FIGHTING ENGINEERS OF THE NAVY . . . Page 54

SCIENTIFIC AMERICAN

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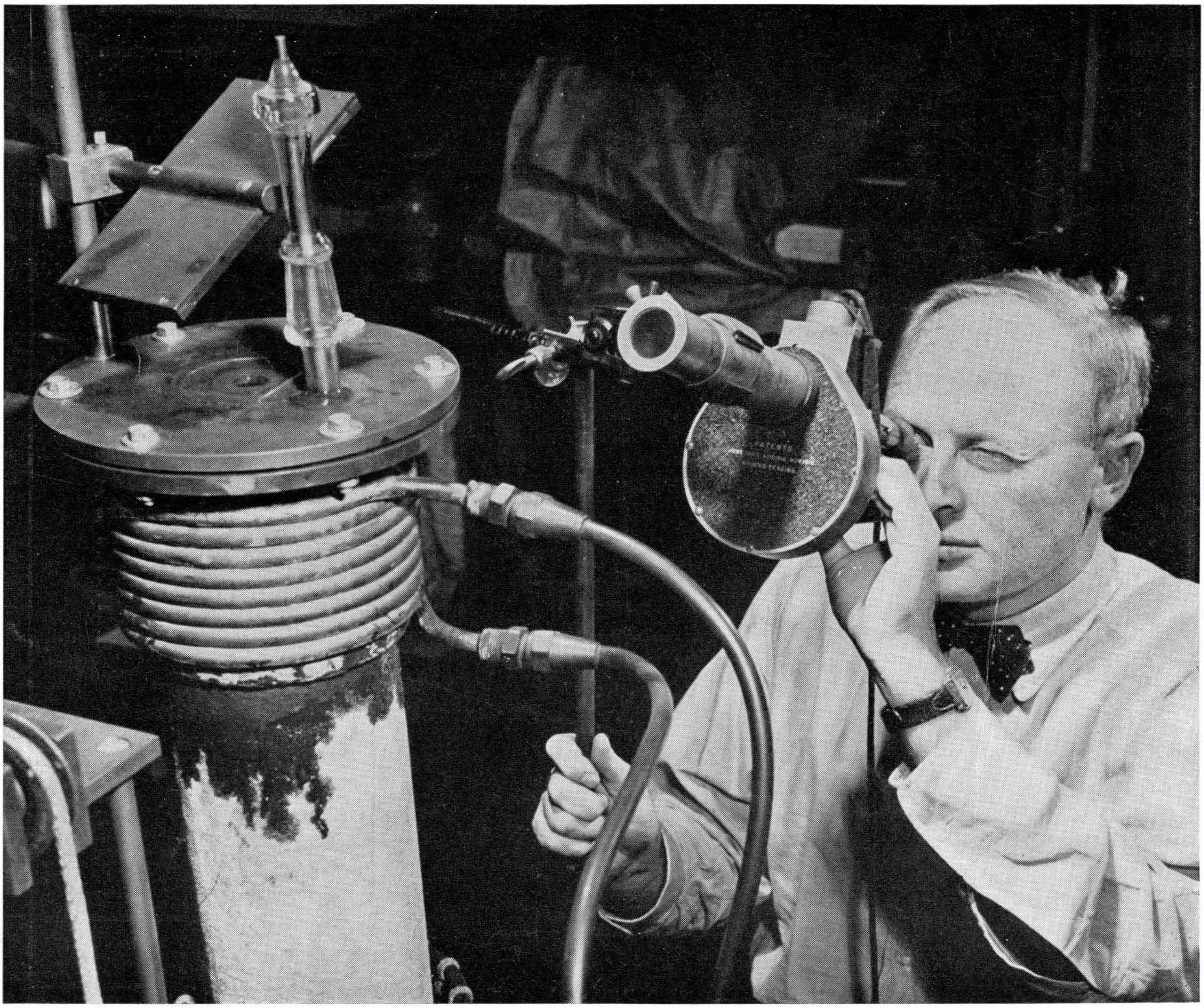

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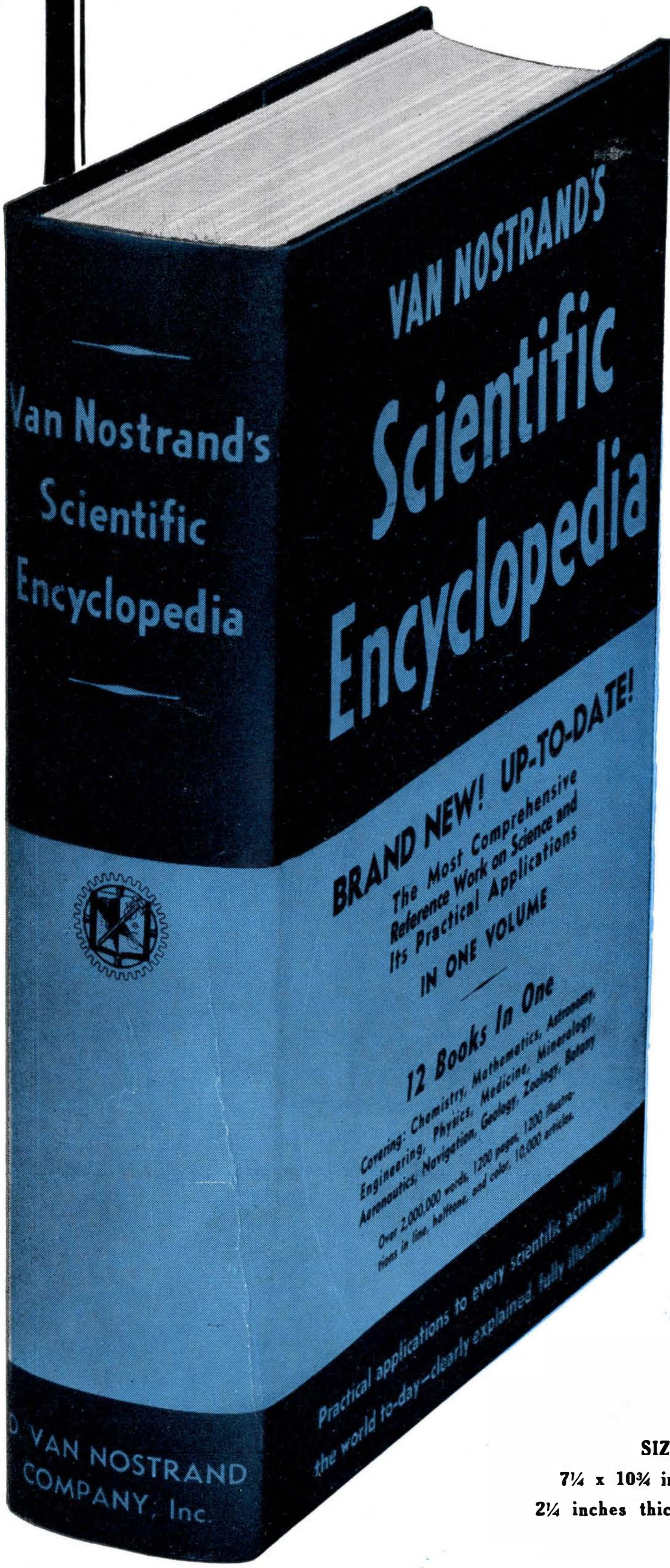

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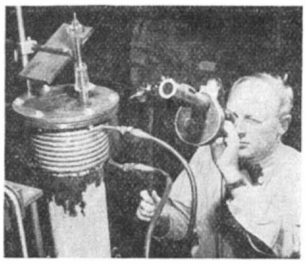

CHECKING the temperature of his electric furnace with a pyrometer, the research engineer shown on our front cover is continuing his search for better magnetic materials for transformer cores. The story of this important work is told in the article "Regimenting Atoms," page 60.

SCIENTIFIC AMERICAN

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OUR *Point* OF VIEW

SCIENCE STUDIES RUBBER SOURCES

AND SO, in the war emergency, it was finally decided to turn to synthetic rubber as the nation's best bet—at least for the short-time pull—and most of us agreed that this was a practical solution.

And the daily tumult died away, when those who had sincerely believed that certain vegetable, or plant, sources of emergency rubber were the best bet, found that they had not won, and got behind the synthetic plan that was adopted and helped push. Whereupon, the old argument slid off the front pages of the newspapers.

No one should run away with the idea, however, that we have heard the last about rubber from plant sources. Quietly it is receiving most careful attention. As soon as the decision to go for synthetic rubber for the immediate need was made, it became possible for a large corps of scientists and technologists to begin a study of plant sources of rubber, unhampered by urgencies and other expediencies. Thus, we shall hear from time to time of the quiet, calm research that is proceeding.

Goodrich, for example, is specializing in the careful study of three rubber-producing plants that seem at present to look best to its scientists—the well-known goldenrod, the Russian dandelion, called kok-sagyz (pronounced, according to the Russian-American Chamber of Commerce, "kuk sag-iz"), and a twining vine heretofore little publicized, called Cryptostegia. This is a perennial which grows wild in Mexico (but has no relation to guayule, which also grows wild in Mexico) and contains rubber latex in all its parts. The tips can be harvested 30 times a year. We may hear more of these hopes.

Then, if ways can be found to handle this weed, it is believed that the same ways will enable us to handle others that grow wild in every fence corner—dandelions, dogbanes, wild lettuce, and others—all of which yield some rubber.

On common fence-corner plants, the New York State College of Agriculture, at Cornell University, has been doing outstanding research, between 1500 and 2000 species having already been tested there. A method of testing a given plant or weed in five minutes was developed. A thin section of leaf, stem, or root is cut by means of a razor, placed on a microscope slide, stained with a dye dissolved in solvents, and examined. The stain renders rubber and accompanying resins visible. If the test gives promise, the plant is later analyzed quantitatively in the laboratory. (A very crude, though simple, field test is to rub out a leaf between the fingers. If the milky latex coagulates into a cohesive ball, there probably is some rubber in the plant. How much rubber is, of course, the next question.) Cornell also grew the Russian kok-sagyz last summer and gained a better production than the average Russian yield, but this plant remains on the doubtful list.

So ineluctable are the basics of economic law that, when the war is over, our permanent source of rubber will be the one which can produce it most cheaply—unless, of course, some artificial obstruction is permitted to interfere with the pure logic of economic law. If synthetic rubber from petroleum, or limestone, or other source; or, if synthetic rubber from one weed, or plant, or another; or, if even the old Hevea rubber tree, proves to be one cent or even one mil per pound less expensive, then that will be our future rubber source.

It has been said, for example, and rightly, that in normal times the rubber industry would have had to buy its plantation rubber from the opposite side of this planet, even if the suburbs of Akron, Ohio, had been a forest of rubber trees—the decisive factor would have been labor costs.

In the meantime, while we let the facts decide on our future source of rubber, the rubber chemists who are now holding the fort with their work on synthetic deserve the nation's thanks. There is pretty solid ground for the assertion that they are right now saving our future skins.—*A.G.I.*

ECONOMY

VARIOUS, indeed, are the interpretations which are placed on the word "economy." It may call up visions of the housewife stretching the wage-earner's dollar to cover steadily increasing costs of living; it may bring to mind the whole process of national management; it may be applied to those common-sense—or necessary—means by which an industry continues to manufacture a needed product after many of its sources of conventional raw material (often all of them) have been cut off. A case in point is the alarm-clock industry. These mechanisms, largely composed of essential brass and often housed in a casing of the same material, have been placed on the "verboten" list. But workers, and war workers in particular, must have alarm clocks if they are to report for work on time. What to do? Practice economy; put into operation the common-sense procedures of economy that would be used under ordinary stress of economic necessity. The result is the so-called "victory" clock, reported at the time of writing these lines to be made largely of non-essential materials with cases of thin wood or plastics of the less costly and more largely available types.

What the alarm clock industry is doing can be—and in many cases is being—done by other industries. Not only is this true of civilian products but of military or war-required materials as well. (Incidentally, the line between these two classes is becoming more and more difficult to draw, as the needs of the civilian over-lap more and more on those of the military, and vice versa.) Scientific research is constantly uncovering new ways of doing old jobs; new materials which replace, and do a better job than, older ones; methods of procedure which make former practices as out of date as the one-horse shay. Applications of such research are constantly reflected in these pages, where is told the running story of industry and the benefits which it constantly draws from science.

Leaning away, for the moment, from practical things as they are being accomplished today, but still touching on science and "economy," as the word is applied here to the alarm clock and other industries, perhaps no better example of long-range research and its ultimate economy can be found than that being devoted to natural domestic sources of rubber, dealt with in the preceding editorial on this page.—*A.P.P.*

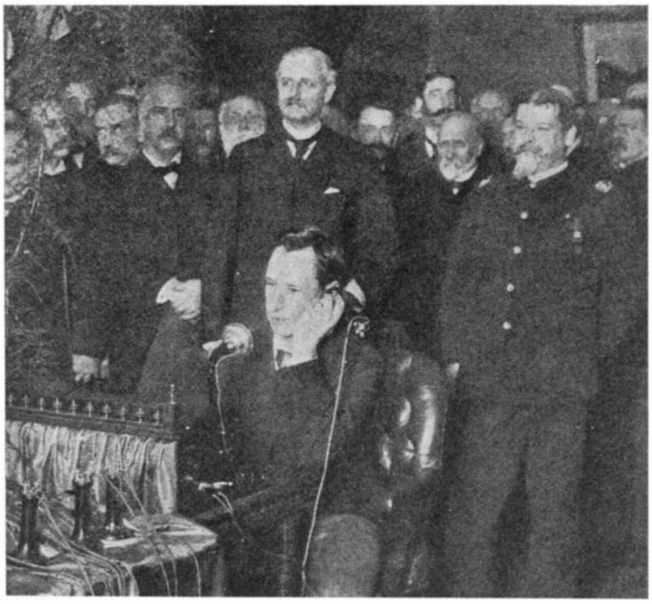
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of February, 1893)

PANAMA WON—"The present outlook for the completion of the Nicaragua Canal is far better than for the Panama, but they both seem to be hipped in the same way. It is simply a question as to which company can first get the necessary funds. *F. R. Brainard, U. S. Navy.*"

LONG DISTANCE—"February 7 of the present year, witnessed the opening of the telephone line from Boston to Chicago. Telephoning is successfully carried on over 1250 miles of wire, owing to a somewhat circuitous route followed by the line. All



First phone call over Boston-Chicago line

distances hitherto covered are insignificant compared to this. The possibilities it holds for the future cannot well be overestimated. A step beyond Chicago and the banks of the Missouri will be reached, and we may yet see Omaha and San Francisco connected by a line which will form the final link in a chain bringing San Francisco and New York within speaking range of each other."

ARMOR—"A Harvey nickel steel armor plate, 6 inches thick, was tested on board the *Nettle* at Portsmouth on the 17th ult. The 6 inch breech loading gun was used, firing Holtzer's forged steel projectiles weighing 100 pounds each. The trial was of a very unusual kind, the gun and projectile being those regularly employed for testing 10½ inch plates. . . . This is a most remarkable trial, for it must be borne in mind that the resisting power of a plate is more as the square of its thickness than as the first power, so that for a 6 inch plate to break up a projectile which until recently was a match for 10½ inches is a great triumph."

FAIR LIGHT—"Invitations have just been received in Chicago from the Westinghouse Electric and Manufacturing Company, asking an inspection of some of the electrical apparatus which is to form part of the incandescent lighting plant at the Columbian Exposition, and which is now exhibited at this company's shops, previous to its being shipped to Chicago. The feature of particular interest at this display is one of the 10,000-light dynamos direct coupled to a 1000 horse power Westinghouse compound engine."

TELESCOPE—"It is proposed in Paris to construct a gigantic reflecting telescope, the mirror of which is to be 10 feet in diameter and the length of the tube is 140 feet. It is to be ready for the exhibition which is to be held in Paris in 1900. The mirror is to be silver on glass."

BRIDGE—"One of the two or three highest bridges in the world is the viaduct over the Pecos River, Texas. . . . It is on the line of the Southern Pacific Railway, and its construction shortens the former line of the road by 11.2 miles, besides saving some heavy grades and avoiding bad curves. . . . The Pecos River bridge is 2,180 feet long between abutment walls, and it is built of plate and lattice plate girders resting on steel towers. . . . The height from the base of the rails to the surface of the water is 320 feet 10¾ inches, and to the bed of the river is 330 feet."

ONE REASON—"The fact that people lost on a desert or in a forest . . . walk in a circle is due to slight inequality in the length of the legs. Careful measurements of a series of skeletons have shown that only ten percent had the lower limbs equal in length, thirty-five per cent had the right limb longer than the left, while in fifty-five percent the left leg was the longer. The result of one limb being longer than the other will naturally be that a person will unconsciously take a longer step with the longer limb, and consequently will trend to the right or to the left, according as the left or right is the longer, unless the tendency to deviation is corrected by the eye."

BALLOON—"A large dirigible ballon is being constructed at the military balloon works at Chalais-Meudon, under the direction of Commandant Renard. It will measure about 230 feet in length and 43 feet in its greatest diameter. By a new arrangement of motor it is expected to be able to make headway against air currents not exceeding 40 feet per second, or 28 miles an hour. The motor is not fully described, but it will act either with gasoline or the gas of the balloon, giving an effective force of 45 horse power."

COBALT—"Cobalt is now bought up in bulk by two or three chemical manufacturers, and is almost entirely used at present for blue coloring of glass and pottery and blue glaze. Its cost in reality is not more than that of nickel, but it is retailed at something about five times this cost. If cobalt plating, as suggested by Dr. Silvanus Thompson, were to come in, cobalt, being used more largely, would soon become as cheap as nickel."

SKI-TROOPERS—"There are now being made in certain corps of the German army some very interesting experiments relative to the introduction of snow shoes, to permit of marching and service on a campaign in the severest weather. The snow shoes used by the German soldiers are the same as those that have been employed for centuries in the countries of the north of Europe. . . . They consist of a thin strip of wood about a yard in length, a little wider than the foot, curved at the extremity and shod with iron."

Telephone wire coming up

Here's a bomber-gunner hurrying to load his 50-calibre gun. . . .

In peace, a lot of that copper would have gone into new telephone lines. Now it's needed for shooting and winning the war.

That's why we can't build new lines right now. That's why we're saying—"Please don't place Long Distance calls to war-busy centers unless it's absolutely necessary."

Thanks for all your help and we hope you will keep remembering.

BELL TELEPHONE SYSTEM

WAR CALLS COME FIRST

'WE DEFEND WHAT WE BUILD'

Seabees, the Fighting Technicians of Our Navy

A. D. RATHBONE, IV

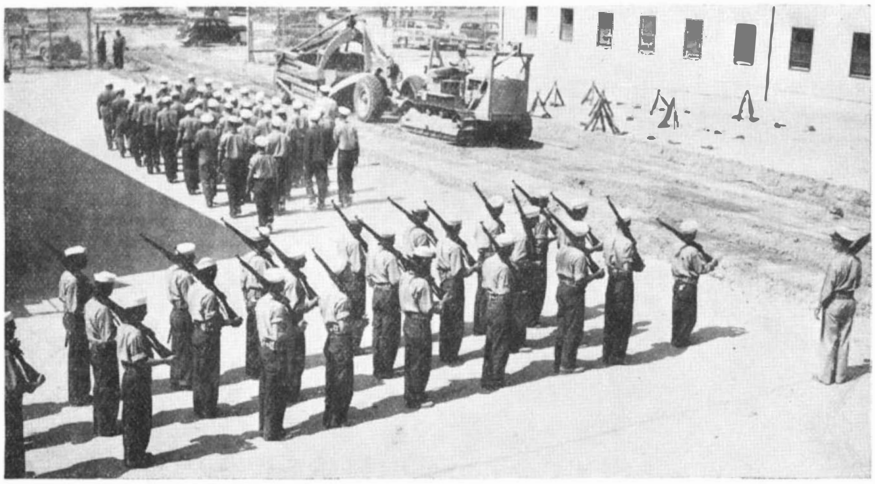
TAKE a map of the world and mark crosses on or near any points you like outside the continental limits of the United States where the Navy has been reported in action. Chances are you will have indicated some Seabee bases. From the Aleutians to the Solomons, from Trinidad to Iceland, from Murmansk to Australia, in many lands and climates, north, south, east, and west, the Seabees have gone to work and to fight. With a brief history, thus far, but a vivid one, the Seabees — who derive their name from the phonetic pronunciation of the letters "CB," Construction Battalion—comprise the newest branch of the Navy, and one of our most dramatic and romantic services.

The wartime business of the Seabees, the broad knowledge and variegated skills of officers and enlisted men, the amazing and forceful esprit de corps they have conceived in a year's time are all best conveyed by a description of their insignia, an escutcheon destined to become as universally familiar as the blue of our Navy, the khaki of our Army, or the symbol of our Marines.

A zooming bee, with white Navy hat perkily cocked above the fighting-mad expression on his tough face, with spitting Tommy-gun in his fore hands, streaks across the hawser-encircled blue background of the insignia. Indicative of his technical ability, he carries a wrench in his second hand, a hammer in his rear fist. His several sleeves respectively bear Naval rating badges of Gunner's Mate, Machinist's Mate, Carpenter's Mate, and on each wrist is the corps device of the Civil Engineer Corps of the Navy, portraying relationship to the Bureau of Yards and Docks, the parent organization of the construction regiments. This rough-and-ready, tough little guy of many parts expresses better than whole columns of words the motto of the Seabees: "We Defend What We Build."

Are you a blacksmith, carpenter, electrician, mechanic, painter, pipefitter, plumber, rigger, steelworker? Can you operate a bulldozer, gas and Diesel engines, a dredge, a crane, a shovel, a truck? Do you know a good deal about generators, evaporators, water purifiers, refrigeration, welding, excavation, dynamiting, concrete, surveying? Maybe you're a cook, a baker, a laundryman, a draftsman, a rodman, a sailmaker, a telephone man, a wharf-builder, or a diver. Perhaps you are a doctor or a dentist. If you are among these, or can qualify with knowledge and experience in any other technical line; if you're over 16 and under 51, still in good health, and want to line up with a two-fisted crew of really tough hombres who fight with one hand and build naval bases with the other, you may volunteer for service in the Seabees. If you're looking for a commission, you'll have to be a college graduate with an engineering degree. The Construction Battalions of the Navy are truly specialist outfits, and it is their stiff requirements of engineering and construction experience that makes them so.

The Seabees were born a child of necessity and have grown to manhood within the short space of time since the Japs took Guam, Wake, Cavite, and other advance base facilities of the Navy. The story of unarmed civilian construction men on Wake Island during the heroic stand by Major Devereaux and his little band of Marines, and the part the civilians played, after grabbing anything that would shoot, is well known. The lesson was quickly learned and shortly after the declaration of war the need for construction personnel at many locations outside the United States became apparent. That this force should be in uniform and under military command went without saying, with conditions as they were. The Navy's Bureau of Yards and Docks authorized its Civil Engineer Corps, which, through the medium of individual civil engineers, has served the Navy since 1775, but as a unit with authority to command only since 1942, to recruit one regiment of three battalions, totaling approximately 3300 officers and men. That was in December of 1941. By mid-November of 1942 the Seabees were authorized to enlist 210,000. After training, each battalion is a complete entity unto itself, each of which can build or tear down anything constructible, each of which is seeing service somewhere on the far-flung fronts of this war, and each of which has been trained to protect and defend what it builds.



The "boots," upper left, learn first principles of drill, while those with guns are further advanced. In background are Seabee road machinery and stacked rifles

At the special training camps for men of the Construction Battalions at Norfolk, Virginia, and Davisville, Rhode Island, volunteers have been arriving for months. These "boots," as new Navy men are termed, are assumed to have had varying amounts of technical training or experience, depending upon their age. They have filled out lengthy applications which tell the story of their various skills, they have had their physical examinations, and "boot school" will teach them how to drill, salute, shoot, wear their Navy uniforms, and generally conduct themselves as Navy men should. During the three weeks of this specialized boot school the men who some day will build on the borderlands will also learn military courtesy, the manual-at-arms, combat signals, rifle marksmanship, extended order drill, the techniques of the 45 pistol, hand grenades, the

The dynamite crew sets a charge

Thompson sub-machine gun, bayonet drill, the layout of bases, and principles of air-raid protection.

It's a tough schedule, that first three weeks, and it catches many an old-timer with short breath, weary and strained muscles, and perhaps a secret admission that he isn't quite the man he thought he was. However, all drill, calisthenics, and physical endeavor—and there's plenty of it from reveille at six in the morning to taps at 9:30 at night—is carefully watched by medical men, and the older members of the battalion are urged to take it easy until they once more become the toughened men they were in bygone years. As for the younger fellows, there's no more need to worry about them than if they were in the Army, the Marines, or other branches of the Navy, and the story is about the same.

