

**EATING FOR VITALITY . . . Page 73**

# SCIENTIFIC AMERICAN

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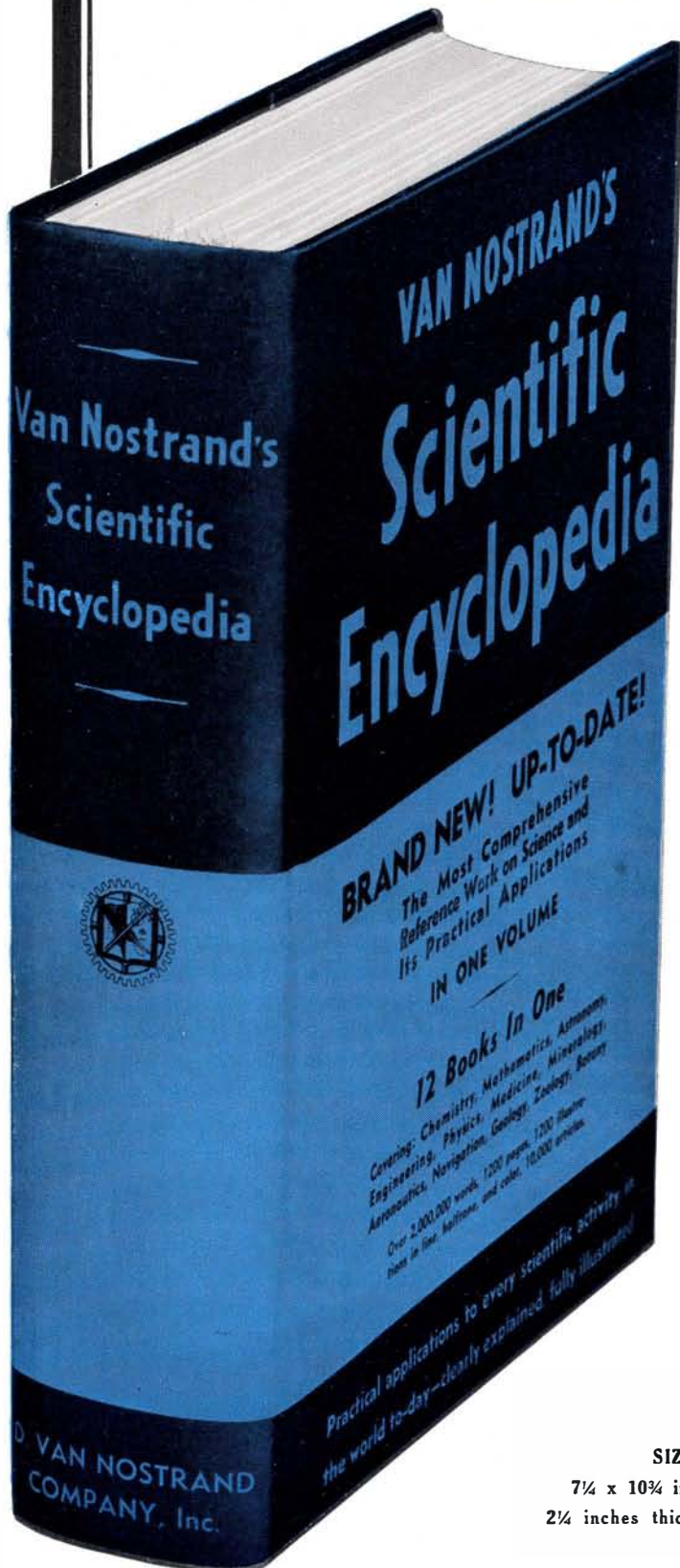


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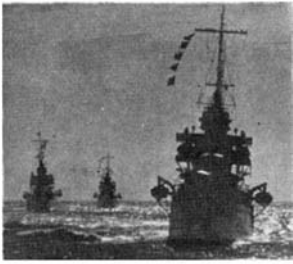
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DEVELOPMENT of the destroyer in the navies of the world has been such that today no other fighting ship is depended upon to carry out so many varied tasks. The work of these versatile naval vessels is described in detail in the article starting on page 55.

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NINETY-EIGHTH YEAR

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## CIVILIAN DEFENSE

**I**N THE kind of war we are fighting today civilian protection is necessary because this is an "all-out" war, a "total" war, an "everybody's" war—and there's nothing new about it. It is as old as mankind. In fact, we have Mr. Schickleguber's statement for it that one objective of this kind of a war is "the disappearance of the vanquished people from the stage of history." Accordingly, as everyone now knows, total warfare is waged not only against the armies and the navies and the air forces, but the civilian men and women as well, to say nothing of the children and the old people. That's why we must consider civilian protection. That's why we are faced with the necessity of perfecting organizations to minimize the effects of air-raid damage, to prevent hysteria, and above all to save civilian lives.

To accomplish this, the United States Office of Civilian Defense was established by Executive Order on May 20, 1941. It was assigned the job of preparing and organizing a means of defense against the horrors of hostile attacks on the unarmed portion of the nation by air or otherwise. To this end Civilian Defense basically has been shaped up on a "neighbor-help-neighbor" policy—a volunteer program as broad as the United States itself and as American as Lexington's Minute Men.

Contrary to public opinion in many quarters, the Office of Civilian Defense had made remarkable progress prior to Sunday, December 7, 1941. Before the bombs fell on Pearl Harbor, too many of us were of the opinion that "it can't happen here," and as the growth of the many-sided plan depended entirely on volunteer action on the part of the people it was designed to protect, its efficiency was stultified. After Pearl Harbor—who among us didn't ask the questions, "What can I do? Where do I fit in?"

The answer is simple. The three broad categories of help in this war are: Armed forces, productive forces, and civilian defense. The first needs no amplification. The second includes necessities of civil life such as groceries, clothing, and fuel, as well as planes, tanks, guns, and shells. For the third, volunteers—thousands upon thousands of them—are needed in every community, whether large or small. There's room for everybody in Civilian Defense, and everybody is sorely needed, from doctors and nurses to file clerks and publicity experts; from dietitians to telegraphers; from air-raid wardens to sanitation experts. Ignorance of the requirements needed to fill a civilian defense job is no excuse. There are now thousands of classes being conducted daily and nightly by competent instructors in every phase of this vast program of help. Westchester county, for example, just north of New York City, has trained 30,000 of its residents as defense workers. Business men who commute to the city by day stand guard over aqueducts, pumping stations, and the like by night, while their wives graduate from Red Cross First Aid courses or maintain constant watch of the sky at aircraft warning posts.

It's the same all over the country. The Office of Civilian Defense has established nine regional offices—coinciding as to area and jurisdiction with the nine Army Corps Areas—and 48 state organizations, each of the latter being headed up by the governor and members of his state defense council. From there on down to the smallest community or rural area, a civil-



ian defense council has been or soon will be established, and in each case it will be led by the head of the civil governing unit—the mayor of a city or village, the selectmen, the township or county supervisors. All existing services, such as firemen, police, and public utility repair crews will be used as nuclei for the organization of larger groups. The American Red Cross is the only organization accepted as an entity; all other enlistments must be voluntary and must be individual in nature for reasons that are obvious. A men's civic club, for example, may enroll each individual member—presumably in the service for which he is best fitted—rather than joining en masse as an ambulance corps, or a decontamination squad, and so on.

One authority has stated that in the last war Germany devoted approximately 50 percent of her civil resources and energy toward winning the conflict. Today, it is estimated that better than 80 percent of all German civil existence is unalterably linked with active furtherance of Mr. Schickleguber's ambitions. On the other hand, England is said to have attained to about 40 percent of potential civilian effort toward wrecking those ambitions, yet the United States today can claim but 15 percent active civilian participation. It has also been said that German leaders, advocating a truly all-out civilian participation in war effort, estimated that such additional impetus would this time tip the scales in favor of victory.

There can be no doubt but that the people of the United States can organize, build, and maintain the greatest civilian war effort the world has ever seen—if they have a mind to do so. The Pearl Harbor catastrophe placed the stamp of action in millions of minds hitherto inactive on this subject, but we are still a long haul from 100 percent civilian co-operation. There's a branch of the United States Office of Civilian Defense in your neighborhood.—A. D. R., IV.

## WAR-TIME GARDENS

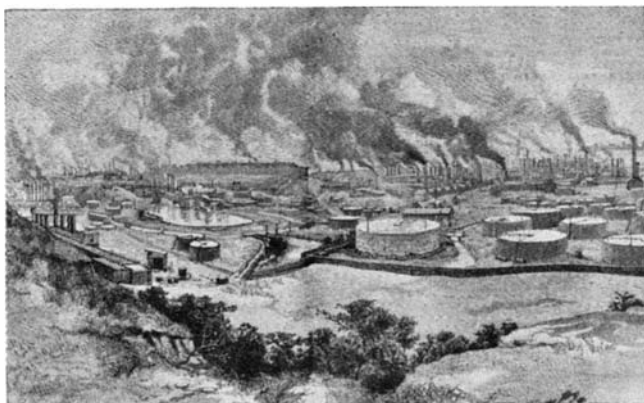
**T**HE United States Department of Agriculture is to be commended for calling a nation-wide conference to discuss and formulate a broad, co-ordinated program for enlistment in and guidance of a national campaign to encourage farm, home, and community gardens as a defense measure. If the goal for 5,760,000 farm gardens under controlled planting is even partially achieved in 1942, we shall all be healthier through better food habits, our home food supplies will be improved, and we'll try not to be hysterical this time and dig up golf courses and flower gardens in favor of potatoes!—A. P. P.

# 50 Years Ago in . . .

## SCIENTIFIC AMERICAN

(Condensed From Issues of February, 1892)

**OIL**—"To-day the petroleum industry represents one of the greatest industries of the world. With gas and the electric light to compete against as illuminants, it is every year acquiring more importance, and holds a position as one of the three great sources of artificial light. . . In 1862 and 1864 the first suggestions toward transporting oil by lines of pipe were made, and in 1865 a pipe, 3,200 ft. long, was laid from Pithole toward Oil Creek, at Miller Farm. It could pass 81 barrels a day. . . At the present day the



Central oil refinery at Cleveland

entire oil region is covered by pipe lines. . . Transportation trunk lines have been laid to New York, Philadelphia, Baltimore, Cleveland, and other points. These lines are for the most part owned by the National Transit Co., which is, really, a branch of the Standard Oil Company, which controls practically all of the refineries, as well as the oil business of the United States."

**CABLE**—"The preliminary survey of the Hawaiian cable has been nearly completed. The *Albatross* has laid out a line from Salmas Bay across the Pacific. . . The line laid down by the *Albatross* on its outward trip is slightly north of that laid down by the *Tuscarora* fifteen years ago. Several submarine peaks were encountered, but the bottom is for the most part regular and suitable for the bed of a cable."

**ELECTRICITY**—"High authorities cannot even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is, if, like life or like matter, it should remain an unknown quantity, we shall assuredly discover more about its attributes and its functions."

**AIRPLANES**—"So far as the mere power to sustain heavy bodies in the air by mechanical flight goes, such mechanical flight is possible with engines we now possess.' These words, coming as they do from Prof. S. P. Langley, carry with them the weight of authority. Nearly five years ago, Prof. Langley, then the director of the Observatory at Allegheny, Pa., commenced there a series of experiments in aerodynamics. . . 'I am not prepared to say that the relations of power, area, weight, and speed, experimentally established for planes of small

area, will hold for indefinitely large ones; but from all the circumstances of experiment, I can entertain no doubt that they do so hold far enough to afford assurance that we can transport (with fuel for a considerable journey and at speeds high enough to make us independent of ordinary winds) weights many times greater than that of a man.'"

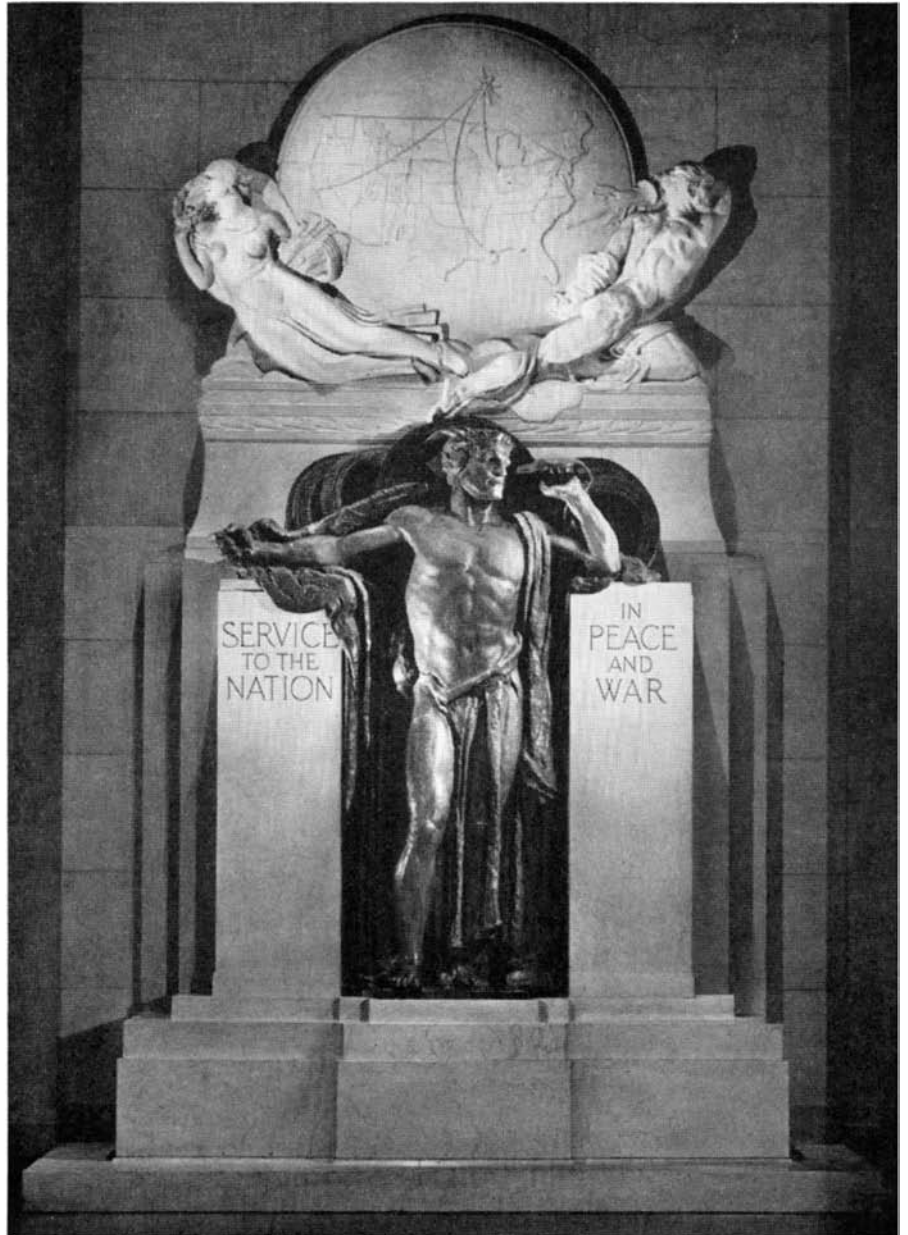
**CAMELS**—"Neither the most broiling heat nor the most intense cold nor extreme daily or yearly variations hinder the distribution of the camel. It seems, indeed, that the dromedary of the Sahara has better health there than in more equably warm regions; though, after a day of tropical heat, the thermometer sometimes goes down several degrees below the freezing point, and daily variations of 90 degrees occur."

**ALUMINUM**—"Taking into account the development made by the factories of aluminum in recent years, it may well be believed that the production almost equals the demand, although new uses for this light but ductile metal are being daily discovered. . . Toward the middle of last year American aluminum was quoted at a rate of \$2 per lb.; some few months later the price was reduced to \$1 per lb. The present prices are: For No. 1 quality, 90 cents per lb. in small quantities and 75 cents per lb. for orders of at least one ton; for No. 2 quality, of a purity of from 94 to 97 percent, 65 cents per lb. for quantities of not less than a ton. These prices are quoted by the Pittsburgh Reduction Company."

**TIME SIGNALS**—"Some interesting experiments have been made by Mr. W. P. Gerrish on distributing time accurately by flashes of magnesium powder. Signals were thus sent from a station on Blue Hill, Mass., twelve miles distant. They were readily visible, and the exact time to within a fraction of a second could be taken from them. These flashes were also seen from Princeton and Mount Wachusett, forty-four miles distant, and from numerous nearer points."

