and does not shock the patient as do large amounts of insulin or metrazol. Like insulin and metrazol, hypothermia is associated with a significant alteration of the internal environment of the tissues. We have become accustomed in recent years to thinking of the treatment of mental disorders in terms of procedures which produce profound alteration of the internal environment of the body. But insulin and metrazol cause demonstrable structural changes and perhaps irreparable damage. Hypothermia does not cause such damage or any demonstrable change in the structure of brain cells.

The two psychiatrists, aided by a generous grant from the Lucius N. Littauer Foundation, carefully learned the medical intricacies of general refrigeration and turned for facilities to the medical research laboratory of the Massachusetts General Hospital, where many famous discoveries have been made. (The Corn Industries Research Foundation supplied additional aid.) They selected patients who had not responded to insulin or metrazol.

The majority were negativistic, showing the aversion response to all social contacts and communications. Some were irritable, aggressive, impulsive, and for the most part, in extreme psychotic states, representing that seemingly unsurmountable barrier between reality and unreality, in which fantasy and confusion seem to produce a mental state with extreme negativism and a struggle even against the factors fundamentally essential to the organism's life, such as the taking of food.

All patients had been diagnosed by five or more psychiatrists as schizophrenic. They were all physically normal.

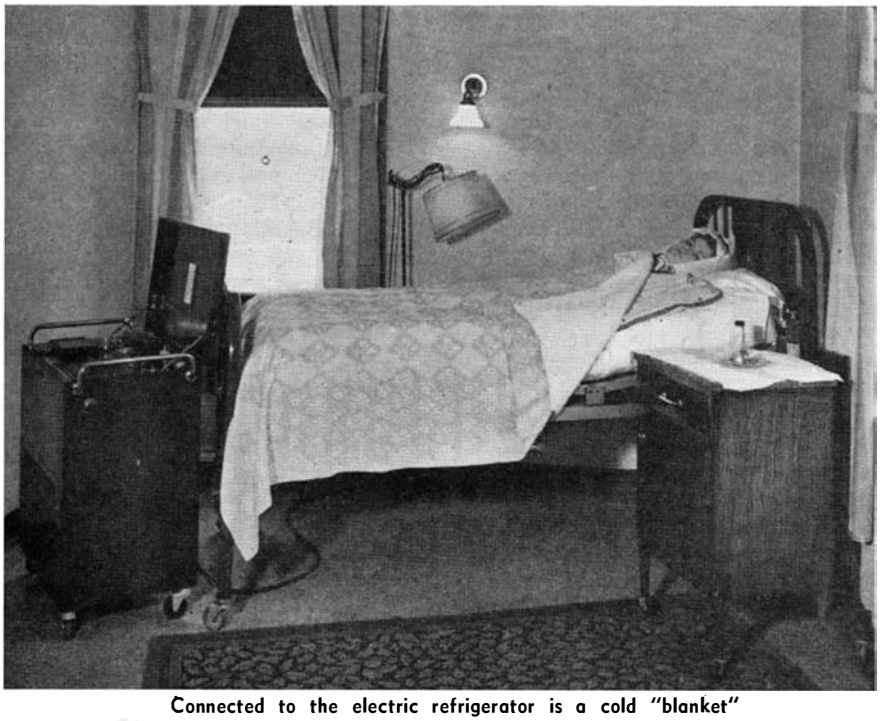
Miss P. M., aged 38, had been sick for eight years. Her clinical course was unaffected by refrigeration.

Miss B. R., aged 41, had been a schizophrenic since the age of 21. For the last ten years she had done no more than vegetate. She did not respond.

Miss S. E., aged 29, had been mentally ill for more than four years. In 1938 she had received two series of insulin shock treatments, resulting in only temporary improvement. On June 12, 1940, refrigeration was tried. Her temperature was maintained below 98 degrees for a total of 38 hours during the first treatment; for 34 hours it was kept below 95; and for seven hours it was below 80, actually falling for a short time as low as 75. She was drowsy and unco-operative for the first day after being warmed up again. Then for two days she was mentally clear—not only displaying a close approach to normal responsiveness but even becoming co-operative. She evanescently exhibited a surprising insight into her condition and vouchsafed that she must have been confused for some time. All who saw her believed that she was better than she had been for more than two years. But after 48 lucid hours she reverted to her former state.

A second treatment followed on October 12. Twenty-nine hours of hypothermy brought only disappointment to the psychiatrists.

A third treatment was given in November, and refrigeration was prolonged to 54 hours, though the minimum thermometer reading was 87 degrees. After 12 hours of restored warmth, she became mentally alert, oriented, able to carry on a normal conversation, yet somewhat suspicious for three days. Since then she has been more responsive and co-operative than before treatment, though maintaining only partial contact with reality.



Connected to the electric refrigerator is a cold "blanket"

Miss H. I., aged 37, sick since 1923, had received several insulin shock treatments without benefit. Refrigerated for 33 hours, she improved markedly through five days, being pleasant, co-operative, appreciative of things done for her. But she reverted to her former state on the sixth day. Three months later, she was made hypothermic again—for 68 hours. As her temperature was allowed to re-approach normal, she became mentally clear and carried on a lively conversation about many topics in a logical and coherent manner—but only for six hours, until her temperature reached 95, when she became confused again. The next day she became lucid again, and for a day and a half gave every appearance of a normal and completely recovered individual. She wrote a letter to her mother and father. She was sociable, courteous, and an interesting conversationalist. Then she slipped back into her mute psychotic state.

If you will note the ages of these patients and the durations of their sickness, you may conclude that the response, if any, is disappointing in older, chronic cases. Yet a discovery is obvious. The mentally ill do respond. Presumably, as is speculated in regard to failures with insulin and metrazol shock, cases of long standing suffer irreversible brain-cell changes. Younger, newer cases provide confirmatory evidence.

S. R., aged 16, was first hospitalized in April 1940. In July, his body was sent below normal warmth for 27 hours, below 95 degrees for six hours, and to a low of 92. During the succeeding four months he improved. His hallucinations and queer ideas vanished. Quiet, polite, friendly, he was discharged as sufficiently improved to live at home.

Miss M. F., aged 25, had had symptoms for about ten years but was first diagnosed as frankly schizophrenic in April 1939. Neither insulin shocks nor metrazol altered her state. On July 29, 1940, general hypothermia was tried. Her temperature was kept below 98 degrees for 29 hours, and below 95 for 22 hours, at one time reaching a minimum of 83. "The adjustment of this patient outside the hospital," Talbott and Tillotson report, "had been unsatisfactory because of hallucinations and ideas of a bizarre, delusional type, and she had had to be confined intermittently. Following hypothermia she returned to her home, and at the last follow-up report it was apparent that she had made a good social recovery and a satisfactory social adjustment."

The most interesting case studied is that of Miss H. A., a medical student, 26 years old, admitted to a mental hospital in 1937. Her disease did not respond to either insulin or metrazol. She was the sickest of the group, but:

"During the first hypothermia treatment, when her body temperature reached 89 F., she commenced to talk. For all practical purposes, that was the first time that she had conversed in more than two years, being for the most part mute and combative. She

talked clearly, logically, and with insight, and expressed herself normally until her temperature reached 93 F. At this level her conversation became confused and her speech thick. During the four intervening hours she had looked and acted quite normal and could not have been diagnosed as suffering from schizophrenia. When her temperature reached 96 F., she became mute and reverted essentially to her former schizophrenic state."

For three months her conduct was but barely improved. She was less combative, yet refused to talk.

After another two months she was refrigerated again. She repeated her previous performance. When her temperature reached 88 degrees, she became mentally clear and conversed for nearly four hours with her father, a physician. But, as before, when her temperature was raised to 94 she became once more unresponsive and confused. As her temperature approached 96 she was mute.

The following month brought no improvement. A third treatment induced the same queer response. As her temperature reached normal, she reverted again, and remained mute, combative, unco-operative.

At the end of 48 hours, however, she suddenly came out of her schizophrenic world, asked for her personal effects, expressed a desire to dress, requested her eyeglasses so that she could read. Once more she was herself, an intelligent, social personality.

For two weeks she stayed well. Thereafter, she tended to fall into moments of confusion, became overelated and boisterously active at times. Still, her general improvement has been sufficient to permit participation in occupational therapy, and a "fairly adequate social adjustment" has endured.

These and other striking results justify further investigation of hypothermia in insanity. In the words of Talbott and Tillotson:

"A more comprehensive statement and a definite conclusion will have to await further application in a far greater number of patients together with a longer follow-up study. The clinical results seem to be at least as promising as insulin and metrazol in the treatment of schizophrenia. That hypothermia may be beneficial in various phases and types of manic depressive psychoses is a subject which we hope to investigate in a similar study, presently."

A search of the medical literature showed Talbott and Tillotson that their success was not the first. A century and a half ago, in 1798, Dr. James Currie, Liverpool (England) Hospital physician, reported how he benefited a young man frenzied by insanity. Currie ordered the patient to be thrown headlong into icy water. "He came out calm and nearly rational," Currie wrote, "and this interval of reason continued for 24 hours. The same practice was ordered to be repeated as often as the state of insanity returned. This direction has been followed, and two days after the first treatment, he was thrown again into the cold water bath at the height of his fury as before. As he came out, he was thrown in again, and this was repeated five different times, till he could not leave the bath without assistance. He became perfectly calm and rational in the bath and has remained so ever since."

Modern psychiatry had to wait for Fay to astonish medical scientists by showing the safety of human hibernation in a bed of cracked ice—refrigeration which you had better not try out in your home since there are many fine medical points to be considered with the utmost care during hypothermia; respiration, heart beat, possible frostbite. For example, a temperature tumble below 75 degrees may be fatal. In human hibernation, life comes as close to death as it is possible to go—and return safely. In the weird world of cold life, you are suspended in the mysterious dark that lies midway between life and death. A medical expert can send you without risk into that dark icy slumber, but even he must have first rate hospital facilities.

The present writer has had a letter from Dr. Talbott, who replied to a query regarding new research: "Due to my participation in our war effort I have been forced to discontinue the hypothermia treatments, and probably shall not resume them for some time to come." One more charge against Schickelgruber.

Resumed these researches will be—of that we can be sure.

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BETTER TESTS

Why Are So Many Being Rejected for the Draft?

Is our national health declining? Such is the suspicion voiced by some who have read about the results of tests on selective-service registrants and note that, in the present war, a large proportion have been rejected. The true reason is rather the opposite—health is better, but medical science is today able to detect ills which, in the last war, were not found until the men were in service and which cost the taxpayer money because men likely to develop disease were inducted. In *The Journal of the American Medical Association,* Leonard George Rountree, M.D., Colonel in the United States Army Medical Corps and Chief of the Medical Division of the Selective Service Division, also Kenneth George McGill, Chief of the Research and Statistics Division, and Captain Oliver Harold Folk, Chief of the Medical Statistics Section of the Research and Scientific Division of the United States Army, have analyzed the health of selective service registrants and they find that:

"Advances since 1918 in clinical medicine and diagnostic laboratory procedures now present the means of eliminating more men from the service. For example, many registrants are being rejected because of latent syphilis that would not have been recognized in the World War. Chest roentgenograms are being used extensively. Many cases of tuberculosis are being found now that could not previously have been detected."

ELECTROCUTION

Home Treatment by Electric Devices May be Dangerous

In a communication to *The Journal of the American Medical Association,* Dr. Richard Kovacs of New York has described a tragic happening and observed that any kind of self-treatment with electric devices may cause death when applied by the inexperienced.

A resident of Long Island was found lying on the floor of his bedroom, fully clothed except for his coat. A metal electrode was on the back of his neck, slipped under the collar and held in place with a scarf. A wire led from the electrode to the radiator and was wired to the radiator. A rheostat was plugged in a wall socket, the handle of a "violet ray" machine was on the deceased's chest and a circular hollow piece of metal was in his left hand.

To reconstruct the sequence of of events, the deceased undoubtedly attempted to treat a back pain with the violet ray contraption and, in the mistaken belief that "grounding" would increase the strength of the current and thus the efficiency of treatment, after plugging in the handle of the violet ray outfit, rigged the connection between the radiator and the metal plate on the back of his neck.

No better way could have been devised to conduct the alternating current from the return ground through the heart area. Hence, as soon as the current flow was started, it caused local burns at the point of entry and instantaneous death.

OUR *Point* OF VIEW

YOU CAN'T SHRUG IT OFF

As THESE words are written, our Navy and Marines have re-taken from the Japs some islands in the southeast Pacific. By the time this is in print, we may know what it cost to drive the yellow men from those points. By then, too, we may have some conception of the cost in American lives of the presently-promised Anglo-American air offensive over Germany and of the Ranger raid on Dieppe. None of these costs will be nominal. The price we will pay to recover other Axis-infested parts of the world must not be forgotten as easily as were the oft-published traffic injuries and fatalities after each national holiday, before G. R. (Gasoline Rationing). So long as the individual was not concerned in one of those frightful highway tolls, the initial shock was easily shrugged off in favor of baseball scores, golf tournaments, or editorial comment.

There is something altogether too reminiscent of that careless casualness in the present attitude of the average American toward the bloody Armageddon now raging throughout our world. With far too many of us the ghastly awakening shock of Pearl Harbor has all but worn off. Although subsequent engagements with the foe have brought succeeding casualty lists; although our merchant ships, with a horrifying percentage of their crews, have been sunk faster than we can make them; although our armed forces, in about a year from now, will number at least half again as many men as we mobilized in World War I—compared to an army of 188,000 before the war; although our national life has been regimented and rationed as never before; although we have lost the Philippines, part of the Aleutians, and other possessions; although, in fact, we are losing the most important war of our existence, there are still too many of us who don't know what it is all about, who have no real conception of the super-seriousness of things as they are today—and who, in some cases, don't give a damn.

Why? What's wrong?

Doesn't the fact that naval casualties to date have exceeded those of the other war (77 officers, 794 men) by thousands mean anything? Doesn't it register that the manpower loss in killed, wounded, and prisoners in the single campaign of Bataan nearly equalled the total killed in action in the former A.E.F.? Can't we all understand that this is not a stream-side picnic of happier days? Is it beyond our conception to realize what it means to have the grasping tentacles of the Axis Powers increase their control of world production since 1938 over rubber from zero to more than 90 percent; crude petroleum, from .4 to nearly 7 percent; bauxite, from 25 to 65 percent; tin ore, from 9.4 to 73 percent; zinc, chrome, iron, and manganese ores, in comparable percentages? Today, we, the United States of America, are a have-not nation in so many crucial items that one wonders how we ever had the temerity to say: "We don't need the rest of the world. We can live unto and by ourselves."

The implications of these and other statistics not only are vital—they are vicious! We *must* wake up! We *must* understand, or else . . .

Again, why? What's wrong with us?

Outstanding among several contributing factors are two: the ever-more confounding confusion regarding availability of gasoline, fuel oil, rubber, clothing, sugar, other foods, and various daily-life items—for which only the government and its multifarious bureaus, departments, committees, "spokesmen" and their continually conflicting reports, estimates, theories, and what-have-you's can be responsible. Who knows whom to believe and what? And if we can't have dependence on what our leaders say about some problems, why should we get into a dither about their other pronouncements? Let us have clear, keen, truthful statements—facts, honest facts, even if they hurt—from sources known to be responsible. Then that irritable, self-satisfied, smug, what-the-hell attitude will largely disappear. Every John Q. Public will then find that he *is* concerned, that he *must* take greater cognizance of what goes on at Tulagi, at Stalingrad—or his way of life and that of his children will submit to the now too largely disregarded Axis menace that so threateningly overshadows him.