Quite naturally the emphasis is on the military scheme of things, for these men already know their trades. However, there is technical training in lecture hall and in laboratory, or in specially designed practical work shops. There are talks and actual labor on boilers and heating, Diesel and gas engines, evaporators and purifiers, generators and electricity, air-raid protection and camouflage, pontoons, propulsion units, and drydocks, tank and radio mast construction, refrigeration, welding, small arms, concrete forms and carpentry, diving, excavation and earth moving, hut erection and fire-fighting. The latter four will be covered still more in detail and actual practice after the men have left Camp Allen, at Norfolk, for the advanced training at Camp Bradford, not far away.

In the course of this formative period the new battalion finds itself. Men who have acquired particularly specialized backgrounds are discovered through a series of new questionnaires and by discussions with the officers. These men, picked from the ranks, are given supplementary and extensive instruction in the subjects listed above; they are excused from routine duties; often they end up by being instructors, which means they are likely to remain at Camp Allen for some time to come. One of these, for example, a specialist in Diesels, enlisted in April, 1942, and, much to his annoyance, he is still teaching the newer men the intricacies of his trade. Although 48 years old, father of four daughters, and a three-times grandfather, he is thoroughly disgusted with his lot of "fighting the battle of Virginia," and admitted to having deep, dark plans for "selling" the idea to the commanding officer of the next battalion to go through the school that he should be sent out to build and fight, rather than remain in the role of instructor.

● Through the courtesy of the Navy Department, a member of our staff visited one of the three training camps of the Navy's new Construction Battalions, known as "Seabees." These men, many of them veterans of the last war, are performing a vital service in the establishing of advance bases in all parts of the world, a service unique in the annals of the United States Navy, and one fraught with danger, which is why the Seabees are taught to fight with one hand while they build with the other. Illustrations are U. S. Navy Official Photos.—*The Editor.* ●

If a man wants action in foreign lands in this war, he'll get it in the Seabees. As soon as a battalion has been formed and has completed its training, it leaves for "Island X," which is the designation for an island, a continent, an isthmus, a beachhead anywhere in the world. When a battalion leaves the United States for its objective, it is as complete and sufficient unto itself as American ingenuity and inventiveness can make it. Food, clothing, arms, and ammunition are but a few of the impedimenta. There must be huts to live in, a laundry, a dentist's and a doctor's office and their paraphernalia, kitchens that cook while they roll, or during tropical hurricanes, or in northern blizzards; in fact, under all conditions. But even that is only the beginning. There men are sent out to

A powered pontoon landing barge, loaded to capacity with men, machinery, and tons of many kinds of materials, chugs its way toward shore in practice maneuvers

construct something. That means all manner of road building and concrete machinery; it calls for welding and acetylene cutting apparatus and the Diesel, gasoline, and electrical power to run them; it means tons of concrete, reinforcing iron, and the lumber for forms; tanks for the storage of water and engine fuel. In short, try to visualize a safari of over a thousand men with everything they'll need for months from toothpaste to aspirin, roast beef to a cold glass of beer, work gloves to a new pair of pants. Then add your list of all conceivable equipment, machinery, and materials to build a city in which to live, to carve an airport out of a jungle, to build storage bases and landing facilities on a coral reef. That is a Seabee battalion.

To prepare the men and officers for what they will run into, there are five weeks at Camp Bradford, a sprawling wilderness of sand, swamps, and pine trees on the Atlantic coast. There huts are built and torn down, storage tanks ranging in capacity from 1000 gallons to 10,000 gallons go up sectionally in jig time, and come down just as fast. Stumps are dynamited, carpenter crews slap together concrete forms just about fast enough to keep ahead of the mixing and pouring gangs. Roads of steel mesh through the rough and sandy country offer engineering problems of the first magnitude and provide field practice for bulldozers, shovels, cranes, scrapers, and for welders and their mobile units. The amphibious side of the Seabees is developed by working with the versatile pontoons, from which are built piers, bridges, drydocks, and landing barges. One important point must be noted. As the new battalion passes through the screen of officer and instructor observation, each man is sifted into the niche for which he is best fitted in this outfit of super-specialists. The battalion is really an organization of highly trained crews of metal workers, carpenters, concrete men, welders, and so on. While each group has its specific work to perform, it is part of the Seabee scheme of things that all will turn to and serve as helpers to any other trade. The heavy stress laid on this phase of training, and the astuteness with which the entire program has been laid out, is what makes a battalion of Seabees such a closely knit unit, gives it such excellent teamwork, and enables it to accomplish the seemingly impossible in faster than record time.

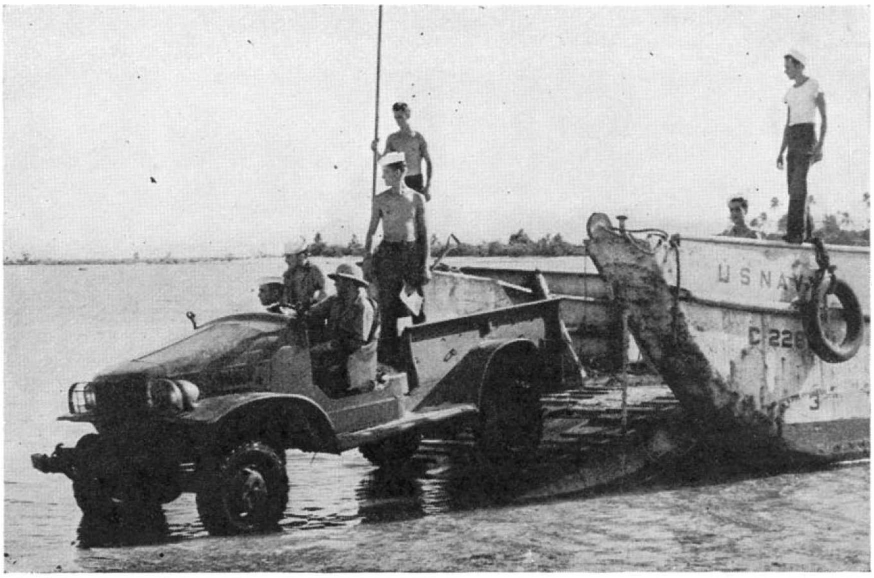
In the course of an early lecture an instructor tells the Seabees that: "The purpose and duty of the Construction Battalions are to erect, reconstruct, or repair advance bases, or to extend existing facilities on an island, or possibly some mainland. The area may or may not already be occupied by the Navy, the Army, or the Marine Corps. Seabees *may* have to clear an area of enemy forces, and their duty *may* include holding such an area."

To lend authority to this theory of action, and to provide practical instruction, realistic landing parties are staged in which the Seabees must attain their objective against "enemy" troops armed with flour bombs, and perhaps entrenched in fortifications and equipped with armament. Powered pontoon barges are loaded with everything the battalion will need for such a task on "Island X." The Seabees, too, are equipped with flour bombs, and at the signal, the landing party starts towards a windswept, sandy beach, held by the "enemy."

In one such maneuver two companies of Seabees were given the task of effecting a landing, clearing the area of the enemy, and constructing a 1500 foot runway for airplanes on a sandy beach, besides establishing their own living quarters and bases, providing themselves with a supply of fresh water, mounting their own guns, and making other preparations for a possible enemy counter-thrust. They were allowed 30 hours in which to complete the assignment.

The chugging barges poked their blunt noses as far toward the beach as possible. Hundreds of carpenters, welders, crane men, metal workers, and other technicians who, by now, were trained combat men in the pink of physical condition, leaped into the sea up to their knees and waists, with rifles and light machine guns, and charged toward land. The shore end of the barge unfolded into a ramp down which

On "Island X" Seabees lay steel mesh on sand for road foundations, then camouflage mesh with finely ground coral, which eventually cakes into hard surface more machine guns and a small field gun were trundled to the beach and set up. Meanwhile, flour bombs had begun to fly in all directions, with ensuing casualties on both sides. Some of the precious Seabee machinery and material was hit, which invalidated it for use in completing the task, and several of the men were put out of action. The attack was fast and furious for a few minutes, but such was the impetus and enthusiasm of the fighting technicians that the enemy were overcome and captured.



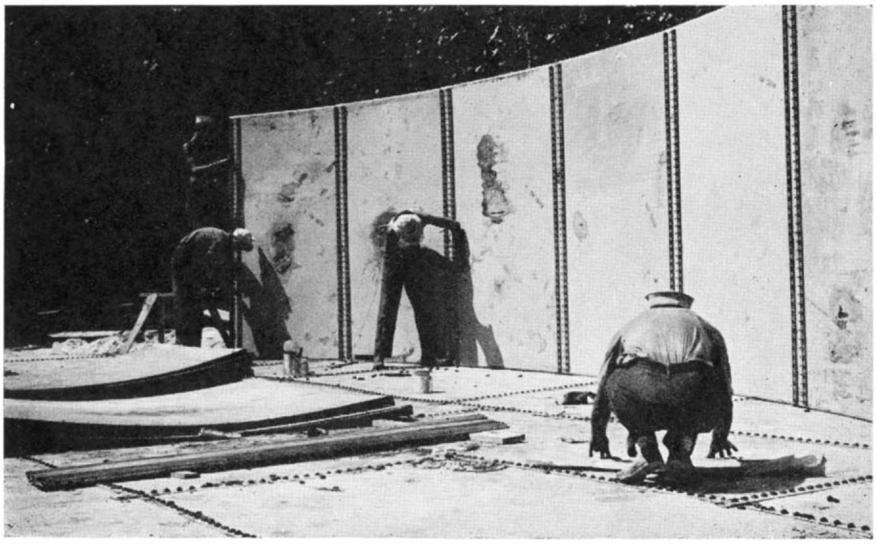
Practice maneuvers at Camp Bradford include frequent use of Navy landing barges, service trucks, and many other special forms of machinery and Seabee equipment

INSTANTLY the scene changed from that of a battlefield to a fast-moving and well organized construction camp. Bulldozers and scrapers came ashore, dynamite crews followed surveyors' instructions and blew up stumps, rocks, trees, and other obstacles in the proposed runway. With perfect precision one crew followed another, each acting as helpers when not engaged in applying its own primary technical skill. A tiny village of huts popped up in the pine trees like magic, the energizing aromas of hot coffee and soup came from the rolling kitchen, the water evaporator went into immediate action to produce a fresh water supply from the sea, the roar of road machinery and the hum of generators competed with the smack of busy hammers and the rattling of concrete mixers.

In appropriate places anti-aircraft guns were mounted, and a continuous stream of crates, bundles, packages, and more machinery continued to come ashore. In fact, the Navy's Construction Battalions might well be known as "the hook-and-eye" service, for everything they own or work with is equipped with large or small rings so that the cranes and derricks, or men, can hook into and lift them from transport ship to pontoon barge, from barge to waiting truck, and from truck to proper location. Even the laundry, capable of caring for either a 200-bed hospital or 900 men in a 16- to 20-hour day, comes in three huge "eyed" crates. When these are spotted, when pipe and other operating connections are made, when the water tanks are filled by the supply of fresh water from the already installed evaporator, and the Diesels are fueled, the laundry starts to hum.

All this and far more those two Seabee companies accomplished in the limited time allowed for their mock invasion. The airfield runway was finished, guns and crews were ready for any return of the "enemy," and a village of over 1000 men was in full operation with water, lights, power, and even medical and dental quarters—in the amazing and unbelieveable time of 26 hours continuous work. Of such men are the Seabees made.

The determination of those comparatively few construction men who were on Wake, Midway, and other Pacific islands when the Japs so ruthlessly attacked them burns ever stronger within the Seabees. This is one reason for the amazing esprit de corps among this newest of fighting services. Even the first battalion to go overseas, soon after the Navy directive established the Seabees, was imbued with this remarkable fighting spirit from first man to last. Their ship was attacked, and the fighter-builders proved they were not mere super-cargo by helping to man the guns which drove the enemy away. These seagoing landlubbers can build anything anywhere, under any conditions, and will fight to prove it.


This will soon be a 10,000-gallon storage tank. During training, the Seabees put them up in record time and then tear them down again, all for the sake of experience

DRAWN from every technical walk of life, they are among the best in the nation. They include many veterans of the last war, their sons and nephews. Many are men who have given up high-salaried positions for a far lower income. A Seaman 2nd Class in the Seabees receives $54 a month for home service and $64.80 while abroad; a Chief Petty Officer commands $126 at home, and $161.20 overseas, so it isn't money that activates men to join the Navy's Construction Battalions — it's something else

A man becomes a Seabee because he has that "something," a "something" the Japs and the Nazis, to their regret, are going to know far more about before the thousands of men who fight with one hand and build with the other are through with their business at hand.

Salvaging Light

How More Light May Be Supplied to Industrial Workers Without Increasing Current Consumed

A. P. PECK

By means of a scientific use of color it is now practical to increase the illumination from most light systems 100 percent without any change in lighting equipment or any increase in wattage. That challenging statement was made as the result of studies recently reported; the data presented in the report, and applications of the system investigated by the writer, bear out completely the broad claims made. This scientific use of color was arrived at as a result of continuing research in the "three-dimensional seeing" work reported in the December 1941 issue of Scientific American, when properly selected paints were being used to tint parts of machinery with outstanding results in matters of better seeing and greater safety.

In the present work, the investigators, co-operative workers from Du Pont and the Philadelphia Electric Company, extended the study area from the machines themselves to include the entire room, and bent their energies to devising colors and color combinations that would reflect light to greatest advantage.

It is well known, of course, that light colored walls increase the illumination in a room by reflecting available light. Actually, however, this method of light utilization has been sadly neglected in the past and only now has been subjected to careful study. In many an industrial plant, a well-designed lighting system is robbed of its efficiency by dull, dingy ceilings, walls, and floors. In others, where walls and ceilings have been painted with light-reflecting finishes, some of the light has been salvaged. Even in such cases, however, a considerable amount of light is lost, "blotted up," by dark, drab floors.

To the uninitiated it might seem, off-hand, that the ideal solution to the problem of light utilization would be to paint all surfaces a dazzling white. Then the light rays could bounce from wall to ceiling to floor in an endless cycle of utilization. True enough, such treatment would result in extremely high values of light at the working surfaces, as compared with the wattage of the source, but other factors would enter that would make the method impractical.

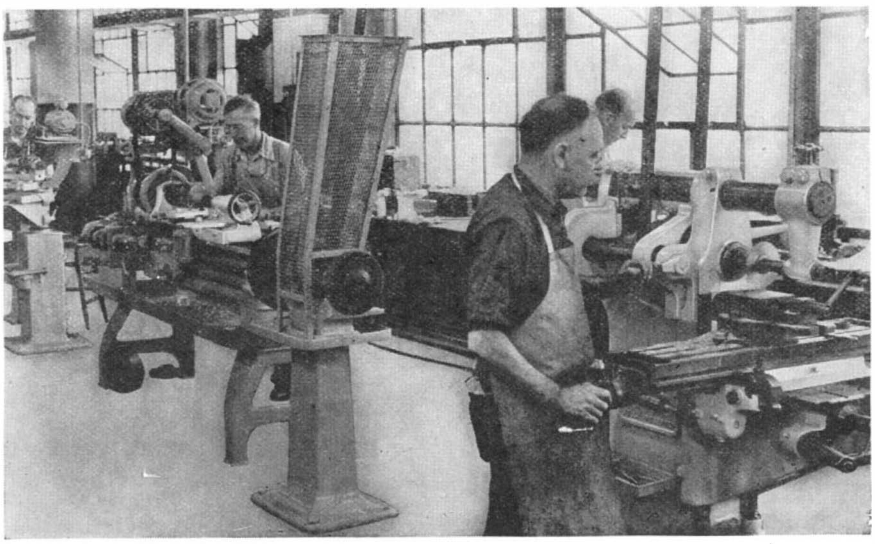
First, any surface that reflects too much light will produce glare. Then, the psychological effects on the workers must be considered; an all-white room would be uncomfortable to work in, aside from the glare, and would be considered an unpleasant environment. Third is the matter of maintenance, a factor of great importance in industry, where ceilings and walls cannot be painted or cleaned too often without undesirable expense and interference with normal operations.

The word "utilization," used above and farther on in this article, should be explained in its specialized sense before it becomes misunderstood. Of course, it means "use," but to the lighting engineer it has a definite mathematical meaning widely employed in his work. Illumination is measured in terms of lumens (light units) per square foot falling on an arbitrary plane, usually horizontal and 30 inches above the floor. The area in square feet of this plane, multiplied by the illumination in footcandles, gives the number of useful lumens. This figure, divided by the rated lumens of the lamp or lamps, is called the coefficient of utilization, or merely "utilization."

Working with such a measurement system, preconceived ideas about paint and light were put to practical test by the research workers. They had available a test room 11 feet 4 inches wide by 22 feet long with a 10-foot ceiling, illuminated by two 500-watt silvered bowl incandescent lamps on 18-inch drop cords. The ceiling and walls were white, the dado was gray, the floor was maroon, and the furniture was dark mahogany. Industrially, there was nothing much wrong with the room, except that the white paint had lost a great part of its reflection value; it was the sort of room that will be found duplicated many times in many places, and is shown as an inset in the accompanying chart.

When the engineers first started experimenting with this room, the light utilization was only 27 percent. When, however, the ceiling was given a coat of light cream paint, with a reflection factor of 85 percent, the utilization coefficient jumped to 33 percent, an increase of 22 percent just by the selection of the correct paint for the ceiling alone.

The next step consisted of applying to the sidewalls a neutral green paint slightly on the yellow side in hue, and having a reflection factor of 72 percent. The original finish had a reflection factor of 40 percent and the gray dado a factor of 12 percent. This change in the sidewall finish resulted in an improvement in light utilization of from 33 to 44 percent. Parenthetically it is noted in the technical report on this work that the men working in this room found the changed color scheme



Color treatment of machines, plus light floor areas, increases visibility quite comfortable and had no adverse comments to make. This factor of psychological effect on workers cannot be too strongly stressed in considering light salvage methods. If light is saved at the expense of mental irritation brought on by color effects, the work done is useless, or worse.

After the effect of the sidewall change in the test room was fully determined, the research workers next refinished the floor, which had a reflection factor of 12 percent, with a white deck paint having a reflection factor of 85 percent. This brought the room utilization up to 56.1 percent. When the dark mahogany furniture was replaced with blond furniture having a reflection factor of 50 percent, the light utilization climbed to 58.5 percent, or a total increase of 113 percent over the light utilization of the original room.

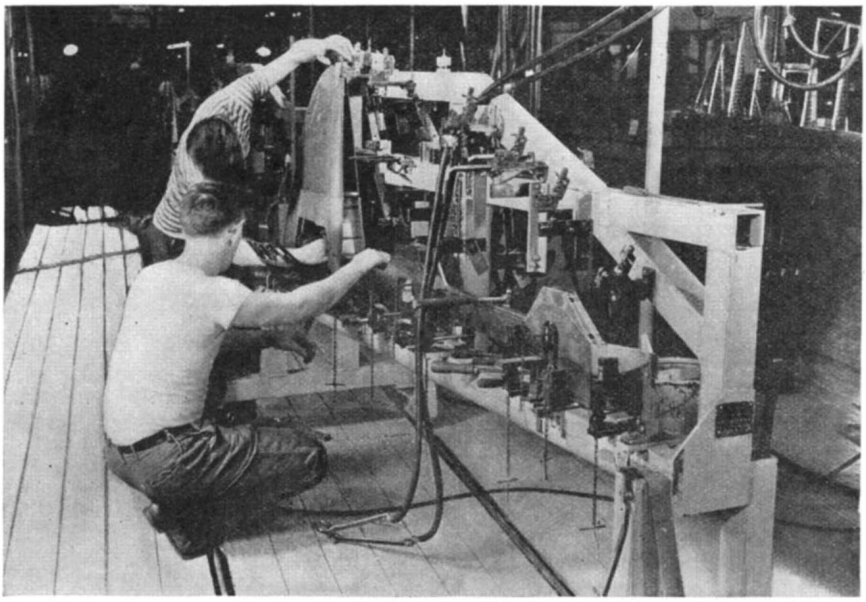
Here was dramatic proof of the ability of engineers to double the effective lighting in a given room without increasing the power consumption of the light source.

ONE final change was made in the test room which brought the room utilization down to 55 percent: In the interest of easier maintenance, the white floor was stippled with russet paint, bringing its reflection factor down from 85 to 70 percent. Still, the gain was in excess of 100 percent over the original.

This last mentioned matter of reducing the reflection factor of the floor for maintenance purposes has one other advantage. When the floor surface reflects more than about 70 percent of the light impinging on it, the result, over a period of time, is likely to be irritating to the human eye. Our eyes are mechanically so constructed—sockets, brows, and so on—as to receive light from above with the greatest comfort. When light in large amounts, relative to the total, reaches our eyes from below the horizon, a sensation of discomfort is created and workers cannot produce at their best.

According to the engineers who did the work with the test room, the experiments established three things: Satisfactory hues may be secured without serious sacrifice in reflection properties; floor and table finishes of 65 percent reflection factor, or even higher, are practical; coefficients of utilization of the order of double the present practice can readily be secured by the use of high-reflection floor finishes of suitable hue.

But the test room was by no means the end of the work with light salvage. The possibilities had been proved and next must be applied in practice. In the repair machine shop of the Philadelphia Electric Company the floor was coated with a paint having a reflection factor of 60 percent. This change greatly improved the machine-operators' ability to work at the various machine tools, particularly when brass and copper were being fabricated. On an aircraft assembly line a similar paint change gave increased visibility on the parts under construction.



The light floor of this assembly line reflects light to needed places

Probably the most outstanding application of this recent research to industry, however, is in the plant of the Ordnance Gage Company in Philadelphia. Here a group of highly skilled workmen produce precision instruments with tolerances running into the infinitely small. Good seeing is essential. To all machinery has been applied the "three-dimensional seeing" system of painting mentioned previously. The ceiling has been painted white and reflects 85 percent of the light which strikes it. Reflection factor of the buff sidewalls is 72 percent, of the green dado 50 percent, and of the dust-green stippled floor 70 percent.

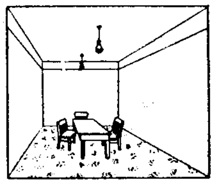
THE overall effect of this color combination is one of striking cheerfulness and light. The workmen are thoroughly pleased with their surroundings, they like the colors and the amount of available light, and do not miss an opportunity to say so in no uncertain terms.

From a careful consideration of the investigations described above, it is apparent that only by the use of interior finishes having a very high reflection value can we expect a maximum utilization of light. This applies just as well to floors, furniture, machinery, and benches as it does to ceilings and sidewalls. Since these high reflection values do not permit efficient and comfortable vision through "brightness" contrasts, it is obvious that such vision must be obtained through contrasts in hues. Hence much of the present research has been concentrated on paint hues, defined as the quality by which we distinguish one color from another, such as a red from a green, and so on.

"THE function of color," states the technical* report of the co-operating research workers on this light-salvaging program, "as a part of the industrial seeing machine is to provide a controlled mild stimulation and to increase visibility by means of suitable contrast. Brilliant colors, such as bright red or yellow, stimulate impulsive action and have their place as danger and caution indicators. Under such conditions, pronounced stimulation is deliberately produced in order to get instant action. Preventive action must be instantaneous if accidents are to be reduced. Achromatic colors (gray) have a deadening effect if used to the exclusion of chromatic colors, *i.e.,* those having hue. . . . Somewhere in between strong chromatic color and achromatic color lies the position of continuous, comfortable, accurate vision with a minimum of fatigue. The need of the correct degree of stimulation within the working area cannot be disputed. It is equally essential, however, that the hue and brightness of the surroundings, including floor and ceilings, must be of such character as to emphasize a return of the eyes to the working

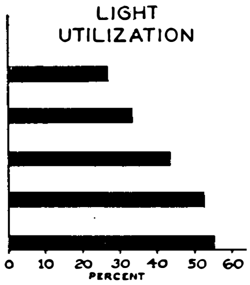
*Readers who are interested in more specific details on this subject will be referred to technical sources on request to the author.

STEPS TAKEN TO SALVAGE WASTE LIGHT IN EXPERIMENTAL ROOM



	LIGHT REFLECTION.......PERCENT			
	CEILING	WALLS	FLOOR	FURNITURE
START	65	40	12	20
2	85	40	12	20
3	85	72	12	20
4	85	72	70	20
5	85	72	70	50

☆ *IMPROVEMENT DUE TO "SALVAGE"......102%*



How light reflection (and utilization) was stepped up

area and to have their greatest comfort while there. In addition, these areas should have an adequate reflection value to insure the maximum use of multiple reflections. . . ."