**INSANITY**—"In the brain of a woman who had a visceral delusion, that was almost her sole idea, to the effect that a tape worm found a lodgment within the internal organs and came and went at pleasure, there was unilateral hypertrophy of the paracentral lobules, those in one hemisphere remaining perfectly normal. The patient was perfectly lucid and rational on all subjects except this one delusion, though it was difficult to induce her to speak of any other."

**PEACE-WAR SHIP**—"A new gunboat, the *Svensksund*, has been added to the Swedish navy. . . The vessel will, however, be more useful in time of peace than in war, as, first, she is a powerful ice breaker, fitted with water tanks for sinking to the desired depth; secondly, she is furnished with heavy gear for towing or hauling off stranded vessels; thirdly, she is equipped as a fire steamer, having ten large suction hoses and a centrifugal pump capable of delivering 22,000 cubic feet of water per hour; fourthly, she is fitted with condensers furnishing 800 gallons of water per hour; and fifthly, she is equipped as a torpedo repairing vessel."



“*S*ervice to the nation in peace and war”

Following the last World War a bronze and marble group was placed in the lobby of the American Telephone and Telegraph Company building in New York. On it are inscribed these words, “Service to the nation in peace and war.”

They are more than words. They are the very spirit of the entire Bell System organization. In these stirring days, we pledge ourselves again to the service of the nation . . . so that “Government of the people, by the people, for the people, shall not perish from the earth.”

BELL TELEPHONE SYSTEM







## A LABORATORY "THUNDERCLOUD" TO AID AVIATORS

**L**ABORATORY study of atmospheric electricity is yielding facts that are being translated into practical instruments for use by aircraft pilots. The experimental set-up of a "cloud charge indicator for airplanes," shown above and described in detail on page 78, has resulted in the design of an instrument weighing only two pounds that will furnish a pilot with an indication of the electrical intensity in the air ahead, thus enabling him to decide whether or not he should change his course.

**'MAID-OF-ALL-WORK'****Place of the Versatile Destroyer in Modern Navies**

WALTON L. ROBINSON

**W**ITH the possible exception of the stealthy submarine and the tiny, ultra-swift motor torpedo boat, there is no class of warship whose past and present exploits have been more daring than that "Maid-of-all-work"—the torpedo-boat destroyer. Originally conceived to combat torpedo boats (hence its name, now shortened to simply "destroyer"), it soon took over their duties and later assumed several additional ones, with the result that today no other fighting ship can carry out so many varied tasks. With its armament of torpedoes, depth bombs, and guns, the destroyer must now be reckoned with by the enemy's forces on, under, and above the sea.

In a general fleet engagement destroyers are indispensable for attacking and screening duties, while on detached or independent service they are extensively used for such important work as laying and sweeping minefields, raiding enemy commerce, escorting convoys of merchant vessels, and waging a ceaseless campaign against the marauding submarine. It is to fulfill these last two missions that the United States and Great Britain so urgently need every destroyer that can possibly be built.

Modern destroyers vary greatly in size and strength of armament, but all of them are swift, handy craft, able to face seas which quickly would have forced the boats of a few decades ago to seek shelter in port. Those displacing less than 1000 tons are now generally classed as torpedo boats, while the relatively few of more than 2000 tons are, in reality, small, very fast light cruisers. France, Italy, and Russia are the only powers which possess these "super-destroyers." What may be

considered the destroyer proper is a boat displacing between 1000 and 2000 tons, able to attain a speed of 33 knots or more, and armed with four to eight guns of 4.7-, 5-, or 5.1-inch caliber (diameter of bore) and four to sixteen torpedo tubes. All of Britain's modern

## NATIONAL DEFENSE

● **INTEREST** in destroyers was enhanced when, last year, the United States sent 50 of these singular warships to Britain. Attacks on the *Kearny* and the *Reuben James* focused the spotlight more clearly. As this is written, Pacific naval warfare has thrust this branch of our Navy into a leading role. Just what are destroyers? How large are they? What are their duties? Why do we and Britain need them so desperately? In these days of history-on-the-blitz, one hardly knows what turn may be taken by the time an article appears in print. Nevertheless, this story essays a reply to the above questions. —*The Editor.* ●

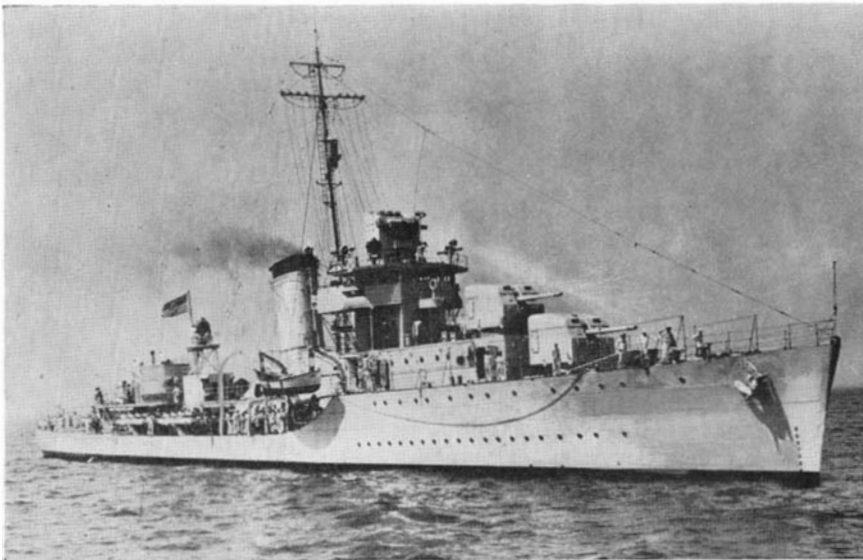
destroyers mount 4.7-inch guns (four, five, six, or eight in number) and most of them have eight or ten torpedo tubes. Germany's *Grosse Torpedoboote* ("large torpedo boats") have a uniform armament of five 5-inch guns and eight tubes. Italian *cacciatorpediniere* ("torpedo boat chasers") are noted for their very high speeds (39 knots in the newest units), but have only four or six 4.7-inch guns and a correspondingly weak torpedo armament. Japanese *kuchikukan* are rather slow (34 knots), but are reasonably well armed; they carry four to six guns and

from six to nine torpedo tubes.

American destroyers have always been remarkable for their very powerful torpedo armaments. Some of our most recent units are provided with as many as sixteen tubes, while even the "flush deckers" of 1916-19 vintage boast twelve. All of our under-age boats, the oldest of which were begun in 1932, mount eight, ten, twelve, or sixteen tubes and from four to eight 5-inch "double purpose" guns, so called because they can be employed against aircraft as well as warships. Our largest destroyers, the five of the *Somers* class, displace 1850 tons and carry eight guns and twelve torpedo tubes. Designed to operate as squadron leaders, they are among the most powerful vessels of their type afloat.

**T**HUS, we have an outline of the destroyer's principal characteristics and can now examine its tactical possibilities in modern warfare. First come its various duties in a fleet engagement, then its several forms of employment on detached service. In either case the destroyer's work may be of an offensive or defensive character, though in the performance of the latter, action of an aggressive nature is often required.

In a major fleet battle the destroyer has two offensive missions to fulfill. The principal of these is to carry out torpedo attacks on the hostile battleship column. To be most efficacious, such attacks must be delivered by one or more squadrons (flotillas), supported by cruisers to assist in piercing the protective screen of enemy light craft. On arrival within effective range, say 6000 yards, each destroyer will carefully calculate the



All photos courtesy U. S. Navy Recruiting Bureau

**A typical American destroyer: 1500 tons, speed 36.5 knots**

enemy's course and speed, will discharge all or most of its torpedoes, and then retire at full speed under cover of dense clouds of smoke. Such attacks *en masse* are far more likely to achieve success than isolated ones made haphazardly by only a few boats, for the more numerous the torpedoes approaching an opponent's battle line, the more difficult will it be for his ships to avoid them. Two squadrons of our modern destroyers—a total of 18 boats—could launch at a given signal over 100 torpedoes, and this number of “tin fish” rushing simultaneously toward an adversary's column of dreadnoughts should score a high percentage of hits. One or two hits on a ship would cause it to lose speed and probably to leave the battle line, while several more would most certainly send it to the bottom. The value of the torpedoes discharged in such an attack would amount to considerably more than a million dollars, while a number of the participating destroyers would likely be sunk or badly damaged. Should the present war produce a large-scale naval action, say between the British and Italian fleets in the Mediterranean or between the United States and Japanese fleets in the Pacific, such massed attacks by surface torpedo craft would undoubtedly play a prominent part and might well decide the issue.

The destroyer's other offensive function in a fleet battle is the laying of what are termed tactical minefields. An operation of this nature was carried out at Jutland by H.M.S. *Abdiel*—a destroyer

with its torpedo tubes replaced by mine racks. During the night this boat laid mines in advance of the retreating enemy fleet, but the Germans altered course and avoided the newly sown minefield, of whose existence, however, they were completely unaware. Despite the failure of the tactical minefield on this occasion, the idea was an excellent one deserving of success. That this form of warfare is considered to hold much promise is indicated by the fact that practically all navies possess a number of destroyers fitted for minelaying. The Italian and Soviet navies are especially enthusiastic about its possibilities and the vast majority of their destroyers are equipped to lay mines.

**T**HREE vitally important defensive tasks fall to the lot of destroyers assigned to the battle fleet. During a major operation, and while the fleet is still in cruising formation, destroyers must screen the great dreadnoughts from possible submarine attack. In the performance of this mission they rely chiefly on the depth bomb. In the present conflict Italian submarines in particular have attempted frequently to interfere with the British Fleet's movements in the Mediterranean, but their successes thus far have been out of all proportion to their heavy losses. Not a single British battleship has been sunk by Italian submarine action, and only one is believed to have suffered damage.

Soon after contact with the enemy's fleet has been established, destroyers will be called upon to repel hostile torpedo attacks and

to lay protective smoke screens. They can best accomplish the former task by dashing out and engaging the attacking flotillas before they arrive within effective torpedo range. Both sides will dispatch cruisers to support their destroyers and much hard fighting will ensue. The result of this secondary action will exercise a profound influence on the course and outcome of the battle raging between the big ships.

**S**MOKE screens are employed to conceal from the enemy some intricate maneuver or to protect a badly damaged ship. They are invariably resorted to by a fleet wishing to withdraw from the action. In the engagement off Punto Stilo on July 9, 1940, between the Italian and British fleets, the former and inferior force succeeded in escaping almost certain disaster by retiring at full speed behind dense curtains of smoke emitted by a destroyer flotilla.

Tactical scouting with other advance units of the fleet is yet another duty which falls to the destroyer, for there will never be sufficient cruisers to do this work, while bad weather or lack of carriers or nearby shore bases may preclude the effective use of aircraft. During the past two years there have been several naval actions in which planes were unable to participate due to one or more of these reasons.

Of the destroyer's several duties on detached service, anti-submarine operations are by far the most important. These may take the form of escorting large convoys of merchant vessels, patrolling defined danger zones, or laying mines at the exits of the submarine bases. In the first two cases the destroyer's most effective weapon is the depth bomb, although occasions may arise in which gunfire, torpedoes, or ramming tactics can be employed. Depth bombs were invented during the last war and proved so successful that they now form part of every destroyer's armament. They are either rolled overboard from racks at the stern or are discharged from a projector known as a “Y-gun.” Detonation at practically any desired depth is effected by hydrostatic pressure. The explosive force of the 300-pound charge of trinitrotoluol—TNT—will destroy or seriously damage an undersea boat within a radius of seventy to one hundred



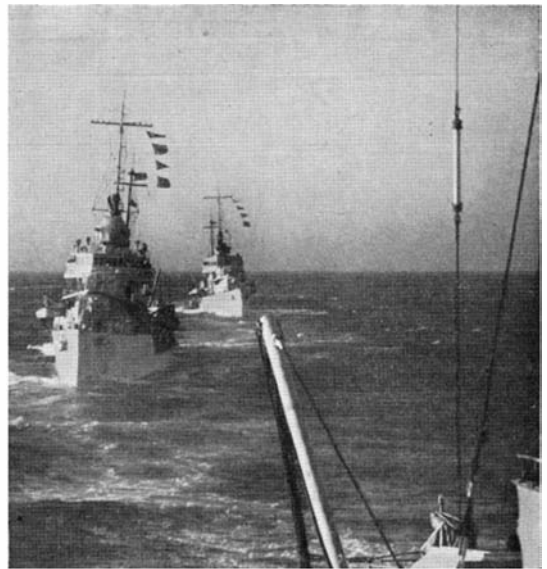
feet. Even if the submarine is not sunk or badly damaged, it is probable that the morale of its crew will be so shaken as to necessitate an early return to port. Many submarine crews have testified to the demoralizing effect of a barrage of depth bombs exploding near their craft.

**D**EPTH bombings are today far more likely to achieve success than was the case 25 years ago. Their increased effectiveness is due in large part to improved methods of detecting a submarine's presence and exact whereabouts beneath the surface. In the last war the only device for such work was the hydrophone, which located the undersea craft by picking up the sound of its motors. In those days, consequently, all that a U-boat had to do after attacking an escorted convoy was to rest on the bottom with motors quiet. Nowadays, however, the problem confronting an Axis submarine commander is much more difficult, for in the years between the last war and the present one the British invented a truly marvelous submarine detector. Popularly known as the "Asdic" (after the Anti-Submarine Detection Investigation Committee), it can locate a submarine lying on the bottom almost as readily as it can one which is under way. The "Asdic's" very existence was among the Royal Navy's most closely guarded secrets prior to the outbreak of war, and the Germans did not discover how it functioned until after

the fall of France, when they examined a number of French destroyers.

In the present conflict the Axis navies have lost a very considerable number of submarines. It is impossible to state the precise extent of their losses, but about one hundred German *Unterseeboote* and nearly half that number of Italian *sommergibili* are believed to have been destroyed. The majority of these boats were sunk by depth charge attack, while mines and aerial bombing accounted for most of the others. Axis destroyers, mines, and planes have taken, of course, their own toll of British and allied undersea boats. During the first two years of war the Royal Navy alone lost 29 submarines by enemy action. While the exact fate of most of them remains unknown, it is safe to assume that fully half were sent to the bottom by depth charges. Several, however, were sunk by ramming. Such tactics, incidentally, often result in considerable damage to the destroyer's bow—sufficient in most cases to put her out of service for several weeks.

Minesweeping is a very important and extremely dangerous task which destroyers are sometimes called upon to perform. They should not be employed in this work, however, except in emer-



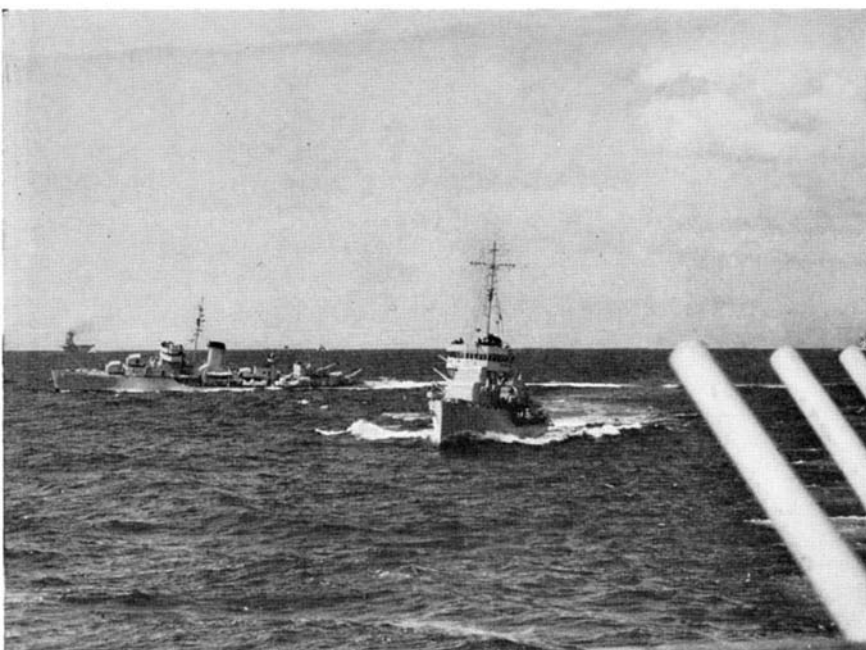
Destroyers maneuvering

gency, for they are too valuable and needlessly large and fast. Smaller, less costly craft, either specially built or converted, can discharge this duty in an equally efficient manner.