The other primary factor concerns us—each and every one of us, regardless of what sacrifices we may have made, or think we may have made to date. "There is no doubt that the American people mean to win the war," said Elmer Davis, "but there is doubt that all of us realize how hard we are going to have to work to win it. The war is a long way off . . ."—and that is one of our troubles. It was a long way off from France and England in late 1939 and early 1940, when German and French soldiers fraternized across the Maginot Line, when British aircraft dropped leaflets instead of bombs on the Reich. There was international smugness and things weren't too tough. Then it happened.

So it is with us. We haven't heard screaming Stukas or Zeros. Bombs haven't—at this writing—smashed buildings, torn our women and children limb from limb. It's all so far away—and it probably won't get over here anyway. The Germans are too busy with the Russians; after Midway and the Coral Sea the Japs aren't strong enough to attack our mainland. Let George do it!

So? *This* is a total war, and the word "total" has no half-way meaning. In total war you either are, or you aren't; you either live or you die, individually, nationally. We must recognize the gargantuan size of this conflict, its hideous, world-wide machinations. It is a known fact, now, that Axis strategy includes the conquering and subjugation of the United States. It can be done, both physically and economically, by the most ruthless, coldly-calculating, best informed, cruelest gangsters and mobsters the world has ever known. As matters stand this minute, only one thing can stop them and lick them—American ingenuity and courage, coupled with those same, already demonstrated factors on the part of the folk of the United Nations.

To accomplish our share, we Americans need two things: an administration policy that will give us the clear, cutting, unadulterated truth, so far as is compatible with national safety in war-time; and we, the people, must realize we have no surplus of resources, productive capacity, or time—that this is a fight to the finish, and that more of us must get more than "ankle-deep" in this war, or we'll lose it.

—*A.D.R., IV*

Future Sources of Power

A Systematic Survey and Evaluation of All the Power Sources at Present Known to Science

C. C. FURNAS, Ph.D.
Professor of Chemical Engineering, Yale University

THE sun's rays shower as much energy on the earth's surface in one minute as the entire human race utilizes in one year. Despite the presence of this bountiful and unusual flow of energy, a large part of the struggles of the human race are concerned with acquiring and controlling sources of power. Evidently our state of development in the utilization of power is still rather crude. Thus, a review of the various practical sources of the present day is in order.

The energy supply which is most critical in America is that of petroleum. At the present time we are using something over a billion barrels per year. The known proved reserve of petroleum in the ground is 12 to 15 billion barrels, depending on who does the estimating. Thus the petroleum actually in sight is only about a 12-year supply. But new discoveries are being made constantly, so most of the people in the petroleum industry say they are not worried about the supply, at least for the present generation. It is a little discouraging to note, however, that the new discoveries are not quite keeping pace with use, so the pinch of partial depletion may come sooner than the optimists anticipate.

There may be discoveries of great new fields but the prospects of that are not very good. There is the possibility of extensive fields lying under the ocean next to coastal plains such as border the Gulf of Mexico. There may also be a great deal of petroleum at far greater depths than are yet explored. We live in hope that there are, but it should be remembered that if recovery is made from the more difficult places, the cost of production is certain to rise and the customer must pay for it.

Technical advances in refining have greatly extended the potential life of the petroleum resources. The widespread utilization of cracking has more than doubled the yield of gasoline and hence has more than doubled the potential supply of motor fuel. Now the polymerization of refinery gases into liquid fuels is beginning to come in and is helping to extend the life line of petroleum. Such technical advances are a great factor in keeping up the liquid fuel supply, but eventually, perhaps distressingly soon, the pinch of depletion will begin to make itself felt. What then?

There are several possibilities that need to be surveyed and evaluated:

Dr. Abbott and experimental sun power plant

I. Getting all the petroleum out of the ground. Even with the best production methods, over half the original petroleum deposit still stays in the ground after the well has gone dry. Mining of the sands appears to be impractical, not to mention being very expensive. If some one will devise an inexpensive means of breaking the adsorptive forces between petroleum layers and the sand grains, he will greatly lengthen the life of our oil resources, not to mention the possibility of making himself rich.

II. Shale oil. There are many billions of tons of oil shale in this country which, when heated, will yield from half a barrel to two or three barrels of petroleum-like oil per ton of shale. The potential supply is enough to supply our motor fuel for from 100 to several hundred years, depending on the grade of shale considered acceptable. But mining or quarrying the shale, retorting it, and disposing of the waste costs effort and money. If the refinery cost of gasoline should double above its present cost per gallon, then shale oil might begin to compete. Thus we have a considerable backlog of motor fuel but we shall get it only by paying higher prices than at present.

III. Hydrogenation of Coal. Germany and, to a certain extent, England are making fairly satisfactory liquid fuels by reacting hydrogen gas with low grade coal at high temperature and pressure in the presence of a catalyst. But the cost of production is about 20 cents a gallon compared to the American cost of five to six cents a gallon from petroleum. That high cost might be lowered somewhat but the prospects are that it will not go down materially. Thus we can drive our cars on motor fuel from coal, but we'll have to pay dearly for it.

IV. Alcohol from agricultural products. This is great fuel for politicians from the corn belt but not so practical for automobiles. First item is cost—15 to 20 cents a gallon under best practice. Next, lack of supply. A small fraction of our fuel might be supplied from waste and surplus farm products, but it would require nearly all the good crop land in the country to supply our motor fuel demand by this means. There wouldn't be anything left to eat.

Summarizing liquid fuels: We can have fuel for automobiles for at least several generations but at a price. The lush days of practically free oil from the ground will begin to end some of these days—probably too soon to please us. This generation may very well feel the pinch of partial depletion. Any economy or conservation steps are very much in order.

Coal: In coal we are the most happily situated country in the world. We have over half of the world's known coal reserve, and less than 6 percent of the world's population. At the present time we have enough coal in sight

(all grades) to last 3000 years. That picture may change if the other 94 percent of the people of the world decide that we must divide up, but that is one of the unpredictables. Hence as regards coal we may say that we are very lucky. But that does not mean we should be negligent of conservation. Within the next 100 years many of the best deposits will be depleted. We shall have to begin to depend on the lower grades. Expenses of recovery will go up, quality will go down. It will be wise to extend the life of our A-1 deposits as long as possible.

Eventually, no matter how much we conserve, this sponging off past ages for fossil energy must cease—the deposits will have gone up in smoke. What then? That's a question which America will face eventually, which many groups of people in the world are facing right now. Other possible sources of energy certainly should be considered.

I. Water Power: The water-power sources of the world are by no means fully developed, but even if they were they would be quite inadequate. About 10 percent of America's energy comes from water power. By full development that could be extended to 20 or 25 percent. It helps but it simply is not enough.

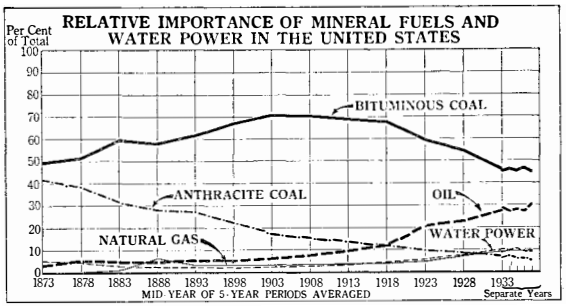
II. Wind: Lots of energy goes to waste in a hurricane or tornado but you can not count on it. The winds are not dependable, even in Kansas. Moreover, the average breeze is at a very low potential as far as energy is concerned. Except for isolated, special cases where a high cost storage capacity can be provided, wind power seems to be out.

III. Tides: In a limited number of places, such as ill-famed Passamaquoddy Bay, the use of tidal power may be practicable if a possible market is close at hand. Like the power from falling water, this may help but it can supply only a small proportion.

IV. Wave Power: Many wave motors have been designed, some of them have been patented. But the item of variability of the source of power seems to relegate this device to the impractical heap.

V. Utilization of Current Vegetation: About 50 times as much energy is stored up in plant life on the earth in one year as man utilizes in that year. It might then appear that we could use the present growing trees, grasses, and shrubs for fuel and thus solve the problem. Close investigation makes that idea discouraging. In the United States we would have to use nearly all our annual crop of vegetation (trees, grass, farm crops) to meet the energy demand. Nothing would be left to eat and the land would all be a desert in a few years. We cannot push vegetation very far from its natural cycle. All the data show that we cannot go back to a tree- and bush-burning economy.

VI. Atomic Energy: The business of smashing atoms to release great gusts of energy is a profitable sport—for news reporters. But it is not an item that has much standing in physics laboratories. Radioactive materials, of which there are only minute amounts in the earth, disintegrate and slowly release large amounts of energy. If radium, for example, were as plentiful as copper, atomic boilers using radium as fuel might be practical, but there just is not very much radium available. As far as artificial disintegrations are concerned, the verdict thus far seems to be definitely thumbs down on such operations for giving a net yield of energy. Far more energy has to be put into the operation than can be got out. There is some evidence that one of the isotopes of uranium, if relatively pure, might, upon bombardment with neutrons, disintegrate to give a net yield of a rather large amount of energy. But this isotope of uranium is one of the rarest of rare materials. Other materials tried have not so far shown any hopes for energy production. Thus any Atomic Energy Development Company seems to be facing a stone wall of discouraging facts. One cannot arbitrarily say that we shall never be able to get energy from atomic disintegration but in our present forecasting we shall be on safer ground if we do not count on it.



Courtesy, "The Index," New York Trust Co.

Graphs showing trends in power sources

This brief survey has not answered the question of where we shall get our energy, but it has pretty well covered the possible sources—excepting one—the direct utilization of the energy of the sun's rays.

The average intensity of solar energy in this latitude amounts to about 0.1 of a horsepower per square foot. The energy falling on one square yard of roof would more than operate all the electrical household appliances, including lights, of the average family—if it could be directly utilized. Most factories have sufficient energy falling on the roof to operate all the machinery in the place—if the management had enough ingenuity to utilize it. No one has developed that ingenuity yet.

One of the obvious possibilities for direct utilization of solar energy lies in photo-electric cells. Thus far photoelectric cells have operated with microscopic efficiency and have been very expensive. If some one can make revolutionary improvements in photoelectric cells, and can cut the cost of construction away down, we might have something there. At present the prospects are discouraging but one hesitates to say that such utilization is forever impossible. Even with the items of efficiency and cost brought under control, the matter of storage of energy during periods of darkness would be troublesome. Large storage reservoirs of water might solve this problem—pumping water to high levels in daylight hours, using it in water turbines during darkness. The overall efficiency of such storage can be about 70 percent. In general, it may be said that photoelectric cells are barely possible but not hopeful.

The simple and obvious device of using focused sun's rays to heat up a liquid has been toyed with for a long time. Solar boilers of various degrees of impracticality have been born in many inventors' minds and the subject of many patents. Dr. Abbot, of the Smithsonian Institution, has a small solar power plant with revolving parabolic mirrors for which he claims an electrical energy production efficiency of 15 percent. We shall have to do better than that if the sun's rays, which are not at very high intensity to begin with, are to be a practical source. It is not likely that the efficiency of the solar power plant, if it operates by steam generation, can be greatly improved.

On the other hand, solar energy may very well be on the verge of being practical for heating of buildings where a high potential is not important. The storage capacity must be sufficient for weeks or even months of operation. A basement full of hot water, periodically reheated by the sun's rays, might be possible, but it hardly sounds prac-

tical. A closed cycle, employing a low-boiling liquid, might better serve for such storage. First costs would be high but operating costs might be cut to the vanishing point.

Such an idea may bring a smile but it is now becoming almost respectable; the Massachusetts Institute of Technology has begun experimentation along this line. [See "Harnessing the Sun," Scientific American, June 1942, pages 284-286.—*The Editor*]

The foregoing suggest some interesting ideas but, with the exception of heating buildings, they do not seem to come within gunshot of practicality. I have saved what I consider to be the best idea until the last: namely, men should try to do efficiently what nature has been doing inefficiently for a billion years—utilize photo-chemical reactions. The basis of all life is some simple photo-chemical reaction thought to be

$$H_2O + CO_2 + \text{Radiant Energy} = HCHO\ (\text{Formaldehyde}) + O_2$$

The formaldehyde immediately forms simple sugars which then serve as the basic material for the multitude of complex compounds in plants. What we should like to do would be to take some such simple compound as formaldehyde formed with the help of radiant energy, put it in an electro-chemical cell, expose it to oxygen, and then reverse the above reaction and get back the stored energy as electrical energy—at high efficiency. Formaldehyde can be oxidized in a cell in a basic solution to give formic acid and a small amount of electrical energy. Perhaps all that is needed is a proper catalyst to complete the oxidation to CO_2 and water and get back all the stored energy.

The catalyst which nature uses for performing the photosynthesis of the above equation is chlorophyll. That's the best catalyst known but it is very poor. Plants are very inefficient stores of energy. Even the most luxuriant plants have an energy-storage efficiency of less than two percent. We ought to be able to do a lot better than that.

It is a wide open field—this study of photosynthesis and the study of oxidation cells which will reverse the reaction. That is the reason it is hopeful. The systems which might be used would not have to be limited to organic compounds. It may well be that inorganic compounds offer the most hope. The satisfactory system would need to be one that is as light-sensitive as the chemicals on a photographic film, as easily reversible as a lead storage cell. If such a photo-chemical-electrical system can be developed, the problem of energy capture and storage would be solved. The storage of the energy would be simply that of storing chemical compounds. We are used to doing that with coal.

Some day the photo-chemical approach to energy utilization will either be solved or definitely proved impracticable. In view of our own energy resources it may seem foolish to start working on it now. But it may not be too early to start. If we wait too long we may be caught short as energy supplies dwindle. Moreover, many parts of the world already suffer from insufficient energy. Many international problems might disappear if every group of people could fully utilize the energy falling on its rooftops.

Enough energy falls on about 200 square miles of an arid region like the Mohave desert to supply the United States. When we become ingenious enough to utilize efficiently the energy treasure wherever it may fall we may solve many of our economic problems. It might be a little hard on the railroads that haul coal, but everyone else would benefit.

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FREE ELECTRONS

May Explain Behavior in Iron Alloys

Loose electrons which float around between the atoms of solid iron and its alloys are responsible for many of the properties of these alloys, said Dr. Roman Smoluchowski, speaking recently before the American Physical Society.

He presented a new conception of the role which these "free" electrons play. Applied in practice, it may lead metallurgists to a better understanding of what happens when other elements are added to iron, making the alloys so important to industry, in peace as in war.

Atoms of iron, like others, consist largely of electrons, each carrying a negative electrical charge, encircling a positively charged nucleus. These atoms are arranged in a lattice formation, making up the metallic crystals.

But also in iron, as in all metals which are electrical conductors, there are other electrons floating around in this lattice, not connected to any particular atoms. The drift of these so-called "free" electrons is responsible for the conduction of electricity as well as of heat.

Pure iron at ordinary temperatures has a crystal structure in which the atoms are arranged in the form of interlocking cubes, the corners of each cube forming the centers of adjacent cubes. Thus they form what is called the "alpha phase" arrangement, and this makes for toughness and strength.

However, when iron is heated there is a change at the temperature of 900 degrees, Centigrade. It then goes from the normal alpha phase to the "gamma" phase. Here the atoms are more closely packed than in the alpha phase and the whole metal contracts slightly. If the heating is continued, at 1400 degrees, the metal changes back to the alpha phase, which is retained until it melts, at 1535 degrees.