The investigators of salvaged light sum up their report, which they emphasize is a record of progress rather than an ultimate solution, with the following facts:

"That carefully selected hue contrast will effectively augment brightness contrast for comfortable, accurate, continuous vision.

"That it is quite feasible to use much higher reflection factors on floors and walls, without discomfort, than has hitherto been considered possible.

"That the use of color does not necessarily mean a great sacrifice in reflection factor.

"That the use of multiple reflections makes possible a degree of light utilization far in excess of existing experience with a consequent reduction in the need of critical materials and an increased return from the electrical power used."

Thus it will be seen that salvaging light for victory holds outstanding possibilities when approached from a scientific viewpoint. Color as well as reflection quality of paint used in the process must be considered. And planning, to be most effective, must take in all surfaces, from ceiling to floor to furniture to machinery. When these are knitted into a light-salvaging whole, better seeing conditions will result without increased light bills.

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REGIMENTING ATOMS

In Search for Better Transformer Cores

SEEKING a better magnetic material for transformer cores, a physicist at the Westinghouse Research Laboratories is "drilling" atoms as if they were a squad of Army recruits on the parade ground.

By melting and then slowly cooling an iron-aluminum alloy, Dr. Sidney Siege gets atoms of the two metals to line up as orderly as well-trained soldiers. When they are arranged this way, the atoms exert their magnetic force together. Ultimate success of this work may increase the efficiency of electric transformers—the voltage-changers that are the key links in the alternating current system of power transmission. As a result, transformers will be able to do more work for their size. This will save copper and steel, make it easier to transport and install transformers, and eventually reduce the cost of transmitting electricity to homes and factories.

"A metal rod, 96 percent iron and 4 percent aluminum, is placed in an eight-inch deep porcelain crucible shaped like a test tube," Dr. Siegel said in describing his work, which is illustrated on our front cover. "Then a cylindrical electric induction furnace is lowered to surround the crucible which is held in a vertical position.

"After the furnace melts the metal, the heating unit is raised slowly from around the tube by clockwork, at the rate of an inch an hour. Complete cooling of the metal takes all day."

Slow cooling makes the rod a single large crystal in which the atoms are piled up in neat layers, just as sugar cubes can be stacked in a box, the Westinghouse physicist said. In such a crystal the magnetism of each atom points in a single direction, producing the maximum magnetic properties for that material. Normally, a molten metal cools quickly and the atoms are piled helter-skelter with their magnetic forces exerted in many different directions. These forces counteract each other so that the magnetic effect is considerably smaller.

Slices from the crystals are used in electrical tests to determine how efficient a magnet the material will make. With these slices Dr. Siegel builds one-inch square transformer cores, hollow in the center. The cores are built so that the magnetic forces point along the edges of the square as if pursuing each other.

Dr. Siegel intends to test other iron alloys until he finds the mixture that will give him the best possible magnetic material for use in transformers. It would be impractical, if not impossible, to make single crystals large enough for commercial transformer cores, he pointed out, but the material which tests best as a single crystal will probably be best when developed for commercial use.

Dr. Siegel's work is a continuation of Westinghouse research which resulted in development of Hipersil, an iron-silicon combination that is a one third better conductor of magnetism than any material used previously in transformers.

STEEL MAKING

Receives Electronic Science With Open Arms

ELECTRICAL engineers of the iron and steel industry have been among the most receptive users of new applications of electronic tubes and photo cells—employing these devices in many ways to control their industrial processes.

As a result of this open-minded attitude toward electronic-tube apparatus on the part of the steel engineers, electronic devices now play an important role all along the line of steel production and fabrication.

This wide use of tube devices by the steel makers—an industry well-known for inflicting the most severe industrial punishment on its equipment—is therefore striking testimony to the fine performance of electronic equipment under terrific industrial stress.

And since steel making also involves enormous and heavy costly machines, continuously handling tons of molten metal at incandescent temperatures, the absolute confidence imposed in electronic devices to control these great mechanisms, gives proof of the dependability and durability of present electronic apparatus.

In the production of steel, photo cells are used in both the open-hearth and Bessemer processes. In the case of open-hearth furnaces, it is important to get the temperature as high as possible, yet not to endanger the melting or breakdown of the furnace and furnace roof.

Photo-cell instruments enable furnace and roof temperatures to be continuously and accurately checked, so that safe limits are not exceeded.

In the Bessemer process, a critical index is the color of the flame from the converter, determining when the exact instant arrives for shutting off the "blow." Formerly, trained experts were necessary to supervise this operation and to judge the color changes exactly. Now, photo-cell color comparators are employed which detect the exact color-changes watched for, and give mistake-proof signals when necessary chemical reactions have been completed.

Reversing mills and cut-off saws are now photo-cell controlled. As huge incandescent billets come cut from between the rolls, a photo-cell catches sight of the red-hot mass of metals and, at the precise instant, reverses the mechanism to send the billet back again through the rolls. Cut-off saws operate in the same way, actuated by either hot or cold material.

Strip width and centering are also electronically controlled in modern steel mills, eliminating close human attention. For scanning strip for pinholes, photo-cells take the place of human eyes and throw out defective sections. Many electronic tubes are also used in connection with control relays.—*Orestes H. Caldwell, Editor of Electronic Industries.*

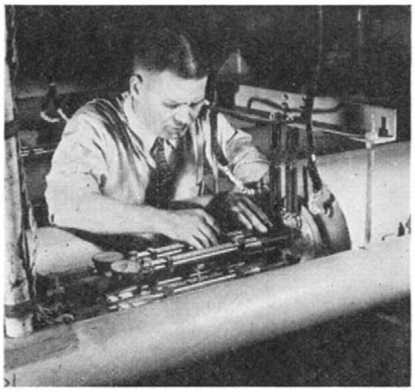
CREEP TEST

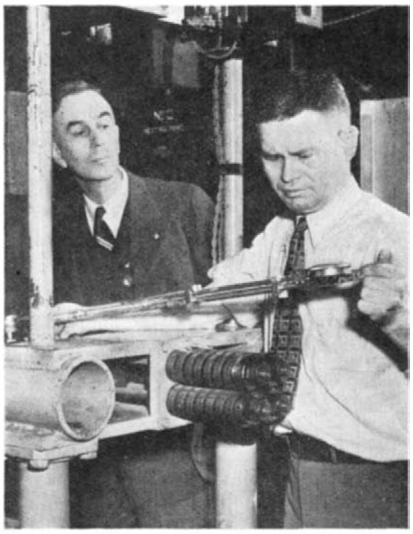
Gives New Data to Turbine Designers

A 100,000-HOUR high-temperature creep test—the longest on record—for four rods of high-strength alloy steel, begun when Herbert Hoover was in the White House, was recently completed by the General Electric Company. The four rods represented one of the best known alloy steels for high-strength forgings and bolts required in the manufacture of steam turbines.

The test was made to determine what stresses could be used at temperatures where all materials are plastic, without causing deformations larger than the minute values tolerable in high-speed machines.

A test of this duration also provides a means for studying the changes in the characteristics of the metal under prolonged conditions of high temperature and stress, and determines whether the material becomes stronger or weaker during the 11 years or the 100,000-hour period. Such tests are necessary for improving the design of steam turbines so they can operate at higher temperatures.





Left: **A final check is made on the creep-test rods before removal from the furnace.** ***Above:*** **Withdrawing the first of the four 100,000-hour test rods**

The rods tested were each four-foot specimens of nickel-chrome-moly steel (S.A.E. 4340), 0.505 inch in diameter. A 12-inch portion at the center of each rod constituted the test area. Temperature of the furnace was maintained at 842 degrees, Fahrenheit; the rods were subjected to constant stresses of 13,000, 17,000, 21,000, and 25,000 pounds per square inch respectively. In the 100-000 hours the No. 1 rod with the constant stress of 13,000 pounds per square inch stretched 0.928 mils per inch of length, or about one thousandth of the 12-inch portion tested. Extensions of the other three rods were 1.398, 2.729, and 4.166 mils per inch of length.

PALLADIUM

Will Find Increased Use in Jewelry

COMMENTING on the recent order of the War Production Board restricting the use of platinum in jewelry, Charles Engelhard, of Baker and Company, Inc., leading authority on platinum metals in the United States, concurs in the recommendation of the Board concerning the use of gold and palladium instead of platinum. He states that the jewelry trade is indeed fortunate in that it has available, without restriction as to its use, ample supplies of these metals.

Mr. Engelhard advises that "palladium is available in sufficient quantities to furnish the jewelry trade with a satisfactory alternate for platinum, and that the major sources of supply lie in Canada, Alaska, and South America. Even though palladium is more rare than gold or platinum, as considered from the point of view of recovery from ores or other natural deposits, it is today possible to effect its recovery in worthwhile commercial quantities by modern metallurgical processes developed over the last decade."

He added that "palladium has been used for jewelry manufacture, sometimes in alloy form with other members of the platinum family. These alloys have the required strength and hardness for rings, and for the setting of gems with security, and they can be readily worked into delicate, lacy designs for pins, brooches, and other larger pieces."

Palladium is lighter in weight than platinum, is about as heavy as 14K yellow gold, and has a current market value approximating 70 percent that of platinum. Its color is admirably suited for the setting of diamonds and it harmonizes with the colors of other gems.

PINE PLASTIC

Resin and Vegetable Fibers in Newly Announced Material

A NEW plastic composition, which can replace steel or other metals in many uses, has been developed from vegetable fibers and a resin from Southern pine trees, according to G. R. Stark, vice-president of The Patent and Licensing Corporation. Mr. Stark said that the resin is made only by Hercules Powder Company from the wood of the Southern pine in its naval stores plants in Georgia and Mississippi, and is now available without priorities.

Announcement of the new plastic followed within three months the announcement by Hercules chemists of another plastic, soft ethyl cellulose, found suitable to replace rubber in many articles.

Lightweight but sturdy, these new compositions can be used instead of steel or other metal for many purposes such as structural members, pipe, wall panels, air conditioning ducts, corrugated sheets, and so on.

To make this plastic, the resin-treated fiber is turned out in sheets on standard paper-making machinery. These sheets are hydraulically pressed together to make compositions which are hard, dense, stiff, but not brittle.

SYNTHETIC CORUNDUM

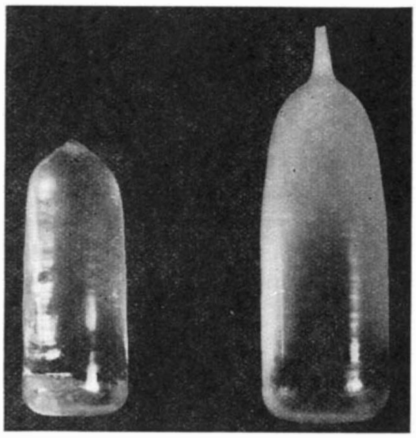
White Sapphire Now Man-Made-in-America

SYNTHETIC white sapphire—the mineral corundum unpigmented and of gem quality—is now available in the form of boules, each weighing at least 150 carats and of a regular cylindrical shape, enabling gem cutters to standardize on cutting and sawing procedures. Instigated by the need of a domestic source of industrial gems, the manufacturer, The Linde Air Products Company, in less than two years equalled and, in some respects, has surpassed the quality of European gems, formerly the only synthetics obtainable. Since domestic production started, it has grown so that it is now capable of handling the entire military demand for all the United Nations.

Mineralogically, the hardness of the American white sapphire is exceeded only by the diamond. Once they are cut, the jewels are also surprisingly tough in terms of resistance to breakage by impact. Moreover, because they have a melting point of over 3700 degrees, Fahrenheit, they are also heat resistant to a high degree. An additional advantage is the boules' uniformity of size and shape, which leads to economical cutting.

Many essential uses are already being made of jewels cut from these synthetic boules. Among locations where they serve economically are as the jewel bearings of chronometers, compasses, and electrical, fire-control, and aircraft instruments. In such instruments, they are employed in the form of ring bearings or V-type and cup-type end bearings. Pallets are also made for watch escapements.

Other successful, although still experimental, uses of the white sapphires are as thread guides in the manufacture of rayon, as orifices for flow meters and oil-burning equipment, and as insulators in gas-filled or vacuum thermionic devices. Indications are that they are also suitable for use as Diesel-engine injector nozzles, as rollers for small needle bearings, and for cutting-tool tips to perform high speed finishing operations on certain non-ferrous metals. Their complete chemical inactivity when exposed to all types of corrosion, except strong mineral acids and alkalies, may suggest additional uses to designers of chemical equipment.



American-made synthetic sapphire boules. At left is a 200-carat boule typical of present commercial production, while at right is one of the largest sapphires yet made—350 carats

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PRESERVATION—The value of wood preservation—both for war and civilian use—is being realized, as indicated by the fact that in 1941 an increase of 20 percent was recorded over 1940 in the amount of wood preservation.

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SABOTAGE

War-Production Lines Are Well Protected

SABOTEURS aren't going to have much chance to throw monkey wrenches into America's fast moving war-production line, if government plant protection officers have anything to say about it. Precautions being taken against enemy agents in war plants were described recently by Lt. Colonel James C. Sawders, chief of the plant protection and safety branch of the Chemical Warfare service.

Special attention is being given in all plants working on war orders to fire prevention, fencing, and protective lighting, investigation of personnel, hiring of new employes, adequate plant guard forces, and protection of confidential documents, blueprints, and special tools, Col. Sawders said. Vital plant facilities and equipment such as water supplies, power plants, and stores of industrial explosives are being closely guarded, he added.

Speaking of hiring practices in war plants, Col. Sawders said: "It is highly important that we know a lot about the people who work on important contracts. The infiltration of enemy spies into plants in positions of trust must be avoided at all costs. All employes in plants working on government contracts are now fingerprinted and a good portion are given physical examinations. We are particularly interested in the examination of food handlers since it is most essential that they have no communicable diseases."

Col. Sawders mentioned that good plant guards are hard to get. He defined good guards as alert and vigorous men of good health between the ages of 30 and 45. "Younger men are all right but men of more mature judgment are preferable," he said.

"I believe there are comparatively few misguided idiots who think our enemies are trying to build a better world or who, for pecuniary considerations are willing to risk their necks," Col. Sawders said, "but this does not mitigate the possibilities of sabotage and we must be continously on the alert. You never can tell when, where, or how those fellows will strike and you may be sure they will strike in places where it will hurt most, particularly if they are directed by enemy agents who are never selected for their work unless they are people of considerable talent."

PROTECTIVE CLOTHES

Are Flame-Proof, Resistant to Wear and Tear

A NEW type of protective industrial clothing known as Ply Garb is flame-proof, preventing serious injury from spontaneous magnesium fires and in other hazardous manufacturing operations. Made of featherweight but tough, plastic, laminated cotton cloth, Ply Garb sleeves and aprons offer maximum comfort and freedom of movement. The sleeves feature special air vents to guard against excessive perspiration. Ply Garb fabric is said to be sturdy enough to resist tears, snags on rough surfaces, and cracking. It is flexible enough, however, to resist wear and afford complete comfort.

INDUSTRIAL TRENDS

THE FUTURE IN THE AIR

SUNDAY supplements and occasional pieces in the daily press have pictured the aircraft industry in general as being in the chrysalis stage of becoming *the* transportation means of the future, awaiting only the end of World War II to burst forth and take over the entire job of railroads, automotive highway vehicles, and steamships. In particular, these purveyors of news have dwelt on the cargo-carrying possibilities of the future, predicting all sorts of fantastic types, capacities, and species.

There is no doubt that the airlines, the aircraft industry, and cargo carrying by air will leap forward after the war, stimulated by lessons learned and problems solved under the stress of military necessity. How far these components of air transportation will leap, however, is subject matter for calm, serious thinking, based on past performances and present operations (so far as they are known under the limitations of military secrecy).

Probably the best way to guide such thinking is to harvest and digest a group of present and post-war "straws in the wind," gleaned largely from airline and aircraft manufacturer's reports, from the recent Air Cargo Engineering meeting of the Society of Automotive Engineers, held in Chicago, and elsewhere. Thus:

On the Airline Front: So great has become the demand for air cargo space that new commercial all-cargo schedules have been put into effect by many of the major lines. These services must not be confused with the military cargo service that the same lines are operating under the Air Transport Command of the Army Air Forces. This new service is strictly commercial. . . . Although the airlines have only half as many planes available as formerly, the heavy volume of business may be enough to enable the airlines to handle at least as much commercial business as they did a year ago, if not more. . . . By the end of 1943, Army Air Force commanders have indicated, air cargo transportation will approach, if not reach, parity with wartime ocean shipping. . . . One airline says that, although at the time of reporting they had only 3600 employees, the jobs they had been given to do would require expansion to possibly 10,000 employees. . . . Compare this with the total personnel of all United States air transport groups, as reported by the Civil Aeronautics Board, of 23,890, as of June 30, 1941. . . . While practical airline operators do not share the over-optimistic views of some regarding the future, they are all certain of a substantial increase in business, once equipment and manpower are made available to them. . . . Again referring to the CAB: It is their estimate that, assuming normal progress, and using as a basis the 12-month period ending April 30, 1942, six billion passenger miles will be flown annually by 1946, on domestic airlines. During the 1941-42 period mentioned only one and one-half billion revenue passenger miles were flown. . . . To do this job the Board states that a seating capacity of 25,000 will be required, or the equivalent of 1200 planes of the size of the DC-3. This would be about five times the capacity of the 1941 domestic airline fleet. . . . In international operations, and with similar qualifications as for domestic work, the Board estimates that, shortly after the war, international passenger traffic, under American-flag operation, will increase at least six times; mail and express at least eight times.

From the Standpoint of the Aircraft Industry: Preparations for post-war work have gone by the board, but experience in military construction has shown that 100-ton cargo planes are entirely possible. . . . They may not be in use tomorrow or even next year, but the manufacturers are doing something about them. . . . For post-war continuance of operations, manufacturers of training planes will be in the forefront for making private planes; bomber and cargo ship builders will be in the driver's seat as far as passenger and freight liners are concerned. . . . However, success in these fields will largely be determined by the government's action regarding excess military planes. If thousands of training planes, bombers, and cargo planes are dumped on the market at a fraction of their cost, many manufacturers will be hard-put to weather the storm. . . . On the other hand, if government decree is—as many of us hope—to maintain a large air force after the war, a certain amount of military manufacturing will be carried on and there will be little or no dumping of planes. . . . American manufacturers of large numbers of war-time cargo planes have one advantage in the international field: No other member of the United Nations is now building such equipment, and hence will not be in a position to compete in post-war markets. . . . Cost of manufacture is a factor that will bear close watching after the war. Operations today are largely "regardless of cost." Later, they will have to be governed by the one element that today is disregarded.

More About Cargo Carrying: Intensive developments in military cargo planes will probably form the basis of post-war operations. . . . Planes now available for huge military cargoes will be tailor-made for peace-time work. . . . Cargo planes will not necessarily all be large. They will be built for specific services, the larger planes being used for long ranges where their greatest economy will be available. . . . While planes will not supplant other shipping methods, they will become invaluable adjuncts. . . . Cargo plane design will evolve as time goes on. Possible features of future ships will include high-wing construction for convenience and safety on the ground; tricycle landing gear for level position of fuselage when being loaded; box-like cargo compartment with large loading doors, smoke detectors, and automatic fire-extinguishing means.

The foregoing constitutes a pre-selected bird's-eye view of the whole situation of aerial transportation, as it appears today from this vantage point. Subject to change as technological developments dictate, and as governmental policies on the sale of materials, on taxation of the industry, and on the maintenance of adequate air fighting forces develop, it gives a basis on which to predicate future trends.

RAMIE ON THE WAY

TEXTILE development, urged on by war requirements, is bringing forward ramie, formerly obtained almost exclusively from China, but now being grown in Florida. This fiber, subjected to scientific study and experiment, is now produced in extremely pliable form, soft, white, and silky. As formerly processed it was durable but not sufficiently flexible for many purposes. Although ramie fiber can be used alone, probable applications of it in the future will be as a blend with other fibers. For example, it is stated that, mixed with wool. ramie gives better wearing qualities and prevents shrinkage when the fabric is laundered or soaked with water.

—The Editors

Two New Discoveries

A New Star, 100,000 Times as Bright as the Sun; and an Old Cometary Puzzle Solved

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

Two recent astronomical developments, though unrelated, may be described this month.

The most notable, of course, is the appearance of a brilliant nova in the southern constellation, Puppis. It appears to have been first noticed by Dawson, at Cordoba, Argentina, on the morning of November 9th, when it was a little fainter than the first magnitude. During the next two days it increased in brightness, and was independently discovered by half a dozen or more astronomers—amateur and professional—before the news was sent out from the astronomers' "news center" at Harvard the next day. Its maximum brightness, according to reports so far available, was about 0.4, surpassing Procyon and nearly equal to Rigel; then it faded rapidly, and at the time of writing it is barely, if at all, visible to the unaided eye.

Had it appeared four months later, it would probably have been independently discovered by scores of people; but at the time of discovery it crossed the meridian at about 5:30 A.M. by "war time" and rose above the haze of the horizon perhaps an hour and a half earlier, so that only early risers had a chance at it.

It was well within the range of the great observatories, and spectra were promptly obtained. They showed the characteristic wide emission bands, with unusually wide absorption lines to the violet, indicating that, as in other novae, an expanding shell or envelope of gas is moving outward from the star at velocities of the order of 1000 kilometers per second.

Lines of hydrogen, ionized iron, titanium, magnesium and silicon, and of neutral oxygen have been identified—which shows that we have to deal with an ordinary nova spectrum and not with the supernova type in which the wide bands have not yet been identified. The rate of expansion, too, is moderate for a nova, and by itself does not indicate an outburst of exceptional violence. However, the actual luminosity at maximum must have been high, for the interstellar H and K lines of calcium are strong, indicating a great distance, which was provisionally estimated, at the University of Michigan, as 1600 light-years. This is of the same order of magnitude as those which have been derived for other bright novae of recent years, and makes its absolute magnitude about −8 at maximum—corresponding to 100,000 times the light of the Sun.

Before the outburst, this star was exceedingly faint. No trace of it has been found on plates taken with the great 24-inch camera of the Harvard Station at Bloemfontein, which, with an exposure of three hours, go down almost to the 18th magnitude. It must then have been more than 17 magnitudes fainter than at maximum—that is, hardly more than one ten-millionth part as bright—and may have been fainter still. With the estimated distance, this gives a real brightness less than one percent of the Sun's, making it emphatically a dwarf star. Whether it was a white dwarf or an ordinary red one, we shall probably never know. But this huge increase in brightness is almost without precedent. Nevertheless, all the evidence, though still scanty at the time of writing, indicates that this is an ordinary nova, though a bright one.

In due time, our knowledge of this nova should be detailed. It will be observable from northern latitudes for four months to come, and from southern observatories practically the year round, so that there should be no serious gaps in the record.

Meanwhile, we may consider a quite different, and rather puzzling, aspect of the general problem of novae. During the first half of the 20th Century—with eight years still to run—there have appeared seven novae which, at maximum, were of the second magnitude or brighter. Nova Persei of 1901 reached the magnitude 0.0; Nova Aquilae, 1918, rose to −1.4; Nova Cygni, 1920, to 1.5; Nova Pictoris, 1925, to 1.0; Nova Herculis, 1934, to 1.0; Nova Lacertae, 1936, to 2.2, and 1942 brings Nova Puppis of magnitude 0.4. This is at the rate of one nova in six years, or 16 per century. Yet during the whole 19th Century only two new stars were ever as bright as this—Nova Coronae Borealis of 1866, which reached the second magnitude, and Eta Carinae, which for some years about 1843 was brighter than Canopus and of magnitude −1. The latter, with its slow and irregular variations (it is now of the 8th magnitude) should not be regarded as in the same class as ordinary novae.

Three galactic supernovae are on record, Kepler's in Ophiuchus (1604), Tycho's in Cassiopeia (1572), and, brightest of all, the one in Taurus (1054) which formed the Crab Nebula. All these appeared brighter than Jupiter, and far exceeded any fixed star. Apart from these, the three brightest of recorded novae have all appeared within living memory and one of them is now fading in the skies.

Not a single reliable record of a nova has come down from the 18th Century. It might be argued (though with no great plausibility) that astronomers then were fewer and less on the watch. But this explanation can hardly be applied to the 19th Century, when astronomers, though not so numerous as today, were much more used to looking directly at the skies, and had on the average a much better personal acquaintance with the constellations. The suggestion that during the century a dozen or so temporary stars appeared, bright enough to be conspicuous to the most casual glance, and to change the familiar pattern of the constellation in which they were found, and that not one of them was noticed by professional astronomer, amateur or mariner—except one faintish object in 1866—is quite unbelievable. It is hard to escape the conclusion that the reason why no novae of the first magnitude were observed in the last century is because none were visible.