**C**OMMERCE raiding is yet another mission which destroyers can carry out. Prior to the outbreak of the current war, this work had been entrusted almost exclusively to cruisers. Britain's perennial shortage of cruisers has obliged her, however, to dispatch destroyers to assist in the capture or destruction of those enemy merchant vessels which from time to time slip out of neutral ports in an effort either to supply some raiding warship on the high seas or to run the blockade and return home. This task the fragile destroyers of 1914 were incapable of performing, but the modern ones, with their wide radii of action and splendid sea-keeping qualities, have had little or no difficulty in carrying out such assignments.

That destroyers are constantly being employed on service of the most hazardous nature is evidenced by the great number which have been sunk during the past two years. Excluding small units of less than 1000 tons displacement, over 100 destroyers have fought their last action. Numerically, Britain heads the list with some 50 lost, while Germany and Italy have suffered even more heavily in proportion to the size of their navies. (At the time of writing it is still too early to give accurate and official data on losses in the "Battle of the Pacific.")

Britain's losses represent about



Destroyers at sea. Note airplane carrier in distance



**A division of destroyers in tactical exercises**

30 percent of her destroyer forces available in September, 1939. Since then she has strengthened her navy by at least 80 destroyers, including the 50 acquired from us. Thus Britain's present-day strength comprises over 200 destroyers. This number is far from adequate, however, for Germany now has in service many more U-boats than was the case two years ago. At that time some 70 Nazi submarines were ready for sea, while today probably twice that number are operating against Britain's vital sea communications. Moreover, Germany is building U-boats at a furious pace: our Navy Department estimates that she is rushing work on nearly 200. The collapse of France and Italy's entry into the war have also done much to increase the Royal Navy's

difficulties, for the French possessed about 70 destroyers and torpedo boats, while the Italians added more than 100 submarines to the enemy's strength.

The coming months will doubtless witness much bitter naval fighting as the "Battles of the Atlantic and Pacific" rage between German, Italian, and Japanese undersea craft on the one hand and the anti-submarine forces of the United States and her allies on the other. In this life and death struggle the destroyer will assuredly share many of the honors. Perhaps some new missions will be discovered for it, though what they might be defy the imagination, as already it is capable of such varied service. Well, indeed, has the destroyer earned the sobriquet: "Maid-of-all-work."



## Inch by Inch, Tooth by Gear

### Army Officers Receive Technical Training in Motor Vehicle Operation and Up-Keep

**F**ROM Second Lieutenant to Lieutenant Colonel, officers of the streamlined, motorized divisions of our fast growing Army are attending each week in Detroit a school conducted by Chrysler Corporation in advanced technical training in the operation and maintenance of the thousands of speedy, sturdy motor vehicles in which our pres-

ent-day fighting forces ride instead of march in maneuvers and in cantonment routine at speeds up to 50 miles an hour.

Each Monday morning at 8 o'clock sharp, officers from the Army posts scattered across the country assemble in the Army School class room. During the first half-hour they are registered and

given their schedule of intensive training for the week.

Actual school work starts promptly at 8:30. The men are divided into four groups, each under the supervision of a trained instructor, an experienced, qualified, automotive service specialist. Two full hours are devoted to the subject of wheel alignment. Each officer is instructed and given actual practice in the mechanics of caster and camber of front wheels. They learn the meaning and importance of proper wheel alignment—the effects of misalignment. Each man is given an opportunity to check the wheels with special gages. They discuss causes and effects informally but thoroughly.

From 10:30 to 12:00 o'clock each group probes the intricacies of an Army truck's electrical system—its nerve structure. They "dissect" the generator, examine its insides, check the wiring, the condenser, distributor, and all the elements that are a part of or affect the electrical apparatus.

Lunch period is from 12:00 to 1:15 P.M. Shop work continues from 1:15 to 4:00 o'clock. The men disassemble and reassemble brake mechanisms, make brake adjustments, bleed the lines of the hydraulic brake system. They discuss the common and uncommon causes of brake trouble, excessive wear and other complaints.

From 4:00 to 4:30 P.M. they return to the class room for a question-and-answer period to clear up any misunderstanding or details that might not be clear in the mind of any man regarding the subjects covered during the first day of the school.

On each succeeding day the hours for discussion in the class room and shop work at the benches are about the same, but during each period a different subject is taken up. At the end of the week, when the officers depart for the return



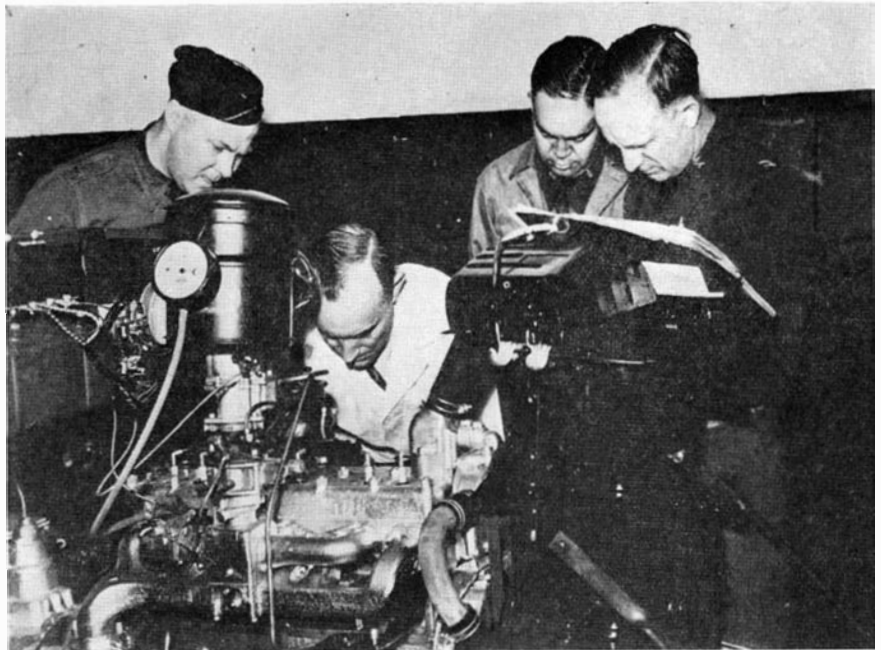
**Army trucks go through their paces**

trip to their respective Army posts, they have gone over, inch by inch and tooth by gear, the vital mechanical parts of the Dodge Army trucks that are being turned out by the thousands in various types for Army use.

From beginning to end in all instructions, in all theory, in shop work, and in discussions, preventive rather than corrective maintenance is stressed with all possible emphasis. "A stitch in time" is what keeps the Army rolling. The men and the weapons and the supplies of a modern, fast-moving Army can't stop and wait for a truck to be repaired. When a vehicle fails and can't keep going, it is simply left by the wayside and the Army rolls on.

**T**HE officers are taught to become familiar with the sound of engines, transmissions, differentials, generators, and various other moving parts so they can detect the noises that are apt to mean trouble. Impending trouble detected by the sound of a vital unit usually can be corrected before serious damage results, thus preventing failure or delay.

A highlight of the training course is the "scrambling" of an engine. The timing gears, carburetor, electrical apparatus, and all possible units and attachments are purposely thrown completely "out of kilter." Each man takes his turn "unscrambling" the mess, putting each part back in proper adjustment and working condition.



Army officers learn truck motor maintenance

Practical training in driving Army trucks in rough going on a specially constructed testing ground adjoining the Dodge truck plant near Detroit forms the spectacular and exciting part of the training course. Each Wednesday afternoon is devoted to a driving field day for the Army men. The officers take turns driving the reconnaissance cars, command cars, weapon carriers, troop transports, cargo transports, and ambulances over precipitous grades of 60 percent and more, through a veritable mud-wallow in which the wheels of the trucks drop practically out

of sight, over rutted fields and bogs, and through second-growth brush.

Each Friday afternoon the officers are taken on a tour of the corporation's engineering laboratories, where they see how the important parts of the motor vehicles are tested in a thousand ways to duplicate days, weeks, months, and years of stress and strain.

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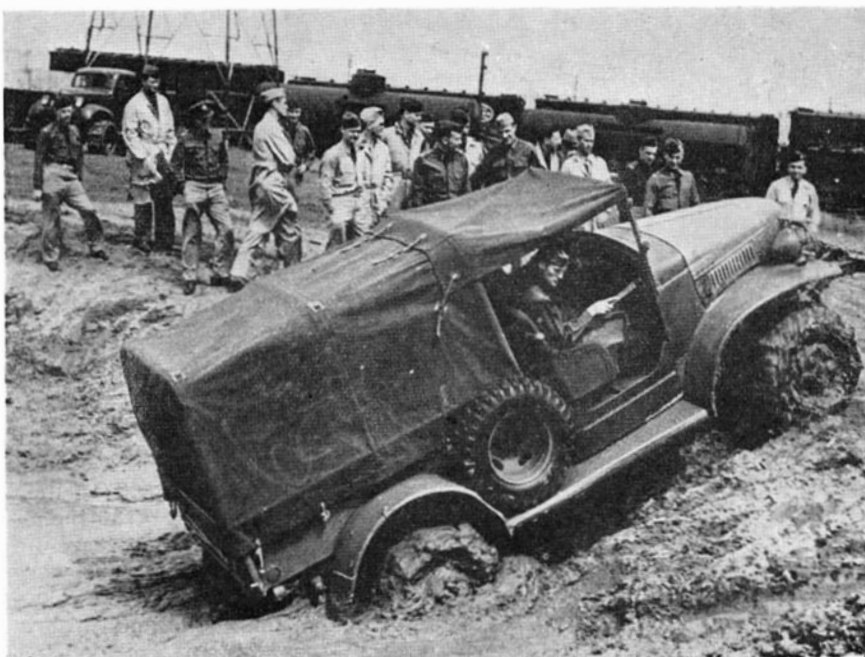
## SMOKELESS POWDER

### Chopped-Up Cotton

#### Speeds Production

**C**OTTON linters, the fuzzy threads left clinging to cottonseed hulls after ginning, has always been the best material for use in the preparation of smokeless powder. Present-day demands for powder production, however, have long since consumed the available supply of linters. Other cotton fibers are too long to use in powder production since they tend to "spin" or "rope" in the nitrating machinery and clog the works.

Now, however, long cotton fibers can be reduced to an approximation of the length of linters by new machines invented by United States Department of Agriculture engineers. The long cotton fibers are first reduced to medium lengths which in turn are sent through a second machine where the fibers are chopped into the equivalent of linters.



Officers at school drive a truck through a mud wallow



# Shutters and Cutters

## High-Speed Motion-Picture Photography Used in Study of Machine-Tool Cutting Edges

B. L. MCKENZIE

**H**IGH-SPEED photography, famous for its trick shots of golf strokes, tennis strokes, and the like, may soon become equally famous for its value to industry as an aid in determining how to bring closer to perfection the design and the performance of milling cutters, lathes, planers, and many other similar machine tools. Such is the conclusion to be drawn from an experimental series of photographs made by this method in the course of the past year.

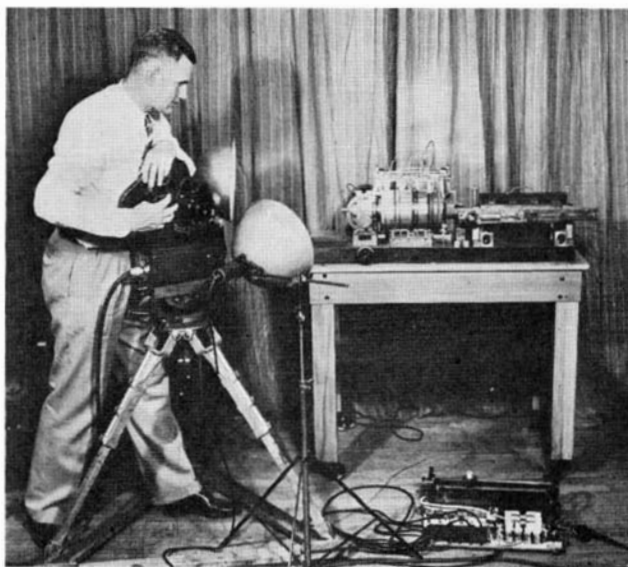
Until a short time ago, very little was definitely known about the action that takes place at the cutting edges of machine tools. It was known, for example, that chips cut from certain materials break off and are thrown clear of the cut, whereas in other cases the chip is removed in a continuous curled strip; that a certain amount of distortion takes place in the material cut away; that abrasive action on the tool occurs during cutting; that in dry cutting there is a tendency toward a welding action between the chip and the tool face; and that a certain amount of chatter in the machine is present at times.

But because the action of machine tools is far too fast to be seen and studied by the naked eye, it was formerly impossible to determine exactly what does take place at the cutting edge. In an effort to gain knowledge on this subject, the General Electric Company developed the necessary lighting equipment to make—and then made—the series of high-speed machine tool photographs.

In the high-speed camera adapted to the purpose, an Eastman Kodak type II, exposures are con-

trolled by a shutter, and images are moved with the continuously moving film by means of a revolving prism, which is used in addition to the objective lens.

Using 16mm film, and operating at a speed of 1000 frames per second, 100-foot spools were exposed in four seconds, the footage exposed in one second requiring one minute to view when projected at normal speed. Built into the camera was a delicate pair of timing dials which, controlled by a 200-



Set-up for taking high-speed photographs of machine tools, to study action at the cutting edges

cycle tuning fork, indicated respectively seconds and thousandths of a second, and were photographed on the right-hand edge of each frame, rendering an accurate account of the amount of movement taking place in a given amount of time.

Principal problem in making the high-speed pictures was that of sufficient light. Since the largest practical lens aperture that could be used was about  $f/2$  and the exposure time approximately  $1/4000$ th of a second, a light approximately five times the strength of sunlight was required to produce a clear image on the negative.

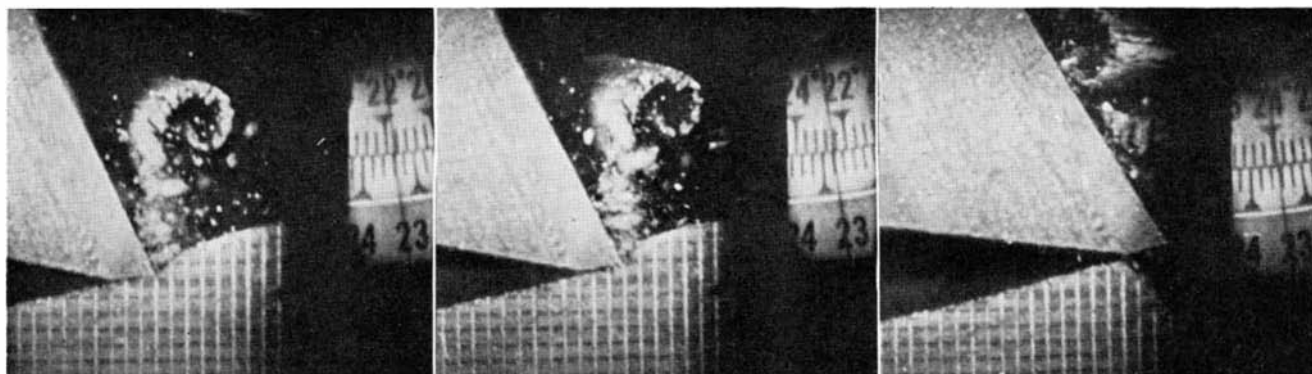
Work on the series of pictures was done at night and during weekends to avoid vibration from neighboring machines. Two high-power lamps were trained directly on the area being photographed, one lamp being placed at each side of the camera to eliminate confusing shadows. Since action in these cases was localized in a very small area, it was possible to place the camera close enough to the work to make pictures of areas one-inch square and  $\frac{1}{4}$ -inch square, thereby permitting movement measurements to within a few thousandths of an inch to be made, on examination of the finished pictures, with a fair degree of accuracy.

The workpieces from which chips were cut were marked in squares  $1/32$  of an inch on a side, to facilitate study of the material both during the cutting process and afterwards, and to permit identification of the metal in chips with regard to previous location in the block of material.

**T**OOLS studied in the photographic series were milling cutters and planers, used without coolant, an effort being made at all times to simulate normal operating conditions—normal operating speeds and feeds. A narrow workpiece was selected for cutting, in order that all of the separation of the chip from the block would take place at one cutting surface. Thus the action observed at the side of the workpiece was the same as that taking place throughout the width of the cut, and in addition

—since chip action was in a vertical plane—an unobstructed view of the work by the camera lens was possible.