When other metals are alloyed with iron, they form a solid solution, comparable to liquid solutions—salt in water, for example. Some alloying metals increase the range of temperatures over which the gamma phase occurs, while others decrease it or eliminate it entirely. Knowledge of their effects is very important to the metallurgist in planning an alloy for a particular use. If a part in a machine has to withstand a temperature of perhaps 1000 degrees, Centigrade, it would not do for the alloy of which it is made to change phase while in operation. One then has to add a metal which prevents formation of the gamma phase. On the other hand, a metal which would have this valuable property might introduce other undesirable properties, as for instance, lessened resistance to corrosion. Hence it is necessary to have a selection of alloying agents, from which the proper choice may be made.

All the 92 elements can be arranged by their atomic weights in a checkerboard fashion, to form the well-known "periodic table." Iron comes close to the middle. It has been found by previous experimenters, said Dr. Smoluchowski, that all the elements to the right of iron (and which can dissolve in it) increase the range of temperature at which the gamma phase occurs. All to the left, with a few exceptions which can be explained, decrease the gamma range, or eliminate it entirely.

According to Dr. Smoluchowski, this remarkable regularity is explained by changes in the energy of the free electrons in the crystal lattice of an iron alloy with the addition of other atoms. "The elements to the right of iron, such as nickel, cobalt, and platinum, have more free electrons per atom than iron," he stated. "Thus they contribute electrons to the iron lattice. In contrast, those on the left, including vanadium, chromium, tungsten and molybdenum, take them away."

Fluorescent Lighting Stretches Out

Cold-Cathode Tubes, Operated at High Potentials, Have Interesting Applications for Many Uses

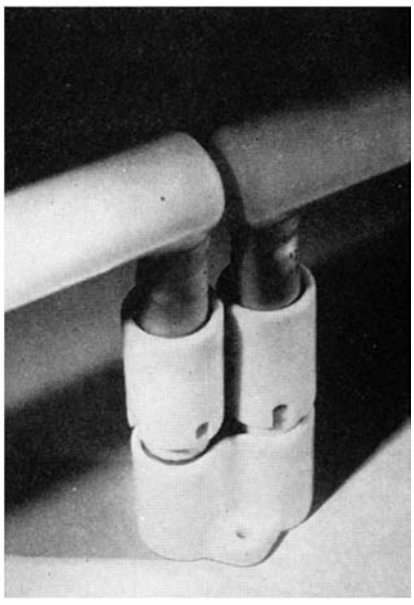
AUSTIN C. LESCARBOURA

FLUORESCENT lighting is being stretched out as the next step in the spectacular development of tube lighting. Continuous cold-cathode fluorescent tubing, as distinguished from the usual hot-cathode fluorescent lamps with their fixtures, and in lengths up to 20 or more feet and in parallel lines, curves, circles, or other shapes to follow architectural contours or specific illumination needs, has been appearing of late in plants, drafting rooms, offices, stores, and other establishments. The fact that this improved fluorescent illumination utilizes all available light, since no diffusion screens are required; that it stretches out the total light over the widest area as contrasted with lamps spotted here and there in fixtures; that it does away with elaborate fixtures and accessories, and even reflectors where white ceilings are available; and that it requires an absolute minimum of hard-to-get materials, has earned for it the significant nickname of "the victory light."

Cold-cathode fluorescent lighting, however, is just another old idea in modern streamlined dress. Many of us recall the Geissler tubes of our physics classes or home experiments. Those glass tubes, blown or bent into decorative shapes and sometimes surrounded by fluorescent liquids held in outer glass jackets, were connected across a spark coil or static machine so that the electrical discharge caused them to glow in various attractive colors. Out of that old idea came the colorful and vivid neon and other gaseous-tube advertising signs that converted night into day along our Main Streets until blackout ordinances compelled reversion to the blackness of the night, and incidentally left thousands of neon sign shops without a reason for being—temporarily, at least.

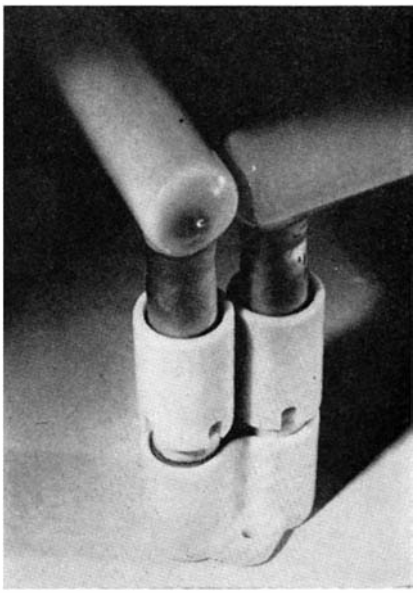
It so happens, however, that the neon sign technique can, with due thought and care, be converted into an advanced form of fluorescent lighting. First, tubing that emits a white light takes the place of the colorful tubing used for advertising displays and decorative purposes. Second, the manufacturer or contractor handling finished tubing and installations now thinks in terms of total lumens, and foot candles, and lumens per watt. Third, the industrialist, seeking the most satisfactory illumination for his workers averaging 60, 70, and even 80 hours weekly, is attracted to the easy-on-the-eyes merits of cold-cathode fluorescent lighting. Fourth, in order that there may be standardization of products and installation practices to safeguard the buyer against being made party to an experiment, the Fluorescent Lighting Association, comprising leading manufacturers of cold-cathode fluorescent products, joined by contractors keenly interested in this latest illumination means, is formulating and issuing definite standards covering approved products and installation practices.

COLD-CATHODE fluorescent lighting is probably the simplest form of illumination so far developed. It consists of nothing more than inside-coated glass tubing properly evacuated and filled with argon gas and mercury vapor, fitted with metal electrodes, and sealed. Such tubing can be straight or bent to any shape. Several lengths, each up to eight feet long or more, can be connected together in series, on one transformer. Parallel rows of tubing can be used where a higher level of illumination is required. The transformer steps up the 110-volt A.C. to the necessary secondary voltage required for the satisfactory operation of the tubing. Usual operating voltages run anywhere from 3000 to 15,000, depending on the tube footage, number of tubes in series, tube diameter, and other factors, all reduced to definite mathematical formulas and tables. The current flowing through cold-cathode fluorescent tubing is generally of the order of 60 to 150 milliamperes, depending on several interlocking factors. Tube diameter generally runs from 12 to 25 millimeters.

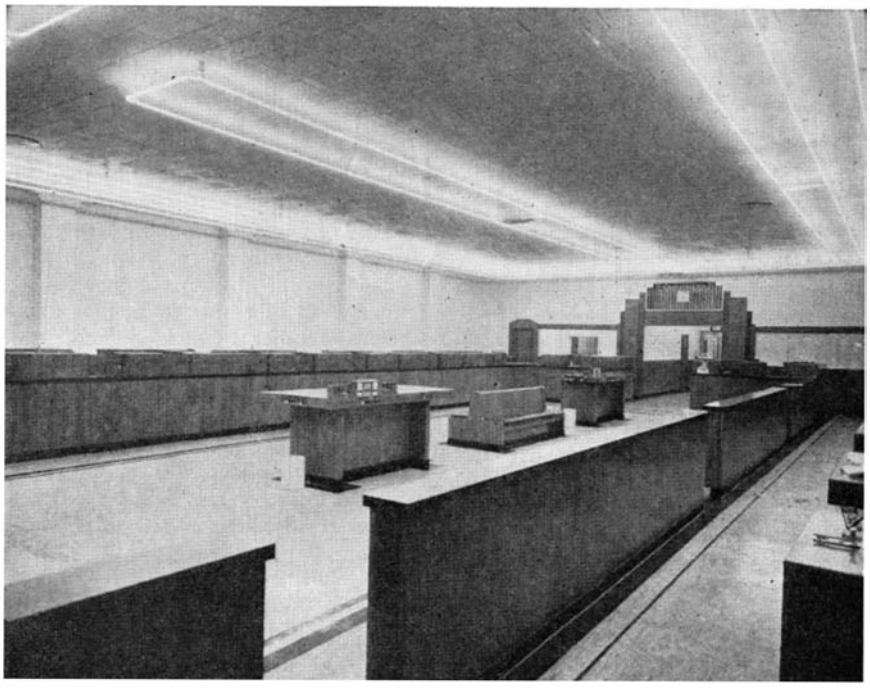


Tubes come close together in mountings, leaving minimum dark space between

What actually happens in the cold-cathode fluorescent tubing is that the coating inside the glass tubing is activated or caused to glow under the action of the ultra-violet light generated by the passage of current through the gas in the tube. The glowing phosphor or fluorescent coating causes the entire length of the tube to emit light. Thus the light is spread out over many lineal feet, instead of being concentrated—as in the case of the usual incandescent lamp—into a few square inches, or again into the 9-inch to 5-ft. length of the hot-cathode fluorescent lamps. The cold-cathode fluorescent tubing stretches out to many feet and, with this stretching process, the surface brilliance or glare of the tubing per unit area is correspondingly lessened. Referring again to the incandescent lamp, we have the light concentrated in a few square inches, with even the translucent bulb still too



Mountings are easily adapted to angular arrangement of the cold-cathode tubes



New lighting method is simplest form—no reflectors or diffusers

bright to permit such a light source to be used unshielded if we have due respect for our eyesight. The hot-cathode fluorescent lamp was a big step ahead, for the surface brilliance is considerably reduced as the light source is stretched out to four or five feet. Now comes the cold-cathode fluorescent tubing, stretching out to 20 feet for the same light output, and the surface brilliance is so lessened that one can look directly at such light source for hours without visual discomfort. Thus, in the case of cold-cathode fluorescent lighting, no diffusion means or translucent screen is required, which means that instead of sacrificing anywhere from 25 to 40 percent of the light output for diffusion purposes, the full light output is put to useful work.

THE stretching of the light source also serves to distribute the light to best advantage. As contrasted to lamps in fixtures spotted here and there, the cold-cathode fluorescent tubing spreads over the area to be illuminated so that there are no light and dark areas, but rather a uniformly well illuminated area. Since this light source operates at a relatively low temperature, the tubing can be mounted close to a white ceiling, which ceiling then serves as the reflector. Simple hangers suspend the tubing. Where a white ceiling is not available, the tubing may be placed in suitably painted plywood reflectors. No metal is necessary for the reflector, and no other fixtures are needed except the simple connecting sockets.

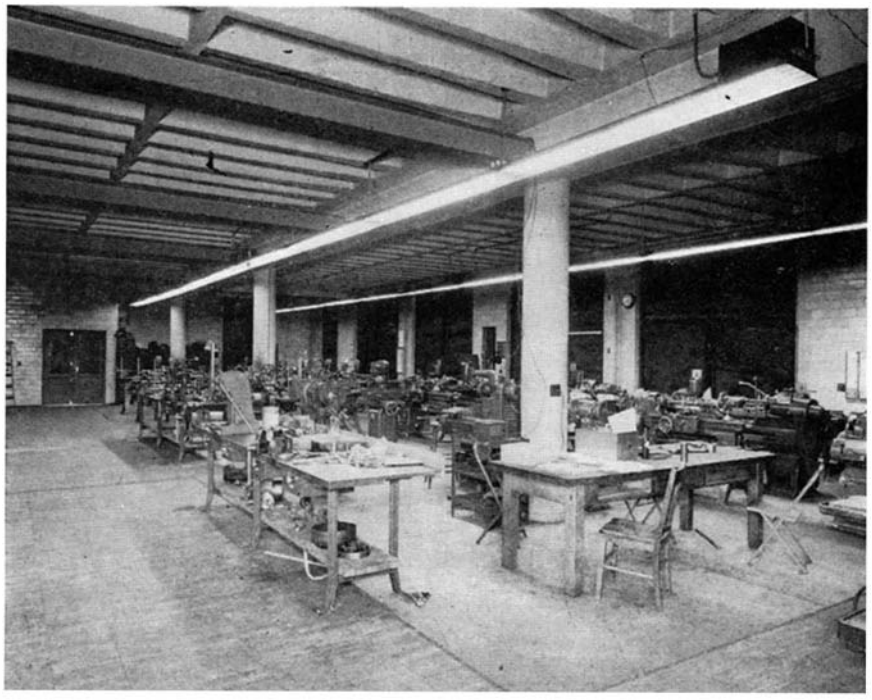
Although cold-cathode fluorescent lighting still is in its infancy so far as actual application is concerned, rapid progress is being made because of the Association's activities. Already suitable porcelain mountings are available, permitting the tubing to be held in series or in parallel, and at various angles in respect to successive lengths. Suitable transformers are available, and decorative housings are now coming through to dress up the installations in offices and stores.

Fluorescent tubing for utilitarian illumination comes in three shades of white termed "Soft White," which has a pinkish cast for a pleasing atmosphere consistent with good lighting; "3500 Degree White," in strict accordance with the color designation of that term; and "Daylight White" which is more on the blue side and suitable for revealing true color values.

The white range of fluorescent tubing is more efficient than that of incandescent lamps because the light output for the former is from two to four times greater than for the same wattage input, while the heat radiation is from 25 to 50 percent less. The latter consideration is important when dealing with showcase lighting, or in confined working quarters, or again where air conditioning is being used.

THE simplicity of cold-cathode fluorescent lighting is another basic reason for the growing popularity of this form of illumination. There are no accessories or starting gadgets of any sort required. Just the tubing and the transformer complete the equipment proper. When the power switch is closed, the tubing lights up instantly, at full illumination. There is no delay, no sputtering, no flickering. With the absence of starters or accessories, there is virtually nothing to get out of order. The maintenance is reduced to nothing more than wiping off the tubing with a damp cloth from time to time, to assure full illumination.

As for life, typical installations show a tube life of 10,000 hours to as high as 30,000 hours in actual service, as



Typical shop installation. Transformers are above reflectors

contrasted to the 2000-2500 hour rating of hot-cathode fluorescent lamps. Furthermore, there is little falling off in light output with cold-cathode fluorescent tubing, as compared with a considerable loss of light for both the incandescent and the hot-cathode fluorescent lamps as they age. Cold-cathode fluorescent lamps have no filaments to burn out or break from jars or vibration. Cold-cathode life is not reduced with frequent starting, whereas life is reduced with each starting of standard fluorescent lamps.

Because cold-cathode fluorescent lighting requires so little hard-to-get materials, particularly when freedom from replacement is considered, this form of lighting is receiving favorable priority consideration.

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GLASS

Now Made Without Use of Sand

IN windows, glass is used to admit light; in optical equipment it must refract, disperse, or condense light, and better control of these functions has long been the aim of research.

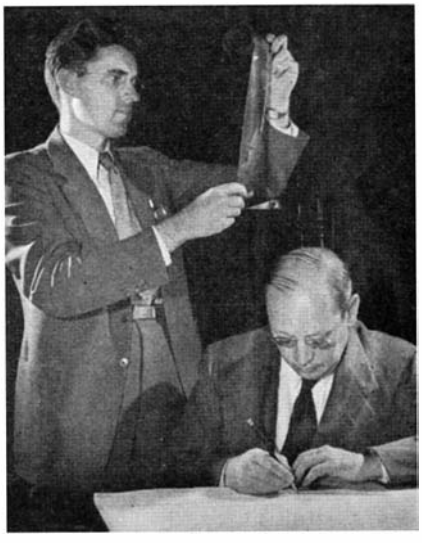
Ordinary glass has as its principal constituent silica in the form of sand, whereas a new "rare element" glass, developed by Eastman, contains no silica as sand but, instead, various compounds of tantalum, tungsten, and lanthanum with boric oxide. Such a glass, suggested eight years ago by Dr. G. W. Morey of the United States Geophysical Laboratory and developed with his collaboration, has a refractive index high in relation to its dispersion, imparting to it unusual "light bending" ability. This makes possible a lens of considerably less curvature for a given focal length, which means that the path of rays through the lens margin will approximate more closely that of rays passing through the center. Practical application in aerial cameras with compound lenses gives better "definition" over a wider area, but with no loss of lens speed.