There is of course a possibility that a bright nova appeared in some part of the sky which was close to the Sun at the time, and faded out before this region got clear of the dawn. This almost happened, in fact, for the supernova of 1054. But the list of 20th Century novae includes those actually observed and would be equally subject to such vicissitudes.

It seems, therefore, that the accumulation of bright novae in the first part of the present century is merely a matter of chance. It would be hard to think of any phenomenon that could be more certainly trusted to be "at random" than the appearance of a nova. The actual outbursts of the stars take place in regions of space hundreds of light-years apart, and it is almost inconceivable that one could influence another. Moreover, we record, not the time of the catastrophe, but the time when we saw it, after many centuries of light-travel. Observers 50 light-years from the Earth—only a small fraction of the distance of the novae—would see some of them 50 years earlier than we, and others 50 years later; and the order of their appearances, and the bunching of these in time, would be very different.

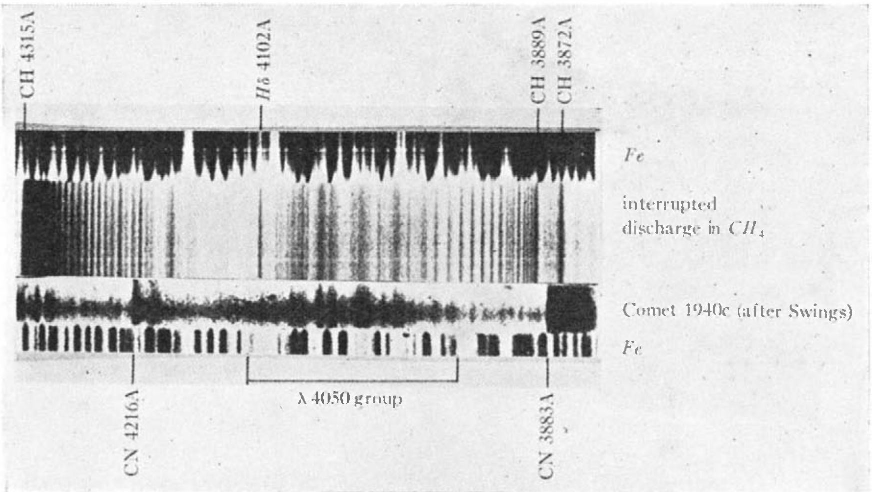
We can not be sure, however, whether the dearth of novae in the 19th Century, or the plethora in the 20th, is more nearly representative of the general average. If they keep on appearing at the same average rate for the next 40 years or so, our successors may shift to the view that the queer run of luck happened in the 19th Century.

Or perhaps they may turn to the principle familiar to every lawyer, that the testimony of many trustworthy witnesses who swear that they didn't see something, does not count against that of one trustworthy man who swears that he did, unless it can be *proved* that the first lot of folks were looking the right way!

Coming back to the solar system, we may note a second important discovery—one regarding the spectra of comets.

Most of the bright lines and bands in cometary spectra have been identified, and arise from compounds of the familiar light elements, C_2, CH, CN, NH, OH, and so on—all molecules composed of two atoms only—fragments of the molecules familiar in the chemical laboratory, which are partly but not completely dissociated or decomposed, probably by the action of very short-wave ultra-violet light from the Sun. One group of bands, composed of lines so closely packed that each group looked like a wide line, in the vicinity of 4050A, has defied identification.

Swings, comparing the spectra of comets at different distances from the Sun, found that, for those outside the orbit of Mars, the unknown bands were strong, and the well known bands of CH at λ4313 were very weak. At the Earth's distances, the former are about the same, but the latter stronger; at Venus' distance, the two are equal; and, for a comet observed inside Mercury's orbit, the unknown bands were very weak and the others strong.



Courtesy The Astrophysical Journal

Comparison of two spectra, the upper that from a laboratory experiment by Herzberg, the lower that of a typical comet

The strengthening of the CH bands, which are known to be produced by a product of dissociation, as the intensity of the sunlight increases, is easy to understand, while the weakening of the 4050 group suggests that they may be produced by some substance which tends to be decomposed by the more intense radiation.

Following this clue, Herzberg, of the University of Saskatchewan, showed that the structure of the bands is what might be expected in the spectrum of a molecule containing not two, but three, atoms (provided that the three are nearly, but not quite, in a straight line). From the close spacing of the bands, it followed that this molecule had a very small moment of inertia—which would be possible only if the two outer atoms were hydrogen. This reasoning suggested that the molecules might be CH_2. To settle the question, it was necessary to produce the spectrum of this molecule in the laboratory—and here Dr. Herzberg's well-known skill has scored again. The obvious suggestion was to use methane gas, CH_4; but, on introducing this into an ordinary vacuum tube, only the spectra of atomic and molecular hydrogen were obtained with faint bands of CH. Evidently the methane molecules were being so badly abused by the discharge that they quite fell apart, leaving only a few in the last stage preceding complete decomposition. It was noticed, however, that immediately after turning on the discharge the light emitted was of a bluish-white color, which soon turned pinkish. This suggested using a tube through which the methane was streaming continuously—flowing in at one end and pumped out at the other—and turning the discharge on for a fraction of a second every few seconds. The spectrum of such an interrupted discharge showed a new group of bands, which proved to be identical in detail with the λ4050 group observed in comets.

It is evident that this spectrum must be emitted by methane or one of its decomposition products CH_4, CH_3, or CH_2. From the conditions of its production, it is probable that it comes from the last of these stages. The question can be settled by a detailed analysis of the structure of the bands—resolving them into separate lines by a powerful spectroscope—and Herzberg reports that this investigation is now under way.

The last important puzzle in cometary spectra is thus cleared up. Its solution presents a fine example of the combination of results obtained in quite different ways. The astronomer, observing the faint light of comets with spectroscopes especially designed to be powerful enough to get results, but not so powerful that they would be unable to get a developable image in the available exposure time, discovered the relation between the intensity of the bands and the comet's distance from the Sun. The theoretical physicist, employing the intricate theory of the spectra of polyatomic molecules, found that the cometary bands probably arose from a molecule of three atoms, two of which were hydrogen. Being also a first-rate laboratory spectroscopist, he devised conditions in which just these partially dissociated molecules were present in large numbers in his tube, observed their spectra, and completed the proof.—*Princeton University Observatory, December 4, 1942.*

Celestial Navigation

A Specimen of the Kind of Studies which the Youth of the Marine and Air Services are now Pursuing

E. B. COLLINS
Nautical Scientist,
Hydrographic Department, Navy Department

TODAY, the anxious plight of a war-torn world calls for the supreme effort from every qualified navigator to aid in the safe guidance of our loaded surface ships over the uncertain waters of the world's seven seas, and, in addition, the shaping of courses for aircraft on long-range combat flights above or below the clouds.

The strenuous war program necessitates an extremely simple and elementary method for the rapid training of hundreds of youthful navigators. This calls for practical, simple, and uninvolved instruction.

The principles of celestial navigation are based on the science of nautical astronomy, but young mariners need not be astronomers, though they must become familiar with certain technical terms, also with the general nature of the universe with which they deal.

Therefore the beginner is concerned only with two revolving spheres, the rotating earth turning eastward on its axis, and the great celestial dome of stars, rotating on the same axis extended and appearing, because of the earth's eastward rotation, to turn westward around the earth.

Vertically over the navigator's head on this celestial dome is his zenith. All points directly over other points on the earth's surface are the zeniths of those points. The geographical position, then, of any heavenly body with relation to the earth is a point on its surface that has the celestial body in its zenith. This point is determined by its co-ordinate of latitude, which is equal to the declination of the body, and its other co-ordinate of longitude, which is equal to the Greenwich hour angle of the body. All co-ordinates for any heavenly body seen at any given instant of Greenwich meridian time are recorded with respect to the equinoctial in the seaman's Nautical Almanac issued annually by the United States Naval Observatory, at Washington.

The mariner at sea invariably deals directly with objects seen on or above his horizon, and with imaginary circles passing through his zenith, called vertical circles. The azimuth, or true bearing of a celestial body in the sky, is the angle at his zenith measured by an arc of the horizon between his meridian and the vertical circle passing through the sun or star. The true altitude is the angular distance in arc from the plane of the horizon, measured on a vertical circle passing through the body from 0° to 90°. From this it follows that the zenith distance is the angular distance from his zenith, and is equal to the complement of the altitude. Thus it is seen that the position of a heavenly body with relation to the horizon is given by its altitude and by its true bearing, or azimuth.

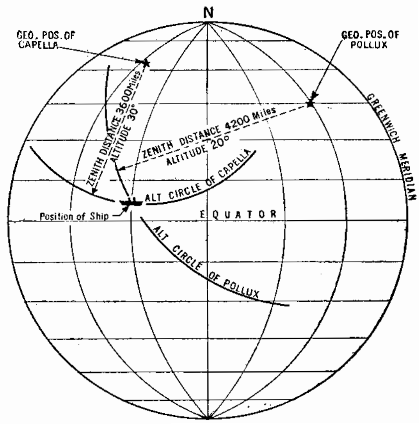


Figure 1: **Intersecting circles**

IT IS well here to explain in a general way to those who are not navigators what the real problem is that confronts the young navigator. Observations, or "sights," of sun, moon, or star, taken by a mariner with marine sextant, or bubble octant, consist in the measurement of arc of altitude of that body above the horizon (azimuth cannot yet be accurately measured). What that observation gives is, in effect, the zenith distance of the body for some specified instant of Greenwich time as shown by the navigator's watch, whose error is always known from daily comparisons made with radio time signals received at the ship from stations on shore, a routine procedure at all times.

The data then obtained from his Nautical Almanac for this observation are the celestial body's co-ordinates of declination, or the body's angular distance north or south of the Equator or equinoctial; and its other co-ordinates, the Greenwich hour angle, or angular distance of the body away from the prime meridian. In other words, it is the longitude measured westward from the initial meridian of Greenwich, England. This enables a point on the earth's surface, which has the body in its zenith, to be readily plotted on a globe, or on the mariner's marine chart. This point is called the subsolar point in case of the sun, the sublunar point in case of the moon, and the substellar point in case of star or planet. It is generally known as the heavenly body's geographical position and is plotted on the earth by its co-ordinate of latitude (declination) and its co-ordinate of longitude (Greenwich hour angle).

AS PREVIOUSLY stated, the "sight" for altitude gives the true zenith distance of the body observed, or the angular length of a radius from the celestial body to the navigator's zenith. If, now, a small circle be drawn on the earth's surface, having its center at the body's geographical position and with its angular radius equal to the body's zenith distance, then the navigator knows that he must be located at some point on this small circle on which all measured altitudes of this celestial body, wherever on the entire earth's surface these measured altitudes

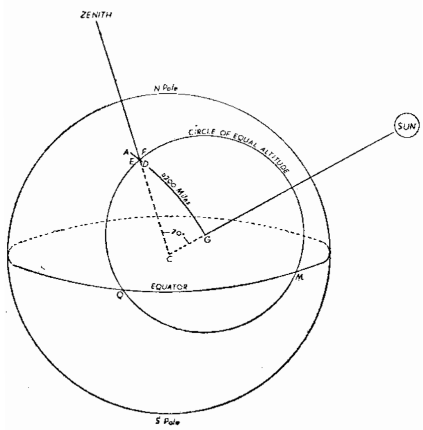


Figure 2: **Practical example**

are found to be, are the same at this chosen instant of Greenwich Civil Time.

If, now, *two* observations of a body are taken at different intervals of time, or if two different bodies are observed at the same instant of time, then two circles of altitude may be drawn. These circles will, of course, intersect in two points. The one selected is the point nearest to the navigator's estimated locality, or what is known as his dead reckoning position (Figure 1).

As a practical illustration, suppose a sight of the sun is observed and the altitude measured with sextant as 20° above the horizon, thus giving a zenith distance of 70°. In Figure 2, let *G* be a place on the earth's surface at which the sun is vertically overhead at the moment of observation. Then this one observation shows the navigator to be at a distance *G* of 70° x 60 (each degree of zenith distance corresponds to 60 nautical miles). Therefore, he must be somewhere on the circumference of the small circle *DMQ,* the center of which is *G,* and the radius 4200 nautical miles, and he may be presumed to be on that portion of the circumference which passes near his dead reckoning position. Let *A* be any assumed point on some integral degree of latitude near the navigator's estimated position. He then also assumes a longitude, or, what is equivalent, he assumes a local hour angle from his own meridian and then proceeds to solve the spherical astronomical triangle *PMZ* shown in Figure 3.

To arrive at his solution by this method, the old-time navigator usually required some 20 minutes or more, because a long, nerve-trying process was used, employing many logarithms, to

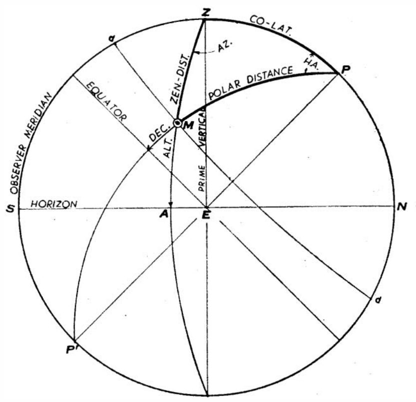


Figure 3: **The old method**

find the value of the latitude and azimuth of this heavenly body at his approximate position. In those earlier days of marine navigation, when all the sights were computed by a lengthy logarithmic process utilizing many numerical figures in the solution of the astronomical triangle, there was a large chance for the occurrence of many mathematical errors. But the navigator of today shoots his sight at any time of day or night and works every observation with the same uniform process to give him the line of position without all that complexity.

Now, in a simpler method, suppose, in Figure 2, that the zenith distance at *A* is computed and found to be 70°10′, and at the same time the sun's azimuth is computed and found to be 135° from north. Then *GA* equals 4,210 miles and *AD* equals 10 miles in the direction 135°. That is, *AD* is the difference between the true zenith distance as found from the observation sextant and the computed zenith distance as found from the astronomical triangle *PMZ.*

Figure 4 shows how the arc *AD* and the arc *EF* of the circle of equal altitude is laid down on the mariner's large-scale working chart. Since these two arcs are extremely short in comparison to their long radii, they will be, for all practical purposes, straight lines. We then lay off from *A* a straight

Official U. S. Navy Photo
Taking a sight of the sun

line *AD,* known as the altitude intercept, representing 10 miles—the difference in minutes of arc between the true measured altitude and the computed one—and in the direction 135° toward the sun, (since the true altitude is greater, but away from the sun, if the true altitude were the less) and through *D* we draw *EF* perpendicular to *AD.* Then *EDF* will represent a small portion of a circle of equal altitude, or what is known as the navigator's "line of position," and the crossing of two lines of position will determine the "fix" of the ship, or its geographical position on the earth.

It is evident that if the solution of all the different cases enumerated above are correctly tabulated for altitude and azimuth in a set of convenient tables, then the navigator need make no more mathematical calculations, for he can now solve his observation by inspection of these tables in less than four minutes of time, with no arithmetical errors creeping into the result.

The Hydrographic Office of the Navy has selected just such a simple process for all navigators to use, and this system is taught to all young navigators; for it is believed to be the best, the fastest, and most fool-proof method yet devised. This is because

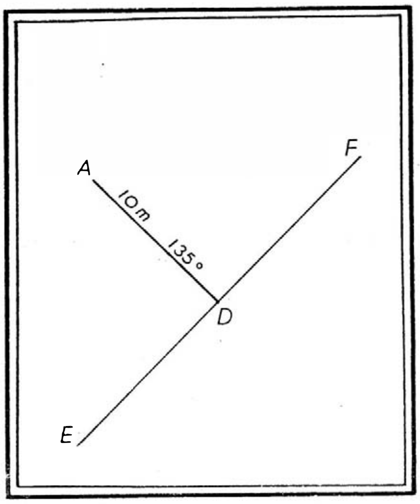


Figure 4: **The actual layout**

every "sight" is handled in the same simple, uniform manner.

No doubt the ideal tables for any navigator with no fondness for mathematical calculations is one with *no interpolation,* but the maker, or designers, of short navigational tables soon encountered three independent variables in every spherical triangle solved, and allowing for combinations for each minute of arc from 0° to 90°, it was noted that the preparation of such tables would involve tabulating the solution of $90^3 \times 60^3$ or 157,464,000,000 separate spherical triangles which, at the rate of 1000 triangles computed a day, would take some 400,000 years to compute and complete. Tables of such voluminous proportion being entirely out of the question, the Hydrographic Office was completely satisfied with obtaining values for three variables cut down to the nearest integral degree of latitude, and each degree of hour angle with an ingenious scheme utilized for correcting for any odd minutes of declination. These numerous computed values were neatly tabulated and clearly printed in nine flexible volumes containing belts of 10° of latitude, from the equator to the north or south poles, and entitled "Tables of Computed Altitudes and Azimuth." Each book contains 264 pages, or about 2400 pages for the entire set of tables, and involves the solution of over 10,000,000 separate spherical triangles.

Something That's Getting Better

Not Wars, not Taxes, but Public Health. Summarized Improvements of a Quarter Century are Startling

● That medicine in our times is making vast strides is a commonplace—too commonplace, in fact, since many of us cannot keep up with its advances. Thus it could come about that an overall reckoning at the end of a given period of years might take us by surprise, exceeding our most optimistic impressions. This is how such a reckoning, published in the monthly *Statistical Bulletin* of the Metropolitan Life Insurance Company, struck the editors of Scientific American—even better than they would have dared claim. Note especially the table below.

For giving prominence to the statements of a private organization, as is done here, no apology need be offered, since many such organizations do scientific research having the same standing as that done at universities. Besides, where else than the large insurance companies can such current statistics be found? These statistics form a most valuable complement to the official statistics on the nation's health. The Metropolitan Life Insurance Company, in one of its departments alone, covers 16½ million policyholders, regarding whom it has detailed statistics, and these 16½ million industrial policyholders constitute a very large sample of the wage-earning part of our population—*The Editors.* ●

THE health of the American people is bound to play an all-important role in the present war. On it depends the maintenance of high morale not only in the armed forces of the nation, but in the civilian population as well. The workers on defense projects cannot be expected to accomplish successfully the great job that still lies ahead if they are not kept well and physically fit.

Fortunately, the country was never better fortified in point of health than today. Thanks to the succession of outstanding discoveries in medical science and notable developments in public health, we are now much better prepared for the hardships and vicissitudes of modern warfare than we were 25 years ago at our entry into the first World War.

This is clearly shown in the mortality experience among the industrial policyholders of the Metropolitan Life Insurance Company. Their death rate in the age group one to 74, adjusted for changes in color, sex, and age distribution, has been reduced slightly more than 50 percent in the course of the last quarter of a century. In this reduction in the general mortality the death rate from practically every important cause of death individually took part, as shown in the accompanying table of standardized death rates per 100,000 persons.

CAUSE OF DEATH	1941	1917
ALL CAUSES—TOTAL	615.5	1264.5
Typhoid fever	0.4	12.0
Measles	0.8	10.2
Scarlet fever	0.5	5.4
Whooping cough	0.7	5.0
Diphtheria	0.7	21.7
Influenza	5.9	15.0
Pneumonia—all forms	23.0	131.8
Tuberculosis—all forms	40.9	202.2
Syphilis	9.1	19.1
Cancer—all forms	84.5	80.7
Diabetes mellitus	19.6	17.1
Chronic cardiovascular-renal diseases	262.8	373.2
Diarrhea and enteritis	2.0	24.6
Appendicitis	7.2	11.6
Puerperal state—total	4.6	17.2
Accidents—total (excluding war deaths)	50.0	84.3
Automobile accidents	20.4	10.0

The diseases of childhood and infancy—measles, scarlet fever, whooping cough, diphtheria, and diarrhea and enteritis—have been virtually eliminated as causes of death within this period. This means not only that there has been a very substantial saving of life at these early ages, but that many of our young people living today have been spared the disabling sequelae of these diseases. In consequence of this situation, thousands are now available for war service who, under former conditions, would have been rejected.

The death rate from tuberculosis among the industrial policyholders has been reduced to just about one fifth since 1917. This is a fact of particular importance in connection with the war effort, because tuberculosis finds many of its victims among those in the prime of life—that is, between the ages of 20 and 50—the very people on whom fall the chief burden of prosecuting the war.

Syphilis is another disease concentrated mainly in youth and middle life, that unfortunately tends to spread in times of war. The mortality from syphilis among the Company's industrial policyholders is less than half of what it was in 1917, and the outlook for its control in this war is much better than it was 25 years ago.

Calamitous in the last war were our losses from influenza and pneumonia. The first of these fluctuates so widely in prevalence and virulence from year to year that it is impossible to estimate the likelihood of a serious visitation within the next few years. Recent research into the causative agent of influenza, however, encourages the expectation that the nation may be better prepared today to cope with any epidemic that might arise than it was in 1918. Pneumonia, thanks to the new chemotherapy, has lost much of its former terror. The death rate from this cause among industrial policyholders has dropped more than 82 percent since 1917.

IN VIEW of the rapidly increasing industrialization of the nation and the fact that many defense workers are for the first time coming in contact with machinery and other hazards of war work, we can hardly hope to escape an increase in fatal accidents. But during the years since 1917 there have been such marked advances in industrial hygiene and in accident prevention, that many lives and countless working days are being saved that would have been lost under the working conditions prevailing at the time of the last war.

A factor that is not without influence in maintaining morale is the marked improvement recently experienced in the mortality of women in childbirth. It is a comfort for the young father, whether in defense work or in the armed services, to know that modern care available to his wife during her pregnancy and confinement has greatly diminished the risks to which she is exposed at that critical time. In this he can have better ground for confidence than had his father during the first World War. Improvement in prenatal care, obstetrics, and hospital facilities since 1917 have achieved wonders in reducing the hazards of the puerperal state. Whereas 25 years ago more than 17 out of every 100,000 of the Company's industrial policyholders died in childbirth, today this rate is reduced to five. While some part of the decline is due to the reduced birth rate during the period under study, much the greater part unquestionably is attributable to better medical and nursing care.

Such are some of the changes in mortality from certain of the principal causes among persons in the more active ages of life. Less directly related to the war effort are the causes of death characteristic of the declining years, including more particularly chronic degenerative orders. As a matter of fact, even among these there has been considerable improvement since 1917.

Inasmuch as the Company's policyholders number many millions and are distributed widely in all sections of the country, they constitute a very representative cross-section of the total wage-earning population. Their health experience since the last war, therefore, reflects closely that of the entire country, and the observations here recorded on the basis of their experience may be considered generally applicable to the nation as a whole.

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PROGNOSTICATION

Modern Living Will Make Us a Myopic Nation

AMERICA is becoming a near-sighted nation. Each decade more and more of the population are near-sighted.

The steady movement of the American population toward near-sightedness, some ophthalmic experts assert, is caused by two factors—modern living conditions, wherein man has changed from a far-looking to a near-looking creature, and heredity. Near-sightedness is a physical characteristic that apparently is handed down by parents to their children.

Mankind for thousands of years spent much of the time out of doors and the human eye developed so that normally it is at rest when gazing at a distance, but hard at work when focusing on near objects. Within the past century education has become almost universal and children start reading at an early age. There are relatively few of the adult population who do not spend many hours each week in reading newspapers, magazines, and books—all hard work for the eyes. Men and women increasingly have moved into indoor occupations, operating machines and carrying on clerical activities—most of which require close focusing. Human eyes are becoming near-sighted in order to meet these new conditions of modern living requiring sustained close vision.

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RECOVERY—Nearly half a minute is required for average eyes to recover fully from exposure to bright, glaring light, according to tests made at the University of California.

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STUTTERING

Believed a Case of "Mind-and-Body"

ACCORDING to *The Journal of the American Medical Association,* stammering (stuttering) is a somatic manifestation of an emotional disorder based on a psychobiologic variation of the organism.

As yet there is doubt as to the exact mechanism that underlies this variation, but evidence strongly suggests the presence of an inherited constitutional factor which predisposes to emotional instability and psychomotor disorganization in general and to stuttering speech in particular.

However, a person's inherent psychosomatic deficiencies would not in themselves cause stuttering speech without some active precipitating factor: shock, cumulative environmental pressure, radical change of environment or, as in the instance cited, acute or prolonged illness.