In photographing conventional milling, materials cut were SAE 1020 steel, of Brinell hardness 160; yellow brass, Brinell hardness 130; and cast iron, Brinell hardness 170. Standard milling cutters were used, at a speed of 37 surface feet per minute, taking a  $3/16$ -inch cut, with a table feed of 30 inches per minute. In photographing climb milling, materials cut were SAE 1020 steel and ascoloy. Cutting speed for the climb milling process was 42 surface feet per minute, with a seven-inch per



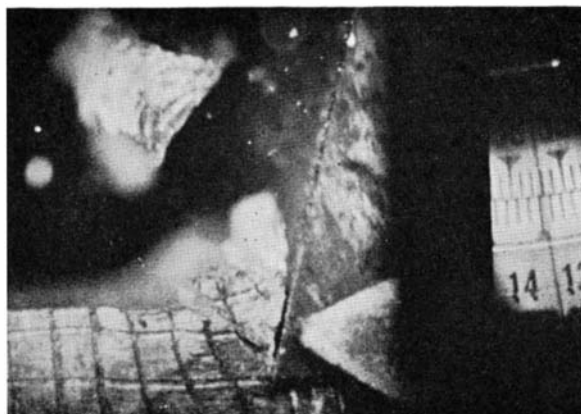
The three high-speed photographs above show a milling cutter cutting cast iron. The characteristic segmental chip of cast iron is evident. In picture at right, chip has been detached from work. Note 1/32-inch cross markings on workpiece. Photograph below shows planer cutting brass. Distortion of work is shown by the cross markings, which serve as indices for study

minute table feed, the cut taken being the same as in the conventional milling photographs — 3/16 of an inch. Various types of standard cutters were used for these operations.

**F**OR the purpose of further study, special cutters were then ground, and photographed at work. The first of these, designed to show the difference in cutting action between sharp and dull teeth, was ground with 10 teeth sharp and 10 teeth dull. The second was ground with two teeth of zero rake angle, followed by two of 5-degree negative rake, two of 10-degree negative, and two of 15 degrees, the remaining teeth being ground with 5, 10, and 15-degree positive rake angles.

In the planing operations photographed, several different materials were cut, with forged high-speed steel tools, one inch by 1½ inch by eight inches long. 18-4-1 high-speed steel tools were used to cut steel, yellow brass, and cast iron, operating at 37 surface feet per minute, the depth of cut being .040 inches; these tools were further photographed cutting, at 60 surface feet per minute, two pieces of steel of different hardnesses, which were clamped end to end on the planer so that one cut followed the other. Carboly tools were then photographed in use on the planer, cutting these same two materials at 160 surface feet per minute.

With the aid of the 1/32-inch horizontal and vertical lines marked on the workpieces photographed, plus the camera's built-in timing dials, it was possible to plot true time-distance graphs for the alternate forward motion and retarding of the teeth of a cutting tool in action. This was done by



projecting the developed pictures, one at a time, on paper marked off in large squares, moving the projection machine until the small squares in the pictures were superimposed on the large squares on the paper. Thus graphs could be drawn to scale, the sides of the large squares corresponding to the 1/32-inch sides of the squares marked on the workpieces.

From these time-distance graphs — together with viewing of the film projected as a motion picture, and study by photomicrography of the structure of the chips and the completed machined pieces — have been learned facts that may be of inestimable value in the constructing of future machine tools; in the designing of the "machine" and the grinding of the "tool."

Through the use of high-speed photography, for example, can be determined the maximum speed at which a given machine tool can be operated without danger of erratic operation, caused by inertia of material being cut or too great deflection of cutting teeth — without danger of distorting the material being cut to such an extent as

to render the material unsuited for the application in which it will be used.

Photographs have shown, among other things, that material ahead of the tool is distorted in the direction of the tool's movement, causing distortion not only of the chips cut away, but of material below the line of the cut. They have shown that compression on and consequent deflection of a tooth, as it builds up power to begin the cut, is much greater at the beginning of the cut taken than when the end of the cut is neared, due to the larger amount of material ahead of the tool in the beginning. They have shown that the speed of the tool is directly related to such compression and deflection.

**M**AXIMUM speed without danger of deterioration, due to heating, of the tool's cutting edge can also be determined. Perhaps most important of all, where speed is concerned, is the fact that the maximum speed possible with minimum regrinding of tools can be accurately fixed, resulting in the highest possible efficiency of a given tool; that is, the highest possible number of cubic inches of material removed, the greatest number of finished pieces turned out, in the least possible time, with the minimum number of tools.

Causes of chatter — that is, the wind-up in the arbor when heavy deflection occurs, and the irregular feeding of tables — can be studied, and in many cases might be remedied by improving smoothness of feed and by operating at slightly lower speeds, thus reducing vibration and lengthening the life of the machine as a whole.

The most efficient rake and clearance angles to provide the largest amount of material cut

away at the greatest speeds may be determined. By improving rake and clearance angles, not only might it be possible to produce a more accurate machined surface, with less slipping and greater smoothness of action; it might also be possible to control the action of the chip, with the purpose of lessening its abrasive or "cratering" action on the face of the tool, thus lengthening tool life.

It can be learned, through photographing teeth of different degrees of sharpness, the length of time the tool can be efficiently used before regrinding, as well as just which coolant is most effective, on a given type of cut in a given ma-

terial, in reducing abrasive and welding action between chip and tool face and in reducing the built-up edge of material which accumulates on the cutting edges of the tool and appreciably slows up its action.

With the information gained through studies made by means of high-speed photography, when such studies have been made in sufficient number, it is believed that changes can be made in the designs of various types of machine tools which will make it possible to obtain from these tools maximum efficiency and the speed so vital, during these times, to American industry.

blocks, which, used in place of windows, provided more usable daylight, more evenly distributed.

These blocks, which incorporate interior prismatic sections, serve to bend or redirect light rays, so that instead of falling in a direct line downward toward the ordinarily dark floor, the rays are turned upward toward the ceiling and upper walls. These surfaces, in turn, reflect the light down and toward the interior. This system of daylighting was developed by the Insulux Division of the Owens-Illinois Glass Company. It is claimed that no system of louvers, reflectors, or baffles now in use equals it for all-around efficient use of daylight indoors.

**T**HE engineers working on the lighting tests used an ordinary room with dimensions of 23 by 25 feet with a single unglazed opening in an exterior wall. Immediately after pictures were made of the room in that condition a panel of Insulux glass blocks was installed in the opening and other photos taken. All of the photos were made with the same camera on the same film, under brilliant sunlight conditions, with identical exposures. Prints were given the same exposure by the printer and were not retouched.

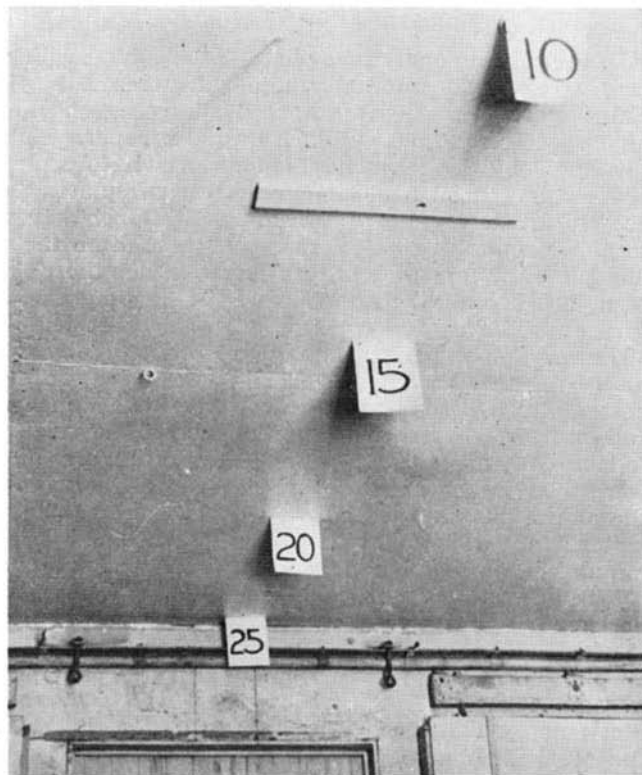
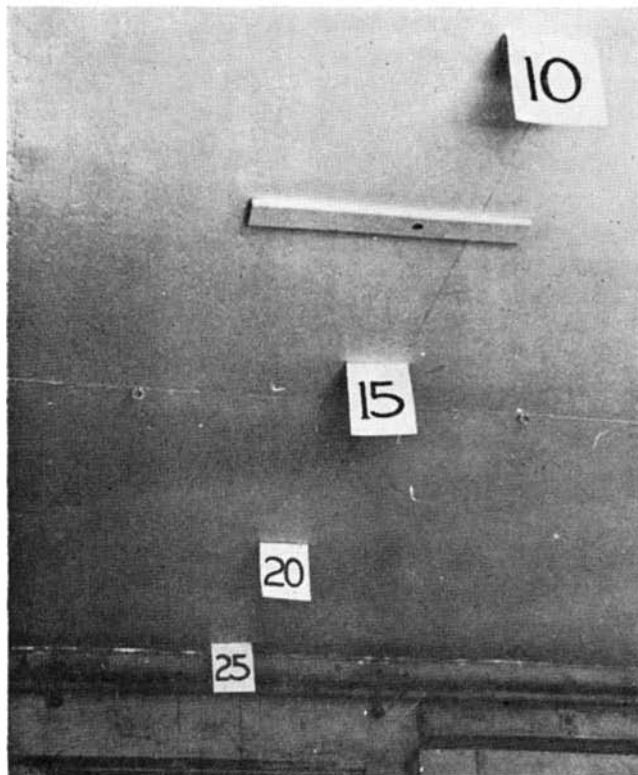
The results were striking. The pictures taken of the room with

## Glass Blocks Bend Light

### Daylight Conservation Achieved by Refraction of Incoming Light to Ceilings and Sidewalls

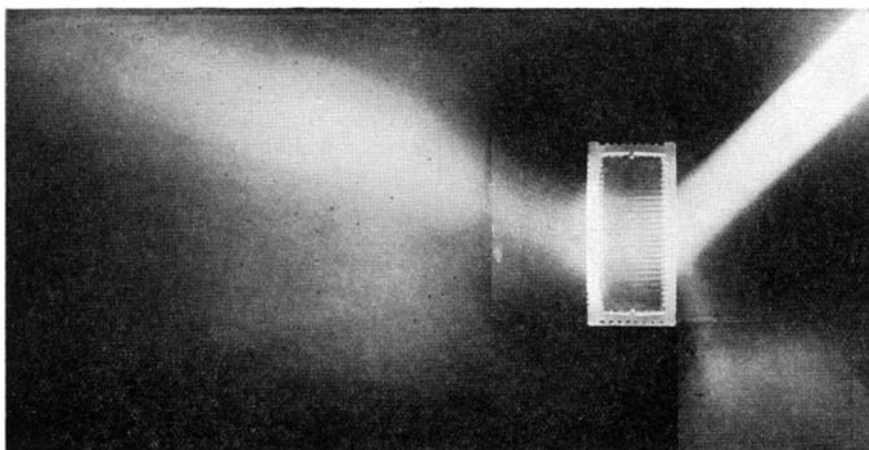
**T**HE current national emergency and its speeding up of industry has caused a drain on the nation's power resources, especially in the east and southeast. Hence lighting engineers, in an effort to conserve as much *daylight* as possible, have

been experimenting with different means of providing maximum useful daylight for interior illumination of office buildings and industrial plants. The most successful test reported to date involved panels of Insulux glass



*Left: Light from unglazed opening compared with (right) light through new glass block*





Section of glass block, showing how light rays are refracted

the unglazed opening show a poor and inadequate diffusion of light, the dark floor having absorbed much of the direct light which streamed in through the opening. When the glass-block panel was installed, the light striking the outside of the panel was redirected upward toward the ceiling and diffused deep into the interior due to the prismatic design of the blocks. Instead of falling, then, on the dark, highly light-absorptive floor, most of the light was directed at the upper half of the room. These surfaces reflected it downward to the working levels.

The fact that the prismatic blocks are translucent insures complete privacy at all times, an essential to many defense plants. Besides redirecting daylight efficiently, they serve as insulation against all types of weather; because of their insulating qualities they retain within the structure much of the cooling temperatures achieved with air-conditioning units.



## SAFE AT WORK

### Better Lighting Reduces Industrial Hazards

**A**MERICA'S 6,000,000 men and women industrial workers handling complicated machinery and entrusted with the task of producing the nation's weapons for defense at an accelerated tempo, are safer from injury at work than at home or in automobiles.

This is true primarily because of the development by research of new light sources such as fluorescent and mercury vapor lamps now

widely used in factories, according to Oscar P. Cleaver, well-known Westinghouse lighting engineer. United States defense industries, says Mr. Cleaver, now use two to five times more light than ever before over workbenches and production aisles to speed output and minimize possibilities of accidents involving workers.

"Industrial leaders realize," he declared, "that more light flooding work areas increases efficiency and cuts down injuries at a time when production must not be disturbed. We cannot afford to lose workers. While we can replace machines, we cannot easily replace highly skilled employees."

Latest available statistics compiled by the National Safety Council, Mr. Cleaver disclosed, report that more than twice as many fatal accidents occur in motor vehicles as in occupational pursuits, and approximately twice as many occur in homes as in industry.

"In recent years," he said, "surveys show that light in factories throughout the nation has been rated at an average of about 10 footcandles, as compared with ideal light in the shade of a tree of approximately 1000 footcandles.

"Under these conditions, statistics reveal that about 140,000 injuries could be expected among 6,000,000 workers in a year. Of this number, one out of four, or 35,000 of the anticipated injuries would result in permanent loss of vision."

This situation is changing for the better, the engineer said. In many defense plants, lighting intensities are now often maintained at averages varying from 30 to 50 footcandles. For close work as many as 100 footcandles are supplied the worker.

"Until research laboratories suc-

cessfully developed fluorescent and mercury vapor lamps," Mr. Cleaver explained, "it had not been practical nor possible to raise lighting levels in industry. The fluorescent lamp, however, is cool, is approximately twice as efficient as an incandescent, supplies glareless light, and is economical to operate when burned long periods of time. Mercury vapor lamps have also become an important source for an abundance of light under certain conditions."

More than 10,000,000 fluorescent lamps were in use in this country early in 1941; during that year the lighting industry estimates that an additional 20,000,000 were put into service.



**LIGHT:** Approximately 156,000 fluorescent lamps are being used in the world's largest installation of these tubular light sources. They are being placed in the \$47,000,000 Ford bomber plant near Ypsilanti.



## TWO LAYERS

### Of Plated Metals to Replace Galvanizing

**D**RASTIC curtailment in the metal-coating industry has stimulated interest in the new Corronizing process, which is claimed to reduce by 50 to over 90 percent the necessary tonnages of zinc and tin used for galvanizing and tinning ferrous and non-ferrous metals.

Corronized coatings, already in use by several licensed manufacturers for various sheet, strip, and wire products, consist of several exceptionally thin layers of metal and alloys, having unusual corrosion-resistant properties. The coatings are formed by electroplating a thin layer of nickel on the base metal, followed by a layer of either zinc or tin much thinner than ordinarily used for equivalent galvanized or tinned coatings. Conventional electroplating equipment and standard plating solutions can be utilized with only minor changes, the novel features of the process arising from the technique of application and subsequent treatment. After the two metallic layers have been plated on, the coating is baked at a fairly high temperature (500 to 750 degrees, Fahrenheit) for up to one

hour, during which time the two metals mutually diffuse to form new layers of alloys of different composition. The resultant coating not only is highly resistant to corrosion in salt spray, humidity, and normal atmosphere tests, but it is reported that it can be twisted, bent, molded, soldered, and even welded satisfactorily.

Applications of Corronizing now in production by several manufacturers include insecticide spray tanks, wire screening, copper oven thermostats, and outboard motor parts, while tests have been made on other products such as welded wire fences, pump rods, oil cans, springs of surgical appliances, metal stampings, and formed parts.

A main present disadvantage of Corronizing is its use of nickel, even though only a small quantity of nickel is required to save much larger amounts of zinc or tin.

While atmospheric exposure tests are not yet completed, preliminary indications are that the superiority predicted by accelerated tests will be fulfilled in actual use. It is further claimed that the coating has some tendency to self-heal when failure occurs, thus slowing up complete deterioration, while ordinary galvanized coatings fail after part of the coating has been corroded away.