At present, "sandless" glass is being manufactured only on a small scale. Before it may be used generally for photographic lenses, different grinding formulas must be worked out, as its higher refractive power prohibits the application of standard silicate glass formulas. Even then, sweeping replacement of optical glasses now being used is not anticipated. Since the new glass is much more expensive, due to costlier materials, whose high density also increases the cost per volume, it will be substituted only where its superior ability to give improved definition over a wider area (as in high-aperture lenses) justifies the extra cost.—*Industrial Bulletin of Arthur D. Little, Inc.*

LIGHTNING CHARTED

To Provide Defense for Power Lines

To prescribe adequate defenses for power lines, Westinghouse engineers now plot lightning charts, called probability curves, to anticipate the approximate number of lightning strokes that will bombard power lines during a given length of time. It has been learned, for example, that every 50 miles of power line will be hit by lightning an average of 50 times every year. Each stroke will have a potential voltage of between 20 and 30 million volts as it streaks earthward from a cloud. Forewarned, power-line designers can erect defenses that prevent lightning strokes from short circuiting transmission systems and disrupting electric service to vital war industries.



Filmed measurements of lightning give data for "probability curves"

The lightning charts have been made after engineers spent four years measuring the power and speed of lightning, and gathering data on the number of times that thunderbolts strike in a given area. They found that an average of 10 lightning strokes bombard every square mile of the United States every year; that the average stroke consists of about 20,000 amperes of electricity (enough to momentarily light a city of 15,000 population); and that the speed of lightning varies between 30 million and 200 million miles per hour.

Such lightning data have produced a great improvement in the defense of power lines against thunderbolts during the past 20 years. Two decades ago nearly every one of the 50 lightning strokes that hit a 50-mile power line each year knocked out service at least temporarily. Today, a properly designed 50-mile power line is unlikely to be put out of service by lightning more than once in five or 10 years.

SWEDISH STEEL

Is Equalled by That Made in Texas

STEEL smelted with charcoal in the Swedish way, and as good as Sweden's best, is an American product fostered by wartime changes in the world's industrial setup, according to Dr. Donald F. Othmer, of the Polytechnic Institute of Brooklyn.

Swedish steelmakers have always favored the use of charcoal in smelting because the absence of sulfur and other impurities from charcoal resulted in a very pure, high-grade metal. The Nazi war-lords have taken advantage of their position to monopolize all of Sweden's export production, and they may yet overrun Sweden itself. So we are getting no more Swedish steel.

At the same time, war-stimulated demands for two of the principal chemical products of wood—acetic acid and methanol (wood alcohol)—have caused a great increase in their production by the American wood distillation industry. By-product of wood distillation is a very high grade of charcoal, excellently suited for quality steel production.

In northeastern Texas there is a great deposit of iron ore that has not been worked hitherto because it is too remote from supplies of coking coal. But all over the region there are forests of post oak, of little value for lumber but very good for wood distillation, and, of course, yielding high-grade charcoal.

By establishing one or more wood distilling plants in that region, it will become possible to turn out new supplies of the war-needed chemicals, and at the same time to convert part of the now neglected iron ore into the finest steel.—*Science Service.*

BRIDGE

For Railroad Crossings In Industrial Plants

DESIGNED for use in industrial plants where loading docks and buildings are separated by roadways or railroad

Bridge in lowered position for crossing railroad tracks

tracks a new power operated cross-over bridge has been made available by the Montgomery Elevator Company.

Operation of the bridge is similar to that of an elevator. When not needed the bridge is housed overhead, out of the way. When loads must be trucked across the open space, a control button is pushed and the bridge descends into grooves provided for it. When trucking is finished, the button is pushed and the bridge automatically returns to its housing overhead. Time required for raising or lowering is less than one minute. This eliminates cumbersome drawbridges and special transfer cars. Danger to employees is also reduced because they do not have to venture onto the tracks or roadway.

FOREST RESOURCES

Heavy Demands Will Come After the War

THE inroads that have been made by war into the timber capital of most European countries will inevitably result in a reduced forest productivity for a long period after the war, C. L. Forsling, assistant chief of the Forest Service, United States Department of Agriculture, said in an address prepared for the Second Inter-American Conference of Agriculture, held in Mexico City.

Following the war, he said, there is likely to be a heavy demand for lumber and other forest products for reconstruction purposes and to meet the normal needs that have been postponed during the war.

"There is reason to believe also that the demand for wood after the war will be large, not only in Europe but all over the world," Mr. Forsling said. "Although some of the supply to meet this increased need can come from other parts of the world, the Western Hemisphere, particularly the countries south of the Rio Grande, will have to supply the major portion. It seems reasonable to expect, therefore, that the countries of South and Central America and Mexico may have the opportunity to develop an export trade in timber. Domestic requirements, which naturally should come first, may be expected to increase.

The development of export trade and increased domestic use will require more knowledge than is now available about the potential uses of the large number of tropical American forest species and the improvement of facilities for marketing. A sound policy of conservation and management of forest lands is basic to sustain foreign markets and to insure adequate supplies for domestic needs in the future. Collaboration in a number of ways should prove helpful in developing the forest resources of the Americas."

MIDWAY PLANTS

Two Rare Varieties Found on Desolate Islands

AT least two plants known nowhere else on earth are found on the remote, rather desolate Midway Islands, outpost of the Hawaiian archipelago, according to botanists of the Smithsonian Institution.

One of these is a variety of mint that once also formed part of the former luxuriant plant cover of Laysan—a small, uninhabited island about one third of the way between Midway and the Hawaiian Islands. About 1903 some rabbits accidentally were introduced on Laysan. In 10 years they had multiplied into thousands. They exterminated all the plants and reduced the island of less than two square miles to a sandy desert.

On Midway grows also a species of nightshade—of the nightshade-potato-tomato family. It is known elsewhere only on the small neighboring Ocean Island. The vegetation on both the Midway Islands—Sand and Eastern—is very poor. Only 20 kinds of native plants have been found there, the Smithsonian botanists say. The islands are among the most recent bits of the earth to emerge from the sea and afford an interesting example of the tendency of life to fill every possible spot and turn it into a suitable habitat.

Originally seeds of plants could have been brought there only in two ways—by ocean currents or by birds. The likelihood of wind-borne seeds traveling so far is remote. Yet plants have been able to establish a foothold there without human agency. They die and make soil, which provides a habitat for still more plants. Most of the plants are of kinds which spread through the Pacific islands.

Since the establishment of the cable station on Sand Island, several weeds and cultivated plants have been introduced—notably the oleander. The so-called San Francisco grass has also been brought in from the North American continent for the purpose of binding the sand, and various common weeds have come with soil brought in for gardens.

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PAINT—The weather-resistance of a paint is approximately proportional to the angle that the grain of the wood makes with the surface: A wood surface with a vertical grain holds paint much better than wood with a slash-grained surface.

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HOGS OR BEER?

Which is the More Economical Source of Food?

THE energy derived from eating meat is two removes from the original energy source—the sun. That is, the first remove is the vegetable which stores up solar energy, and the second is the animal which in turn stores up some, but only some, of this energy. This is why meat is a more expensive source of energy than vegetables and, incidentally, is why the crowded Chinese cannot afford to eat much meat. Now the British are arguing about the food value of beer. The following, from the *Journal of the American Medical Association,* states the crux of the argument about meat versus beer:

British opponents of the brewing industry, quick to take advantage of war conditions, have called attention to the fact that an appreciable percentage of all available English grain is now be-

How A Big Business Man Appears To His Wife

"LOOK at him over there, grinning to himself! Strange how little a man can change in fifteen years! The big boss one minute—and like a little boy the next!

"He was mostly 'little boy' before we were married. He'd been coming around for a couple of years, and I'd just about given him up. Then, suddenly, he was very much a *man*, rushed me off my feet and almost before I knew it, we were married.

"When we were newlyweds he was only a bookkeeper, and he'd come home in the evening all tired and discouraged. Other fellows at the office had been promoted, and he didn't know what to do about it. One night I forgot myself and said, 'If *you* don't do anything about it, Mr. Stick-in-the-Mud, no one else ever will!' Then I was sorry, when I saw how I'd hurt him.

"But it must have made him think hard, because one evening the following week he came home looking as though he'd just robbed the piggy bank. He told me he'd enrolled for a course of executive training. He thought I'd be angry, because we were still paying for the furniture. The 'little boy' and the man, all mixed up!

"After that, his whole point of view toward business seemed to change. One promotion followed another, until a few years later he became Treasurer of the company. Now he's beginning to surprise me. Says he expects to be Vice President soon!

"Of course, he's just as modest as he ever was. He'll tell you he got the breaks, but I know better. He *got* the breaks because he'd learned how to grasp them when they came. He's really smart—and so was I when I said 'I do' to a little boy turned man!"

• • •

What does the lady in *your* life think of *your* success? Get more of the Alexander Hamilton Institute's story in the famous little book, "Forging Ahead in Business." Tells how the Institute's timely training is helping thousands of men to do a better business job in these wartime days. Just clip and mail the coupon—today!

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ing used for the production of beer. They allege that this grain would be of greater social value if used for the raising of poultry or pigs. "Pigs versus beer" has thus become a current political slogan.

The brewers of England have countered by quoting experimental evidence previously published by nutritional experts of London University. Waller, for example, found that the food value of beer is more than half that of the grain and other material used in its production, while pig meat has less than one fifth the food value of the same materials if used in raising swine.

Moreover, 25 percent of the food value of the grain used in brewing is returned to the farmer in the form of brewers' grains, malt culms, or yeast, foods especially high in vitamin content and nutritive value if used in the animal industry.

The use of beer has also been under investigation by the food controller, who finds "no evidence that beer is doing anything to increase crime or bad health, or to reduce the output of munitions."

From such testimony it is officially concluded by the British cabinet that "it is in the public interest that the production of beer should continue at the present amount" (4 percent of all available grain).

UTILITY LANTERN

Combines Powerful Beam With Extension Light

A GENERAL utility electric lantern which has recently been developed features adjustable focus of the main light as well as an auxiliary light bulb on an extension cord that may be used to illuminate objects not reached by the larger beam. The plastic housing of this lantern is made of Tenite, is light in weight, and yet is so strong as to be virtually unbreakable.

Two-in-one lantern

Railway car inspectors, industrial plants, and servicemen are said to be rapidly adopting this lantern for general use.

BLACKOUT STRIPS

Prevent Light From Showing Around Shade Edges

AN ATTRACTIVE edging around window frames, which also acts as a track for the blackout window shade and, at the same time, prevents any light from escaping, is now available in the form of Tenite strips. These strips, which are produced in both black and white and which retain their high natural luster without the aid of polishing agents, offer a satisfactory solution to the problem of how to avoid cracks of light showing around the edges of blackout shades.

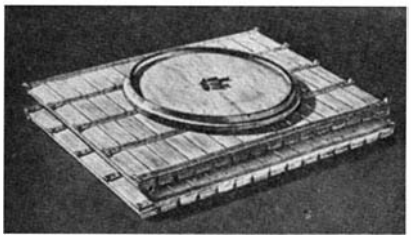
Light-trap window-frame edging

COLLAPSIBLE BARREL

For Bulk Materials, Saves Shipping Space

FOR the shipment of bulk material for which a container is required that can be later emptied and used again, a new collapsible unit offers features of strength and economy. As shown in two of our illustrations, these containers are made in the form of barrels than can be taken apart and shipped flat.

This collapsible container, placed on the market by Planters Manufacturing Company, consists of two plywood heads and two or more assemblies of plywood staves with provision at the ends to retain the heads. Secured to the staves are steel straps which terminate in eyes to take locking pins when the stave assemblies are wrapped around the heads. According to the purpose to which the container is to be put, the design may be such that adjacent edges of staves make tight or loose connection with each other, as may be desired. Individual staves can be removed and replaced if broken.



Right: One of the new barrels made with plywood staves locked in place with steel straps. *Above:* One of the containers in collapsed form for re-shipment

OIL FROM COAL

New Method Being Checked in the United States

NEW research in the production of liquid motor fuels and lubricants from coal by a process not hitherto investigated in the United States, has been authorized in a recent appropriation by Congress to the Bureau of Mines. The Fischer-Tropsch method, developed and now industrially operating in Germany, has a number of advantages over the modified Bergius hydrogenation method which has been investigated by the Bureau for a number of years. Both methods start with coal, but the Fischer-Tropsch process gives a number of the separated fuel and lubricant products directly, while the output of the Bergius process is a single liquefied coal which is further treated much like crude oil in a regular refining process.

A further advantage of the new method is that much smaller plants are economically possible—about 30,000 tons a day against 150,000 tons a day for the Bergius process. This enables a wider and safer distribution of plants. Also, the Fischer-Tropsch process requires less precision machinery, and it can be used successfully with almost any type of coal, while certain coals with high ash content or extreme sensitivity to temperature variations present serious operating difficulties with the hydrogenation process.

Both processes produce about one ton (between 250 and 300 gallons) of

liquid products from four to five tons of coal.

The experimentation in this country follows reports of the development of commercial processes for manufacturing synthetic fuels from coal in foreign countries, particularly in Germany. The Bergius process was introduced first, probably in a plant at Leuna in 1927, and the 13 known plants of this type at the end of 1940 are believed to have produced about 25,000,000 barrels of synthetic petroleum products a year. Fischer-Tropsch plants, the first of which was reported in 1936, accounted for about 11,000,000 barrels a year in 1940.

Experimentation by the Bureau of Mines assumes added importance because of the war, but basically is directed to obtaining all facts possible so that in the distant day when America may run out of petroleum, a rapid change-over to coal can be made.

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TRANSPORTATION—For every passenger automobile available to carry war workers to their jobs in 1917, there are today six vehicles available.

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"ELECTRIC ARMY"

Represented by Generators at Grand Coulee

THE equivalent of a new army of more than six and a half million husky workmen, laboring 40 hours per week, 50 weeks per year, went into action to speed production of war materials when the Bureau of Reclamation placed in service the third main generator at the Grand Coulee Dam power plant.

The big unit is capable of generating 108,000 kilowatts of electrical energy, 30 per cent more than any other hydro-electric generator except its two mates —an enormous output when it is considered that one kilowatt is equivalent to the physical output of 14 men laboring steadily.

The 946,000,000 kilowatt hours a year which the machine is capable of producing at full capacity will do work equivalent to that of 6,622,560 men laboring 40 hours per week, 50 weeks per year. On an efficient treadmill, such a gang would be able to lift 27,000 tons, almost the weight of a battleship, one mile straight up in an hour.

Figuratively speaking, one work crew of this size—Grand Coulee Dam's first generator—has been laboring on Uncle Sam's behalf since early in October, and a second has been in harness since late in January. Almost the entire output of the three units will be used to make aluminum when new production facilities, now under construction, are provided.