There are two stages in the development of stuttering, primary and secondary. The chances of arresting the disorder are much greater in this first stage, before anxiety and inferiority feelings begin to develop and before conditioning has had time to operate. In the primary stage, therapy is largely a matter of slowing down the tempo of living and removing any exciting stimuli in the home environment, particularly the excitement and tensions generated by neurotic parents. Family quarrels, exciting games, rapid speech or other "nervous" reaction patterns on the part of parents or older children should be eliminated. The child should be kept in as good a physical condition as possible, he should have frequent periods of rest and relaxation, and fatigue should be avoided. Also, since the stuttering child demonstrates in general a lowered degree of psychomotor efficiency, especially in those functions requiring fine coördination, a certain amount of rhythmic work is recommended: games and simple exercises in time to music, marching to the beat of a toy drum, bouncing a ball in rhythm, and the like. He should be encouraged to do everything, speaking included, slowly and easily. Games in which the whole family participates can be devised to inculcate the idea of slow, easy, rhythmic activity.

With regard to the stuttering symptom itself, the parents should avoid correcting the child's speech directly, since this may make him speech conscious and precipitate the second stage of the disorder. A tactful suggestion —"Let's all try to talk slowly and easily; I don't hear so well today"—will usually produce better results than making a child repeat a specific word or phrase with which he has had difficulty. The parents should also avoid the all too common habit of interrupting the child when he stutters, talking for him when he is having difficulty or suggesting some "tool"—taking a deep breath, for instance—to help him over the blockage. Such tactics serve only to arouse his awareness of his difficulty and to develop anxiety and feelings of inadequacy. If possible the child should not be allowed to suspect that the physician or parent is concerned about his speech, or that it is in any way abnormal.

SHAKE HANDS

Hands Unimportant in Spread of 'Flu

DISCOVERY that the influenza viruses type A and type B die in a few minutes, if put on human skin, such as the palm of the hand, and allowed to dry there, has been made by Commander Albert Paul Krueger, in command of Naval Laboratory Research Unit No. 1 at the University of California.

"Virus solutions so strong that a teaspoonful would kill half a billion mice, lost all disease-producing capacity within 10 minutes," Commander Krueger, formerly professor of bacteriology at the university, stated. "Hand to hand distribution of the virus and eventual hand to mouth transfer would appear to be unimportant hazards."—*Science Service.*

'Commercial Sound' Enlists

The Microphone and the Loudspeaker Join in the War Effort to Increase Efficiency of Operations

GEORGE R. EWALD
Manager, Sound Products Division, RCA Manufacturing Company

THE rapid transition to wartime activities throughout this country has brought about many startling changes. Evolution that would ordinarily occur slowly over a number of years now takes place almost over night. New ideas, new processes, new materials, and new man-to-man relationships are rapidly taking form in industrial operations. These changes create new needs and, as is usual in periods of flux, the inventive genius of man responds to the urgent necessities of the occasion.

One of the most interesting developments has occurred in the field of what has been somewhat loosely termed "Commercial Sound." Certainly, the word "Commercial" does not now properly classify the tremendously broad field into which amplified sound has made its entrance so effectively. Today the microphone, amplifier, and loudspeaker are vitally necessary adjuncts to the efficient operation of industrial plants of every description; military projects of all kinds; air fields; naval bases; ordnance plants; proving grounds; training schools; shipyards and railroad yards; amusement, educational, and recreational activities; and, in fact, in any inside or outside location where it becomes necessary to convey sound intelligibly to groups of people or over distances where unamplified sound will not serve the purpose.

Commercial Sound has served a fearful as well as a useful purpose. It is indeed doubtful if Hitler's hordes would now be over-running Europe, Asia, and Africa if he had not been able to exercise his almost hypnotic control over millions of people through the use of loudspeakers.

On the other side of the picture, however, the use of amplified sound has become a tremendously important factor in the expediting of production; the improvement of efficiency in organization operation; a most potent time-saver in locating key men in every nook and corner of our great factories; and has tremendously reduced loss of life and damage to property in emergencies. So, a microphone is now found at the elbow of every man who desires to accomplish things quickly and efficiently, and millions of loudspeakers are in use throughout the world, in every place where people gather either for business or pleasure.


Control desk for handling "commercial sound" calls

Originally, when it was found possible to satisfactorily amplify sound and project it for some distance, the field of entertainment seemed to be the most natural development for the use of loudspeakers. As this use grew and developed, the possibilities for educational purposes became apparent, and it was not long before the schools and colleges throughout the country were equipping their auditoriums, laboratories, and individual classrooms with this most useful device. Slowly and gradually the amplifier found a place in various types of business establishments, although at the beginning it was curtailed in most places to the use of intercommunication equipment.

It has only been within the last 24 months that the real possibilities of the amplification of sound in great industrial establishments were realized. This development has proceeded with such tremendous impetus, however, that interesting and even spectacular incidents illustrating the value of sound equipment are developing daily, and the story surrounding the use of such equipment is worth telling.

Perhaps the best description of the varied use of sound equipment in industrial operations can be given by citing specific reports that are now available from many plants that are engaged in full wartime production. Many of the giant buildings that have recently been erected to house production of military equipment cover great areas of ground with immense rooms, unbroken by walls or partitions. Rapid man-to-man contact is difficult because of the tremendous distances and numbers of people involved. Buzzer or horn signaling in code, and the telephone and inter-departmental memo have been tried, but, due to the limitations of time and space, contact has been slow and much valuable supervisory time wasted trying to locate people wanted for quick answers.

Paging executives and key men has now become a fast and efficient process through the use of plant-wide sound systems, and it is interesting to note some of the comments that have been made regarding the actual efficiency in operation achieved in this way. A letter received from one of the big aircraft companies contains the following significant sentence: "To indicate the importance of these sound systems in our plant, it is interesting to note that our main plants make approximately 1500 calls each per day, with the smaller departmental systems making approximately 250 calls each per day, making the total calls of all systems about 6000 per day."

From another large Eastern industrial plant comes this statement: "We also find that our maintenance work is greatly expedited by our ability to reach the maintenance crews and give

Many speakers suspended from ceiling bring music to workers engaged on precision jobs

them orders immediately, no matter where they may be in the plant."

Through the proper installation and use of a sound system the load can be taken off the existing telephone lines. The necessity for new lines is thereby obviated, as well as additional switchboard personnel and telephone lines involved for intra-office and plant use.

A plant manager speaks in the following terse but effective words: "The primary function of our sound system is paging. This averages 1000 calls per day. It is estimated that five minutes time is saved on each call, or a total of approximately 80 man-hours per day."

HUNDREDS of similar quotations could be produced, emphasizing the increased efficiency in operation that comes with procedure controlled by means of industrial loudspeaker equipment. What could be more convincing than this excerpt quoted from a letter received from a superintendent of a big steel mill: "The RCA sound equipment in our mill has been in operation approximately one and one-half years. I feel that since this installation has been made, 95 percent of the mistakes formerly made, due to errors in signaling from the heaters to the rollers, have been eliminated."

The modern industrial plant today is subject to many stoppages of work due to emergencies of various kinds. Fortunately, air raid warnings so far have been entirely a matter of test procedure. Undoubtedly these tests will save lives if hostile airplanes finally should be able to break through our defenses. The quick control of thousands of people, and the proper instructions for the guidance of these people, can only be made possible through the use of sound equipment. There are also other emergencies due to fires, explosions, power breaks, and other unusual happenings. Centralized sound equipment provides the best and safest answer to the proper control and handling of such emergencies. It has proved its worth many times in actual installations.

Portable sound equipment for playing music, and public announcements

Military projects of every kind are now using sound equipment for many purposes. In camp, where trained buglers are not always available, the stirring strains of reveille are played over the loudspeaker from a record made for that purpose. Field maneuvers can be directed over wide areas through the use of mobile equipment, and in a number of large camps the entire camp has been sectionalized and covered with sound equipment so that the camp commander can address the entire personnel of the camp, or the various unit commanders can handle their separate sections individually.

Sound equipment is indispensable at the large air fields, and an interesting development of this use is the ability to control instantly with one emergency switch the entire system for such purposes as direction of personnel in the case of crash landings, or other emergencies of a similar nature.

The amplification of recorded music and the distribution of this music throughout large industrial plants has attracted much attention recently. It is estimated that about 3000 factories in the United States are now using music for this purpose, and many interesting data have been compiled as a result of this use. [An article on this specialized phase will be published shortly in these pages.—*Editor.*]

SCHEDULES have been worked out showing the type of music and the proper times during the day at which these programs should be heard. At many plants during the lunch hour news commentators and other current programs are reproduced over the sound system, and quick-step marches are often played as the workers assemble or leave.

A number of broadcasting stations are now reproducing musical programs for the benefit of workers on the night shifts. Apparently the day is fast approaching when national advertisers will seize the opportunity now afforded through the reproduction of programs of this sort to thousands of industrial workers throughout the nation.

Safety talks and messages can be broadcast regularly to all employees, and large insurance companies are now devoting a great deal of study and attention to the possibilities afforded in this way of emphasizing safety precautions and improved health habits.

Cordial co-operation between management and labor is a tremendously important factor in the speeding up of war activities, and the Government has given its stamp of approval to campaigns based on building morale and the improvement of employer-employee relationship. These campaigns are largely based on mass meetings of employees and the broadcasting of speeches, songs, talks by men in the armed services, and top Government officials. Obviously, such programs are impossible without the use of plant-wide sound systems, and the personnel directors in the large companies are quick to seize upon this method of stepping up morale.

Campaigns designed to stimulate productive activities are efficiently carried on through the use of sound systems, and even though plants are thousands of miles apart, officials can participate and be simultaneously heard in all plants. The quotation below, which was contained in a letter received from the superintendent of one of the big United States ordnance plants, summarizes the value of sound equipment as effectively as can be imagined. He says: "With this installation it was possible for us in the average time of 120 seconds to reach the many officials, contractors, foremen, and other individuals who were moving about the two and one-half square miles of territory comprising this project. It was also possible for us to give instructions to all the thousands of employes at work on this project at one time while work was in progress. On one occasion we assembled 8000 workmen on 20 minutes' notice who could have been reached by no other method. Our ability to contact individuals or groups of people has materially speeded construction and has saved thousands of dollars through increased efficiency."

The progress and development in the use of sound systems which has proved of such great importance in this period of wartime activities is certainly only the forerunner of even greater and more widespread development in the years to come. There are vast fields of activity that have hardly been touched up to the present time.

Sound equipment has been installed in a few railroad yards and the actual use in these yards has already demonstrated the possibilities of time and labor saving in every type of railroad operation. Here, certainly, is a tremendous field to be developed, and one that will pay large dividends.

Already sound installation is playing an important part in the great inland waterways of this country. On both lake and river, tug boats and tow boats are working day and night moving great accumulations of freight by water. Many times the pilot or navigator is hampered by poor visibility and great distances between his location and the various barges or other bottoms he is handling. The lookout at the microphone stationed at the bow or stern of his fleet helps materially in the safe and efficient passage of these cumbersome craft through the water.

Shipyards cover vast outdoor areas, and here the problem of communication is particularly difficult. Practically every large shipyard in this country is now wired for sound, and the flexibility of this equipment permits it to be used in the remotest corners and even on board the ships under construction.

Complete intercommunication between all important desks in the large offices and warehouses not only facilitates the dispatch of all ordinary business, but actually is a great money saver in decreasing the number of telephone units in use, and in relieving the ever-present load on switchboard facilities.

Looking into the future, it seems safe to predict that the up-to-date architect will provide all future buildings, whether they be for business or residential purposes, with completely integrated sound systems. Outlets for sound will be provided just as outlets for electricity are arranged, and it will be comparatively simple and inexpensive to connect speakers to these centralized systems as the occasion requires. The housewife in the modern home will save countless steps and time, as she can sit in her bedroom or living room and talk to salesmen at the front door, or converse with the maid in the nursery or the cook in the kitchen. In the more elaborate homes, she, of course, can direct her instructions to the servants' quarters or to the chauffeur in the garage. Speakers in each room will be switched on and off as desired for the reproduction of radio or recorded programs from a centralized control station. These speakers, of course, can be recessed behind attractive grills in the original construction of the house and thus prevent any unsightly accumulation of individual baffles and wires.

Amplified sound is destined to play such an important part in our daily lives in the future that probably twenty years from now it will seem impossible to believe that we could have gotten along without it. It will have its recognized place in the home, office, and factory, just as electric lights, running water, heat, and refrigeration now do.

In many ways that cannot be told now, sound equipment has enlisted for the duration. This same equipment that is now helping to win the war will emerge in the post-war era in the form of finer and more adaptable equipment, its value and usefulness better understood.

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HEADS

Are Sculptured to Furnish Mask Models

With the permission of the War Department, Orr Goodson, acting director of Field Museum of Natural History, Chicago, recently revealed a unique activity, in which the museum has been engaged for some months past, that contributes to the safety of members of the United States Army Air Forces.

The museum (of all places!) is now a producer of an important war accessory. This is the result of combined application of the scientifically accurate measuring methods (anthropometry) used by physical anthropologists to gage distinctive characteristics of groups of men and women; the researches of medical officers attached to the Army Air Forces; the art of the sculptor in depicting human types; and the driving force of experts in military efficiency and in manufacturing methods to obtain production and action with speed and precision.

For flying in high altitudes, the pilots, bombardiers, gunners, radio operators, and other men of the skies require oxygen masks, and these must be accurately fitted to each man's head. In an anthropometric survey of 2000 fliers, conducted by officers of the Army's Aero-Medical Research Laboratory at Wright Field, Dayton, Ohio, it was found that the shapes and sizes of aviators' heads could be reduced to seven basic composite types from among which the fliers could be properly fitted with masks. One of these head types—labeled as No. 1, "the mean" (in the sense of average) type—corresponds to the fitting requirements of the majority of the fliers; the other six head types represent the extremes of contours and out-sizes in all directions. The head models give the manufacturers of masks and headgear guidance in their production of the variations required, and the quantities of each size as needed.

After the original master set of sculptured head models, based on the measurements furnished by aero-medical officers, had been approved by Army authorities, the problem arose of producing sets of these models in quantity, as the heads, to meet the medical and air-safety standards, have to be micrometer-accurate.

Because of the scientific nature of

Unretouched pictures photographed directly from RCA television receiver screens.

FROM TELEVISION'S ALBUM OF PROGRESS

Felix the Cat had a bewildered look on his face in 1929 when he swung around for hours on a phonograph turntable in front of television's early scanning disks. Felix's image was slashed into 60 horizontal lines—60 streaks of light and shade. Engineers of RCA watched the antics of Felix as he was tossed through space to receiving screens. They realized that all streaks and flicker must be removed.

Scientists of RCA Laboratories abandoned mechanical scanners and developed an all-electronic system of television, featuring the Iconoscope and Kinescope, electronic "eyes" of the radio camera and the receiving set. Motors and high-speed disks were eliminated both at transmitter and receiver. Electronic television became as quiet and fool-proof in operation as a home radio set.

By 1936, the number of lines per picture had been increased to 343, with marked improvement in quality. But the research men still were not satisfied. They continued to experiment, and to develop new equipment, for finer pictures of 441 lines. Before Pearl Harbor, 525-line television pictures were on the air from the NBC station atop the Empire State Building.

The streaks had vanished. Television at last had the texture of rotogravure. Now, faces and scenes are photographed directly from television screens without betraying the presence of scanning lines.

Brought to life by electronic tubes, and given wing by radio, television emerged from RCA Laboratories to reveal its practical usefulness. Today, knowledge gained from years of television research is contributing vitally to the war effort.

Recognizing the importance of television as a post-war industry and useful public service, RCA is continually pioneering in the science of radio sight. Television's album of progress has only begun.

RCA LABORATORIES

A Service of Radio Corporation of America, RCA Building, New York

PIONEER IN RADIO, ELECTRONICS, TELEVISION

Other Services of RCA: RCA Manufacturing Co., Inc. • Radiomarine Corporation of America
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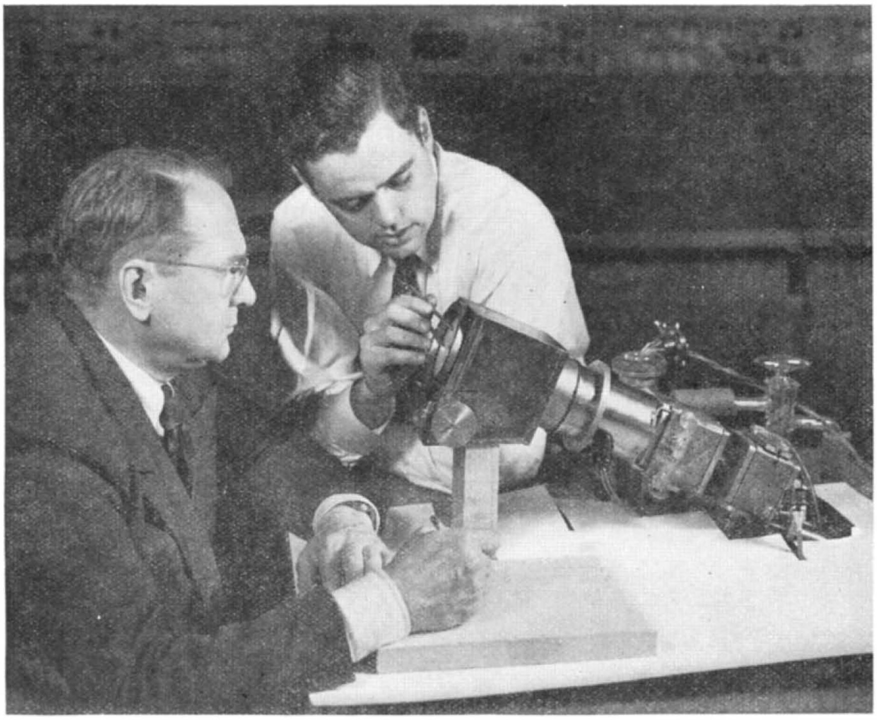

Drs. Zworykin and Hillyer, of RCA, with the new portable electron microscope

this project, the services of the museum laboratories and technicians were enlisted; production of accurate molds, and from them of accurate plaster casts of the sets of aviators' head types in accordance with the specifications of the aero-medical officers, is consequently now well under way at the museum.

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SALT—One vital war material which will never need to be rationed to consumers is salt. The United States has inexhaustible supplies, including the world's largest salt mine, the International Salt Company mine in New York, which covers 1000 acres, has 120 miles of passageways and goes to a depth of 1073 feet.

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SOUVENIRS

Should Not be Collected After Air Raids

ADMITTING that the tendency to collect "souvenirs" is a natural one, James M. Landis, Director of the Office of Civilian Defense, cautions that in case of an air raid on this country the gathering of bomb fragments and other mementoes may deprive the armed forces of vital information.

Objects of particular value for the information they convey include grounded enemy planes or parts of planes, personal equipment, weapons, and projectiles dropped or lost by the enemy, it is pointed out.

Any such objects found should be left in place and guarded until civilian defense authorities have been notified and an OCD technical assistant or a military representative has made an investigation. The location of the object, its position, and the degree or lack of penetration may be of great importance.

SKIS

Produced Rapidly By New Resin Process

BECAUSE the United States army needed skis in a hurry, the Allied Aviation Corporation of Baltimore started research work. Operating with the Vidal process, wood is bonded with synthetics, placed on forms, and covered with a rubber blanket and heater, using the pressure tank method. The process not only forms the skis but stabilizes the wood against warpage caused by changes in humidity, temperature, or contact with water: extra hardness and durability also result. Neither boiling water nor sub-zero weather will seperate the layers of wood, and it is not necessary to keep the skis in clamps to hold their shape when not in use.

PORTABLE

Electron Microscope Widens Its Field of Usefulness

A NEW electron microscope, small enough and inexpensive enough to be available to hundreds of medical, university, and industrial research institutions, has been developed by RCA Laboratories, Dr. V. K. Zworykin, Associate Director of the Laboratories and Contributing Editor to Scientific American, announced recently.

Only 16 inches long and light enough to be portable, the new model of the microscope makes one of science's latest and most powerful tools available to war work on a wide scale. It is capable of magnifying infinitesimally small particles of matter up to 100,000 times. In this respect it equals in performance the standard size instrument, introduced some two years ago.

Dr. Zworykin made it clear, however, that the standard electron microscope, a highly flexible instrument equipped with special adaptors for various types of investigations, is by no means superseded by the new small model. It has been found, he explained, that in numerous electron microscope researches the versatility of the larger instrument is unnecessary.

"In the study of colloids, viruses, and macromolecules, in particular," continued Dr. Zworykin, "a fixed magnification and a relatively low operating voltage, giving large contrasts, has proved most satisfactory. Hence a new electron microscope has been developed, distinguished by extraordinary compactness and simplicity of operation. Mounted on an ordinary desk, the microscope column, from electron source to fluorescent screen or plate, measures only 16 inches." (Height of the standard electron microscope is 7 feet.)

"The magnification of the (new) microscope, which operates with two magnetic lenses of fixed strength, is approximately 5000," he explained. "Since the grain of the photographic materials normally employed is fine enough to permit twenty-fold enlargement, micrographs with a total magnification of 100,000 may be obtained with the instrument. This is adequate to make use of the full resolving power of the microscope."

SYNTHETIC TIRES

Being Tested, but None Yet for Public

TIRES whose rubber content is 99.84 percent synthetic rubber are now being tested on the highways in various parts of the country, according to Dr. Howard E. Fritz, director of research of the B. F. Goodrich company. In discussing the present relative positions of natural and synthetic rubber from the standpoint of their usefulness in tires, Dr. Fritz emphasized that this testing of high-percentage synthetic rubber casings should not be considered as indicating any early public availability of such tires—that it does

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Cortinaphone Courses in French, German, Italian and English (for Spanish-speaking people) are as effective in teaching you a new language as the Spanish course described here, and are sent on the same "Proof in 5 Days" Offer. Check the language of your choice on coupon below.

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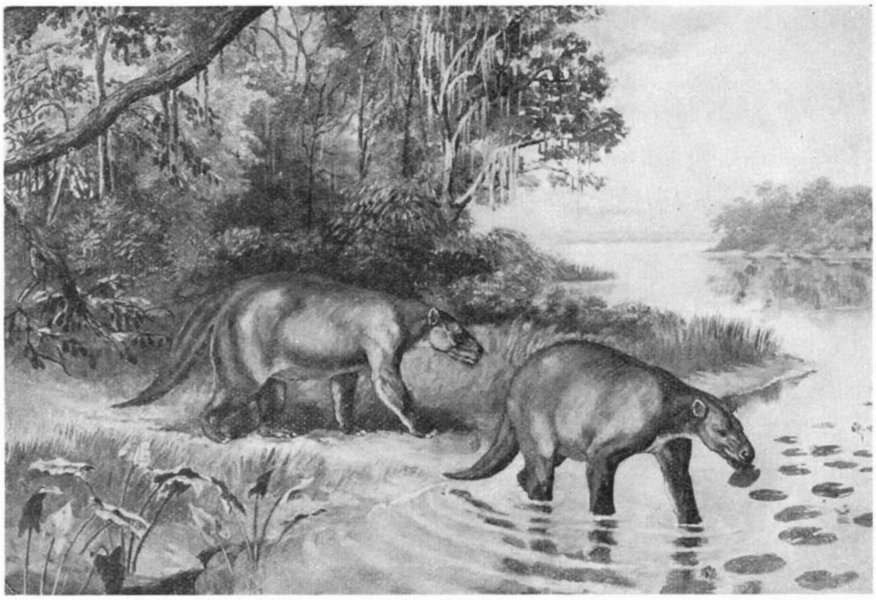
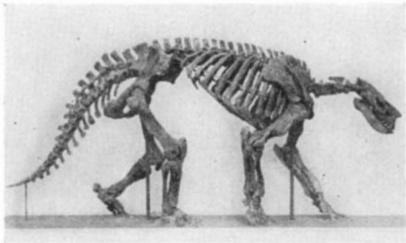




Photographs courtesy Field Museum of Natural History

A reconstruction of Barylambda and, *right,* the skeleton as now exhibited

not affect the nation's tire supply situation at all.

"Experimental development work done with samples of butadiene-type synthetic rubber — the type which makes up the great bulk of the government synthetics program—has already shown up much that is good and several things that are still unsatisfactory about this new rubber," he said.

"Passenger tires and small-size truck tires give excellent service. When we come to large-size truck and bus tires, several difficult problems arise due to the fact that synthetic rubber while running generates more heat than natural rubber, and may fail from that cause in spite of its higher heat resistance. However, we are now hard at work on this problem and are confident it can be solved as we gain more experience in the field."

BRAZILIAN R. R.