Because of the reduced quantities of metals necessary for a given quality of protection, Corronized coatings are now said to compete in cost with hot-dipped and electroplated zinc coats in the lower-quality field, though its possibilities have not been definitely established for higher-quality applications of various kinds.—*The Industrial Bulletin* of Arthur D. Little, Inc.

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**ERASERS**—Plastic eraser holders on pencils, in which one pound of plastic replaces about two pounds of metal, released an estimated 150,000 pounds of metal to vital industries during 1941.

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## GUNGA DIN

Now Plays His Role in Modern Industry

**F**OR dispensing water in a sanitary manner, on defense construction jobs and in factories, a new mobile water tank unit has been devel-

oped by Universal Paper Products Company. These units eliminate the dangerous "germ-exchange" bucket and dipper method of dispensing water—a method which is actually prohibited in all but three states, but which has crept back into practice unnoticed, in the drive for increased defense production.

In tests it was found that the new water tanks are definite time-savers. Where workers were



Industry's Gunga Din

spending from 5 to 10 minutes going to and returning from stationary drinking-water dispensers, these mobile units eliminate the valuable waste time.

Tanks are made in two models. One can be carried on the back, and the other at the carrier's side. Both are made from lightweight metals and have adjustable shoulder straps, a paper cup dispenser, and standard faucet. A large mouth allows quick filling and easy cleaning. Both models can be had with a sturdy canvas jacket that has a hair-felt lining which serves as both insulation against hot and cold, and as a padding for the carrier's comfort.

## MORE WORK

From Existing Tools to Increase Production

**I**N A single airplane engine there are often 900 different parts; counting duplicate parts, a total of more than 8000 pieces of metal. And with the exception of the rocker arms, every fraction of every square inch of these pieces must be machined. In producing a single 75mm shell and fuse there

are more than 100 separate machine operations. There are 3390 separate machine operations on the parts of a .50-caliber machine gun. Production of an aircraft engine may involve as high as 45,000 separate operations on machine tools.

These illustrations are typical of the defense program as a whole. The volume of machine tool work in defense industries is enormous. Expanding machine tool output is a very different proposition from expanding output of a single article, such as a lawn mower.

In size, machine tools range all the way from that of a sewing machine to that of a two-story house. In cost, they range from less than \$50 to over \$50,000. Machine tools must be designed to do the particular job for which they are to be used.

Therefore the machine tool industry could not use the principles of mass production. Machine tools, on the whole, have to be built to order, and this takes time.

If every machine tool operator of this country would step up his output by 10 percent, the result in increased performance would be the equivalent of a whole year's production of new machine tools.

Of course, we can attack the situation from a more wasteful point of view. We can build dozens of new plants, train thousands of new men, sub-contract more extensively. But all this takes more money, and what is still more important, it takes more time. Certainly it would seem vital at this particular juncture to make an "all-out" effort to get maximum productivity out of existing machine tools. With that behind us, we would then be in a position to know concretely how many more machine tools, how many more new plants, and how many more new men would really be required.—*Charles J. Stillwell, president of the Warner & Swasey Company, in The Clevelander.*

## HARDENED STEEL

New Process Recalls Fame of Damascus Blades

**A** NEW method of hardening the surface of steel by the use of synthetic urea was described recently by Ray P. Dunn, research metallurgist of the Electro Manganese Corporation; W. B. F. Mackay, flying officer, Royal Canadian Air

Force; and Prof. Ralph L. Dowdell, professor of metallography, University of Minnesota.

The use of synthetic urea as a source of nitrogen in the "nitriding" of steel was investigated because it is cheap, easy to handle, can be obtained in commercially pure crystals, and gives off ammonia gas, a compound of nitrogen and hydrogen, when heated to 270 degrees, Fahrenheit.

This process brings to mind the famous Damascus blade of medieval times, which is said to have been surface-hardened by the use of camel's dung. If so, these early artificers were unwittingly applying a crude form of the modern process of nitriding steel.

The present investigators tested their process on small specimens of three types of steel, using different furnace temperatures to ascertain the best conditions. Hardness tests on the nitrated specimens showed that high commercial hardness can be obtained with the urea method and the conclusion was drawn that the method has distinct commercial possibilities.

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**REFLECTORS:** Silvered glass reflectors are being used to replace highly polished aluminum reflectors in the pendent type street light manufactured by one large electric company.

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## RESEARCH MILLIONS

### New Record Set For Expenditures

**B**REAKING their own records for spending millions to develop new American-made products, manufacturing industries throughout the country invested \$117,490,000 into research during 1941 for America's future.

Contrary to the wide belief that big companies do all the research work, little and medium-sized companies spend relatively as much as big companies on experiments and tests and inventing, Robert I. Lund, chairman of the National Association of Manufacturers' committee on patents and research, reports as the result of a study of 1008 firms, conducted by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

Only 8 percent of the companies

reporting research outlay said that they are spending less than in 1940, while 43 percent said they are spending the same as in 1940, and 49 percent are spending more. Companies with research programs averaged more than \$116,000 per company last year.

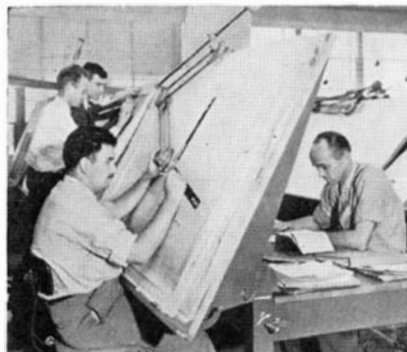
"Here is tangible evidence of industry's faith in America's future," declared Mr. Lund. "In industrial research lies the great hope for re-employment, for productive application of savings, and for the beneficial utilization of war production plants."—*Science Service*.

## DRAFTING BOARD

### Cranks Up and Down, Provides Comfort

**A**N ENGINEERING drafting board which cranks up and down is a new development of the engineering department of The Glenn L. Martin Company. Taking a load off the feet and stomachs of the men who have spent most of their lives standing or leaning over tables, the new board now seats them comfortably in swivel chairs.

When not being used, the board lies flat on its desk-top. The drafts-



Less clean-up time required

man, seated in his chair, twirls a small window-type crank which raises the board to the desired level. Then, by means of a horizontal bar, beneath the edge of the board, he adjusts it to the proper angle. The board is kept in firm position by a "dog," controlled by the bar, which drops into a notched locking sector. These tables are set in parallel rows so that the draftsman uses his own adjustable table for drawing and with but a half-turn of his chair has immediate use of the desk half of the combination table behind him.

Draftsmen, who for many years endured the strain of being on their

feet all day at the old tables, like the new invention and contend that they accomplish a considerably greater amount of work and with noticeably less fatigue at the end of a long day.

Another advantage of this tilted drawing surface is the greatly diminished amount of soiling due to perspiration and the rubbing in of pencil dust, as the draftsman stretches and reaches across his work. This in itself is quite a time-saving factor as finished work requires less cleaning-up.

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**NAILS**—Five tons of nails—100 kegs weighing 100 pounds each—are used every day at the Windsor plant of the Ford Motor Company of Canada in crating military vehicles for shipment to the British armies overseas.

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## REFRIGERATION

### Has Many Uses, Even in Defense

**O**F COURSE refrigeration will keep vegetables and meats from spoiling and occasionally give you the shivers when you enter a really air conditioned room on a hot day. But what about these less usual cases. Iced cookies are kept firm, do not stick together. Coffee is kept fresh. Bread and pastry are kept from molding. Sugar and salt kept in the refrigerator do not get lumpy. Cigars are kept in good condition. Cosmetics do not get soft and oily. Medicinals such as cod-liver oil and mineral oil if well chilled show a reduction of odor and taste intensity and are more palatable. Even a young lady reports that her angora sweater does not rub off on her boy-friend if put in the refrigerator for a couple of hours before wearing.

Refrigeration even has its place in the defense program, and not only to chill soft drinks and provide ice cubes for more authoritative beverages. Mercury fulminate is the detonator which sets off the charge of powder in a cartridge and of other explosives in shells. As one may imagine from that use it explodes pretty readily and isn't manufactured in the center of any of our large cities.

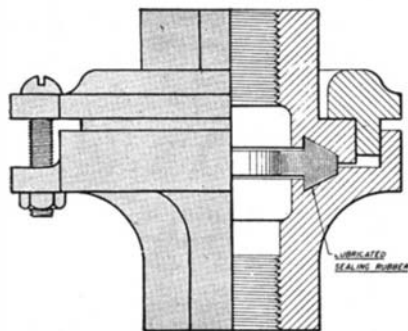
An explosion is a chemical reaction, therefore is slowed down with decrease in temperature, gen-

erally lessened in rate by one-half for every decline in temperature of 10 degrees, Centigrade. So mercury fulminate is stored in refrigerators until ready to be used, as a means of increasing safety in handling it.—*The Chemical Digest*.

## LEAD LUBRICANT

### Combined In A Rubber Gasket

**T**HE lubricating qualities of lead are serving a useful purpose in a new type of swing joint for low-



Powdered lead in rubber gasket

pressure steam lines developed by the Patterson-Ballagh Corporation. The secret of the efficiency of the joint lies in a rubber gasket, into which powdered lead is milled before the gasket is shaped.

Because of the lubricating action of the lead, it is claimed that the new joint turns more freely under pressure than other types and that the lead lengthens the life of the gasket.

As the cross sectional drawing herewith indicates, the lead-rubber gasket is specially shaped to insure a tight seal and at the same time provide flexibility to the joint.

The swing joint, which handles steam pressures up to 100 pounds, is designed for use on moving machines or equipment which are connected to stationary steamlines. Typical applications are steam lines on rubber molding and chemical equipment.

## AND NOW SHELLS

### A Long Step From Automatic Pencils

**M**ASS production methods, as developed by American industry, are being effectively applied to the manufacture of war materials for the national defense program in hundreds of factories, large and

small. Most of these plants had been making articles for peacetime consumption. Now they have converted many of their machines and tools for the production of instruments of war.

An interesting example is the case of Paul Hauton, consulting engineer, who gathered a group of young engineers, 18 years ago, and organized the Scripto Manufacturing Company in Atlanta, Georgia, which today produces from 13 to 15 million automatic pencils a year. These pencils are sold throughout the world for ten cents or the equivalent.

When the national defense program got under way, Scripto was given an order to make two million brass boosters for artillery shells. Engineers estimated that by working 24 hours a day, 1000 men could produce 10,000 boosters a week at a cost of from \$1.75 to \$2.50 each. After months of designing gages, making tools, and building machinery, Scripto was ready to begin production. With just 150 workers Scripto turned out tens of thousands of boosters a week, and they only cost the Army 55 to 75 cents each.

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**TRUCKS: One out of every twenty trucks operating on the highways of United States is owned and operated by local, state, or federal government units.**

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## HIGH GLOSS

### Liquid Plastic Used in Printing Process

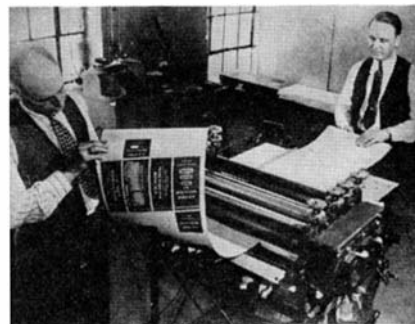
**A** HIGH-GLOSS surface applied over any type of printed matter on heavy paper or cardboard, and which is designed to replace present varnishing and other methods, is simply achieved with a machine which applies a molten coating of plastics either over the printing for enhancement or as a protective interior coating.

The plastic material used is reduced to liquid form by heat, there being no solvents or liquid carrier used. Hardening of the film is obtained by chilling alone, eliminating any drying or racking; the piece is finished when it leaves the machine.

The plastic is put into a heated tank or reservoir, from which it is picked up by an application roll,

which in turn is doctored to give the proper coverage. A pressure roller is adjusted by adjustment screws and from this point the piece is carried between polishing rolls which are adjustable for the weight and character of the sheet. All heated parts are thermostatically controlled to operate at varying temperatures, depending upon the coating material used.

The chemicals used in the process, developed by Bert C. Miller, Inc., are specially formulated materials to give the desired characteristics to the particular job. For example, where an extremely high gloss is desired, with full flexibility at the folds, one material is used; should a very high degree of greaseproofness be desired, another material may be used. The



Over-printing with plastic

range of materials is quite wide and designed to cover most any requirement.

When box blanks are coated they may then go directly to the gluing machine, but special glues for holding on waterproof surfaces are necessary.

## WELDING

### Experiments Shed Light on Effect of Rod Temper

**"R**ESULTS of extensive welding experiments with rods of nickel, Monel, and Inconel, in which the nature of the wire was varied from the soft, fully annealed to cold drawn hard tempered condition, proved that the condition of temper of the core wire had no effect on the resulting weld." This statement was made by F. G. Flocke and K. M. Spicer, welding technicians of the International Nickel Company, in a paper entitled, "A Study of the Effect of Core Wire Temper on the Quality of Welds in Nickel, Monel, and Inconel," presented before the Annual Meeting of the American Welding Society.



# INDUSTRIAL TRENDS

## MOLYBDENUM LOOKS UP

**T**UNGSTEN, nickel, vanadium, chromium, and molybdenum are five elements that hold places of importance in the steel industry; they are used in varying proportions in steel alloys to produce resulting metals that have characteristics which fit a wide variety of purposes. Yet of these five elements, molybdenum holds a unique advantage over the other four. It is the only one of the five that is currently produced in sufficiently large quantities in the United States to meet present needs. In the case of the other four, relatively large quantities must be imported to supplement our own supplies. And, at the time of writing, it appears that at least two of these needed alloying metals will be available in even smaller quantities than in the recent past; much of our chromium comes from the Philippines and of our tungsten from China.

The properties which molybdenum impart to alloy steels include an increase in the elastic limit of the metal and in resistance to impact and other stresses. "Moly," as the element is frequently called, is also used in the manufacture of stainless steels.

Molybdenum may be used alone in producing high-strength steel alloys or in conjunction with one or more other alloying metals. Now, in view of the decreasing supplies of some of the other ingredients of alloys, and even complete unavailability in some cases, it is no matter of wonder that increased attention is being given to research directed along the lines of finding the best ways of getting the most advantageous results with this relatively plentiful element. It is no secret that these researches are successful in many respects and that new uses being found for moly will find permanent places in industry. When the world returns to normal, and other steel alloying elements once more become available, they will find moly well up on top of the pile, doing jobs that they used to do and in many cases doing them just as well and just as economically or better and cheaper.

## CORK FACES TROUBLE

**D**ESPITE continuing endeavors to grow satisfactory cork trees in the United States, particularly in southern California, the supply of commercial cork still comes from countries bordering the western Mediterranean. It is thus obvious that those industries in the United States which require cork for any purpose are facing a production problem of no small moment.

Of the 150,000 tons of cork normally consumed each year in this country, some 70 percent goes for insulation purposes, 16 percent to crown corks and gaskets, 8 percent to linoleum, and the remainder to life preservers and other cork products including solid corks for bottles, according to *Barron's*.

Let's get some of these uses down on their backs and examine them in the light of possible alternate materials, thus getting a view of the possible trends

which must result if our cork supply is cut off or even drastically reduced.

**Insulation:** The tiny air cells in cork give the material its outstanding insulation properties. But glass wool, rock (mineral) wool, and many wood and other vegetable fibers have similar properties and can be produced in large quantities.

**Crown corks and gaskets:** These two products use cork in thin sheet form. Several forms of synthetic rubber are possible alternates in these fields, as are also other substitutes, all of which have the disadvantage of higher cost, but the advantage of availability. Gaskets, used in internal combustion engines, stand the best chance of continuing to be made of cork as long as any of the material is available.

**Linoleum:** Very little cork is used in present-day linoleum, except in the heavy-duty types. Advances in the linoleum industry have produced many satisfactory substitutes long before the exigencies of war made them necessary. Thus there is already a foundation for production of all needed linoleum without cork.

**Life preservers:** Balsa wood and kapok are logical substitutes as long as they can be obtained. Then there is the inflatable type, already in wide use, which depends on carbon dioxide to furnish flotation.

**Solid corks:** Many whiskey, wine, and other liquid containers are now being sealed with metal and composition screw caps using inserts similar to those in crown caps, placing this problem in the same category with crowns, if and when the cork shortage forces all bottlers to turn to this type of closure.

All in all, it does not seem that the cork situation is so serious that it cannot be met by ingenuity, although it will undoubtedly mean serious and expensive readjustment throughout the industry.

## WHAT ABOUT THE WAR?

**W**HEN "Industrial Trends" was first inaugurated as a feature in *Scientific American*, its purpose, which is still being pursued, was to acquaint readers with those phases of the progress of science and industry which, because of their partly speculative nature, could not always be treated by the straight reporting technique which pertains in the rest of the magazine.