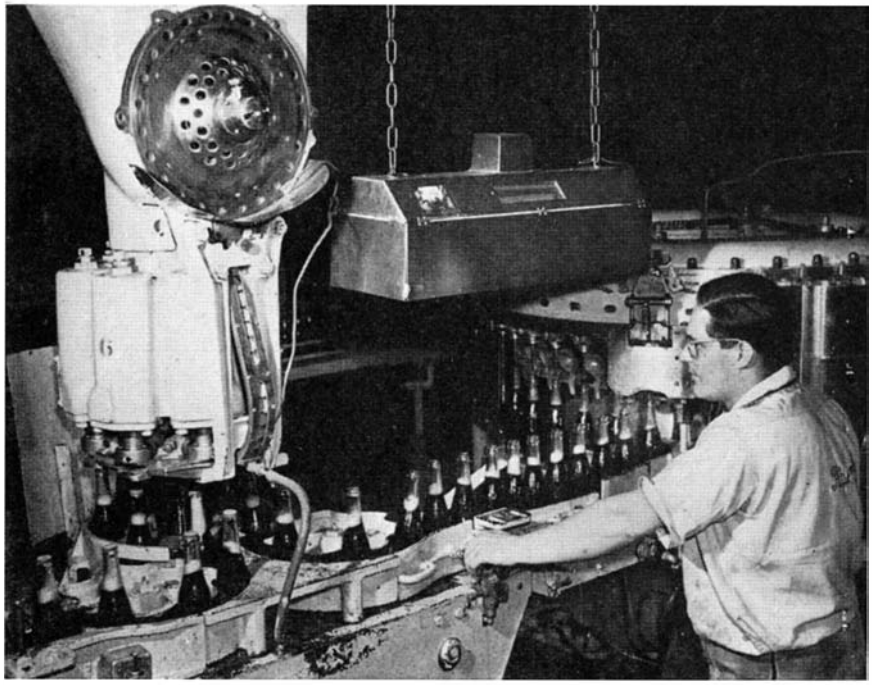
The throwing of the switch on the new machine marked the third time in about six months that the output of the big plant has been enlarged. In that short space of time, its capacity has been brought from a mere 20,000 kilowatts to 344,000, making Grand Coulee Dam, with only one-sixth of its generators in place, one of the largest hydro-electric power plants in the world.

The west powerhouse is scheduled to reach full development in 1944. Contracts have been awarded for six additional units, the first three to be installed in 1943. A powerhouse of similar capacity is being erected on the opposite bank of the Columbia, in the anticipation that more power will be required in the near future.

NOT SCIENTIFIC

Aversion to Non-Caucasian Blood is Emotional, not Factual

RECENTLY there has been agitation about alleged discrimination against Negroes, with regard to the use of



Germ-killing rays emanate from over-head reflector

their blood for blood-banks for war purposes, and the question has been referred to the American Medical Association. The Association has stated, through its *Journal,* that there is no factual basis for such discrimination against the use of Negro blood or plasma for injection into white people.

Since syphilitic blood is eliminated from use for this purpose by thorough serologic testing, the rate of syphilis in Negroes is of no concern in this connection.

The transfusion of Negro blood into white persons and that of white persons into Negroes has been repeatedly performed in civil practice without any evidence of harm or aversion on the part of the recipients.

The present agitation arises from the inopportune publication of orders prohibiting the inclusion of Negro plasma in the military plasma bank.

The aversion perhaps represents the persistence of the ancient folklore that one's personality is closely associated with one's blood. Frequently used clichés, such as "noble blood," are remnants remaining in the language from a day when such superstitions were more prevalent than now.

GERM KILLING

Rays Used To Sterilize Bottles, Contents

SAFEGUARDING every manufacturing step of a soft drink, from the sterlization of the syrup to washing, filling, and capping of bottles, invisible ultra-violet radiations are being used to kill or inactivate more than 98 percent of all bacteria. One of our illustrations shows a hooded ultra-violet unit suspended over bottles about to be capped. At the Long Island City, New York, Pepsi-Cola plant 50 more of these Westinghouse Sterilamps are ranged around the top of a 1,500,000 gallon syrup tank.

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PRESERVING—In spite of a long-clinging fallacy, the charring of wood to protect it from decay has no great preservative value when used alone. A modern treatment combines the charring of wooden poles to remove sap rot and spraying the charred areas with hot creosote.

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FIBER PIPE

Supported by Concrete, Used in Illinois Oil Well

THE world's first oil well to be cased with fiber pipe and concrete as a substitute for steel is in successful operation in southern Illinois, and experts in the industry believe it is the beginning of increased oil production in all parts of the United States, especially in the shallow-well fields.

The experiment with fiber pipe cemented in the well as a substitute for steel in the well was conducted under the supervision of the Illinois State Geological Survey, where the idea of using fiber pipe originated. Based on official figures of well drillings, it is estimated that the substitution of fiber conduit for steel casing will save some 75,000 tons of steel during the next 12 months if drillings continue at the present 1942 rate. Should drillings

reach the 1941 rate, a saving of some 150,000 tons of steel would result, according to this estimate.

According to the Fiber Conduit Company, the use of fiber pipe, supported by concrete, as oil-well casing is "a process which should prove to be of great value to the government, both as a means of saving much-needed steel and of increasing oil production."

TOO SOON

Anti-Aircraft Wires

Invented During World War I

BRITAIN'S newest anti-aircraft weapon, a rocket that trails long tentacles of entangling wires, is no new thing under the sun. Its essential idea was proposed during World War I by Prof. R. W. Wood, noted Johns Hopkins University physicist, who was then overseas in war service. His idea was to have the wires spun out of an anti-aircraft shell. Ordnance men were interested in what they termed the "spaghetti shell," but the war ended before it could be developed to the field-test stage.

Since 1918 the general idea has persisted, and a number of inventors have had a go at it. Shells, rockets, balloons, and airplanes have been among the means proposed for getting the menacing steel tentacles into the air. It has also been proposed to string small bombs at intervals on the wires, to act like miniature mines when the aircraft struck them or pulled them into contact by winding up the wire on its propeller.

VEGETABLE FUEL

Being Used by Power Plants in Argentina

SUCCESSFUL conversion of steam-generating equipment in Argentine power plants now permits the burning of surplus vegetable fuels for power, according to the magazine *Power*. Use of shelled and cob corn, barley, bran, sorghum, seedcake, and sunflower seed husks, almost completely takes the place of imported coal and oil supplies now cut off by the war, the magazine states.

The converted plants are owned and operated by Argentine utility companies affiliated with American and Foreign Power Co. The Calchines plant in Santa Fe has operated entirely on substitute fuels since the early part of this year. Shelled corn is burned on traveling-grate stokers, while bran is fed to forced-draft burners at the rear of the stokers.

A single large boiler at the summer seaside resort of Mar del Plata fires pulverized barley or bran. Corn on the cob, as well as sunflower-seed husks and shelled corn are burned at the Tablada station in Cordoba. Other plants at Tucuman, Mendoza, and Chivilcoy have been converted in a similar manner to utilize substitute fuels. Coal consumption has been completely eliminated in these stations and the quantity of fuel oil for boiler furnaces and Diesels has been materially reduced.

FERTILIZER

Magnesium Content Not Endangered

MAGNESIUM, one of the critical war metals, is also an essential fertilizer element on some soils, but there is no prospect of a shortage of magnesium for fertilizers, say Colin W. Whittaker and William M. Ross, of the United States Department of Agriculture, who have studied the supply situation.

Most soils have magnesium enough to supply the small quantity which plants require. Some magnesium, however, is a prime essential, since chlorophyll, the green coloring of the plant, includes this element. Lack of magnesium causes severe disorders in plants that can be remedied quickly and easily by supplying small quantities of soluble magnesium in fertilizers.

Before the war, the main source of the quickly soluble salt was calcined kieserite, imported mainly from Germany. With this supply cut off, fertilizer manufacturers turned to various forms of magnesium oxide, one of which is obtained by heating dolomite (magnesium limestone), of which the United States has abundant supplies. The heating changes the magnesium in

the dolomite to a more soluble form. In areas where the problem is merely the prevention of a magnesium shortage, and not the need for a quick-acting remedy, the indications are that use of dolomite in mixed fertilizers or in liming fields will supply magnesium that will gradually become available.

Most of the supply of magnesium metal required in the war effort comes from other sources and war use does not affect the supply of agricultural magnesium.

DENTAL CHAIR

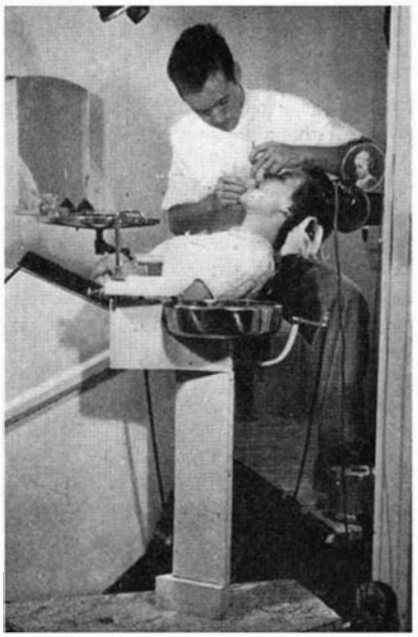
Is Fully Adjustable By Automatic Means

A DENTAL chair in which elevation and inclination of the patient are accomplished without moving the patient's mouth from the pre-determined and pre-focused illumination area, and without the necessity for the dentist to remove his hands from critical work at a crucial time to manually tilt chair and patient, has been developed by Dr. Richard W. Page, of Chappaqua, New York. Furthermore, by localization of the mouth area at a pre-determined point and by maintaining that position, the dentist is able to work entirely from a sitting position, thus avoiding the physical fatigue and foot discomfort which aggravate so many dentists. Likewise, cuspidor and rinsing cup at all times are more conveniently located for the patient and are reached by no more than a slight turn at the waist and a brief forward-leaning motion. This is in contrast to the former method of tilting the patient far back in the chair to obtain better operating conditions, a procedure which required the patient to pull himself erect in order to utilize the cup and cuspidor.

"If the operator is to assume the most convenient and restful positions while working," explains Dr. Page, "it becomes necessary in many operations to change either inclination or elevation of the chair, or both, one or more times. Most of these changes result in bringing the mouth out of the effective illumination area of even the best lights. This, in turn, places both patient and operator in awkward, uncomfortable positions in an effort to secure better lighting, or it requires the operator to use his hands to adjust chair and light, often at an inconvenient time and requiring re-sterilization of the hands."

In the dental chair shown in two of our photographs, changing the inclination or elevation is accomplished by foot controls. The patient can therefore be positioned in the most convenient manner, even though both of the operator's hands are occupied in the mouth; no matter how far above or below the patient it is desirable for the operator to be, the spotlight is always focused on the mouth and can, therefore, be mounted entirely out of the way of other essential accessories. The drill arm can be short and does not require constant adjustment to reach the patient in various positions.

The chair is recessed in the front section of the platform and is raised or lowered by means of the foot controls. Inclination is managed through use of rollers on tracks, motivated by an electric motor, also connected to the foot controls. The rear section of the platform, on which the operator's stool and the controls are



The spotlight (at top in both pictures) is always focused on the mouth, as indicated by the crosses in the two photos, regardless of how much this new dental chair is tilted

mounted, can likewise be raised or lowered to place the operator at any level desired above or below the patient. The close-coupled operating range of the chair permits a more compact and pleasing location of accessories which, due to swivel arrangement of the stool, are always within easy reach of the operator.

CABLE GAS

Keeps Moisture Out, Sounds Automatic Alarm

WHAT if a tiny pin-hole should open and let a tiny drop of water get inside a telephone cable? This cable is the protective metal sheath enclosing the fine copper wires, in some cases as many as 4242 of them. The answer is that even slight moisture might cause short circuits and service interruptions.

But such troubles rarely happen, usually only if a violent storm, explosion, or accident causes a cable break. The reason is that a vast part of the telephone cables of this country, carrying in all some 100 million miles of wire, are charged with dry nitrogen, a harmless gas, which is kept there under pressure.

Should a leak develop, the escaping gas keeps other moisture out. Moreover, instruments on the cable detect the drop in pressure, sound an alarm at a nearby station, and indicate the approximate location of the break. A repair crew is quickly on its way.

BETTER GUN

Results from Use of Substitute Material

IN making an important piece for a heavy machine gun, a former automobile maker produced a casting to replace steel tubing. The purpose, of course, was to effect a large saving of alloy steel in the manufacture of thousands of machine guns. But it was found that use of the "substitute" also greatly reduced the production time and resulted in a unit of higher quality.

With the approval of Army Ordnance engineers, a sample was cast, machined, and assembled into a gun for testing.

"I kept my fingers crossed when the Army inspector took the gun into the cold room and began whacking at it with a heavy steel bar," says the automotive factory manager in relating the story of the development. "I thought he was not being impartial when I saw him hit the standard unit only twice and then wallop our experimental gun eight times; but, after he came

out of the cold room, he explained that the second blow had buckled the regular unit and that our cast substitute had come through undamaged."

Having won official approval, the substitution has effected larger savings of time and material than even its original proponents estimated.

The section of tubing which was replaced had weighed 20 pounds in the rough, and was whittled down in a series of machine operations which reduced it to a thin cylinder, pierced with many holes, and weighing less than five pounds.

In other words, manufacture of the part, as originally specified, required handling, machining, scrapping, transporting, and re-melting of three quarters of the steel in the original piece.

Refinement of the casting, on the other hand, sends only 1½ pounds of steel into the salvage bin. The reduction in man-hours required for machining alone is more than 45 percent. —*Automotive War Production.*

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PLYWOOD—For appearance or economy, plywood panels are sometimes constructed with faces of one kind of wood and backs of another: For example, they may have a birch face for appearance, the rest of the plies of Douglas Fir.

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PARACHUTE BOAT

Carries Much Equipment, Yet is Light in Weight

A NEW one-man parachute boat for emergency use on single-seater fighter planes has a total weight, including the 11 items of vital equipment that help protect the flier, of only twelve pounds. The boat is attached to the pilot as a seat pack when he is in the plane, is held tightly to him in parachute descent, and can be inflated in from five to ten seconds by turning a valve on a small CO_2 cylinder. First shipments of the new type boat have already been made by United States Rubber Company.

Advantages of the one-man parachute boat for speedy, small fighter planes are its light weight, great compactness and the fact that the boat always stays attached to the pilot.

Although this orange-yellow boat is 5 ft. 6 in. long by 3 ft. 4 in. wide when inflated, it folds into a compact seat pack only 14 by 15 by 4 in. Within this package is a full set of vital equipment. Two wire-reinforced fabric paddles fit the hands of the flier and are used to propel and steer the boat. A concertina hand pump is fastened to the inflation valve and can be used for maintaining required pressure.

The action of the pump, shown in use on our front cover, is similar to that employed when playing an accordion.

In case the boat should be pierced by machine-gun fire, the equipment includes special plugs the flier can quickly fasten into the holes made by bullets. If any accident should happen to the boat he has equipment for emergency use which he can use either working from within the boat or from in the water. In addition, he has a collapsible fabric bailing cup and a collapsible fabric sea anchor.

Total weight is only 12 pounds. In addition, the Government furnishes a can of water, and a sea marker for use by the flier in drawing attention for rescue purposes.

This new one-man parachute boat includes innovations developed by Fred Patten, boat expert of United States Rubber Company, working with basic British designs.