To be Electrified to Save Coal

In order to avoid excessive cost of importing coal to run its railroads, Brazil has embarked on a long-range railroad electrification program designed to make the republic self sufficient with respect to power, and at the same time independent of foreign sources of fuel.

The country has abundant water power, but is faced with the wartime problem of obtaining necessary turbines, generators, wiring, electric locomotives, and other necessary equipment.

First line to be electrified is a 90-mile section of the Sorocabana railroad, between Sao Paulo and San Antonio. The project, said to be the largest now under way in the Western hemisphere, is expected to cost about $10,000,000, and to be completed within three years.

Heavy rails are now being laid, and the 80-ton steam locomotives formerly in use are to be replaced by electric locomotives of 180 tons—said to be the heaviest electric locomotives ever built for narrow-gage track. Trains will be longer and will travel at greater speed.

Seven thousand poles to support the electric lines will be made of reinforced concrete. Power for the line will be supplied by three secondary plants.

Electrification equipment is being purchased from the United States.

The Sorocabana Railroad, owned by the state of Sao Paulo, is 1316 miles long.—*Engineering News-Record.*

BARYLAMBDA

Restoration of Heavily Built, Extinct Mammal

A practically complete skeleton of Barylambda, an extinct mammal which, when it lived 50,000,000 years ago in west-central Colorado, attained a development entitling it to be rated as one of the most heavily-built animals of all time, has just been placed on exhibition in the hall of paleontology at Field Museum of Natural History, Chicago.

"Barylambda was unlike and unrelated to any present-day animal," states Bryan Patterson, acting curator of paleontology, who led the expedition which excavated the remains of the rare creature. "It appeared during the course of the greatest revolution of life the earth has ever seen—a revolution that had been in progress about 10,000,000 years before Barylambda appeared on the scene. This revolution was the transition from the age of reptiles to the age of mammals, which was ushered in by the dramatic and worldwide extinction of the dinosaurs and other giant reptiles that had dominated land and sea. At the beginning of this epoch the mammals were small to medium in size. Once they had succeeded to dominance, however, diversification and specialization along many lines went on rapidly, resulting finally in the animal world we know today. One line of specialization was the acquisition of large size. This evolutionary trend especially characterized various orders of the great hoofed mammal stock, exemplified among living animals such as elephants, rhinos, and hippos. These were preceded by a great variety of extinct groups of which Barylamdba and contemporaries were earliest.

"Barylambda stood some four feet high, had an overall length of about eight and a half feet, and its width across the hips was almost equal to three-quarters of its height. Its bones were extraordinarily massive, indicating the possession of immense muscular power. The head was small in comparison to the size of the body. It had a long, large tail, flattened somewhat from side to side. It was found under conditions which indicate that at the time of its life this part of Colorado was a broad flood-plain. Rivers and streams from the Rocky Mountains evidently meandered back and forth across the plain, the climate was warm, and the vegetation was heavy. Barylamdba was well-fitted for such an environment —its strong body was adapted to forcing a way through the tangled vegetation, and its teeth indicate it was vegetarian in diet. Its broad spreading five-toed feet supported its great weight well on soft, treacherous muddy ground, and its large compressed tail suggests it was a capable swimmer."

DIESEL PROPHECY

Will it Replace The "Iron Horse"?

An old familiar institution will someday be only a memory, in at least one man's opinion:

The steam switching locomotive, the

great puffing behemoth whose friendly sinew has inspired so many boys to become its master at the throttle, is obsolete. No more new ones will be constructed for American railroads.

This prophecy was made recently by B. B. Williams, president of The Cooper-Bessemer Corporation, Diesel engine manufacturers, who said the lovable giant's place is rapidly being taken by an unromantic midget not much larger than the steam locomotive's tender.

The midget, run by Diesel power, is being turned out in large numbers to meet the increasing demands of American railroads and industry which have a tremendous volume of war materials to handle.

"The old steam switching locomotive is gone," Mr. Williams said. "Of course, the ones now in use on the main lines will be rebuilt and repaired until they are run to the thin end. But no new ones will be constructed."

The chief reason for the old friend's demise is its failure to develop enough power from a dead stop, the Diesel manufacturer pointed out. After it gets up enough speed it is powerful enough, but in getting up speed much effectiveness is lost.

According to Cooper-Bessemer engineers, a Diesel switch engine, in a head-on contest, would back up a locomotive three times as powerful and with full steam up.

They explained that both the direct-drive Diesel and the Diesel-electric switching locomotives show better performance because of their enormously increased starting torque. The steam switching engine requires some time in the acceleration of its driving wheels to develop a comparable pull.

EXPLOSIVE FISH

Sardines Furnish Glycerin for Explosives

THE government's "scrap-fat drive" to obtain new sources of glycerin and soap acids asks housewives and restaurants to save their grease drippings for defense. From these scrap fats the government expects to make glycerin for explosives, replacing the imports of cocoanut oil from the Philippines and other Pacific Islands, which were cut off by the war.

In searching for increased sources of glycerin-producing fats, the government is also increasing domestic production of various plant oils, including soybean, peanut, flax, and cotton. But there's another not-so-widely publicized source which has been providing the United States with oil-producing glycerin for two decades—sardines and herring, which inhabit the Pacific Ocean from Alaska to Mexico—and this source has a distinct advantage, in that the product needs only to be harvested; it requires no preliminary planting and cultivation.

Although the average production of 2,000,000 gallons of herring oil obtained yearly from Alaska will be curtailed somewhat this year, due to the government's prohibiting fishing in certain areas, there will still be sardines caught off the Pacific Coast from British Columbia to California—and production of pilchard oil on the West Coast alone has averaged 13,000,000 gallons yearly.

Tests of the pilchard oil, which have been made in Laucks Laboratories, Inc., in Seattle, since 1921, have shown more than satisfactory glycerin content, and the lowly sardine and herring are finding themselves blasting away behind the front lines. Not as powder for guns—because nitroglycerin (glycerin, plus acids) is too violent to be used in this way, but as dynamite and other explosive preparations which are the mainstays of the Engineer Corps and others. This is very important in clearing roads for troops and tanks and guns and trucks rushing to the front, in excavations for new munitions plants, mines, and new road construction. Also, huge amounts will be used to destroy bridges, and to clear away debris in bombing attacks.

Glycerin, in normal times, was more than 90 percent manufactured as a by-product of soapmaking. Now soap is definitely a by-product of glycerin.

Sardines and herring are a logical source of glycerin. They're easily caught, and studies of their migratory habits have proved that they reappear year after year in large schools in the same places. They don't swim too far off shore, spawn prolifically, and are so thick in schools that it's possible to catch 35 or 40 tons in one net.

In certain seasons there's a comparatively large quantity of oil in these fish—and the larger quantities of oil, the more glycerin. In fact, because of their excessive oiliness, sardines are not a favored article on the fresh fish market. In Laucks Laboratories, where sardine and herring oils are now being tested daily, it was found that the glycerin content of the oil of these fish was from 8 to 10 percent.

GUN MOUNTS

Require High Degree of Accurate Machining

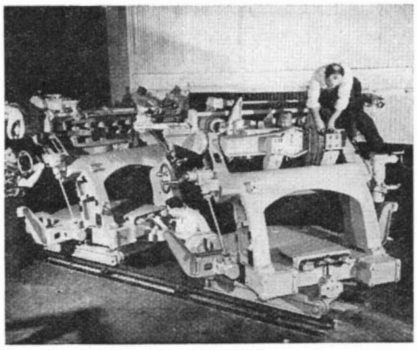
RECORD-BREAKING production of gun mounts carrying four rapid-fire anti-aircraft guns—the weapons which hurled hundreds of shells a minute at Japanese planes in the battles of Pearl Harbor, Midway, and the Solomon Islands—was disclosed recently by the Westinghouse Electric Elevator Company. These multiple gun units are being produced by Westinghouse at a saving to the Navy of more than 10 million dollars in cost and 4,400,000 man-hours of work.

"Before we tackled the job in the summer of 1940," explains Frank C. Reed, president of the elevator company, "each gun mount required 8500 man-hours of labor and cost about $27,000—but assembly-line production methods enabled us to turn out each unit with about 2100 man-hours of work at a cost of about $12,000. Difference between estimated cost and actual cost were returned to the government. By May, 1942, we were turning out nearly 40 percent more mounts each month than our contract called for."

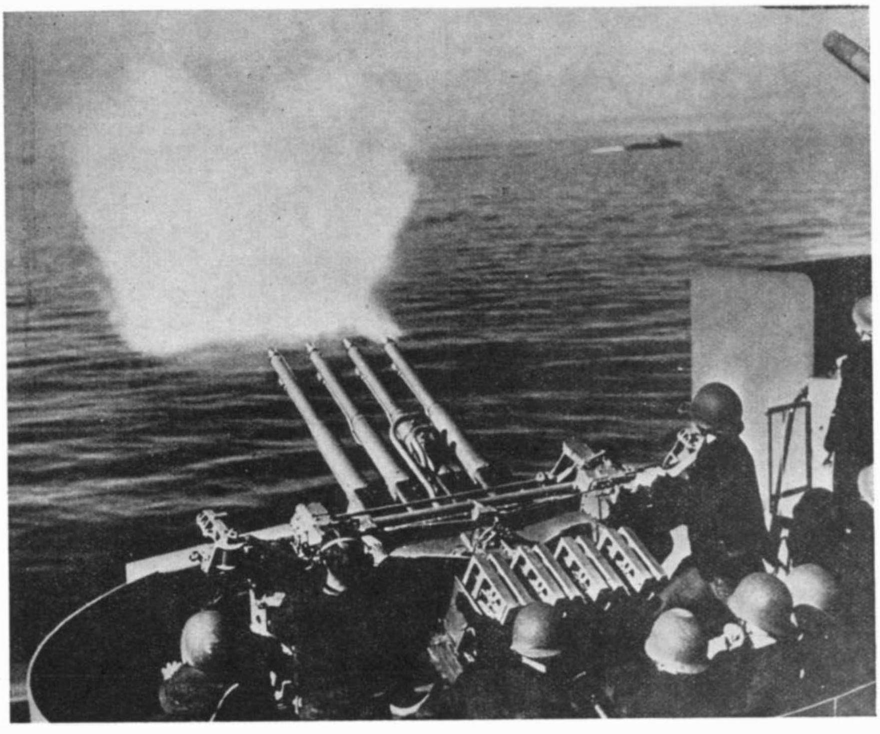
Weighing 14,000 pounds, each mount consists of an adjustable four-foot long horizontal gun support, installed in an H-shaped stand which is moored to a revolving steel base. Each gun support has four large grooves, nine by 13 inches, into which water-cooled gun barrels are inserted. The four guns, although not synchronized, are fired in nearly simultaneous bursts by a single trigger mechanism on the left side of the unit.

Guided by sights on both sides of the unit, Navy gunners train the guns on flying targets by quickly moving them up or down and left or right. When necessary the entire mount can be swung in a complete circle. The guns are aimed manually by a series of easy-turning cranks near the sights, and also by hydraulic power controls which are installed when the gun units reach a ship.

Maneuverability of the mounts depends upon precision manufacturing at extremely close tolerances. Principal surfaces must be levelled to a point that engineers call "dead flat," with an allowable discrepancy of two-tenths of a thousandth of an inch. Other parts must be accurate within four-tenths of a thousandth to a thousandth of an inch.



High accuracy is required in these gun mounts, shown below when complete and in action, which are now being produced in huge quantities



Just before the gun mounts are ready for shipment, sights that are used in actual combat are installed temporarily and tested for accurate alignment with gun barrels. Maximum allowable tolerance in this test is one minute, or one sixtieth of one degree—which would result in a deviation by the gun projectiles of not more than ten and one-half inches per thousand yards.

SOLOMON ISLANDERS

Led Easy Life—Until War Intervened

FEW peoples on earth are less known to ethnologists than the short-statured, hairy, Melanesian black men of the dense jungles and lofty mountains of the Solomon Islands, say ethnologists of the Smithsonian Institution. Throughout the archipelago, now the scene of some of the most crucial fighting of the war, ways of life differ widely from island to island, Smithsonian ethnologists point out. So great has been the isolation that in some cases villages a few miles from each other speak different languages. But all belong to the same basic Melanesian stock as the inhabitants of New Guinea, most of the neighboring groups of islands, and probably Australia.

The Solomons gained a bad reputation as "the cannibal islands." There is little evidence, however, that the Melaneasian peoples ever were cannibals, other than ceremonially. The central islands of the archipelago were, however, a center of the curious head-hunting custom which in most places has been suppressed under the Australian mandate. A head—and it need not be that of an enemy—was considered a token of valor and was a cherished possession. A young warrior needed a good string of skulls to have much prestige among the women of his village.

The Solomons were in the stone age stage of culture when first visited by the whites and, for the most part, have advanced little. They have been slow to accept white influences, and few peoples on earth have been less exposed to these. But the people can hardly be considered as a very low grade of aboriginals, such as the long-extinct natives of Tasmania, to whom they probably were distantly related. They had developed a rather advanced system of agriculture, effective boats and weapons, and an exceptionally complex economic system. To a high degree they had domesticated the pig.

By and large, life to the Solomon Islander is easy and, from his point of view, luxurious. Little work is required for his crops. Most of this is done by the women. The men, as among so many primitive peoples, are hunters and warriors. But neither sex works very hard at its traditional vocations, although the islanders are good workers for short periods on plantations.

• • •

BIRDS—Among the strange birds on Guadalcanal are the brush fowl, which buries its eggs in a mass of fermenting dead leaves which acts as a natural incubator; and the dwarf climbing parrot, a little bird no bigger than a sparrow, that climbs trees like a woodpecker and makes its home in the nest of termites which appear to be its principal food.

• • •

EARTH SHOCK

Is Responsible for Much Bomb Damage

Earth shock, one of the most dangerous and least understood effects of bomb explosions, endangers large and small buildings of nearly every type of construction and foundation in an area under attack, according to Professor William H. Hayes, of the Columbia School of Architecture.

With the exception of all-steel or concrete frame buildings, all structures are affected to some degree by the vibrational effect, or earth shock, produced by a bomb explosion below the surface of the earth, an effect which is similar to that of a local earthquake, except that earthquake movements may be said to be slower, says Professor Hayes.

"Few phenomena are more troublesome at times or more baffling than vibration," he declares. "It is a force that has long been recognized, though not generally too well understood. The severity of a vibrational action is measured by: its acceleration, or an increase or decrease in the speed with which it travels; its amplitude, or its size; and its frequency, or the number of vibrations occurring per second.

"These factors are large or small depending mainly on the magnitude of the explosive charge and the nature of the ground—clay, loam, or rock, for example—in which the explosion occurs. Buildings on unstable ground are generally more severely damaged than those on firmer ground, and moist ground usually responds to earth shock more violently than does dry ground.

"The earth reacts when disturbed by an explosion much as water behaves when a stone is dropped into a still pool, concentric waves traveling outward, away from the point of origin, with a decreasing velocity and with decreasing amplitude or height. The frequency of the waves, that is, the number of waves that pass a given point in a certain space of time, depends in part on the impact with which the stone struck the water.

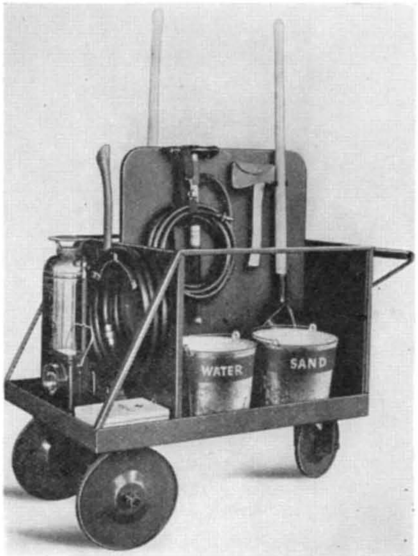
"Another aspect of earth shock which renders it dangerous is its characteristic of traveling rapidly in a vertical direction, and more slowly in a horizontal direction. Consequently, any subsurface structure, such as a foundation or a shelter, may be first lifted by the vertical component and then moved horizontally by the horizontal component. The effect on a non-flexible structure is obvious. Wall-bearing

buildings, or those whose walls support all other parts, and unreinforced masonry buildings, fare badly from the effects of earth shock," Professor Hayes concludes.

AIR-RAID UNIT

Small Truck Carries All Needed Supplies

INTENDED to transport fire-fighting equipment and first-aid materials to the scene of a fire, a new welded steel hand truck is of particular interest for air-



Carry-all for air raids

raid service. Allocated spaces on the truck provide for water and sand, stirrup pumps, hose, shovels, and so on. The center steel panel can be used as a shelter while fighting a fire. Mounting of the truck, which is 43 inches long, 29 inches wide, and 40 inches high, is on two fixed and one swivel wheels.

NIGHT ACCIDENTS

On the Increase As Result of Several Factors

WITH night traffic accidents showing a decided increase in proportion to those occurring during the daylight hours, street-lighting manufacturers have urged municipal and state lighting engineers to maintain their present illumination on the nation's thoroughfares, and to increase it in localities where war industries have created serious night traffic problems.

Reports from motor vehicle commissioners and state police officials reveal that the decline in daylight traffic deaths was not being accompanied by a similar decrease in night fatalities. In the State of New York, one month's night fatalities rose 19 percent, while daytime deaths decreased 28 percent. Night-time fatalities are now two and three tenths the number of those occurring during daylight on Chicago's streets.

"The nation has been rejoicing about an overall decrease in traffic accidents without taking much time to analyze the reasons for it," says A. F. Dickerson, chairman of the Street and Highway Lighting Safety Bureau. "What at first seems a gratifying result of our safety efforts resolves itself after closer inspection into a reduction in daytime accidents that is merely proportionate to the lowered volume of traffic. This is not usually true of night fatal accidents, however. In most localities their decline is not keeping pace with the daylight decrease.

"The necessary curtailment of street lighting in the dim-out areas is partly responsible for this. Crowded road conditions around our war production centers have also posed a new and increasingly difficult problem. In Michigan, for example, 50 percent of the drivers involved in traffic accidents are factory workers. Over one hundred service men are hurt or killed on California's roads each month. Three out of five persons killed by automobiles in Texas for the first half of this year were members of our armed forces.

"Every safety device must be employed to its capacity in order to conserve life and limb for victory," says Mr. Dickerson. "High among them is the humble street light. If permitted to continue its vital function of furnishing visibility after darkness has set in, street lighting will have contributed a full measure to the winning of the war. It is as unthinkable to reduce street lighting in this emergency, except where dim-out regulations require it, as it is to imagine that safe, speedy transportation is not a cornerstone of victory."

ARMY SHOES

Available in 238 Sizes,

Plus "Made to Order"

If you're a man with peculiar feet, the Army's the place for you these days, according to *The Army Officer*. The Army's feet that are hard to fit are getting special measurement shoes that in civilian life could cost as much as $25 a pair. A survey of Army posts in the United States reveals that no army in the world has taken so many precautions to assure its soldiers of a correct shoe fit. Any soldier who cannot be fitted properly with one of the 238 different sizes provided in the regular service shoe is given special attention by an experienced shoe man. Accurate measurements are taken at all parts of the foot, and a plaster cast is made, if necessary. To insure that the man may continue to get his special measurement shoes, his individual lasts are tagged with his name and identification number and filed for future use.

RAFT INFLATOR

Gas in a Bottle Does the Job

THANKS to a ten-inch steel cylinder containing three quarters of a pound of liquid carbon dioxide, Army and Navy pilots forced to bail out over water now have a seaworthy boat with

Inflating the seat-pack raft

them when they reach the surface of the ocean. The new device, developed by engineers of Walter Kidde & Company, is attached to a rubberized fabric boat, which folds up, together with eleven items of equipment, into a bundle 17 by 5 inches and weighing 12 pounds. It is worn by the flier as a seat-pack. In case of emergency the flier turns a valve on the cylinder, releasing the gas which expands 450 times and transforms the seat-pack into a five-foot, six-inch rubber boat.

DUMB?

All Animals Said to Have Means of Communication

THERE are no "dumb" animals. This is the belief of Ernest P. Walker, Assistant Director of the National Zoological Park, after years of observation of creatures of hundreds of species. All, he contend, have some means of communication between themselves.

For example, he says, "a tiny pocket

mouse that lived on my desk for several years appeared to be entirely silent. But when I held him against my ear I found he was carrying on a rapid chattering and scolding. A little female of the same species, a temperamental spinster, had but to look at him, change her expression ever so little, and he would almost be cowed. I am satisfied she talked to him most effectively."

Kangaroo rats, Mr. Walker, says, generally are believed to be "dumb," but when two are brought together and do not like each other they utter buzzing growls. Also one will give the same sort of call when it is in the immediate presence of a grasshopper mouse, its mortal enemy in the wild.

"I have heard my little kangaroo rat," he says, "utter chirps that could be heard a distance of eight or ten feet. If one of these animals is held close to one's ear a series of buzzing sounds can be heard—dots and dashes in varying frequency and tempo—that must mean something to the creature who makes them. In their deep underground dens a distinct tapping of feet or tails can be heard from outside. These sounds evidently serve as a means of communication between different nest chambers within the elaborate dwelling.

"My pet grasshopper mouse calls, apparently to attract attention. The loudest of his calls can be heard by the ordinary human ear at a distance of 40 to 50 feet. I have seen him go through the motions of giving the call when the sound was so faint or high-pitched that I would not hear it when I was not more than two to four feet away from him."

The classic "dumb" animal, Mr. Walker points out, is the giraffe but he contends that there are authentic records that these animals, under the stimulus of extreme excitement, utter bleating calls.

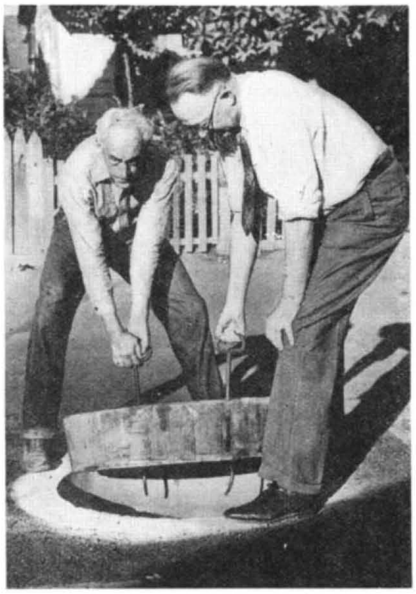
MANHOLE COVERS

Now Made of Wood to Save Metal

Engineers have solved one metal shortage by the development of wooden manhole covers, said to be equal in strength and durability to the customary metal lids. The Los Angeles county surveyor's office first manufactured the timber manhole covers when a local shortage of cast-iron covers threatened to delay an essential sewerage project at a new war housing project. Recently the WPB prohibited use of metal for manhole covers.

One type of the new cover uses no metal—avoiding even nails through the use of glued-in wood dowels to bond the wood laminations. In an alternative method the planking is bolted together.

The cover, weighing approximately 130 pounds, is constructed of two by eight inch planking. It has a diameter of two feet, nine inches. Built in either



Wood for metal

circular or hexagonal design, the covers are pressure-treated with a preservative salt solution to provide resistance against termites and rot.

A metal saving of 250 pounds in the lid and 250 pounds in the concrete frame is possible by construction of the wooden covers which may be cut in local wood-working shops without extensive fabricating equipment. Altogether there are 63.3 board feet of lumber in the cover and 0.140 cubic yards of concrete in the supporting frame.

RUBBER SEEDS

From Santo Domingo For Experimental Work

Thousands of seeds from selected Hevea rubber trees growing in the experimental nursery of the B. F. Goodrich Company on the island of Santo Domingo were recently presented to the Bureau of Plant Industry, United States Department of Agriculture, which has under its control a program for promoting the cultivation of rubber-bearing plants in the Western Hemisphere. Plans to collect the seeds have already been started by the bureau.

The experimental nursery in Santo Domingo has been in operation since 1931. Test tappings have shown the presence of trees yielding as much rubber as some of the high-yielding hybrid trees of Malaya and the Dutch

East Indies, now controlled by the Japanese.

The trees are also free of the South American leaf blight, a fungus disease which has inflicted such damage on rubber plantings there that plantation development in the past has met serious obstacles.

The trees are the offspring of seeds collected in the uplands of Brazil where disease-resistant varieties are found. They are better adapted for growth in cooler climates than those found in equatorial regions, since the seeds were gathered from trees of Hevea brasiliensis (the world's best rubber producer), 6 to 10 feet in circumference and 70 to 80 feet high, at an elevation of 1100 feet and latitude of 14 degrees, South. This is the outer fringe of the native habitat of this species of rubber tree in the Amazon valley.