Now we have come to an important crisis in world events. At the time of writing, the flames of war have scorched American possessions, continental United States is rapidly preparing to face possible invasion, every effort has been turned toward production of those military and naval materials that are essential to the protection of our country and the successful waging of war against aggression.

Still the trends of industry remain of outstanding importance. Higher production speeds are being gained in many lines; new and better methods are being developed under the pressure of necessity. And out of the lessons that industry is learning are coming the trends of peace-time production—new materials, improved processes, industries based on products heretofore unknown.

More than ever, then, it is essential to keep an eye on the rapidly changing picture of industry if trends are to be projected into the future when human beings turn from Mars to Mother Earth and once more take up their normal lives.

—The Editors

# Stellar Advertising Signs

## Neon, So Rare on Earth, Proves to be 1000 Times More Abundant in the Stars

**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

**T**HE average citizen knows more about chemistry than did his predecessor 50 years ago — at least about the names of things and some of their properties. In those days chromium was known to most folks, if at all, as a constituent of certain paints. Now its appearance is so familiar that we talk of the “chromium-plated” type of architecture. But a little longer ago, aluminum was a costly curiosity — now it is even more important in defense than in the household.

A list of all the elements which have passed from the unfamiliar to the familiar would be fairly long. Some of them, like the two just mentioned, occur in great quantities, and owe their changed economic status to the development of practical methods for producing and utilizing them. Others, like tungsten, are rare but have found important technical applications. Should we ask what is the rarest element which is now utilized in a manner familiar to everyone, the answer must, of course, be radium — whose use in luminous paint depends on its most distinctive property. Next to this comes neon, which is unique in being commercially valuable solely for its spectroscopic properties. Like all other gases, it can be set shining by a high-tension discharge; but no other gives off light of such esthetic appeal.

Argon has a spectrum exactly like neon in structure — they can be matched line for line — but the argon lines corresponding to the great group of neon lines in the red are in the infra-red, or so near it that they are hardly visible, so that an argon tube shines with a feeble purplish light (compounded from fainter lines in various parts of the visible spectrum) and has no advertising value.

Neon forms 1/55,000 part by

volume, or 1/77,000 by weight, of the atmosphere, which itself has only a millionth part of the weight of the whole earth. It was formerly supposed that neon, which does not combine chemically, must be absent from the body of the earth; but Lord Rayleigh, after a very careful investigation, found that igneous rocks contain, on the average, one cubic centimeter of neon in 12 tons, or one part in 14 billions by weight.

These are, of course, surface rocks. No one knows whether the deeper rocky part of the earth contains the same proportion. If it does, the whole amount of neon trapped in the solid body of our planet comes out four times that present in the atmosphere. On this admittedly uncertain basis, it appears that neon accounts for only about one ten-billionth part by weight of the whole earth.

**I**N THE atmosphere, argon is 520 times more abundant than neon by volume, and very nearly 1000 times by weight. Rayleigh finds about 500 times more argon than neon in the rocks.

Most of the elements which we call “rare” are far more abundant on earth than neon. In the surface rocks (which alone can be analyzed), there is one part in ten millions of silver and one in 200 millions of gold or platinum. The rarest of the “rare earths” are more abundant than silver.

If neon was as rare in the heavens as on earth, we could not expect to find perceptible traces of its lines in any spectra — but in some cases they are conspicuous. Lines of neutral neon — the very ones which make neon signs so conspicuous — appear in absorption in the spectrum of stars like Rigel, and lines of ionized neon in hotter stars. The gaseous nebulae, too, show neon lines in their spec-

tra (forbidden lines, as in the case of other elements). Some lines of argon have been observed, both in stars and nebulae, but these are fainter, indicating that the relative abundance of the two gases is reversed.

From measures of the widths of the absorption lines in good stellar spectra, the relative abundance of the elements which produce them can be determined. An attack upon this problem was made just before the war by Unsöld, a first-rate German astrophysicist, using spectra taken for the purpose at the McDonald Observatory in Texas. The hot star, Tau Scorpii (next to Antares on the left), proved especially well adapted for this study, as its spectrum is full of sharp lines. A few copies of the resulting paper have reached America. The methods of calculation, some of which are new and very ingenious, need not be described here; but the results are of great interest.

**L**INES of only a few metals were observable, but these are among the most abundant in the Sun and the cooler stars, and afford a connection with our previous knowledge. Magnesium and silicon are about equally abundant (as in the Sun) and ten times more so than aluminum. Taking these two as a standard, the amount of carbon, by weight, is approximately 1½, of nitrogen 3, of oxygen 10, and of neon 15. Neon is the most abundant element (whether by weight or number of atoms) except for the lightest of all — the amount of hydrogen by weight being 600, and of helium 450.

The enormous abundance of hydrogen has long been known, and that of helium anticipated — though these are the first numerical data. But the high abundance of neon was unexpected. The evidence in its favor is fully convincing, and any surprise at it is only one more indication how much our terrestrial experience subconsciously influences our thinking.

It will be of great interest to test the relative abundance of neon and oxygen in other stars which show the lines of both, and this will doubtless be done before long. But it is highly improbable that the conclusion that neon is among the most abundant of all the elements after the first two will be upset. We need not worry about the Sun, for a simple calculation shows that, at its low temperature, even the strongest neon lines

(being absorbed only by highly excited atoms) would not show unless it was very much more abundant than oxygen.

But the extreme rarity of neon on earth urgently demands some explanation. There is at least a billion times more oxygen than neon on our planet. How could such a tremendous difference have arisen?

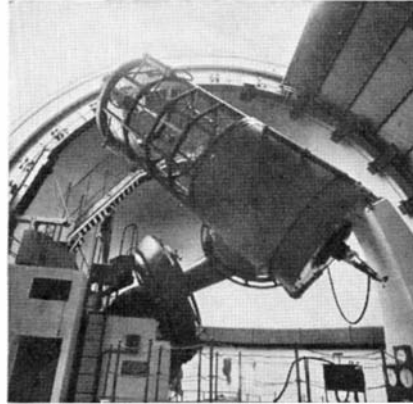
The answer is not really far to seek. The relative proportions of the heavier elements, from sodium onward, are nearly the same in the Earth and the Sun. In several cases, when previous estimates of the abundance in one or the other have been corrected on the basis of better evidence, the agreement has been improved. In other words, the relative proportions of all those elements which form compounds that are solid or liquid at the temperature of molten rock are nearly the same, while those elements whose compounds are gaseous at such a temperature are much less abundant on the earth.

This is exactly what might be expected if the material which now forms our planet had condensed out of a cooling, but still hot, gaseous mixture similar in composition to the Sun or the stars. Just as rain drops or snow flakes form in moist, cooling air — although water-vapor forms but a small percentage of the whole — compounds of high melting and boiling points would condense out of the gas. With hydrogen present in large excess, the more easily reducible metals, including iron, would separate out wholly or partly in metallic form. Difficultly reducible metals — magnesium, aluminum, calcium, sodium, and also silicon — would combine with oxygen, and condense into a silicate magma. Large quantities of oxygen would thus enter the melt, and smaller quantities of carbon, or even of nitrogen, might be included; but helium, neon, and argon could at best be dissolved by it, probably in very small amounts, and the great excess of hydrogen would remain free.

**S**PITZER'S investigations (reported on in these columns in March, 1940) show that such condensation would not occur in a "filament" of matter stripped off by the collision of two stars; but they do not prove that condensed droplets, or large masses, could never be formed under any circumstances. The composition of our planet affords the

best reason for supposing that, at some time and in some way, it *was* so formed.

**O**UR planet is now surrounded by vast empty spaces, hence it must have escaped from the gas-cloud which is here postulated. When it began an independent existence, it was presumably very hot even at the surface. It may have carried with it some of the lighter permanent gases; but hydrogen and helium would rapidly escape and, if it was hot enough,



**The great 80-inch telescope at McDonald Observatory, where the work described was done**

neon would escape too, and also water-vapor and nitrogen, so far as the  $N_2$  molecule was dissociated into atoms. The probable later history is familiar. The dense metal sank to the center, where it still forms a liquid core. The silicate mantle, 1800 miles thick, gradually solidified, beginning at the bottom, where the pressure raised the melting-point. As it froze, great quantities of water-vapor and other gases were released, which rose to the surface — now not hot enough to admit of the escape of these gases against gravity — and formed a great atmosphere, mostly of steam. When the surface grew cool enough, the water of the oceans condensed, leaving a permanent atmosphere.

The oxygen in our present atmosphere may be accounted for by decomposition of carbon dioxide by plants since life began. The nitrogen, neon, and argon must have been there before the oceans condensed. Whether they were there before the great lava-mantle froze is uncertain.

Rayleigh, in the work mentioned above, found that there is a small, but easily measurable, amount of nitrogen in ordinary rocks, amounting to about 1/200 of one

percent by weight. On this basis, the rocky mantle still contains 50 times as much nitrogen as the atmosphere.

The nitrogen in the rocks is, at least in part, chemically combined, and is converted into ammonia by heating with alkali. This important discovery makes it entirely possible that the nitrogen of the atmosphere is not primitive, but was liberated by physico-chemical processes during the solidification of the rocks.

Oxygen accounts for nearly half the weight of the rocks, and is about 10,000 times more abundant than the nitrogen — while in the stars the difference is the other way. This difference may be taken as a measure of the average relative affinity (to use an old word) of the rock-forming metals for the two elements.

Similar reasoning about neon and argon would have to start with some assumption how they got into the rocks. At present, as Rayleigh suggests, they are probably trapped, an atom here and there, in the lattices of atoms composing the crystals. Whether they were previously dissolved in the molten silicates, and, if so, how much would have been set free on solidification, is a question on which the present writer has no data. Until more is known, it is hard to be sure that any constituent of the present atmosphere consists mainly of gas which was in the original atmosphere of the liquid planet.

**O**NE puzzle still remains. Lines of argon have been identified in the stars and the nebulae, but are weaker than those of neon, and it seems quite safe to conclude that argon is less abundant than neon, cosmically speaking. We must await measures of the intensity of the argon lines to find out how much less abundant it is. But it is clear that neon is at least a thousand times more abundant, compared with argon, in the stars than in the Earth's atmosphere. Rayleigh finds the same to be true for the gases in igneous rocks. Whether this means that the rocks got these gases in some way from the atmosphere, or that the original molten rocks in some strange way dissolved argon a thousand times more readily than neon, no one can say.

It is stimulating to have some things left for future discovery. — *Princeton University Observatory, December 5, 1941.*

# Ancient Ostia

## Ignoring Present-Day Strifes, Archeologists

### Unearth Rome's Once-Thriving Seaport

ALINE ABAECHERLI BOYCE

Fellow of the American Academy at Rome

**F**IFTEEN miles west and slightly south of the city of Rome lies the mouth of the River Tiber, where, according to legend, Aeneas, the founder of the Latin race, disembarked at the end of his long journey from Troy after the fall of that famous city. On this spot, it is said, was founded the ancient town of Ostia, in historical times the seaport of Rome. Archeological excavations, however, have indicated that the town actually goes back only to the 4th Century B.C., when Rome sent a military colony to garrison the site. Thereafter, Ostia became a distributing station for grain, and grew and thrived until, in imperial times, it was an emporium of 100,000 inhabitants, many of whom were foreigners from across the seas.

The excavations that have been going on there have revealed the town chiefly in its period of greatest prosperity—from the 2nd to the 4th Century A.D. The "dig" at Ostia is a project of tremendous importance to archeologists all over the world. Ostia has been

undergoing scientific and systematic excavation since 1909, but has recently been uncovered on a large scale in sections previously almost untouched by the spade of the archeologist. For years the excavation has been under the direction of Professor Guido Calza, who has brought to light market buildings, apartment houses, shops, paintings, sculpture, mosaics, and inscriptions that equal, if they do not surpass, important finds of previous campaigns.

**T**O STATE the problem of excavation simply, we have at Ostia a city of the imperial period—that is, the middle of the 1st Century B.C. to the 4th Century A.D.—superimposed upon a city of the Roman republic (4th Century B.C. to 1st Century B.C.). The republican remains must be studied without destroying the younger and therefore higher imperial city, and the imperial city must be reconstructed safely and accurately.

Ostia, like Rome, suffered much in medieval and modern times from pillage for marbles and other

materials, and parts of buildings and statues not previously carried off must be excavated and reconstructed with painstaking care. To quote Professor Calza: "In these works of restoration and reconstruction an attempt has been made to create the most complete picture possible of the ancient buildings, putting back the fragments found in excavating into their original places, which have previously been scientifically ascertained. . . This has also been done to some of the painted ceilings and mosaic floors fallen from above, which have been raised and replaced on their original level. . .



The elegant granary in Ostia

Sometimes, in order better to preserve the paintings, we have protected some of the rooms either by restoring the original vaulted roof or by making a wooden covering."\*

The buildings lie chiefly on either side of a main street, or *decumanus maximus*, which leads from the entrance of the excavations toward the lower reaches of the Tiber. On the bank of the Tiber, opposite Ostia, lies a cemetery of imperial times, which contains the tombs of artisans or engineers connected with the later artificial harbor of Porto—tombs which are striking because of the handsome brick design which adorns their facades. Between this cemetery and the river on the one hand, and the previously excavated parts of Ostia on the other, lie the newly excavated sections, which spread out from the main street in all directions. Within the last five years the size of the excavated portions of the city has doubled, and it is indeed a large town of imperial Rome that the archeologists now can look upon.

Like many cities in ancient Italy, Ostia was surrounded by a wall constructed of large blocks of tufa, a volcanic stone. Before the

\*G. Calza, *Ostia, Historical Guide to the Monuments*, translated by R. Weeden-Cooke, Milano, 1926, pp. 77-8.



The view from the top of the ancient theater (see the text)





In the foreground are big storage jars and a garden, while in the background are the archeologists' excavations in the vicinity of the forum

city wall was built there was a small *castrum*, or fortification, which goes back to the earliest history of the settlement, probably the 4th Century B.C. The gates of the *castrum* and considerable portions of the city wall have been found, though most of the remains are below the ground level. Before passing the foundations of a city gate near the entrance to the excavations, one must walk along that section of the main street which is lined with tombs of various levels and types. There are republican tombs at a lower level, with imperial burials above them; there are *columbaria*, or dove-cotes, which held cinerary urns, and there are sculptured sarcophagi indicating inhumation, or interment, burials. Here and there an inscription gives the name and trade or official position of the dead.

**S**TREETS lined with tombs, just outside the city walls, are a common feature of ancient cities. The Via Appia, leading south from Rome, ancient Rome's first great military highway, is perhaps the most famous example of such a street, though other roads leading from Rome were lined with tombs. Similar streets exist in Pompeii, and tombs were found on the outskirts of Ostia, the best preserved being the brick-faced tombs on the "Sacred Island" across the Tiber.

In the city proper, along the main street, which is crossed at intervals by minor streets, lie baths, warehouses, police barracks, temples, and a theater. From the

top of this theater one obtains an excellent view of some of the excavations now in progress—a view shown in one of the illustrations. Beyond the theater lies a large rectangular open space, green with long, straggling grass, in the center of which stand the remains of a temple, consisting of the podium, stairway, and two columns of the porch. The remains of a colonnade surround the open space and behind the colonnade on three sides are traces of the offices of transport and merchant guilds from many towns of the Roman empire. The names of some of the guilds, together with the names of the towns and the symbols of the guilds which they represent, are still to be seen on the black and white mosaic floors of the offices. For the economic history of Rome these inscriptions in mosaic are of great interest. As one might expect, the rear of this enclosure lay close to the ancient course of the Tiber, which has since changed its direction.

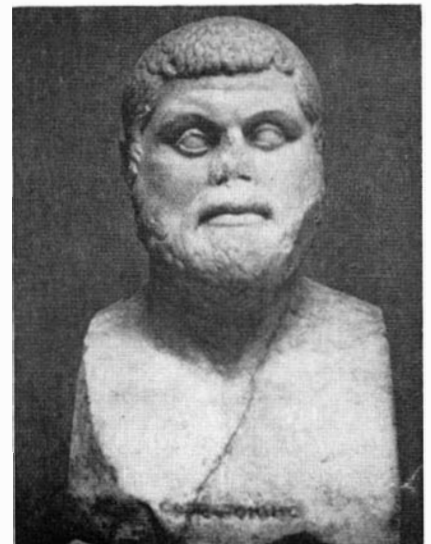
On the main street, opposite the theater, are some of the new excavations of large public buildings, and on lesser streets are apartment houses and warehouses. One of the latter, shown in a photograph, is a granary, but it has a fine entrance and a handsome courtyard which anticipate in architectural style the palaces of the renaissance. In several storehouses, one of which has recently been excavated, and which also is illustrated here, can be seen immense earthen storage jars.