PHONOGRAPH FILTERS

Serve to Reduce Needle Scratch, Equalize Tone Values

USERS of electrical phonographs, either complete in themselves or attachments to radio receiver amplifiers, will find interest in two new devices recently designed to improve the playing qualities of such equipment. These units, one of them fixed and the other adjustable, are designed to be used with either magnetic or crystal pickups and to reduce to a minimum any annoying and unnecessary needle scratch. Furthermore, they can be used to alter the tonal range of the reproduction.

Needle scratch control is accomplished through the use of tuned filter circuits which by-pass the objectionable high-frequency noises from the amplifier circuit to the ground, leaving only the desired musical tones.

By means of other tuned circuits, control is exercised over the tone of reproduction. In the non-adjustable model of these units, manufactured by Gold Shield Products, tone equalization is obtained by switching connections to the proper binding posts. In this way, bass notes may be emphasized, or high fidelity reproduction may be obtained. In the adjustable model the needle scratch filter operates in the same manner as in the fixed unit, but the frequency response characteristics of any record may be varied at will by means of a special control knob.

The method of connecting either of these devices to any type of electrical phonograph is extremely simple and, the manufacturers state, anyone who can tune in a radio set can install and use one of them.

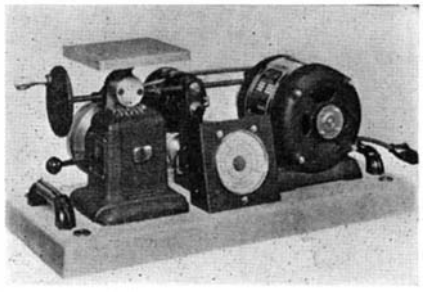
Industrial Growth

New Products and Processes That Reflect Applications of Research to Industrial Production

DESTRUCTION TEST

Simplified by New Vibrating Equipment

DESIGNED for use in aircraft and industrial plants where there exists a need for testing products under conditions of vibration, a newly designed test table can be applied to determining the vibration resistance of a wide range of instruments, carburetors, control units of many types, and so on.



Variable vibrations

When the apparatus shown in one of our photographs is to be used in testing, the instrument or other equipment to be tested is firmly clamped to the six-inch square table. The drive will then impart vibration to the table in a vertical plane at variable speeds from 600 to 3600 cycles per minute over an amplitude range variable from zero to one-fourth inch. Both of these ranges are completely adjustable. It is claimed that the equipment will handle test work up to ten pounds maximum weight. Developed by Televiso Products Company, this testing device operates on 110-volt 60-cycle A.C.

THROW-AWAYS

Made of Plastic, Release Important Machinery

SCREW plugs, dummy plugs, cap plugs, and other devices are often used for the protection of hollow equipment or other articles from dirt, dust, and moisture while being handled or in transit. These plugs, commonly known as "throw-aways," have no functional value after the shipment reaches its destination. Formerly made of metal, and requiring the use of screw-machines, die-casting equipment, and other needed tools, these "throw-aways" are now being produced by American Molded Products Company from a tough plastic, thus releasing metal-working machinery for other and more important work.

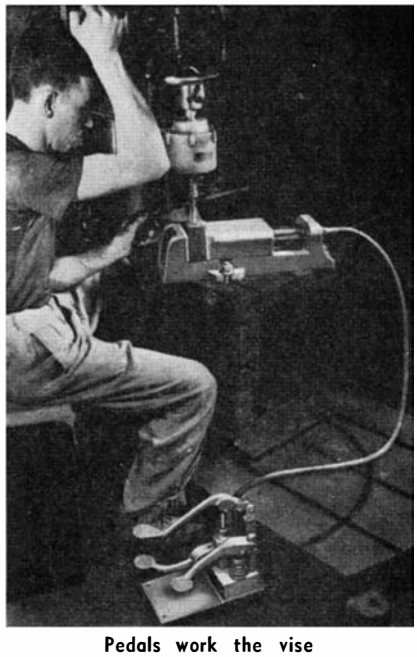
DRILL VISE

Operated Hydraulically by Pressure on Pedals

A NEW vise for use by tool and die makers, machinists and machine operators, and designed for holding work on the table of all types of drill presses, planers, shapers, milling machines, surface grinders, lathes, cut-off saws, and other machines, is called the Drilvise by its makers, the Studebaker Machine Company.

Entirely foot controlled and hydraulically operated, this new tool permits the use of both hands in the operation, set-up, and removal of work from the machine on which it is mounted. Exerting in excess of 10,000 pounds per square inch pressure between the jaws, this unit is ideally adapted for hundreds of machine shop uses.

Self-contained, requiring no outside power or air supply, the unit consists of a conventionally-shaped drill press vise (but without the usual screw or



Pedals work the vise

handle) and, connected to it by a six-foot length of flexible rubber tubing, a hydraulic foot control base. Parts are readily portable and can be easily moved from machine to machine.

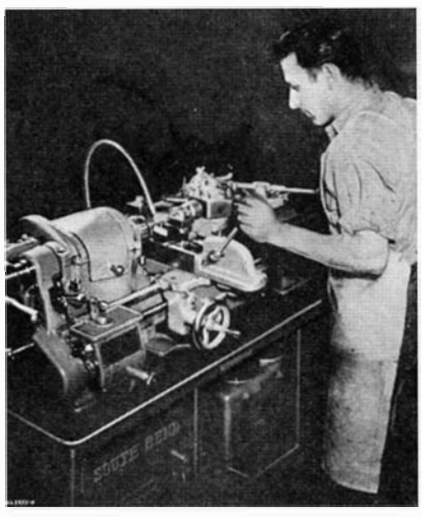
Work is placed between the open jaws of the vise, the operator moving the rear jaw toward the stationary front jaw by depressing the middle pedal of the foot control. This operation, taking only a second, moves the rear jaw against the work, exerting just the right amount of pressure to only grip the work. The right or booster pedal moves the jaw a maximum of 3/16" for each downward stroke of the foot and exerts a maximum non-slipping pressure of 10,000 pounds per square inch. To release work held between the jaws, the left pedal is depressed with one downward movement of the foot.

TURRET LATHE

Adaptable To Many Precision Jobs

A NEW bench model turret lathe for rapid production to close tolerances on chucking operations of bar works has just been announced by the South Bend Lathe Works. This lathe has a 10-inch swing over the bed and saddle wings, 1⅜-inch hole through the headstock spindle, and one-inch collet capacity. It is well adapted to second operation work.

The hand-lever operated bed turret indexes automatically and has an adjustable stop for each of the six turret faces. The lathe is equipped with both a compound rest cross slide and a hand-lever cross slide, which are interchangeable. The latter is furnished with front and rear tool blocks which provide three tool positions. A quick-change gear box supplies 48 longitudinal power feeds for the universal carriage, 48 power cross feeds for the compound rest cross slide and 48 thread-cutting feeds, 4 to 224 per inch. The underneath motor drive and back gears deliver 12 spindle speeds, from 97 to 700 revolutions per minute.

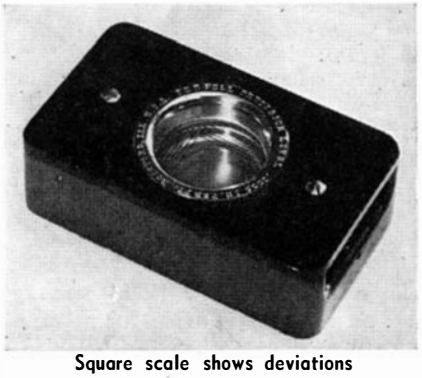


Ten-inch swing

LEVEL

Has Circular Bubble Which Accurately Shows Deviations

A NEW and compact level with which deviations in both longitudinal and lateral directions may be read on one setting has recently been announced by the William P. Fell Company.



Square scale shows deviations

The new unit, with a bearing surface 3½ by 6 inches, contains a gage glass 2⅜ inches in diameter. The indicating bubble, 1 5/16 inches in diameter, floats inside square graduation lines so spaced as to represent .0005 of an inch per foot of deviation from level.

RUBBER SUBSTITUTE

Made Practical by Use of Synthetic Wax

IN replacing rubber as a cloth backing in the manufacture of raincoats, life belts, and so on, the plastic material polyvinyl butyral has been used with considerable success. However, the characteristic surface tack of this material has to be eliminated without, of course, adversely affecting the other properties. It has been found that Acrawax C, a synthetic wax manufactured by the Glyco Products Company, Inc., when added to the polyvinyl butyral in amounts as low as 1 percent, effectively eliminates this surface tack. Furthermore, Acrawax C is a high melting point wax (275-280 degrees, Fahrenheit), non-brittle, water insoluble, and non-greasy. One percent is completely compatible with the plastic and shows no signs of blooming to the surface. It is available in powdered form and therefore can be readily incorporated with the other compounding ingredients in the milling operation.

The Mighty Mars

Huge Cargo Planes Will Play a Leading Role in After-the-War World Economic Developments

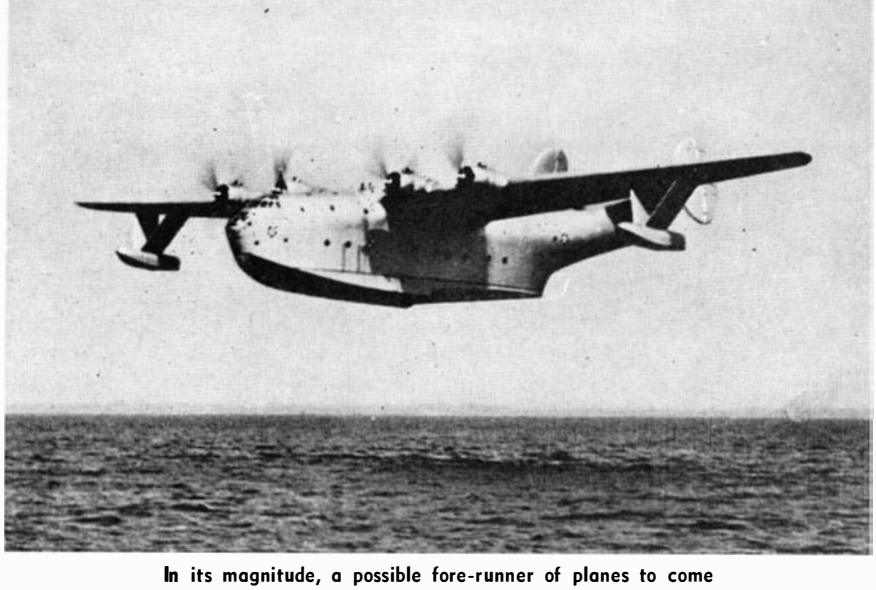
ALEXANDER KLEMIN
Aviation Editor, Scientific American. Research Professor, Daniel Guggenheim School of Aeronautics, New York University

To anyone who follows the press, the hearings before the Senate Committees investigating the possibility of our building huge cargo planes must be of considerable interest. We shall not enter into the argument nor attempt to analyze the statements of such authorities as Grover Loening, Eddie Rickenbacker, Henry J. Kaiser, and others. It is a very tempting idea to provide huge cargo aircraft, which will fly large loads rapidly to the outermost ends of the earth in a fraction of the time required by slow surface vessels, but there are two points on the other side. How quickly can we build such giant aircraft, and will the engines and other materials diverted to this task delay the construction of bombers and other fighting planes?

We are, however, able to present to our readers some preliminary information on the Mars, the huge new flying boat built by the Glenn L. Martin Company, prototypes of which are now under discussion for mass production. The Mars has recently made its first official flights, on behalf of the United States Navy, over the Chesapeake with complete success. With a wing span of 200 feet and a gross hull displacement of 995,000 pounds, the Mars could fly non-stop to Europe and back. Although rated as a patrol bomber, she can carry a large cargo, or, as a troop transport, 150 armed men. With such load-carrying capacities the proponents of the plan of building comparable boats in large numbers have some real ammunition with which to fight their battle.

The Mars is huge in every proportion. The cubic content of the hull is roughly that of a 15-room house. The crew can walk in the center portion of the wing to service the engines in flight. The four Wright Cyclone engines develop 2000 horsepower each and swing propellers 17½ feet in diameter. There is a spacious wardroom for officers and recreation space for the crew. The Commanding Officer has his own desk on the bridge and his own private stateroom. He can pace the bridge in flight in true sea-going fashion. There are two full decks throughout, a telephone exchange with 24 stations. Life aboard the Mars will be like life on a naval warship. The maximum normal weight of the ship will be 140,000 pounds, and the length overall is 117 feet, 3 inches. The height to the top of the hull is 24 feet. Sleeping accommodations will be available for 13 men. The gasoline capacity is enormous.

In one of our photographs the huge boat is in flight. The first impression



In its magnitude, a possible fore-runner of planes to come

we get is how closely the giant hull approaches the most desirable aerodynamic characteristics. The size of the hull is so vast that the landing step becomes almost insignificant. In the Boeing Ranger, another development in plane design, the tip float is mounted on a single cantilever strut; here we see two struts disposed at an angle providing for the bracing. The cockpit, or navigation room, blends beautifully into the rest of the hull. Twin rudders are employed. The rear portion of the hull rises cleanly upwards so that the tail surfaces are far from the water at all times. Tremendous skill and millions of engineering and shop hours go into the construction of the prototype of such a flying boat. Whether the Mars should be built now for war use is not for us to say. But we will go definitely on record that after the war such huge flying boats will make the Queen Elizabeth and the Normandie obsolete so far as first class over-ocean passengers and mail are concerned. Even as regards freight, the new seaplanes of this size will give surface vessels some stiff competition. It is not surprising that American Export Steamship Company has gone into the air transport business over the Atlantic, and that the Chairman of the Cunard Company, addressing his stockholders, speaks of his company giving consideration to the operation of flying boats after victory has been attained.

PLANE RANGE

Increase is Desirable for Pursuit Ships

OUR bombers are the best in the world and wherever they appear we stand a fair chance of aerial supremacy. Moreover, our bombers have long range and can proceed under their own power to almost any quarter of the globe where they may be needed. The problem of delivery of the pursuit planes which may be needed to accompany the bombers, however, is not so easy, and a number of suggestions have been made for increasing their range.

One of these suggestions is to build a convertible monoplane-biplane. The biplane could carry a greater gasoline load than the monoplane, and the wings would be folded back into the fuselage when there was fighting to be done. Another suggestion is to use a biplane at the start and allow one of the wings to drop off when its duty had been done. Still another is to use an external gasoline tank of streamline form, to be jettisoned when the fuel in the tank had been exhausted. It is this last idea which is illustrated in the reproduced photograph of the Army Bell P-39 D *Airacobra*. The only change over the earlier production type is in the addition of the "belly tank."

The Airacobra carries a heavy cannon and is powered by an Allison V-type liquid-cooled engine, submerged behind the pilot's compartment. It is

One of several suggestions for increasing flying range: "belly tank"

connected to the hollow-hub propeller by a 10-foot drive shaft. It will be noted that the Bell fighter is equipped with a retractable nose wheel, and a movable canopy for the cockpit to the left in the photograph.—*A.K.*

JAP ENGINES

Analysis of Mitsubishi Kinsei Motor

OUR friends frequently ask whether Japanese planes and engines are really good. Mr. W. G. Ovens, of Wright Aeronautical, answers the question in a paper published in the *S.A.E. Journal,* entitled "Some Notes on Design Features of the Mitsubishi Kinsei Engine." This is a two-row engine of 14 cylinders, with a take-off power of 1050 H.P., apparently fairly comparable to one of our own engines and in excellent condition before it crashed. Mr. Ovens drew the following conclusions:

"'The engine is undoubtedly a highly dependable, even though not highly developed, piece of equipment, probably produced under time and tooling limitations which we would consider nearly impossible.'