As a result of surveys carried out over a period of years by the company, Santo Domingo was chosen as one of the most favorable sites in this hemisphere for the cultivation of rubber, and the nursery was established there.

In addition to the seeds, the company is supplying the Government with budwood from the high-yielding trees. Both seeds and budwood will be used by the United States Department of Agriculture in its co-operative program with the Dominican Government and other Latin-American countries for the development of high-yielding, disease-resistant trees suitable for planting in the Western Hemisphere.

FAN

Has Plastic Blades for Corrosion Resistance

PLASTIC-IMPREGNATED reinforced fabric is used to replace aluminum in the blades of a new type of fan for cooling-tower use. The hub of the fan, of welded steel construction, is so designed that the blades can be clamped into it at the desired pitch position.

TANK DESTROYERS

Race on "Shoes" of Steel and Rubber

HIGHLY mobile, cannon-carrying "tank destroyers," capable of outsprinting their ponderous quarry over battle terrain, are described as a timely example of war-time "wedding" of steel and rubber.

The use of an endless-band type of track in which steel cables and crosspieces are imbedded in rubber to form a "one-piece" belt, says J. D. Beebe, executive of the B. F. Goodrich Company, has "made possible a wide variety of army vehicles—tanks, tank destroyers, and 'half-trac' personnel and equipment carriers—which possess new low-rolling resistance, freedom from noise and vibration, higher speeds, higher traction, and greater all-around efficiency."

These "racing shoes" for the tank chasers, Beebe explains, are an outgrowth of work originally undertaken by his company in developing this type of band track for farm and special industrial uses. They are so light and flexible, relatively, he said, that carriers can travel almost as fast on them as on wheels—over terrain that wheels alone couldn't negotiate — and they actually use some 200 pounds less rubber per vehicle than tires would require.

LIGNIN IN PHONES

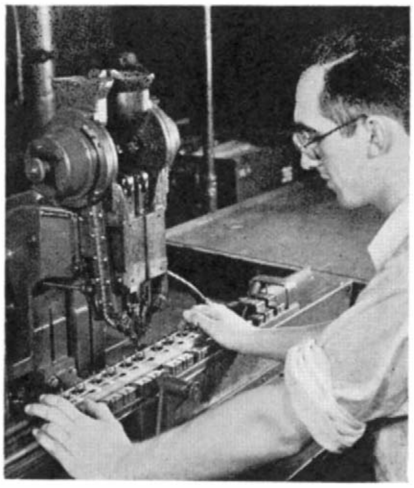
New Insulating Material Made from Paper Waste

LIGNIN now stands for a new kind of plastic which Western Electric engineers have adapted to telephone manufacture as a part of the Bell System's program of alternative materials that has already released hundreds of tons of war-vital materials for munitions manufacture.

You're going to hear a lot about this use for lignin, since with its development the engineers have turned a waste material into a valuable electrical insulation for communication equipment.

For years the sulfite water waste pollution of the nation's waterways had been a major problem with pulp manufacturers, a major source of woe to fishermen. Two-and-a-half years ago chemists discovered that a very tasty vanilla extract could be manufactured from the waste. The introduction of lignin as a plastic for piece parts in telephone apparatus, however, took more than a year of co-operative development work by W. E. engineers and

Making slabs from sheets of lignin



Fitting lignin insulation parts

the chemists from the paper supplier.

The engineers knew that if they succeeded in developing a new plastic fiber that would take the place of phenol fiber, widely used as an insulating material, they would divert to military use such war-essential components of phenol fiber as cresylic acid, formaldehyde, resin, and paper. Today, lignin takes the place of phenol fiber in about two thirds of its former applications.

When lignin paper sheets come to Western Electric Works, they are conditioned to a definite moisture content, heated and subjected to high pressures, yielding a tough fiber board with—pound for pound—the strength of steel. Lignin fiber possesses good electrical characteristics, is less corrosive than phenol fiber, is readily punchable, and has many of the other properties of phenol fiber board.

Already placed on the lengthening roster of new W. E. insulating materials, lignin—as a result of continuing researches—will take its place in more and more manufacturing processes, a triumph of science which refuses to admit that there is such a thing as "waste."

TAPERED NYLON

Now Available to Replace Natural Bristles

To SYNTHESIZE a paint brush material with the taper, resiliency, and toughness of natural bristle has been a goal of chemists for a quarter of a century. It became a national necessity to achieve that goal quickly after Pearl Harbor, for virtually all bristle had been imported from China and Russia, and these sources of supply suddenly were shut off.

Nylon paint brush bristles, announced recently for the first time, not only have the required taper but also resiliency, toughness, length, and inertness to paint ingredients. Moreover, they wear at least three times longer than natural bristles. The achievement of this tapered synthetic culminates five years of intensive research in DuPont laboratories.

Today, the Government is preempting for military uses the entire output of a busy pilot-scale plant. Early next year two full-scale units are expected to be in production, but their entire output will be required by the military. Nylon paint brushes for civilian use must wait.

In 25 years of experimentation virtually every type of resin material had been tried. Then came nylon, the first satisfactory synthetic bristle material. It was introduced in uniform diameters in 1938. Wearing several times as long as natural bristle, it soon was used in most of the quality toilet brushes as well as brushes for 22 different kinds of industries.

A year prior to this public introduction of a level bristle, Du Pont had started its chemists and engineers to work on tapered nylon. It was a comparatively easy job to spin a level filament of tough, resilient nylon. To spin a tapered filament was something else.

All kinds of ingenious spinning devices were designed, tried, found wanting, discarded. There was no "magic" at work here; rather it was the "sweat" of chemical engineering. Finally a taper was achieved by pulling a continuous nylon filament from a special spinneret at a controlled variable speed. That is, the size of the filament varies with the speed of pulling—thick diameters resulting at slow speeds, and thin diameters at fast.

This solved only one of many problems. Nylon filaments, after being spun, have to be drawn to several times their original length; that gives them their strength and resiliency. To draw these tapered filaments to several times their original length without snapping them at the thinnest sections was not easy. More months of labor and more research funds were given to this work before a satisfactory technique was developed.

Means of conditioning the filaments so they would not curl, and of automatically cutting them to ordered size, had to be figured out before a plant could start operating. "Bugs" and "kinks" showed up, but were overcome. At last the day came when tapered nylon streamed from the spinneret in quantity, ready for allocation to war jobs. In reality, the chemist and engineer, as they have so often done in the past, had produced a material superior to Nature's own in many of its properties.

Industrial Growth

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

RAPID PLATING

Possible With New High-Amperage Brush Unit

WHEREVER an electrical outlet is available, it is possible to set up a new portable brush-type electroplating unit and to accomplish overall or touch-up plating with a wide variety of metals. The power unit itself weighs only 30 pounds, has duplicate outlets so that two operators can use it at once, and delivers controllable power of from 1 to 25 amperes, D.C., at from 2 to 10 volts. Although designed for A.C. operation, the unit may be used on D.C. with a converter.

Brush plus paste plus current

The portable nature of this unit makes it feasible to apply metal plating to parts of equipment without dismantling; the unit is connected to the part to be plated and the operation is completed right on the job. Electrical companies are using this plating method for protecting copper bus-bars and switch parts against corrosion by the use of a silver coating, thereby at the same time obtaining higher electrical conductivity; it is being used to apply zinc over welded seams where the protective coating has been burned off; anti-corrosion deposits are being made with it on vats, tanks, and so on; it will deposit hard nickel-cobalt facings on steel press dies; in other fields it is finding similar and even more wide-spread uses.

The power unit is connected, when in use, to the part to be plated by one cable; another cable terminates in a metal anode, the composition of which is determined by the metal to be deposited. This anode, in the plating unit made by Consolidated Equipment, is enclosed in a nylon filament brush of a size corresponding to the anode and to the work to be done. The work pieces, after cleaning and preparing, are coated with a plating solution in thin paste form, the paste being applied by the brush and kept in a state of constant agitation. The result, it is claimed, is a uniform deposit of close-grain plated metal which is completely and securely bonded to the base. Speed of application is high; for example, a .00025 of an inch plate of pure silver can be applied over an area of one square foot in approximately 30 minutes. Tin, cadmium, zinc, copper, and so on, can be deposited at comparable speeds.

TIMBER TRUSSES

Used in Construction of Pre-Fabricated Plant

A STRIKING example of the use of pre-fabricated structural timber is afforded at a large aircraft plant nearing completion in eastern Canada. The production floor of this factory has eight bays 99 feet wide with columns 30 feet apart in the other direction. A sawtooth roof, framed into the main trusses, provides natural light throughout the plant.

Main trusses, of 99-foot span, have top and bottom chords of two 6 by 14-inch timbers, with verticals of single 6 by 10 to 6 by 14-inch pieces between the pairs of chord members. The diagonals are pairs of square rods welded into slotted gusset plates that have flanged shear plates welded to them for connection to the timber truss members. Split-ring connectors and bolts are used for all wood-to-wood connections.

Columns are formed with two pieces of 6 by 16's and one 7 by 16, the latter being in the middle. The members are made into a laminated unit by inserting ring connectors and drawing the pieces tightly together with bolts. Throughout most of the factory the columns have an unsupported height of 22 feet to the underside of the trusses, but this is increased to a clearance of 35 feet under the trusses at one end. The columns extend to the top chords of the trusses, which are spliced on a single gusset plate at that point.

Over 1,000,000 board feet of Douglas Fir timber were required for the structural frame, and more than 100,000 ring connectors were used. The complete frame was accurately prefabricated at a West Coast plant and shipped to the site, knocked down and marked, ready for assembly and erection.—*Engineering News-Record.*

GREASE SOLVENT

Used With Water As Vehicle

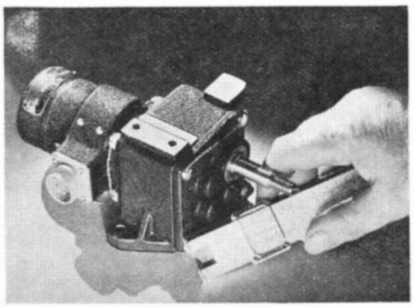
Accumulated grease on concrete floors is readily and completely removed by the use of a new solvent known as Turco Aktiv. This solvent is marketed in granular form and is to be dissolved in water before use. A suitable solution is mopped on the greasy floor and allowed to stand for three to 15 minutes. The solution, together with the dissolved grease, is then mopped or brushed up; while working, it does not fume and is non-toxic.

POWER PACKAGE

Provides Many Items for Specialized Purposes

A new driving mechanism—the power package—has been especially devised for use in aircraft subassemblies. The design of a particular power package depends upon the application for which it is built and designs are now available for such applications as bomb-door operation, landing-gear and wing-flap operation, and operation of control and protective devices.

The new General Electric power package combines in one compact unit as many items as a motor, brake, clutch, and limit switch as well as indicators, gears, and whatever else is required to do a specific job. They are designed for 24-hour service, and can be obtained in ratings from about 1/100 to 3 horsepower.



For specific power jobs

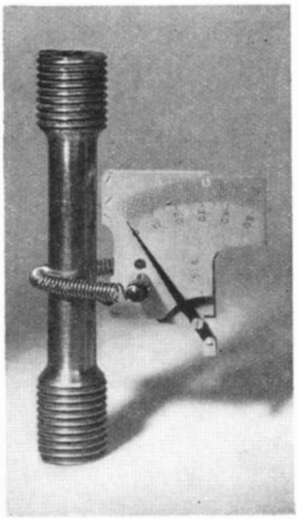
Each element in the power package is reduced to its simplest terms to save weight and space. For instance, where either a brake or a clutch could be used, the brake is chosen because it has one moving part while the clutch has two.

A new planetary gear system permits the use of a magnetic brake in the power package for some applications. The brake is of the quick-acting friction type and stops the motor quickly to prevent overtravel and consequent jamming.

STRAIN GAGE

Now Available For Structural Testing

The Porter-Lipp strain gage, an American built instrument, is now offered to meet the demands of the recent rapid development of volume and technique of structural testing in this country. A mechanical type of gage, the Porter-Lipp is accurate, light, compact, rugged, and convenient, yet inexpensive. The strain multiplication factor of this gage is approximately 300 and it has a range of 0.008 of an inch or better.



Accurate to 0.00002 of an inch

Weighing only 0.4 of an ounce, the gage has overall dimensions of 1¾ by 2 by ⅝ of an inch. It is graduated so that each division corresponds to a strain of approximately 0.0001 of an inch and has a readable accuracy of 0.00002 of an inch for a gage length of one inch.

The gage is said to meet the requirements that have grown out of the specialized needs of the present emergency and to have proved itself superior to similar devices imported from Europe before the war.

Freight Planes

Future Cargo-Carriers of the Air May Supplement, But are Unlikely to Supplant Surface Transportation

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

No one is more confident of the future of air transportation than the writer of this column, but he is also aware of the danger of undue expectations against which W. A. Patterson, youthful, energetic and capable president of United Air Lines, voiced a timely warning. In his address before the National Industrial Conference in New York City, Mr. Patterson said: "The airplane is destined to occupy a much more important place in the international scheme of transport and communication of our new world. However, I feel this picture is being harmfully distorted by over-enthusiastic predictions of the extent of post-war use of the airplane for freight transportation."

The speaker predicted that all first-class mail of the future would probably be carried by air, that the airlines and the railroads would compete for certain types of passenger traffic and for certain types of express package traffic. But quite definitely the airplane would *not* make serious inroads on the freight revenues of railroads and steamships. The reasons given were similar to the reasons offered by those who oppose too great a concentration of our war effort on cargo airplanes, and comparable to considerations which led the Navy Department to cancel an order for great numbers of the Vought-Sikorsky cargo-carrying flying boats.

For freight carrying, the airplane's service is too limited and too expensive and the following remarks are cogent and conclusive: "Based on peace-time conditions and using as examples the present types of operating equipment, a normal freight train could deliver 1560 tons between Chicago and San Francisco at a total cost of $50,000. A fleet of 57 airplanes of the DC-3 type, now in use on commercial airlines, would be required to carry the same amount of cargo between the two cities in one month, at a total operating cost of $1,750,000."

If ocean-going cargoes are considered, the situation again is definitely not in favor of the airplane as far as heavy, large quantities of freight are concerned. A 13,000-ton freight steamer of the type now being constructed for the Maritime Commission could carry 6400 tons between San Francisco and Australia in the round trip time of two months at a total operating cost of $120,000. A total of 144 airplanes of the four-motored type would be required to transport the same

United's Patterson

amount of freight in the same period of time at an operating cost of about 250 times as much. Even if advanced engineering research was utilized in reducing transportation costs by air from, say 40 cents a ton mile, to 10 cents a ton mile, the cost would still be many times greater than the cost of surface transportation which measures its ton-mile costs in mils, not in cents.

Four conditions have to be met before freight, properly speaking, as distinct from express, can be carried by air. They are: An emergency has to be met; an opportunity exists for saving in warehousing and inventory costs; commodities are so valuable that financial and insurance costs are important; surface transport is inadequate or non-existent. Mr. Patterson is perfectly right in his contentions. Air cargo will supplement but not supplant surface transportation, and fears that railroads and steamships will disappear under the competition of the airplane are groundless.

ZERO TRUTH

Is Not so Alarming as Early Reports Indicated

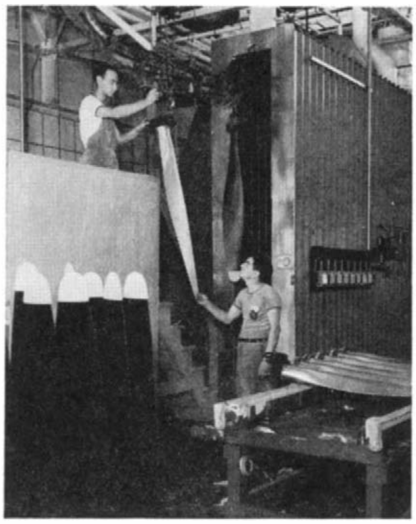
We have heard so much about the deadly Japanese Zero fighter, and what it was doing to our boys in the Pacific, that we have taken special pains to ascertain the truth from a reliable source. The Zero is a single-seater fighter, equipped with a 1000-horsepower air-cooled engine. It is of modern aerodynamic design, and in the hands of one of our test pilots it has fully lived up to its reputation of high maneuverability, fairly high speed, wonderful climb and ceiling. It does not come anywhere up to the speed of our fighters, though it has comparable climb.

The Zero is much lighter for the same horsepower than American machines, and, of course, very much lighter than American single-seater fighters which have greater engine power. It is excellent as an interceptor of the bomber plane. But these fine qualities have been attained by the ruthless sacrifice of others, namely, fire power, armor protection for the pilot, self-sealing tanks, and ruggedness. If the Japanese plane can instantly get on the tail of one of our machines because of its greater maneuverability, then our man is liable to be in real hazard. But if the fight goes on beyond the first burst of fire, then the American machine with its greater fire-power, its self-sealing tanks, its robust construction, and ability to withstand fire can almost invariably knock the enemy out of the sky. The situation is not so alarming after all!—*A.K.*

WARTIME PROPELLERS

Are Blacked Out by Conveyor Painting Process

For the duration of the war, the bright, flashing, beautiful surface of an airplane propeller has gone, because experiments have shown that a dull, black-painted blade reduces visibility to the enemy and also produces less reflected glare for the pilot. For safety when on the ground these days, the tips of the blades are painted yellow. For this additional task of blacking out the propeller, Hamilton-Standard devised a rapid conveyor-type spraying process. The endless-chain conveyor takes the blades through several chambers in which the several operations in the paint job are carried out, and blackened blades can be turned out at the rate of one every minute, the entire operation requiring only 41 minutes. In the first chamber the blades are cleaned in hot, vaporized "tricethylene", which removes all dirt and grease. Next, the blades are put into a chamber where blowers dry and cool them. A priming coat of zinc chromide is sprayed on in the third compartment, and drying at 160 degrees, Fahrenheit, and cooling by blowers carry on the process. Then the tip is sprayed with yellow paint, and the blade passes on for the final coat of black paint.



One a minute

So perfectly balanced must an airplane propeller be, that it is carefully re-balanced after the above operations, even though the applied paint weighs but a small fraction of the weight of the whole propeller.—*A.K.*

PARACHUTES

Pioneer Parachutist Writes a Manual

There are some interesting items to be found in the "Parachute Manual," written by J. Floyd Smith. A historical note: on July 24, 1808, a Pole, Jodaki Kuparento, safely escaped from a burning balloon with a parachute—the first recorded instance of a parachute being used for life saving purposes. The early chutes were of many and varied designs and had very little stability. Fatalities were frequent. But in 1880, an American, Captain Thomas Baldwin, invented the vent in the peak of the canopy. The escaping air causes a vortex which provides a stabilizing effect on the parachute during the descent and enables the jumper to select his landing location with more safety and wider latitude. Since those early days the technique of the parachute has developed enormously. Parachutes now open very quickly, avoid shock, though they may be heavily loaded, are ready for instant use, and give splendid service to our air troops.—*A. K.*

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 the names of available books, 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.

YOUR INCOME TAX

By J. K. Lasser

Brief, straightforward explanation in clear, non-technical language of what must be done about your federal income tax, when and how to do it. Simply, yet completely, arranged with excellent cross-references. For those preparing their own or first return; for those interested primarily in legal deductions; for men in the Armed Services; for salaried men, business men, partnerships, husbands and wives, farmers, estates, trusts, and minors. Contains list of possible deductions available to those in 312 different jobs and professions. By mailing postcard contained in the book, you may obtain free supplementary service to keep abreast of federal tax law changes prior to March 15, 1943; also, a free supplement covering income tax laws for your state. Author is a Certified Public Accountant. (151 pages, 8½ by 11 inches, indexed.)—$1.10 postpaid.—*A.D.R., IV.*

POPULAR MATHEMATICS

By Denning Miller

Anodyne for those who have mathematical indigestion. More than any of the numerous mathematical crutch books recently published, this one gets down to the average lone sufferer's level and it really purrs. That is, the text is more largely chat than formula, and its atmosphere is friendly and helpful and distinctly sympathetic. It is to a typical textbook as a kindly outside tutor is to a sour, dour, case-hardened, classroom instructor. Ground treated is arithmetic, geometry, algebra, analytical geometry, trigonometry, conic sections, solid geometry, spherical trigonometry, calculus. The coverage is not complete; it would not stand alone. It is, rather, a collateral book—and good friend. (616 pages, 5½ by 8¼ inches, illustrated.)—$3.85 postpaid. —*A.G.I.*

SCIENCE REMAKES OUR WORLD

By James Stokley

Applied science has many aspects and so has James Stokley, whose competence to present and elucidate them to a science-minded public is based on many decades of background in interpretive science writing. Here he deals with explosives, tomorrow's fuels, plastics, chemical clothes, rubber, agricultural and medical chemistry, vitamins, new metals, metals from sea water, glass, aviation of the future, electronics, radio, light sources, the atom, new power sources—all in a way to instruct and entertain. (299 pages, 5¾ by 8¾ inches, 35 illustrations.)—$3.60 postpaid.—*A.G.I.*

A-C CALCULATION CHARTS

By R. Lorenzen

Highly specialized time-saver, in the form of 146 charts, for engineers and others who work on electrical communication and power problems. With the straight-edge, provided in a cover pocket, it is possible to solve all alternating current calculations in series circuits, parallel circuits, series-parallel and mesh circuits, at frequencies from 10 cycles to 1000 megacycles. (10 by 12½ inches, printed in two colors.)—$7.60 postpaid.—*A.P.P.*

NEAR HORIZONS

By Edwin Way Teale

Relatively few scientists are heavily gifted with literary charm, while some of the most charming writers who have ventured into scientific realms were not very scientific. This author's writings do have charm and they also are scientific. This delightful work is an account of intimate observations of insect lives and affairs in an "insect garden"—just a typical patch of farmland. Its intimacy with the insect world is easily doubled by the author's remarkable close-up insect photography—not of dead bugs on pins but of real live ones in the field. This piece of writing should endure like those of Fabre, which it resembles. Not for study but for enjoyment. (319 pages, 7 by 9¾ inches, 100 illustrations.)—$3.85 postpaid.—*A.G.I.*

AMERICA AT WAR

By S. Van Valkenberg, Ellsworth Huntington, W. W. Atwood, Jr., W. Elmer Ekblaw, Clarence F. Jones, Earl B. Shaw.

Studies of and information on such vital wartime matters as The Quality of the People; Our Land and its Coastline; Terrain and War Strategy; The Climatic Factor; Foods for Defense; Industrial Capacity and Supplies of Raw Materials; United States Atlantic Defense; United States Pacific Defense; America and Peace. The six authors, each covering a global and geographic phase which is his particular forte, offer this solid and profound treatise on the factors to be considered if a lasting peace is to be achieved after the war. (296 pages, 5¾ by 9 inches; maps, charts, tables, index.)—$2.60 postpaid.—*A.D.R., IV.*

PLASTICS, PROBLEMS AND PROCESSES

By Dale E. Mansperger, M. A., and Carson W. Pepper, M. A.