The apartment houses of Ostia are of interest because they, too,

provide a precedent for renaissance and modern Roman houses, and because they are in direct contrast, moreover, to the suburban style of ancient house with leisurely atrium and peristyle, which is the dominant type in Pompeii. At Pompeii one occasionally finds a staircase leading up to a second story. At Ostia the apartment houses had several additional stories, and sometimes on the upper floors there were balconies reminding one of the balconies on apartment houses in the Rome of modern times.

**F**ARTHER along the main street one begins to realize from the freshly uncovered appearance of the bricks that he has entered a newly excavated section—from here on all of the excavations are new. There appear two charming shops—a fish market with a marble table for wares, and a mosaic floor with fish outlined in black tesserae, or little black squares; and a second shop with a marble, rectangular basin surmounted by two thin, graceful columns. Of the shops throughout the old and new excavations, not the least interesting are the bars, or *thermopolia*; that is, "hot-drink shops." Some of the little wine-shops in Rome today bear a strong resemblance to these *thermopolia*.

One of the prettiest buildings in the new section has a dining room with marble-encrusted walls and a multi-colored marble floor, beautifully reconstructed from the ancient marbles found on the spot. This room is entered from a *nymphaeum*, or fountain room. Here, on one side, water flowed from the wall over thin slabs of marble



Portrait bust of Themistocles



4th Century Christian basilica

overlapping in the style of our slate or tile roofs. Below, there emerge some pipes, probably showing that water also flowed from terminal heads of fish or animals such as often provide the inlets for our modern swimming pools. In the background, a columned arcade, comparable in style to renaissance loggias, forms the only surviving decorative feature of the fountain. In the foreground, a small plot of grass touches off the scene, and one can well imagine that it was a handsome and lively fountain that some wealthy citizen of Ostia built here.

**I**N GENERAL, the streets at Ostia are laid out according to a very regular plan. But among the recent excavations there lie close together three temples whose orientation is quite haphazard. All these temples show, at a lower level, platforms which, perhaps, go back to the 2nd Century B.C. The largest of them has a dedicatory inscription to the god Heracles.

The new excavations have brought to light many interesting pieces of sculpture—statues, portrait busts, and reliefs. The most recent finds are placed in a large vaulted room of one of the ancient buildings. One of these is a large statue of the oriental god Mithras slaying a bull, a common Mithraic motif. Shrines of Mithras are always turning up at Ostia. There are also in this room a statue of the emperor Trajan wearing a cuirass of unique style, a portrait bust (see photograph) inscribed "Themistocles," the curious nature of which has given archeologists some trouble; also, reliefs of shop scenes, and a relief possibly representing the birth of Minerva from the head of Zeus. A small permanent museum houses the sculpture, inscriptions, and small objects previously found. Of the inscrip-

tions, the fragments of a Roman calendar discovered a few years ago are the most important. There also is a fine collection of portrait heads.

The most spectacular event occurring at the dig was the discovery of a 4th Century Christian basilica on the north side of the main street (see the illustration). This building had a vestibule with an entrance formed by two arches, a type which one naturally compares with old churches in Rome having porticos. The features of chief interest in it are a baptismal basin and an architrave on which are inscribed the Christian monogram and the names of four Biblical rivers, including the Tigris and Euphrates. The basilica has two apses and two naves separated by a row of columns, and on the eastern side there are several rooms that must have been side chapels.

The last chapter of imperial Ostia's history was not a spectacular one, when compared with that of Pompeii, a city which was completely lost in one of the world's major catastrophes, and the recovery of which has therefore been widely publicized. For Ostia was never completely lost, but suffered a gradual and pathetic decline as the result of neglect and plunder. Early in the imperial period the first artificial port was built at the mouth of the Tiber to replace the port of Ostia, which was no longer adequate to handle the volume of trade between Rome and towns beyond the seas, but it was not until the reign of Constantine the Great, in the 4th Century A.D., that this new port was favored so completely as to exclude Ostia entirely from commercial traffic between Rome and the sea. The more interesting is it, therefore, that in this period of the city's decline a Christian basilica of considerable size was superimposed on remains of pagan buildings.

Not long after the erection of this church, Ostia became associated with one of the great figures of church history, for it was to this town that Saint Augustine came with his mother, Saint Monica, to take ship for his home in Africa after his conversion. Saint Monica never sailed, for here—as Augustine tells us in the ninth book of his *Confessions*—after nine days of illness, she died. Her death took place in a little inn overlooking a garden. Such a gar-

den one may see today in Ostia, giving warmth and life to the ancient bricks and mortar that surround it. Archeologists like to think that now they may look upon the garden of the little inn where the devout Monica spent her last days, and they like to think, too, that perhaps the saint and his mother stopped and worshipped in the little church which still stands there.



## FOSSIL

### World's Oldest Evidence Of Animal Life

**E**ARLIEST known record of animal life on earth may be the fossil imprint of a stranded jellyfish on a slab of fine-grained red sandstone now in the geological collections of the Smithsonian Institution. It came from pre-Cambrian deposits at the bottom of the Grand Canyon of Arizona, which are more than half a billion years old.

Dr. R. S. Bassler, head curator of geology at the United States National Museum, states that the imprint has all the appearance of having been made by a jellyfish. It resembles jellyfish fossils of Cambrian age, earliest period from which animal remains are at all numerous. It also resembles the dried-up stranded jellyfish washed ashore on modern beaches. There are ripple-marks, as of an ancient beach, on the Smithsonian specimen, and the lobed structure of the animal is impressed on these.

Pre-Cambrian rocks are singularly empty of traces of animal life, despite the high probability that the earth had inhabitants at that remote time. During the Cambrian age, which began about 550,000,000 years ago and lasted 70,000,000 years, there were abundant animals, representing practically all of the major zoological groups except the vertebrates. This argues that a long period of evolution must have preceded the Cambrian. But for some reason (possibly the lack of lime in the waters of those days) they have left no shells or other hard parts by which they could be recognized. Hence the great scientific interest of the jellyfish markings on the ancient stone slab.—*Science Service.*

# No Mystery In Pep

## Seven Simple Rules for Getting and Maintaining a Reserve of Vigor

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**D**O YOU have more horsepower than you need for the day's activities?

Your automobile quite likely has much more horsepower than is usually used. This is reserve power, power which gives it pep. Some energetic people, also, have more energy than they use up and can finish the day with as much pep as they began it.

The chief source of this human horsepower, this reserve of vigor, comes from protective eating. Everyone understands the importance of foods, but few realize the relationship which exists between what they eat and how vigorous they are. Those few who are aware of the influence that the daily foods have on one's daily pep, often go off on a tangent; they become food faddists, and try to subsist on some fearsome combinations, such as honey and clabbered milk. Or, they hear about some fanatical, but impressive, dietary cult, and religiously follow its leader, avoiding combinations of food which he claims are harmful.

It is a scientific fact that these dietary cults, almost without exception, are injurious to vigor and pep. Yet human nature seems to like to embrace all kinds of new and silly fads, instead of old, monotonous, scientific truths. I think one reason for this is the ease with which a fad can be remembered—avoid carbohydrates and proteins at the same meal, to quote from one cult. Now that surely is easily remembered and easy to practice, but it has no scientific merit.

Scientific rules, in contrast, are usually complicated, loaded with chemistry and strange weights, and completely bewildering to the average person. Protective eating, however, can be reduced to simple rules, which require no chemical knowledge, and do not tax the memory. In this article we shall

take up rules for protective eating, or *Rules for Getting a Reserve of Vigor*. These rules will be reduced to such simple and essential terms that any average adult can remember them, and follow them with little effort, and then can learn to conserve the same vigor after getting it.

### **Rule 1: Eat three different vegetables a day**

In this era of highly refined, ready-prepared foods, quick lunch sandwiches at the soda fountain, nine people out of ten do not get sufficient vitamins and minerals in their daily food. The vigorous pioneers of a century ago got a more adequate supply of vitamins and minerals than do their pepleless descendants of the present day. Even the prisons and almshouses of the 17th and 18th Centuries, dismal and unsanitary as they were, served food which made for more vigor than the wealthy get in their luxurious clubs today.

Moderns need to watch carefully to make certain that they get three different vegetables a day so that they may keep up a reserve of vigor. The vitamins and minerals give a little extra horsepower, which is sorely needed by almost everyone. (Potatoes, whether white or sweet, do not count in this discussion, as vegetables.)

The vegetables do not need to be fresh; canned will do just as well. They can be in soup. They can be raw, or cooked, or warmed over. It is not complicated—just remember three different vegetables a day, in addition to potatoes.

It is helpful to have one of the vegetables of the leafy variety, such as lettuce, cabbage, broccoli, or even spinach.

Some time ago a 35-year-old advertising man who had suddenly found himself making big money, confessed to me privately that he felt himself slipping. He was worried because his thinking was slowing down, as were his movements—he felt tired all the time. In addition, he was bothered by a

little rash, on which he had tried all sorts of patent ointments.

He did not realize, until it was pointed out to him, that his new prosperity was the cause of all this. The rash, his failing memory, and increasing tiredness, were all indications that he was violating the Rules for Getting a Reserve of Vigor. Since he had been earning a fat salary, he had been indulging in his lifelong suppressed desire to eat all the steak he wanted. Five nights a week he would feast on a double steak, a dill pickle, and a thick slice of pie. He was putting on a little weight, and thought that was a sign of good health. Occasionally he would have one vegetable at lunch, but more often he had none.

He did not dislike vegetables. He merely wanted to eat the more expensive foods which he now could afford. Of course, his diet was seriously off balance. His rash was apparently a dietary dermatitis. The rash, the slowed thinking, the peplessness, and his bowel trouble, all cleared up within a month after he began to practice these rules. He still had his steak, but it was smaller to make room for two vegetables every night. The story has a happy ending, for he is still in big advertising money. In fact, six months after he began to follow these rules he was given an increase—and he had been definitely on the skids only a short time before he was slowing down—the result of eating too well, rather than wisely.

### **Rule 2: Eat two fruits, or fruit juices daily**

These are also necessary for their vitamin and mineral content, in addition to their moderate regulatory action. As with vegetables, the fruits can be either canned or fresh.

The value of the excellent, modern, refrigerated, fresh fruits and canned juices which have been on the market in quantities only since about 1930, cannot be overestimated for their vigor-renewing value, as well as their luxurious time-saving quality. In contrast, we remember grandma as she used to sweat over her stew kettles canning fruits during the ripening season.

Either the fruits, or the juices, can be used as a between-meal snack, as well as at mealtime. It does not matter when they are taken. A good New England custom, for example, is to eat an apple just before going to bed.

That advertising executive who was slipping now indulges his luxury with a large glass of fruit juice each morning, served on a silver tray while he is shaving. I drink my own glass before I leave the house, to climb Blacksmith Hill Road for the mail each morning, and then come home for breakfast. We always have a dish of fresh fruit in the laboratory for a between-meal snack.

It is easy to get two fruits a day—and equally easy to remember the rule.

**Rule 3: Eat eggs and milk once a day**

These are nourishing foods, as well as protective, but people tend to forget them. They were mainstays in the diet of John D. Rockefeller, Sr., and he did not have a false tooth in his head at the age of 97 years. He would often stop during a round of golf to drink a deep glass of cool milk.

People often ask me if one does not get enough eggs in one's cakes and puddings. The only eggs that count for those who follow this rule are those that do not conceal their identity—an egg that looks up, smiles, and says, "Hello, I am your egg." The only camouflaging the egg can undergo and still count is in an egg-custard. It does not matter how the egg is cooked—it can be deviled, or a pickled egg in the tap room—but it is easiest on the stomach if it has been cooked at the lowest possible temperature, and not very long.

I am also asked if people do not get adequate milk in their puddings. This concealed milk does not count with these rules. The only way the milk may be disguised is in chocolate milk, milk stew, or as cheese. At lunch this noon, for instance, I ate a 12-cent carton full of cottage cheese: A little square of cheese means nothing—it must be a man-sized piece.

That advertising genius who started to skid now drinks a bottle of chocolate milk in the middle of each afternoon, in place of the bottle of imported sparkling water he used to affect in his outburst of first prosperity. He also is pleased with the rule's recommendation of cheese, since it gives him an excuse to order the most rare and expensive varieties with his evening apple pie. (He still wants me to count that pie as one fruit!)

Eat anything else you want, but make sure you get the essential three vegetables, two fruits or juices, egg and milk, as a basic

diet every day. These need emphasis as they are the things folks tend to overlook—few need to be reminded to eat meats and desserts.

**Rule 4: Drink enough water to make your urine a light straw color**

Eight glasses of water a day have often been suggested as the ideal quantity, but some people need more water, and others need less. The best index, and one that is easily followed, is to watch the color of the urine; if you are getting the right amount of water, the urine should be a light straw tint.

Many people avoid water with their meals, in the false belief that it dilutes the gastric juices and slows down digestion. As a matter of fact, however, experiments show conclusively that digestion is actually helped when water is taken along with the food.

Most of the water people need can be taken during the day, before the evening meal, and then one's sleep need not be disturbed by bladder distention. A glass of water, or fruit juice, is desirable the first thing in the morning.

We have water piped from a protected spring on the hillside to our laboratory. Deliciously cool the year 'round, we take many small drinks of this throughout the day, in addition to having it with meals.

Alcoholic drinks contain a large percentage of water, but water disguised in liquor does not count. The alcohol may make a person forget his fatigue temporarily, but it leaves him in a less vigorous condition after the stimulation wears off. For those who must have their drink, cheap gin, or Scotch whiskey have the least undesirable after-effects, especially if one drinks them in plain water.

**Rule 5: Relax residual tensions before, during, and after meals**

"Business man's stomach" is usually attributed to restaurant cooking. Restaurant cooking may not taste like grandmother's, but it is all right, and should not be blamed. The person himself is usually to blame, for he takes his business and his worries to the table with him. He eats in a tensed condition, instead of the ideal, relaxed condition.

Belching, indigestion, a heavy feeling in the stomach, and bowel disturbances are all caused, at times, by lack of relaxation at mealtime. Some specialists claim

this to be the outstanding cause of these vigor-sapping troubles.

I find that folks can remember this rule most easily if they get in the habit of relaxing residual tensions every time they see food or a dining table. Even the sight of someone else eating a candy bar should be a reminder to relax those usually present residual tensions around the jaw, around the eyes and forehead, and on the back of the scalp between the ears.

It is not primarily a question of eating slowly, but of being relaxed in body and mind. Relaxing the residual tensions assures a relaxed spirit, and that is the mealtime goal to be sought.

**Rule 6: Get one hour of sunshine daily**

Five hours of sunshine and a sunburn the first day of vacation do not count. It is the regular daily exposure to the Sun's rays that gives real help. As much of the body as possible should get the kindly rays. I often walk with my hat in my hand in order to have more area exposed to the sunshine. Many city workers, unfortunately, cannot get an hour of natural sunshine daily, so the farmers outclass them in vigor.

It is also difficult to get natural sunshine on much more than the tips of the nose and ears in the winter months, although the entire body would benefit by it. Artificial sunshine lamps can be of service in overcoming this dilemma. If you buy one, make certain that it is approved by the American Medical Association, otherwise you may be buying some wires and switches which appear impressive, but which yield no real benefit. An hour is too long under such a lamp; the book of instructions will tell you how long is safe.

The vigorous, young general manager of a silverware manufacturing company is one of thousands who lets a sunshine lamp help him keep his vigor at a high peak. Each evening before dinner he undresses, takes a 20-minute sun bath, relaxing all the while, and gets up irradiating sunshine himself.

The Sun's rays, as with the three vegetables and two fruits a day, the eggs and milk, plentiful water, and mealtime relaxation, will not produce instantaneous results but 95 out of 100 people will notice definite results in improved vigor sooner or later. How soon depends largely upon the person, upon how starved his body has been for these



neglected essentials, and how faithfully he follows the rules every day—including Sundays and Saturday nights. A single breach of the rules may set one back a couple of weeks.

It takes a week or two for the average person to notice clear-cut results from following these rules. We can't expect to remedy a lifetime of maltreatment of the sources of vigor overnight, especially if we realize that even a week's maltreatment may require a month for recovery.