"The designers 'did a very ingenious job of combining what they apparently believed to be the most desirable features of a number of foreign engines—proved features all—into a composite design that "has to work the first time," and probably did.'"

That certainly answers our friends' questions so far as engines are concerned.—A. K.

CAMERA ANGLES

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

How Black is Black?

We say that a black surface absorbs light, although we do admit that certain black surfaces absorb more light than others. However, it is not too generally appreciated that it is not alone the tone of the black that we have to consider in this connection, but in addition its texture or *lack of texture*—whether its surface is matt or glossy. A smooth black surface, regardless of its reflective capacity as compared with a textured surface, will reflect light as strongly under certain circumstances as if the surface were not black but were some gray tone. These circumstances involve three factors—gloss, direction of the incident light, and viewing angle.

Remember the rule that the angle of the incident light (the light source) is equal to the angle of reflection? A black surface will appear almost white if it is smooth, glossy, and the angle of the camera to the black surface is equal to the angle of the incident light. Changing the angle of the light source or that of the camera will minimize the reflection and substituting, where possible, a textured, matt surface for the smooth, glossy one, will break up the partnership even more effectively.

Better Than the Whole

Isolate a detail suggestive of the entire scene, and you often get a more impressive picture. This is particularly useful in a situation such as that illustrated. Folk dancers entertaining an outdoor audience had to be shot against a background of such distractions as those seen in one of the illustrations, or not at all. The composition was good, but the effect was greatly diminished by the busy background. A closer viewpoint produced the other picture, in which the distractions are largely eliminated by the rather drastic expedient of "eliminating" parts of the subjects as well! However, this major operation seemed appropriate to the photographer in this instance, for interest was focused chiefly on the leg movements. For when skirts fly and legs are revealed, where do *you* look? So do we!

Prints for the Service

With a couple of thousand prints already on display in 16 or more Army and Navy posts in the Third Corps Area and overseas Atlantic bases, the

Distractions eliminated

"The effect was greatly diminished by the busy background . . ."

Photographic Division of the Citizens Committee for the Army and Navy, Inc., is now in full sway. The shows, which are displayed in the day and recreation rooms of the posts, vary from 25 to 350 prints and enjoy not only the approval of morale officers but their active support as well.

Prints are solicited from the ranks of both the amateur and the professional, the best ones selected, and shows assembled to furnish representative salons of the finest work available in this country. In addition, the committee has assumed the responsibility of supplying the camps with the necessary hanging facilities. Members of the exhibit committee serve without remuneration and the funds required to defray the cost of display materials are contributed by individuals and groups. The presentations, which will continue for the duration, got off to a full start recently with a showing of 300 prints at Fort Hamilton.

Dustless Negatives

CONTRARY to popular belief, Augustus Wolfman says that a camel's-hair brush or a soft cloth are *not* the proper mediums for removing dust from negatives before enlarging. "While either of these items will brush the dust off the negative, they induce a static charge of electricity in the negative which attracts more dust, like a magnet attracts steel," he asserts. Moving the finger lightly across the film or blowing lightly will clear the surface of dust without "charging" the negative, he advises.

He suggests further that in removing fingerprints and grease marks from negatives, it is wrong to use carbon tetrachloride, as this, being a "dry" cleaner, has the same effect as using a camel's-hair brush. He therefore recommends the following "wet" cleaner as being most effective:

Film Cleaner

Ethyl Alcohol (pure grain alcohol)	85%
Methyl Alcohol (wood alcohol)	10%
Strong Ammonia Water	5%

Tinted Movies

MOVIE makers shooting black-and-white film have occasionally adopted the practice of placing a filter on the projection lens to obtain "color" movies. This method receives the stature of an accepted procedure with the introduction commercially of a set of four monochrome projection filters, "blue for snow and sea scenes, red glow for sunsets, green for masses of forest and lawns, mellow yellow for late afternoon and even to 'warm up' Kodachromes."

Small vs. Large Prints

THERE has been much ado among pictorialists recently on the subject of the proper size print to submit to exhibitions. The discussion has been precipitated by the growing number of 14 by 17's being submitted and the fact that the large prints generally win out over the smaller ones. One pictorialist even went so far as to refer to a 14 by 17 as a "normal" size enlargement. This was a little too much for the chaps who feel that they can just about afford 11 by 14's and would gladly come down to 8 by 10's if only the judges would not be prejudiced against their offerings on the count of small size.

So the discussion goes back and forth and self-righteous judges, claiming complete impartiality, say print size means nothing, only the picture counts; while exhibitors charge that judges lean to the big prints and are most impressed with them. J. Ghislain Lootens, a well-known judge and teacher, declared that the reason large prints win over the smaller ones is because the distance at which judges usually sit is about right for viewing the 14 by 17's but is prejudicial to the smaller ones. As a cure-all he suggested that prints of different sizes be viewed from different distances appropriate to the size of the print. The 1942 New York Salon of Photography adopted the idea and announced the fact in its entry blank. We shall see how it works out.

Using Etching Knife

MANY of the failures of beginners in using the etching knife, whether on negative or print, are due to the desire of the operator to get it over with as quickly as possible. As a result, the amateur holds the knife in such a way that the point digs the offending bit of emulsion out instead of merely *shaving* it off gently and gradually. This operation is easily accomplished, if you will be patient, by repeated applications of the knife at a narrow angle to the negative or paper base. With careful shaving, the black spot in the print can be eliminated without anyone being the wiser, and if too much is removed, leaving too light an area, it is a simple matter to spot it with pencil or spotting color. Shaving undesirable densities on a negative is a more difficult matter, but can be accomplished by persistence and some experience. It is wise, incidentally, to use different knives for negatives and prints, as the delicately sharp edge required by the former may be injured in working on the print.

Wall Paper Backgrounds

FOR something different in the way of backgrounds for your color shots indoors, try wallpaper for a change. You can use the paper already on the walls in your home, or get sample pieces. Backgrounds of any type are always something of a problem, but frequently they are very useful where unusual results are desired. In color work, you have the additional factor that the color of the paper should be harmonious with the colors worn by the subject. Also, the design must be "quiet," lending atmosphere to the picture but not stealing the show.

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. Books listed in these columns may be ordered from our Book Department.

METALLURGY

By Carl G. Johnson

TEXTBOOK, written especially for home readers. Recommended to those who are working in industry and who seek some general knowledge of why metals behave as they do. Not a complete, detailed book, but an introduction. Emphasis is on the practical. Coverage: properties of metals; chemical metallurgy; producing iron and steel; physical metallurgy; shaping and forming metals; commercially important non-ferrous alloys; light metals and alloys; copper and alloys; steel; heat treatments for steel; surface treatments; alloy or special steels; classifications of steels; powder metallurgy; literature of metallurgy. Physical metallurgy is stressed more than chemical metallurgy. The author is Assistant Professor of Mechanical Engineering at the Worcester Polytechnic Institute. (262 pages, 5½ by 8¼ inches, 127 illustrations.)—$2.60 postpaid. —*A.G.I.*

THE RADIO AMATEUR'S HANDBOOK

Special Defense Edition—A Manual for Radio Training Courses

EVERYTHING from the regular edition of the "Radio Amateur's Handbook" has been retained in this volume that will be useful in defense radio training courses. To this material have been added new chapters on mathematics, measuring equipment, and code instruction. Thus a book which has long been the accepted standard in its field has taken on a new and outstanding importance in this special edition. (288 pages, heavy paper covers, 6½ by 9½ inches, numerous drawings, charts, tables, and photographs.)—$1.10 postpaid.—*A.P.P.*

CHEMISTRY

By Gerald Wendt, Ph.D.

NOT chemistry made easy—it can't be—but chemistry made easier. Intermediate between the popular works which make chemistry easy simply by skipping what's hard (and usually important also) and the more complex classroom texts. The author's praiseworthy aim—one envied by older generations of sufferers—is "to omit all that is likely to be forgotten in any case," thus not forcing the student or home reader who does not expect to specialize in chemistry to follow the instructor up and down every single dearly-beloved little side street and alley of the science. The result is a book containing the main substance of the typical first-year chemistry course as taught to college students (part of a survey course), one requiring real study, but from which the outside reader may garner a much better than sketchy background in chemistry. The author was formerly dean of the School of Chemistry at the Pennsylvania State University. (300 pages, 5½ by 8½ inches, 30 illustrations.)—$2.35 postpaid.—*A.G.I.*

THE COMING BATTLE OF GERMANY

By William B. Ziff

FORTHRIGHT, hard-hitting facts on the development of the war thus far, with special emphasis on the rise of air power, its past uses, and possible future utilizations. Replete with vital statistics on world economics and their bearing on Axis success or failure. In lucid, fast-moving style this is an analytical summation of the Axis plan of strategy, how it has worked to our detriment, how it may continue to do so, its bearing on the defense of the Americas, with a conclusion that we must fight the "Battle of Germany" now or we shall have to fight the "Battle of the United States" later. (280 pages, 5¼ by 8 inches.)—$2.60 postpaid.—*A.D.R., IV.*

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE

APPLICATION of welded construction to the implements of war has given a tremendously added impetus to this up-to-date and thoroughly proved method of fabrication. Thus, this seventh edition of a widely renowned handbook has greater significance and value than ever. The text covers the whole field of its subject from welding methods and equipment through technique and costs, testing, and machine design to typical applications of arc welding in manufacturing, construction, and maintenance. (1268 pages, 6 by 9 inches, completely indexed, thoroughly illustrated with drawings and photographs, flexible cover.)—$1.50 postpaid in United States, $2.00 elsewhere.—*A.P.P.*

TECHNIQUE OF PLYWOOD

By Charles B. Norris

PLYWOOD demand is skyrocketing in the production of wartime housing, airplanes, boats, and other defense needs, yet specific information on the material itself is difficult to find. Here, between

the covers of a plastic-bound book, has been gathered technical information on all phases of plywood manufacture, specially written for engineers, designers, and users of plywood. (249 pages, 5 by 7½ inches, tables and drawings.)—$2.50 postpaid.—*A.P.P.*

33 LESSONS IN FLYING

By Jay D. Blaufox

A FORMER Lieutenant in England's RAF of 1918, the author talks directly to the reader in fluent yet conversationally simple manner about taking a plane off and landing it safely; flying in fair weather and foul; high altitudes, storms, fogs, clouds; care of the engine: flying instruments; acrobatics; military flying. A supplementary manual to actual school flight instruction for student pilots of all ages. (319 pages, 5 by 7¼ inches, indexed. Numerous line drawings by C. B. Colby, editor of *Air Trails.*)—$2.60 postpaid.—*A. D. R., IV.*

HOW TO DESIGN AND INSTALL PLUMBING

By A. J. Matthias, Jr.

ALL-AROUND treatise, by an author who served his regular indentured apprenticeship and worked as a journeyman for a number of years, but who for the past 12 years has been circuit instructor of plumbing in the Wisconsin Vocational Schools. The book explains and illustrates all commonly used plumbing principles. for students, journeymen, and architects. (442 pages, 5½ by 8¼ inches, 349 illustrations.)—$3.10 postpaid.—*A.G.I.*

THE STORY OF THE AIRSHIP

By Hugh Allen

WHAT is the value of the non-rigid airships (blimps) that are becoming such a common sight in coastal areas of the United States? They appear to make ideal targets for enemy gunners, are relatively slow, and would seem to lack maneuverability. The author of the present book, long associated with lighter-than-aircraft operations, answers this and other questions which Americans are frequently asking. He tells of the advantages which the blimp holds for certain types of military operations, relates some of their history, shows how they have been improved since World War I, and presents the outstanding results of recent fleet operations. (74 pages, 6¼ by 9¼ inches, thoroughly illustrated with photographs and drawings.)—$1.10 postpaid.—*A.P.P.*

INDUSTRIAL INSTRUMENTS FOR MEASUREMENT AND CONTROL

By Thomas J. Rhodes

FOR use as a textbook for the formal study of the subject of instruments and automatic control in engineering schools and as a practical reference book for those concerned with instruments and control problems in industry. Author is engineer, Proctor and Gamble Company. Coverage: standards; pressure and vacuum gages; indicating and recording

The Editors Recommend

Best Sellers in Science

JANE'S FIGHTING SHIPS, 1941. This is the latest edition of the world-famed London authority on all world navies. Contains discussions, data, photographs, silhouettes, details of construction. Now, more than ever before, this is a "must" reference for all who have naval interests. **$19.00**

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CURRENT BULLETIN BRIEFS

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

MORE PRODUCTION—BETTER MORALE is a 16-page bulletin which details a program for American industry, based upon the premise that both management and labor have an equal stake in winning the war. How these two groups can be lead to realize this fact is discussed in the pages of this pamphlet. Request this bulletin on your business letterhead. *Institute of Public Relations, Inc., Graybar Building, New York, New York.*

INDUSTRIAL CHEMISTRY AS AN OCCUPATION is a six-page leaflet which covers the nature of the work, abilities and training required, income, and miscellaneous advantages and disadvantages. *Occupational Index, Inc., New York University, University Heights, New York, New York. Single copies 25 cents, $5.00 a hundred.*

GLUE, PLASTICS AND YOU, by I. F. Laucks, is a 16-page bulletin prepared in an attempt to lessen the confusion which now exists regarding the difference between the gluing art and the plastics art. *Laucks News Bureau, I. F. Laucks, Inc. Maritime Building, Seattle, Washington—Gratis.*

LATHE CATALOG NO. 16 is an eight-page pamphlet which describes a line of 16-inch Toolroom Lathes and 16-inch Quick Change Gear Lathes. Attachments, accessories, and tools for these lathes are also listed. *South Bend Lathe Works, Dept. S7, South Bend, Indiana.—Gratis.*

THE NEW OPEN HOUSE is a 32-page pamphlet which presents scores of timely ideas adaptable to civilian and farm home modernization and repairs. All of the suggestions given are within the limits set on remodeling and repair by the War Production Board. In addition, many practical ideas for making war housing more attractive and more livable are given. Considerable attention is paid to providing adequate storage space through the use of practical closets. *Ponderosa Pine Woodwork, 111 West Washington Street, Chicago, Illinois.—10 cents.*

STURDIMATIC HEAVY DUTY LIVE CENTERS is a four-page folder giving complete information and specifications regarding standard Morse taper live centers. Illustrated with photographs and drawings. *Sturdimatic Tool Company, 5224 Third Avenue, Detroit, Michigan.—Gratis.*

SPECTRUM CHART is a seven-color chart approximately 30 by 40 inches in size printed on heavy white cloth and bound at top and bottom with wooden rods. The entire electromagnetic spectrum is presented, every part of practical significance being analyzed in detail. Emphasis is on uses of each kind of radiation. Terms are defined in a special glossary. Of specific interest to teachers of physics, chemistry, and electrical engineering and to practicing engineers and scientists. *Publications Section, 6-N-17, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.—$2.00.*

METAL DUPLICATING WITHOUT DIES is a 32-page illustrated catalog describing in detail several mechanical devices designed specifically for duplicate forming of parts and pieces to die accuracy without the time delay and expense of die layouts and die sets. *O'Neil-Irwin Manufacturing Company, Minneapolis, Minnesota.—Gratis.*

CENTER SCOPE is a 20-page bulletin which gives instructions for using an optical tool to locate work to the center of a machine-tool spindle, to correct for run-out, and to locate layouts. Data are given on available models, edge block and table plug accessories, and typical set-ups. *Center Scope Instrument Company, 631 S. La Brea, Los Angeles, California.—Gratis.*

ACCIDENT FACTS—1942 EDITION is a 116-page statistical yearbook which gives most of the answers to safety problems. According to the National Safety Council, accidents—97 percent of them preventable—cost the nation $4,000,000,000 in 1941. This yearbook analyzes and presents statistics for the previous year and compares them with earlier years. *National Safety Council, Inc., 20 North Wacker Drive, Chicago, Illinois.—Gratis.*

TIN AND ITS USES (No. 13) is a 16-page pamphlet devoted to emergency economies in tin. This issue of the publication describes practical methods of saving tin in various fields of use. Articles describe methods of using solder less rich in tin than usual, using newly developed types of joints on lead pipes, the advantages of thinly coated tin plate, methods of using bearings containing less tin, and so on. *Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio.—Gratis.*

THE RATE OF OXIDATION OF COPPER, by Addison H. White and Lester H. Germer, is a study of the rate of reaction between copper and pure dry oxygen at room temperature and 20mm. pressure. The experimental technique is described in detail. *Bell Telephone Laboratories, Inc., 463 West Street, New York, New York.—Limited Free Distribution.*

TURNER TOPICS is a four-page folder devoted specifically to users of blow-torches, in an endeavor to enable them to get the maximum efficiency and service from these vital war tools. *The Turner Brass Works, Sycamore, Illinois.—Gratis.*

STEEL IN A YEAR OF WAR, by Walter S. Tower, is a summary of what has been accomplished in this industry during recent months, present problems, and a speculative look into the future. *American Iron and Steel Institute, 350 Fifth Avenue, New York, New York.—Gratis.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

METAL is not in the same class with glass for optical surfaces. Your scribe recalls Professor Ritchey saying: "You can't put a real optical surface on metal."