THE whole story of plastics, including a resume of manufacturing processes and a number of chapters devoted to plastics uses, is presented in this thoroughgoing book written by men actively engaged in the work of which they write. Main emphasis is on practical design and work. Appendices give lists of plastics manufacturers, and of supplies and equipment. (350 pages, 6½ by 9½ inches, profusely illustrated with photographs and drawings, a comprehensive bibliography, complete index.)—$3.10 postpaid.—*A.P.P.*

SCIENCE IN PROGRESS

Edited by George A. Baitsell

EIGHT chapters, respectively by Shapley (Galaxies); Hubble (expanding universe); Bethe (energy production in stars); Zworykin (electron image formation); Bridgman (high pressures); Marks (power generation developments); Franck (photosynthesis); Kirkwood (structure of liquids); Long (sulfanilamide); Marks (synthetic rubber). Not a highly technical book, but not light, popular stuff. Sigma Xi lectures. (322 pages, 6 by 9¼ inches, 112 illustrations.)—$3.10 postpaid.—*A.G.I.*

FIREARMS AND THEIR USE

By W. T. Castles and V. F. Kimball

A CONCISE review of various models of shotguns, rifles, and pistols with descriptions, instructional chapters on the use, and the intended purposes of the arms mentioned. Helpful for those learning the art of shooting as well as to instructors. (232 pages, 5¼ by 8½ inches, index, many illustrations.)—$2.10 postpaid.—*A.D.R., IV.*

AIRCRAFT SHEET METAL CONSTRUCTION AND REPAIRS

By M. P. Harrold

METHODS and processes described in this book are those which pertain particularly to aircraft construction and repair, yet much of the information given can be applied directly in production work. Emphasis throughout the book is on detailed instruction for actual jobs. (158 pages, 5½ by 8 inches, 123 drawings.)—$1.60 postpaid.—*A.P.P.*

HOW TO GET AHEAD IN A DEFENSE PLANT

By Kenneth C. Hawthorne

HOW to read blueprints; what to know about iron and steel; how to do simple mathematics; what should be

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known about simple alloys; taking measurements; wood and wood finishing; care of tools; knowledge of plastics; use of special instruments; lubrication. All these, and more, are delineated for the benefit of war plant workers by an author who has had a broad technological education and experience. (270 pages, 4¾ by 7¼ inches. Over 150 illustrations; index.)—$2.60 postpaid—*A.D.R., IV.*

THE AMATEUR SCIENTIST
By Stephen Thomas

STUDY of the place in society of the amateur scientist, using Philadelphia (where amateur science groups reach greatest numbers and variety) as an example. It shows what can be accomplished in any live community in the organization and conduct of amateur science groups based on zoology, aeronautics, geology, astronomy, botany, photography, entomology, and a large number of others. This is not a book on any hobby *per se,* but is aimed at organizers, museums, and the like. (291 pages, 5½ by 8 inches, 17 illustrations.)—$3.10 postpaid.—*A.G.I.*

GETTING ACQUAINTED WITH CHEMISTRY
By Alfred Morgan

CONTRIBUTIONS of chemistry to our daily lives are here explained in terms of articles and products which we constantly use. From this simple, yet thorough-going story, the reader can readily acquire more than a speaking acquaintance with many of the phases of this fascinating science. Also given is advice on building the home laboratory, and a number of practical experiments. (272 pages, 6 by 8½ inches, a large number of drawings and a few photographs.) —$2.60 postpaid.—*A.P.P.*

THE EIGHT MILLION
By Meyer Berger

SUBTITLED "The Journal of a New York Correspondent," this book is by one of the country's best reporters. Berger's raw materials are people—the queer, quaint, curious, pathetic, and heroic. He combines the scientific objectivity of a seasoned reporter with deep understanding, sympathy, and a distinct bent for the nostalgic. The result is a series of more than two score vignettes of life in the New York that the out-of-town night club and theater visitor seldom sees. It's an up-to-date "Bagdad on the Subway." (334 pages, 6 by 8¼ inches, illustrated.) —$2.60 postpaid.—*A.D.R., IV.*

A SHORT HISTORY OF SCIENCE
By Charles Singer

SCIENCE, from its earliest beginning to now. The author is a distinguished British authority on such history. The text is compact and possibly too much so —a bit jerky, like a notebook,—possibly from an attempt to cover too many details in a given length. Authoritative as a reference book. (399 pages, 5½ by 8½ inches, 94 illustrations.)—$3.85, postpaid.—*A. G. I.*

CURRENT BULLETIN BRIEFS

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

Rubber Guide Book is a 32-page bulletin which covers the principle methods of manufacturing rubber products and places special emphasis on hydraulic equipment parts made from Ameripol synthetic rubber. Rubber gloves, sponge products, extruded goods, hard rubber parts, rubber cement, and so on, are some of the specific subjects covered. *Miller Rubber Industrial Products Division of the B. F. Goodrich Company, Akron, Ohio—Gratis.*

Directions for Inspecting, Recharging, and Maintaining Portable Fire Extinguishers is a six-page folder stressing the importance of keeping fire-extinquishing equipment in good operating condition at all times. *Pyrene Manufacturing Company, 560 Belmont Avenue, Newark, New Jersey.—Gratis.*

Magnetic Separation of Ores, by R. S. Dean and C. W. Davis, is a 417-page book, containing 165 figures, which discusses briefly operations and trends in magnetic separation, explains the process, describes and classifies machines used, and outlines their development. Request Bulletin 425. *Superintendent of Documents, Government Printing Office, Washington, D. C.—$1.00 cash or money-order.*

Fend is a 16-page brochure which discusses the whole subject of industrial skin troubles, and describes different types of creams and lotions which have been developed for barrier protection against industrial dermatitis. Request Bulletin FA-79. *Mine Safety Appliances Company, Braddock, Thomas, and Meade Streets, Pittsburgh, Pennsylvania.—Gratis.*

Housing Terms are given in a newly compiled glossary, the definitions being those that are generally accepted and currently used. Request "Building Materials and Structures Report BMS91." *Superintendent of Documents, Government Printing Office, Washington, D. C.—15 cents, coin.*

Tell It To Sweeney is a 16-page illustrated pamphlet showing the advantages to be had from a properly designed interplant sound system for industrial communication. Request this bulletin on your business letterhead. *Stromberg-Carlson Telephone Manufacturing Company, 100 Carlson Road, Rochester, New York.—Gratis.*

Vinylite Plastics for Wire and Cable Insulation is a 12-page illustrated booklet which reviews the advantages of these resin compounds for insulation purposes, from standpoints of installation, service, and safety. Tables which are included indicate physical and electrical properties of the compounds, and typical applications. Request this booklet on your business letterhead. *Halowax Products Division, Union Carbide and Carbon Corporation, 30 East 42nd Street, New York, New York.—Gratis.*

Rapid Review of Elementary Algebra, by Jonas T. May, is a quick, efficient review for class or individual use. All main points are covered. Answers are given to all problems. *Emerson Books, Inc., 251 West 19th Street, New York, New York.—18 cents.*

Lithco Principles and Data is a 8-page booklet illustrated with charts and drawings which describe recent advances in heat-treating and carburizing atmosphere processes. Advantages of these processes are stressed, and sufficient general information is given to show how they are applied. It is claimed that these processes are especially suited to high-speed production work. *Lithium Corp., 42 Raymond-Commerce Building, Newark, New Jersey.—Gratis.*

Midget Metal Base Relays is a single sheet giving technical data on a type of relay widely used in small radio transmitters, aircraft circuits, and other places where space is limited. Request Bulletin 104. *Ward Leonard Electric Company, Mount Vernon, New York.—Gratis.*

The Specific Heats of Certain Gases Over Wide Ranges of Pressures and Temperatures is a 22-page bulletin covering the subject of the title as applied to air, carbon dioxide, carbon monoxide, ethylene, hydrogen, methane, nitrogen, and oxygen. Given are the general equations needed as well as graphs. Request Bulletin 30. *Engineering Experiment Station, Cornell University, Ithaca, New York.—Single copies gratis.*

Laminated Solenoids is a single-sheet circular giving engineering data on two new units designed for maximum magnetic force for a given electrical input. The units are of the pull and the push-pull types. *Dean W. Davis & Company, Inc., 549 West Fulton Street, Chicago, Illinois. —Gratis.*

Quality Production Tools is a 56-page listing of saws, drills, shapers, grinders, and so on, stressing their efficient applications to present-day production requirements. Request Industrial Catalog No. 10. *The Delta Manufacturing Company, 600 East Vienna Avenue, Milwaukee, Wisconsin.—Gratis.*

Princo Catalog 42 is a 42-page illustrated display of a wide range of electric counters and actuating switches, mechanical counters, and timing and recording devices. Many specific applications are shown. *Production Instrument Company, 710 West Jackson Boulevard, Chicago, Illinois.—Gratis.*

Books and Films on Lathe Operation is a four-page folder describing helpful material which has been prepared for training lathe operators. Request Circular No. 21-C. *South Bend Lathe Works, South Bend, Indiana.—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"

COLORADO'S altitude and clear air provide encouragement to amateur astronomers, and one of these is John Bunyan, president of the Berthoud National Bank, Berthoud, Colorado, whose observatory, first pictured in these pages in January 1934, then consisted only of the nearer structure in Figure 1. This contained a meridian telescope (note covered roof slot). The square structure behind it houses, beneath a gantry roof which runs off to the right, a 10" Cassegrainian.

Just beyond this run-off roof a third has now been added, to house a camera and mounting. The roof of this addition rolls off to the north, and the south gable, visible in Figure 1, near the telescope, is hinged and lets down on a post.

Thus, John Bunyan, a pilgrim originally from New York State, has progressed from one to two, and from two to three, observatory entities. The recently added camera assembly (Figure 2) was built, Bunyan states, largely with the help of Carl Conder, a good local mechanic.

Bunyan writes: "The supporting frame and the rectangular polar axis are built of 5" channel steel. The ends of the polar axis are of 2" steel shafting, the lower, which carries most of the weight, resting on a thrust ball bearing. The upper bearing is plain. The declination axis is made of 2" steel shafting with one end threaded and screwed into a steel plate which is bolted to a piece of ¾" plywood, 16" square. The camera and guiding telescope are fastened to the plywood.

"The counterweight at the other end of the declination axis is a steel pulley partly filled with concrete. The right ascension and declination circles are turned out of ¾" plywood and are bound with brass strips (kind used to cover joints in linoleum). Tightly fitted over the brass strips are circles formed of 45" lengths of steel tape. Thus each ⅛" on the declination circle is 1°, and each ⅛" on the R.A. circle represents 4 minutes of time.

"The camera lens is a 4⅛" group portrait lens of about 25" focus. The camera box is built of wood and is equipped with plate holders for 5" x 7" film. The eyepiece used in the guiding telescope is homemade. It has a biconvex lens and the crosshairs are made from tungsten filaments taken from an old style 25-watt lamp. These are illuminated by a flashlight bulb. A full sized dry cell, contained in a can mounted beside the telescope, furnishes the current. A volume control from an old radio is used as a rheostat to dim the light.

"A 12" cast-iron worm gear (Figure 3) with 96 teeth moves the polar axis by means of a friction clutch. This gear is driven by a single-thread hardened steel worm fastened to a steel shaft which carries a 30-tooth worm gear. The latter is driven at sidereal rate by a double-thread steel worm which turns at 1 rpm. A Hansen synchronous motor, with shaft geared to 1 rpm mean solar time, furnishes the timing and acts as a brake against the pull of a weight and sashcord over a plywood pulley on the polar axis. Interposed between the 1 rpm motor output and the 1 rpm sidereal rate of the last-mentioned worm are spur gears giving a ratio of 364 to 363, which is the closest I could approximate the sidereal rate with stock gears. However, the error is so slight that it is inconsequential for the periods the camera is at work.

"There is a clamp on the declination axis with worm for slow motion. A worm connected with flexible cable moves the whole assembly in R.A., for manual guiding whenever a selected guide star strays from the crosshair.

"The whole outfit is carried on a heavy concrete pier and no part of the building touches it. Moving around in the building does not set up any vibration at all in the instruments."

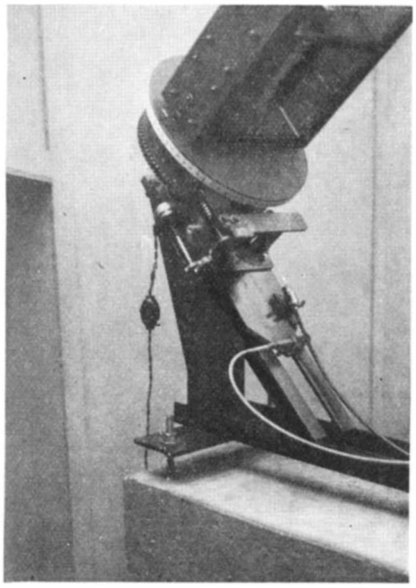

Figure 3: **Bunyan's drive**

SUNDIALLING is a kind of cousin to amateur astronomy, and of course the average amateur's general reading in astronomy enables him to pick up its principles relatively easily. Figure 4 shows a stone sundial made by Bunyan, who also is the author of the chaper on making a sidereal clock, in "A.T.M.A." The base of the gnomon ("substyle") is 15" in length and this gives the scale of the other details. The lines and numerals were not incised, but sandblasted at a local marbleshop, and are ⅛" wide by ⅛" deep. In cutting inscriptions, marble cutters, until a generation ago, used a hand chisel and mallet. Then came the pneumatic chisel, and now this has been supplanted by sand blasting. The flat stone is first covered with a coat of elastic material and the desired lines and letters are cut through this covering—like a stencil. When a continuous blast of air-propelled sand from a nozzle is directed against this prepared surface, the sand grains rebound from the coating but strike the stone wherever it has been cut away, and thus they rapidly eat away the stone. This method explains the deep inscriptions on the more recent tombstones—cuts far too deep and narrow to have been made by percussion tools.

Figure 1: **Bunyan's family of observatories**

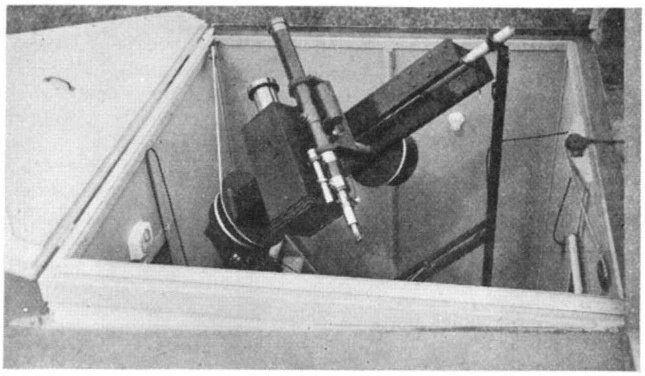

Figure 2: **The 4⅛" camera and mounting**

Bunyan's dial is set up near his observatory. If really carefully designed and painstakingly made, a dial will give accurate time within about one minute, provided the daily correction for equation of time is made. Naturally, only a dial of this kind would suit the pride of the average amateur telescope maker.

This department often is asked for the "inside figures" on the total number of telescopes made since "Amateur Telescope Making" first appeared in 1926. We don't

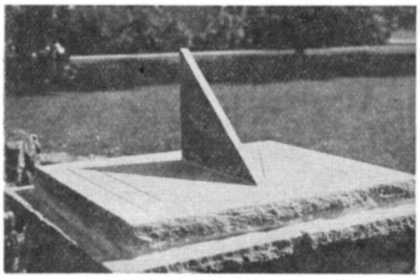

Figure 4: Bunyan's sun dial

know. To obtain really solid data on this would be difficult. All we can do, therefore, is "guestimate." Over 30,000 copies of "A.T.M." have been purchased since 1926, but what percentage of purchasers actually made telescopes? What percentage made two? Three? Five? Ten? (Yes, some have made that many). Our guestimate is 20,000 telescopes—what's yours? Some think this figure too conservative. Perhaps. Perhaps not. Anyway, let's say 20,000.

It's fun to imagine all these 20,000 telescopes assembled in one place. Let's allot each one ten feet square and one observer. That represents a Telescope Farm of about 50 acres, solid. Go aloft in a plane and look down at them all!

To make it more interesting, let's have them all pointed at one object; it might as well be the plane, and there'd be a poetic justice in having in the plane the man who, more than any other man, made it all possible—Russell Porter. Maybe he'll wave a hand over the side (this story is becoming melodramatic).

Of course, not all these telescopes are now in actual use. There must be a few thousands which could be put in other hands to good advantage. Readers also ask us, now and then, where they can purchase a second hand telescope. To test whether any good could be done by thawing out this frozen situation we shall be glad to publish, in one number, the names and addresses of those who have second hand telescopes they would be willing to dispose of.

Fun to make your own eyepieces. Whole battery of them (Figure 5, top and bottom) were made by H. J. Gebelein, 1314 Carey Ave., Davenport, Iowa, and are respectively 1¼", ¾", ½", ¼", 3/16" and ⅛" efl. Middle photograph shows some of the innards of the same eyepieces —those of the 1¼", ¾", ½" and ⅜". The eyepieces are the solid type (see "A.T.M.," page 178). The glass used was Chance Brothers C. C. Crown 1.51.

Gebelein also built an 8" Gregorian with

TELESCOPTICS

23" *f.l.* primary and ratio 6. "This telescope," he says," has given me many hours of real enjoyment."

TURRET for battery of telescope eyepieces is a decided convenience. In this department, November 1940, a 3-eyepiece turret was described. That turret was made on a lathe, but J. Irland, 22035 Donaldson, Dearborn, Michigan, says he made the 4-eyepiece turret shown in Figure 6 without benefit of lathe. Two slices off a 4" brass rod, file, soldering iron, 1¼" tubing. "I confess to some furtive assistance from a small drill press in hacking out holes to start filing on," Irland says, "but even that could be done by hand. Incidentally, one of the slices of 4" rod was a wedge, 3/16" thicker one edge than on the other, and hogging it down was as much work as roughing out a mirror. But the thing works."

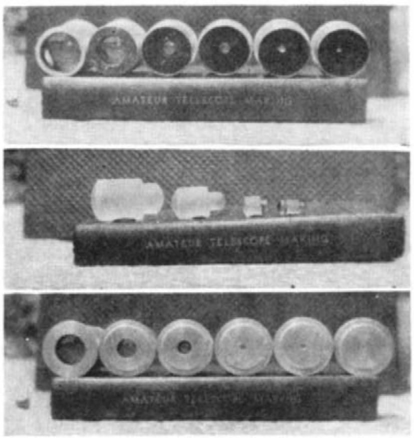

***Figure 5:* Gabelein's battery**

ABRASIVES are becoming scarcer, and methods for husbanding them, described by Lewis A. Parsons, 125 Brentwood Ave., San Francisco, California, should prove useful until the war is over.

"In washing, or levigating rouge, the particles flocculate or bunch up, and thus the finer parts are dragged to the bottom with the coarse. I therefore disperse the particles, settle them, pour off the finer parts and then purposely flocculate these so that they will settle.

"Put, say, 4 oz. of rouge into a cleaned one-gallon bottle and add about 1 oz. of sodium silicate (ordinary water glass). Then fill the bottle with water, shake it thoroughly, and let it stand an hour. Next, siphon off the top half into another bottle, to which add perhaps 2 to 4 oz. (determine empirically) of lime water, a solution from slaked lime. This flocculates the rouge, which settles almost at once, permitting the clear water to be siphoned or decanted off. Then refill the first bottle, shake and repeat the operation. When the first bottle stops producing more, throw away the residuum. As the sludge settles in the second bottle, flush it into a mason jar and from time to time decant off the water. Use it as a cream or paste and do not let it dry. This produces beautiful rouge—not a scratch in a carload."

The following will similarly recover rouge, also Carbo and emery. The dispersing agent is Igepon AP Extra, sold by General Dyestuff Corporation, 435 Hudson St., New York, also 38 Natoma St., San Francisco, at a rather low rate in five pound lots. It is a detergent, and comes in powder or flakes.

"Grades of Carbo coarser than 240 settle so fast anyway that the finer stuff is best washed out first (elutriated by a gentle upward stream of water) and then dispersed and separated into its fractions. Carbo or emery that has been used a couple of times will yield as fine a product as desired. After the dispersed abrasive has been siphoned off, it is flocculated. The best all-round flocculating agent is ferric chloride. Caustic soda could be used for Carbo alone. *Caution:* Don't use it together with ferric chloride.

"The technique is simple. Shake up the abrasive in a bottle or jar with a little Igepon (experiment for exact proportion). Let it settle for a time based on the size you are after. Siphon off. Flocculate with ferric chloride. Continue the cycle till no more good stuff comes off. Dump the residue into a coarser size. Nothing is lost.

"Many use too much abrasive with too little water, which prevents free settling. The grains hinder each other and there may be some big chunks in the part siphoned off. Use not over a quarter pound dry abrasive weight of abrasive, to a gallon of water. For the very fine sizes and double levigation one would probably do better with five gallons for the final settling.

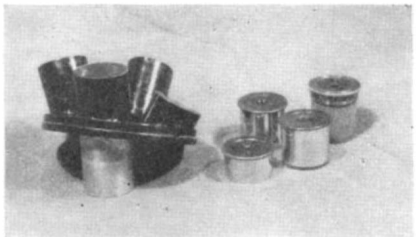

***Figure 6:* Irland's eyepiece turret**

"There are evidences that glass will not flocculate and can be decanted after the good stuff has settled.

"Iron can be removed from the dried abrasive powder with a magnet.

"Some more work remains to be done on these methods.

"If some of the abrasive is placed on a slide under a microscope, the field will be seen to be made up of grains that fall in one size-group, yet the sizes are not all the same. Sticking out are usually a few much larger grains—enough to scratch. These are the grains whose grooves must be ground out with the next finer size, and which slow down the grinding process."

The methods described above by Parsons will prepare grades corresponding to the finer sizes of Carbo. In inexperienced hands they will not often duplicate the results obtained by the manufacturers since there is a vast amount of technique in grading abrasives and the manufacturers have spent years learning it. It will, however, approximate these results. It also will provide some of the finer sizes such as Carbo 1000 and emery 2600.

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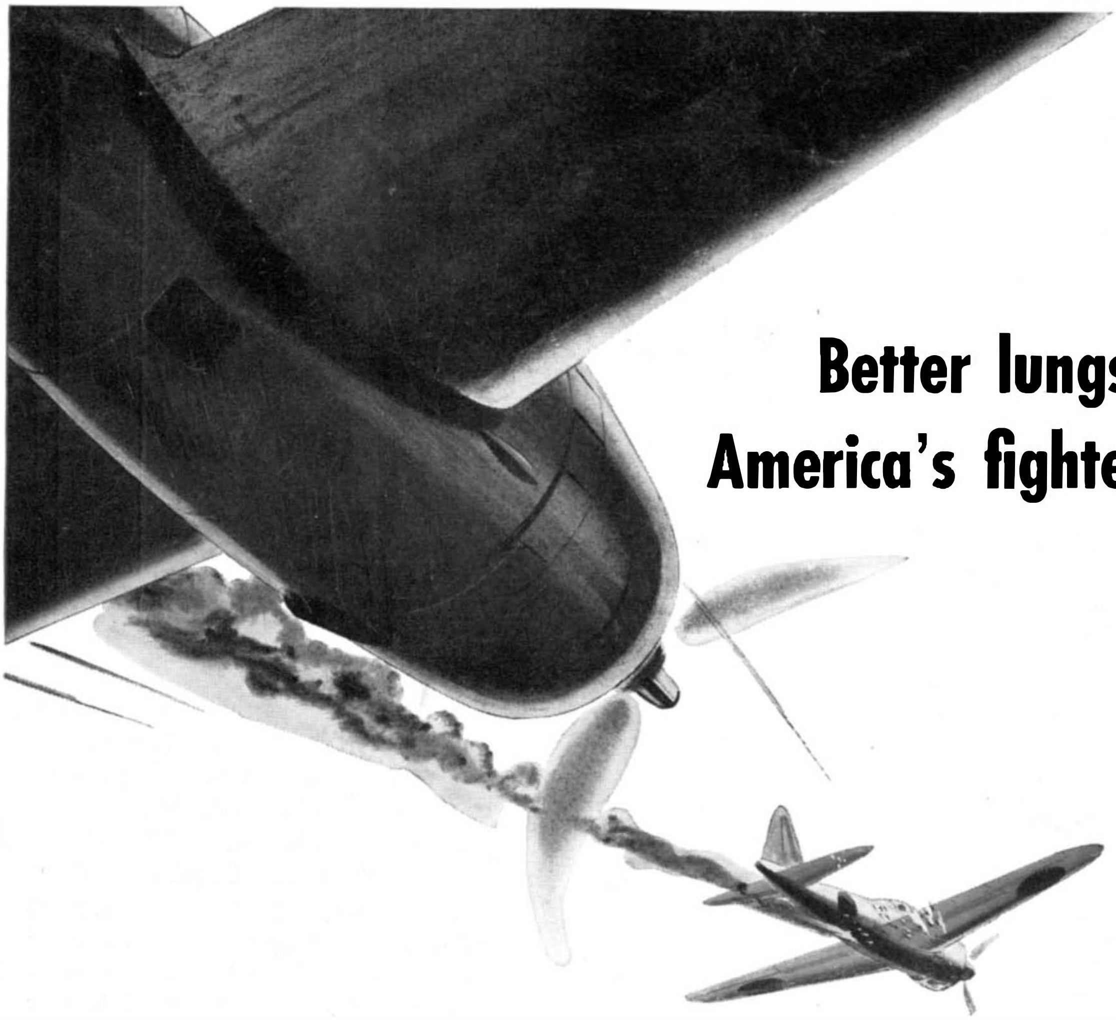

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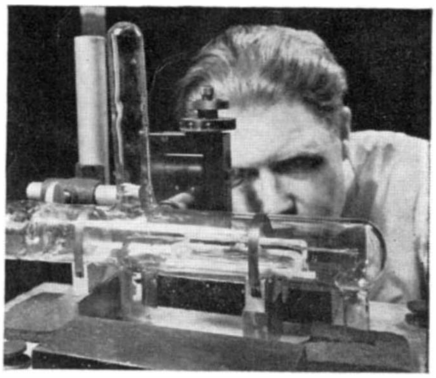

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