Another man who had worked with both materials comments as follows:

"Glass—like all insulators of electricity—is no good mechanically; but it is homogeneous and it is seldom that a noticeable variation in hardness can be detected in any particular sample. Hence, when one piece is rubbed against another, with an abrasive between, it is to be expected that all parts of the same piece will be similarly affected by the same rubbing speed and pressure. Not so with the metals. The metal is composed of crystals and hence is of varying hardness. If the steel is tempered, the lack of uniformity of hardness is even more noticeable.

"The chances are that the metal mirror maker has two strikes on him before he even starts to work. The chap who uses glass can depend on what he is getting, and be reasonably sure that his next piece will be pretty much the same as the piece he is now using. However, metal is much easier to handle than glass.

"Steel," continues the same man, who wishes to remain anonymous, "cannot be ground disk on disk, because of the tendency to gall. Little pieces pick up and roll into large balls, making deep, torn furrows in the work. Hardened steel is much better in this respect. Hence, I grind and fine-grind the mild steels on a lead lap. The fringes soon become visible and I can almost finish the job on lead. Then a little polishing on pitch, with rouge, gives a gorgeous finish."

A man who has worked with metals for flats is Sydney J. Needs, The Fairfax, 43rd and Locust Streets, Philadelphia, Pa. He is not an amateur telescope maker but an engineer who was aided by "A.T.M." in learning to make metal flats for use in an extended non-optical but high precision mechanical research on boundary films of lubricant in machine bearings, an account of which he published in *The Transactions of the American Society of Mechanical Engineers,* May 1940, pages 331-345.

As he did not there include data on his method of working metal flats, he was invited to describe his technique for these columns. Much of his description will seem strange to the worker in glass but, since amateur opticians often are called on to do precision work on metal surfaces, the technique he developed after much laborious experimentation should go into the permanent record and not be lost. Your scribe has a neat little flat of hardened tool steel presented by Needs. It tests flatter than 1/20 wavelength—a millionth of an inch. Needs writes as follows, in describing his working technique:

"A metal surface produced by the lathe or grinder may be fine ground on a lead lap in preparation for the final polish. The lead lap has the advantages of being easily prepared; it wears away very slowly; and the degree of surface perfection produced may be varied within wide limits. In fact, the lead lap is capable of producing finishes quite satisfactory for most purposes without the necessity of further polishing.

"FOR work up to about 6" diameter, an 8" lap is ample. A lap of this diameter should be about 2" thick, but this thickness ratio is arbitrary and unnecessarily high for laps of larger diameter. The casting is prepared by melting lead of the purest and cleanest grade obtainable and pouring into an oversized wooden mold. To produce a good surface on the work it is necessary that the lap be free of foreign particles. For this reason, scrap lead should not be used. When machining the lead casting, the horizontal table of a small boring mill will be found preferable to the chuck or face plate of a lathe. The outside diameter and the upper face of the casting are finished in one setting. Half inch lifting holes about 1" deep may be drilled radially from opposite sides midway between the two faces. These holes are useful for holding the lap on the machine table, while the second face is machined parallel with the first, and are necessary for handling the lap when in use.

"Both sides of the lap may be used, one for coarse grades of Carborundum or emery, the better side being used with only the finest grade of abrasive.

"After machining, the faces of the lap should be scraped to fit a plane surface plate. Lead will be found very difficult to scrape, and a poor surface will result unless a few simple precautions are observed. The scraper used is the ordinary flat double-edged hand scraper forged from a discarded file and hardened. Time will be well spent stoning the cutting edges of the scraper until they are smooth and sharp. Lead is so soft that the scraper will remain sharp indefinitely. Place a piece of carpet or several opened newspapers on the bench to form a support for the lead lap. Moisten a clean cloth with lard oil and wipe the upper face of the lap. A thin film of lard oil will remain on the lead and, thus lubricated, the scraper will cut smoothly and without tearing the metal. Scrape the surface until all machine tool marks have been removed. Now clean both lap and surface plate thoroughly, moisten both with lard oil, and wipe dry with a clean cloth. A film of lard oil will remain on each and when the lap is gently rubbed on a surface plate, the trace of lard oil present will be sufficient to lubricate the points in contact. Upon removal of the lap these high points will be found brightly polished; and sufficient lard oil will still be present to lubricate the scraper removing them.

"After a test on the surface plate, remove all high spots, moving the scraper in one direction. After the next test, remove the high spots by moving the scraper at right angles to the previous direction, thus preventing the formation of furrows. Before each test clean the lap and reference plane thoroughly and apply a fresh film of lard oil; then remove as much of it as possible with a clean dry cloth. Should scratches be found on the lead after testing, more care in cleaning is probably indicated. When the contact spots are quite close together and well distributed over the surface of the lead, the lap will be found to float quite freely with no perceptible friction when first placed on the reference plane. This is due to a film of air separating the surfaces and an appreciable time is required for the air to escape. When this occurs, the lap is fairly flat, but the scraping may be carried on as long as patience will permit.

"ONE important detail concerning the use of the scraper must be added. Lead is so soft that merely reducing the pressure on the scraper at the end of a forward stroke is not sufficient to raise the scraping edge and stop the cutting. The scraper must be lifted from the work while still moving forward at the end of each stroke. If this is not done, each stroke will end below the surface of the surrounding metal and a burr will be raised where the scraper is stopped. The forward motion of the scraper removing the high spot has exposed metal, free of lard oil. If the scraper is moved back or a second forward stroke made over this unlubricated surface, scratching and tearing of the metal will result. The chip removed by the forward stroke will be found on the edge of the scraper and must be removed before the next stroke is started. After a few trials, the trick of raising the scraper and removing the chip with a finger will become automatic and require no further attention.

"After the scraping, the lead lap is ready to be charged and used. No grooves are necessary since the lap *is used dry.*

"For charging, a flat cast-iron plate is convenient, having approximately the same diameter as the lap but it need not be as thick. After it is machined all over, one side of the cast-iron plate is finished plane and smooth, either by scraping to fit the reference plane or by the time-honored process of grinding

three plates against each other in pairs. Lifting holes similar to those in the lead lap are drilled in the side of the cast-iron plate. To charge the lead lap, No. 600 Carborundum is sprinkled on its scraped surface and spread as evenly as possible with absorbent cotton. The cast-iron plate is gently placed on the lap and moved in several directions with short straight strokes. Ten or 15 strokes should suffice to spread the abrasive evenly and drive some of it into the surface of the lead. After removing the plate, all excess carbo is removed with a cloth and the lap is ready to use (with the work on top). At first the lap will cut rapidly but, after 40 or 50 strokes, recharging is necessary. Before recharging, however, much can be gained by rubbing the work over the cast-iron plate, since this also was charged when charging the lead lap. Being harder, the charged cast-iron plate will cut more rapidly than the lead lap, but the scratches in the work will be much deeper. By using the cast-iron plate and the lead lap on small work, the time required for removing the tool marks will be so short that there seems to be no advantage in using any of the coarser grades of abrasive. The lead lap produces a surface that is quite bright, and, almost from the start, the surface contour may be observed by interference fringes under a master glass.

"In addition to charging the lap, the cast-iron plate makes it possible to keep the work flat as the lapping proceeds. It has been found that, if the lead lap is flat, the work will be slightly convex, particularly if of small diameter. This is probably due to elastic deflections of the lap caused by the pressure applied to the work moving over it. To get the work flat, it is necessary that the lap be slightly convex. This is accomplished during charging by rubbing the cast-iron plate on the lead lap with the proper stroke. The plate will tend to become concave and the lap convex in the same manner as spherical mirrors ground by the telescope makers. Should the work become concave, the lap is too convex, and this is corrected during charging by reversing the process and rubbing the lap on the cast-iron plate. Thus surface control may be maintained during the process of the work.

"As soon as all tool marks have been removed from the work it is no longer necessary to use the cast-iron plate as a lap, and the finish is made on the lead.

"It is important that the lap be dusted free of all loose abrasive after each charging. The lap will cut faster when loose abrasive is present, but the edge of the work will be badly turned. When the abrasive is sprinkled on the lap, it will fall in small mounds. If these mounds are not broken up the cast-iron plate will be placed on several little hills and the local pressures over such small areas will be sufficient to distort the lead permanantly, causing humps to rise around the depressions. Hence, the necessity of spreading the abrasive as evenly as possible before using the cast-iron plate.

"As stated above, the lead lap cuts comparatively rapidly when freshly charged and it follows that the scratches in the work will then be deepest. When

all tool marks and visible flaws have been removed from the work and the test glass shows the surface to be of the required flatness, the polish may be considerably improved by continued working on the lead lap with no further recharging.

"From time to time, the lap should be washed with soap and water, washed again with clean water to remove as much of the soap as possible, and thoroughly dried with a clean cloth. Continued effort will reduce the depth of the scratches, with a corresponding improvement in polish. Unless removed mechanically or chemically, traces of soap will remain on the lap and these seem to assist by slightly lubricating the surfaces.

"The limit seems to be reached when the surface of the work begins to lose its brightness and take on a cloudy film. This is probably due to all the abrasive being forced into the surface of the lap, thus permitting the work to come into actual contact with lead. By stopping just before this point, the best results with the lead lap will have been achieved. Viewed through the low-power objective of the microscope at this time, the surface of the work is seen to be a mass of tiny scratches. The scratches, however, are very fine indeed and may be entirely removed in a few minutes by rouge on a pitch lap. If the pitch lap is flat at the beginning of the final operation, the polishing action on the work will be uniform and the surface contour unchanged by the pitch polisher."

With regard to metals for *optical* surfaces, Needs largely concurs with the anonymous writer first quoted, stating in the *Transactions A.S.M.E.* article cited above that: "There appears to be no metal which, when polished and examined even under low powers of the microscope, will present a surface of uniform surface even remotely approaching that of well-polished glass." If this is so decidedly the case, why then publish anything at all on the working technique for metals? Because of legitimate special uses for metal, and perhaps a little because of human nature. Amateurs will, and do, make metal mirrors.

Needs has told how he avoids turned edge without recourse to the exquisite skill developed by long-experienced makers of flats—simply the "surround" principle ("A.T.M.," page 53). "Turn up a ring (Figure 1) of the same material as used for the flat. Let the outside diameter be about 1" larger than the flat. Turn the outside of the flat a neat sliding fit in the ring. The fit must be good. If ever so little tight the flat and ring will both be sprung. If too loose, fine Carborundum will get between flat and ring and cause trouble when polishing. Heat gently and cement the flat in the ring with beeswax. Finish up, and the turned down edge will be on the ring. To separate, heat, push through hole *A*, and the ring will drop off, leaving the edge undisturbed."

SIXTEEN-INCH CLUB: In July, 1941, we told how Clyde W. Tombaugh, Lowell Observatory, Flagstaff, Arizona, sponsored a "club" of amateurs who, if as many as 20 members could be rounded up, would get a greatly reduced price on 16" Pyrex disks; and in November, 1941, we told of the success of that attempt. We now bring the story up to date.

Some months ago Tombaugh gave us the names of 19 of the Sixteen-Inch Club "members," thus: Dr. C. O. Lampland, Flagstaff, Ariz.; Dr. James G. Baker, Harvard College Observatory, Cambridge, Mass.; Dr. H. Sidney Newcomer, New York; Messrs. John Kshir, 1702 Green St., Phila., Pa.; Harold Simmonds, 517 20th St., Sacramento, Calif.; Arthur Brear, 50 Willow St., Lawrence, Mass.;

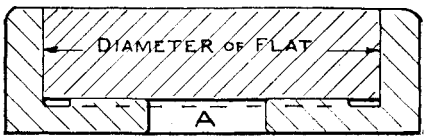

Figure 1: Surround for tde

Lyman H. Allen, 100 Franklin St., Boston, Mass.; Irvin H. Schroader, Angwin, Calif.; Byron S. Warner, 610 S. Reese Pl., Burbank, Calif.; Prof. Newton, Angwin, Calif.; W. L. Whitson, Washington Missionary College, Wash., D. C.; Harry A. Shaw, 2401 Mar Vista Ave., Altadena, Calif.; James J. Connors, 2318 S. 61st St., Cicero, Ill.; A. M. Mackintosh, 70 Arnold Rd., Jamaica, B.W.I.; Franklyn Creese, 269 Davis St., San Leandro, Calif.; Arthur Hugenberger, 2322 Kenworth Rd., Columbus, Ohio; Otto R. Griener, 55 Plane St., Newark, N. J.; Clyde Tombaugh, Flagstaff, Ariz. These ordered a total of 21 disks.

In August, Tombaugh wrote that the total had risen to 33 members and 37 disks, and of the former he knew of the following: Messrs. C. C. Taylor; B. L. Souther, 24 Harrison Ave., New Canaan, Conn.; H. A. Lower, 1032 Pennsylvania St., San Diego, Calif.; J. R. Smith; Russell S. Booker; C. H. Gamble; Marvin J. Vaun; J. W. Fecker; but did not know the addresses of some. "It would be nice if you could publish the list of buyers," he writes, "to keep interest alive. This club certainly exceeded my expectations. But I don't think I can do anything more with the Sixteen-Inch Club until the war is over, as I am organizing civilian defense and really am busy. After the war I hope to get the members organized into doing some serious observing."

Admittedly, the lists as given are far from complete or definite. Data are now difficult to round up, because of the war, and personnel is in a relative state of flux. The club has partly passed out of its original organizing control (it really never was a definite organization but a convenience to guarantee Corning the cost of a master mold). As word of the availability of this ideal size for a bigger-than-average telescope has got around, people have gone direct to Corning Glass Works, at Corning, N. Y. for the disks.

Those who build 16" telescopes are invited to keep in touch with this magazine and send in photographs and descriptions.

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