**Rule 7: Have a complete check-up once a year by a physician and dentist**

Automobiles are examined and tuned up periodically, oil changed, batteries checked—all preventive measures to avoid breakdowns, and to avoid any loss of vigor and pep. People, also, should be looked over at regular yearly intervals. Eyes and teeth, as well as the rest of the body, should be thoroughly examined. Those who wait until there are pains, toothache, noticeable eye strain, are locking the garage after the car has been stolen. Minor physical defects which develop from time to time must be caught early, before they have been able to undermine vigor seriously.

People who are pepless and habitually fatigued should have a basal metabolism included in their examination to discover whether, perchance, a sluggish thyroid is responsible for their lack of vigor. If it is, a glandular prescription usually remedies the condition easily, and restores the vigor.

Many firms require these complete physical examinations once or twice a year for all key employees. The company does not want to take a chance—it costs too much money when an important executive loses his vigor.

One of my closest friends has been very thankful because I insisted that he have a complete examination when his peplessness seemed unexplainable. His physician found nothing, but the dentist discovered some apical abscesses which, when cleared up, seemed almost miraculously to restore him to his old vigor. Another needed eye attention. He had felt that he might need glasses for some time, but shunned an examination because he said, "Glasses make men look like sissies." I pointed out that the real sissy was the man who lacked nerve to wear them.

With another it was a sluggish

thyroid, detected by the metabolism test. He is one of our foremost public speakers—you would gasp if I mentioned his name. His successful career was at stake, because pep and enthusiasm are indispensable for a public speaker. He could no longer even pretend to be energetic on the platform. Audiences that had formerly listened eagerly for each word began to grow restless. Glandular prescriptions made up for the slight deficiency discovered in his thyroid and he is again the popular, enthusiastic speaker.

I am often asked about the usefulness of many common "fatigue remedies" and "pep preparations." Here is a brief summary of current scientific evidence on these:

Yeast, in almost any form, gives renewed vigor. It will seldom be needed, however, by people who follow the rules we have given.

Coffee and tea contain substances which give a temporary boost by lessening the feeling of fatigue for a couple of hours. They do not remove the cause of the fatigue which still remains to sap vigor. "Cokes" are essentially the same as sweetened coffee. Their caffeine gives the same passing lift, but does not make up for lack of vigor.

Sugar and candies will give heavy muscular workers some needed "quick energy" about a half hour after being eaten. People who are in sedentary work may find that these decrease their vigor, however, since they may add more weight, and thus more effort is required to move.

**B**Y FOLLOWING the seven simple rules outlined above, the middle aged can regain much of their lost vigor, and the young will go much longer before losing their youthful vim.

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## YARDSTICK

### For Planning the

#### Daily Diet

**A**MERICANS now have a scientific yardstick for planning the daily diet that will give them health, strength, and morale for total defense. The yardstick, translated from laboratory terms of allowances for vitamins, minerals, protein, fat, and carbohydrate, was announced by Dr. Lydia J. Rob-

erts, head of the department of home economics of the University of Chicago, as follows:

One pint of milk daily for an adult, more for children.

One serving of meat.

One egg daily, or some suitable substitute such as beans.

Two servings of vegetables daily, one of which should be green or yellow.

Two servings of fruit daily, one of which should be a good source of vitamin C, such as the citrus fruits or tomatoes.

Bread, flour, and cereal, most and preferably all of it whole grain or the new, enriched bread, flour, and cereals.

Some butter daily, or margarine with vitamin A added.

Other foods to satisfy the appetite.

Cheaper cuts of meat, Dr. Roberts reminded, are just as nourishing as the more expensive ones.

## NOISE

### Ear Plugs Protect

#### Industrial Workers

**F**ATIGUE, irritability, and nervous exhaustion experienced by workers in or about noisy operations are lessened by the use of Ear Defenders, plugs which reduce loud noises by 35 to 45 decibels or to about 1/10 their former loudness, yet are so designed that warning signals and conversation can easily be heard. The resulting effect from the reduction of noise, it is claimed, will enable the workmen to better concentrate on their jobs and thereby increase their efficiency.

Essentially, each Ear Defender, made by the Mine Safety Appliances Company, is a tapered tube molded from surgical-type soft rubber. Each consists of two barriers, an outer one of metal and an inner one of soft rubber, separated by an air space. The tapered construction permits easy insertion and removal without any danger of coming in contact with the ear drum. The devices can be easily cleaned with soap and water, thus insuring a sanitary article at all times. The cost to the user is thus relatively low in comparison with other ear protectors which must be discarded after being used a short time.

The plugs were designed by Dr. Vern O. Knudsen, an authority on acoustics, and Dr. Carey P. McCord, an industrial health expert.

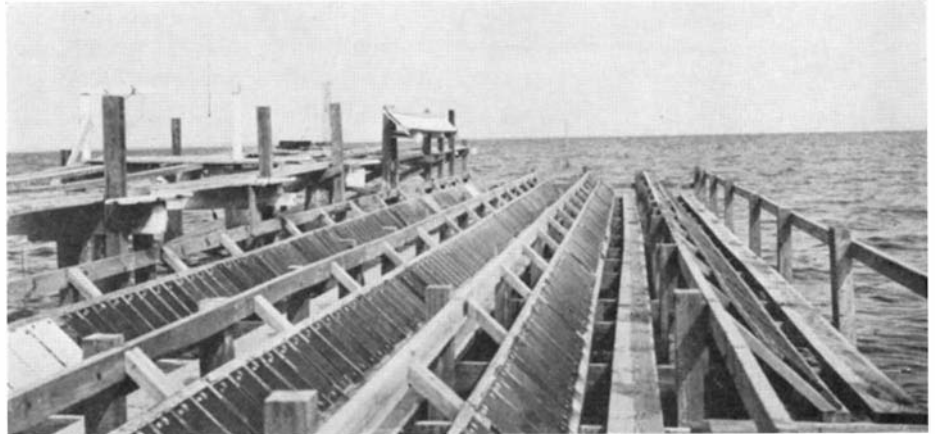
# For Better Paint

## Methods of Testing Surface Coatings for

## Metals Have Definite Place in Maintenance

**I**F THERE'S a paradox confronting every maintenance engineer engaged in testing and selecting metal protective paints for general maintenance work, it might be expressed as "making haste slowly." For, although it is true that accelerated tests provide the engineer with much information about a coating that it would otherwise take many years to obtain under actual service conditions, it is equally true that many accelerated tests may produce results that are not typical of exterior exposure or normal service. Hence a balance must be struck, and a combination of tests must be used, as a brake to guard against the ever-present possibility that a really worthwhile coating will be discarded and an inferior coating will be adopted, on the basis of performance in an isolated test of no practical significance. In other words, the aim of all testing work should be to provide a composite picture of a paint's performance rather than one phase of it.

Because in "weather" lies the



Tide-water tests of painted panels, such as that shown above, call for careful preparation of the test panels and require expert interpretation of the results

● Protection of metal surfaces by paint coatings to prevent corrosion assumes even greater importance as the need increases for conservation of materials and economical maintenance of structures. Yet, as the accompanying article points out, engineers responsible for this work must exercise care in their interpretation of the tests that have come into wide use, correlating results so as to reach a final decision which will be based on a consideration of all the factors that affect surface coatings.—  
*The Editor.* ●

ultimate answer to the durability of most metal protective paints, every engineer has had to ask himself the question, "What is weather?" The plain and simple answer is that it is variable, unreliable, and constantly changing. Montana's weather means armpit-deep snow in winter and blazing hot sun in summer. Atlanta, Georgia's, weather includes, among

other things, a mean yearly precipitation of over 48 inches, and very little of it snow at that.

For many a maintenance engineer, it is a perfectly logical procedure to forego normal weathering panel testing and apply a test section of metal priming paint to an actual structure. While a single exposure of this type cannot be as indicative as desirable, multiple exposures of the same nature on properly prepared surfaces provide a comprehensive background with which there cannot be any argument.

Next best thing to testing a metal protective paint under actual service conditions is to expose test panels of it to the weather, usually on racks facing south to insure the maximum amount of sunshine. Panels of non-copper-bearing black iron are generally employed. Simple as "normal" weathering exposure may seem, it is not without its pitfalls. For example, many of the best metal priming paints are so formulated that they have characteristics which make them totally unsuitable as finishing paints or for lengthy exposure to the weather. However, when properly protected with suitable finishing coats, they do a splendid job of protecting the metal



Sub-Tropical Testing Service

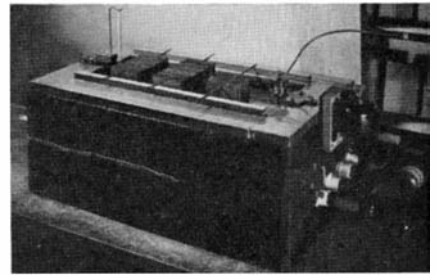
A test panel fence, facing south to insure maximum sun exposure, is of particular use when complete painting systems are to be tested against each other

underneath. Hence, single-coat weather exposures of metal priming paints to the weather, although proceeding with greater rapidity, can sometimes be misleading unless supplemented by test surfaces finished according to the painting system used in ordinary practice. Of course, this same precaution also applies to other test procedures.

Time was when little attention was given to the nature of the metal panel itself. More recently, studies have shown that the nature and extent of the mill scale on the metal surface have an appreciable effect on the performance of metal priming paints, and that this effect is not the same for all paints. It is also claimed—and practical knowledge would seem to support the claim—that the nature of mill scale present on metal test panels is different from that existing on structural steel shapes such as "I" beams, angle irons, and so on. Since the ultimate aim of metal protective paint-testing work is to simulate the conditions which exist on a structure (where some mill scale is nearly always present), it is but a step removed from such conditions to make test exposures of paints on sections of structural steel members. The procedure has so far been applied mostly for determining the suitability of metal prim-

ing paints as shop coats, but further extensions of its use would seem likely except where the lack of portability and bulk of the tests is a major objection.

Outdoor weathering tests are slow at best, and to speed up results various types of accelerated tests are used. Exposures on Florida tidewater test racks provide one type of accelerated test which gives much useful information, especially where the durability of marine coatings is concerned. Because of the severity of the test, which consists of placing test panels on racks so that they are alternately exposed to salt water and Florida sun, failures occur within a relatively short period,



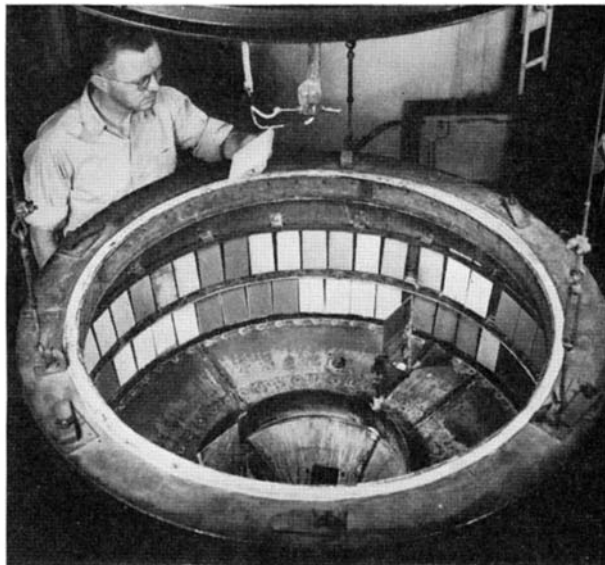
**Immersion tests provide clues to service in presence of moisture**

usually from 1½ to 2 months. The test provides a more or less fixed set of conditions to which some paint coatings are more susceptible than others and this, coupled with the speed of determination, makes it a valuable supplementary test method. However, its highly accelerated nature calls for care in controlling such factors as the preparation of the panel, and warns against drawing broad conclusions from moderate differences in results.

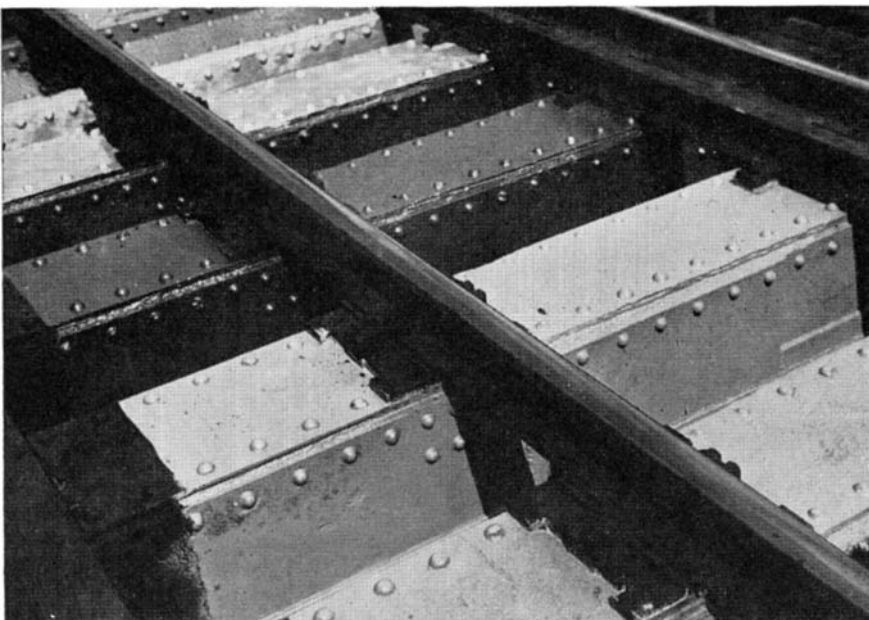
Another form of accelerated test which has come into extensive use is the so called laboratory accelerated weathering machine. Basically, it makes provision for the exposure of test panels in a predetermined sequence to a mercury arc lamp (to simulate sunlight), humidity as developed by atomizing warm water in the tank, water spray to simulate rain, refrigeration to provide low temperatures, and a combination of sulfur dioxide and carbon dioxide gases similar to that encountered in industrial locations.

The purpose of the machine is not to simulate and strike an average of the weather in any one locality, but to intensify, within reasonable limits, each and every one of such weathering factors, and thus to reproduce in a relatively short period failures which can be interpreted in terms of actual service. Notwithstanding the vagaries of actual weather, "artificial" weathering as obtained with accelerated weathering machines is of real benefit in testing work, provided no one weathering factor (as, for example, light) is intensified to the point where the balance between all factors is lost.

Exposure of metal priming paints, or more particularly metal finishing systems, to chemicals



**In accelerated weathering tests, all factors must be intensified in correct proportion to each other**



**Many authorities on paint problems prefer small-scale tests under actual service as here, where structural members are given different coatings**

(acids, alkalis, brines, and salt sprays) is never desirable unless these represent actual service conditions. Among tests which are designed to reproduce and measure one particular type of failure, laboratory immersion tests (salt or fresh water) are useful in determining the tendency of metal priming paints to blister under moisture conditions, which are nearly always encountered in actual service.

Difficulty is sometimes experienced in grading the performance of a paint if a number of individuals are making observations of the results. The American Society for Testing Materials is now attempting to establish so called pictorial "rusting standards" which, if finally adopted, may become the universal language every paint technologist and engineer can use for designating degrees of corrosion. And that will mark another forward step in the already progressive field of corrosion prevention.—*Courtesy Paint Progress and the New Jersey Zinc Company.*



## CLOUD CHARGE

Indicator Will Assist in Studying Upper Air

**A** DEVICE for indicating to airplane pilots the intensity of electricity in a nearby thundercloud, illustrated in laboratory form on page 54, is called a "Cloud Charge Indicator for Airplanes." It is a delicate instrument containing a neon tube and a microammeter and can be mounted on the panel board of the plane. The glow of the neon tube serves as a signal for the pilot.

The instrument is connected to a pointed tungsten rod similar in size and shape to a lead pencil and protruding 14 inches from the plane. The glow of the neon tube rod picks up the electrical discharge from the cloud and sends it through the instrument. This causes the neon tube to flash and the meter needle to deflect. The amount of this deflection indicates the intensity of the electrical disturbance ahead and permits the pilot to change or maintain his course accordingly.

In the laboratory, an artificial cloud-plane arrangement was provided. A brass sphere, about two feet in diameter, was suspended a known distance above a tungsten

rod which was connected to the cloud charge indicator. The sphere served as the cloud; the rod, 14 inches high, served as the airplane. Voltages of known magnitudes were passed through the "cloud" and the instrument readings noted. The voltages, or electrical pressures, per linear foot in the atmosphere, were calculated for any given reading on the instruments. Data also were prepared for a six-inch rod. From these data, charts were prepared for use by the pilot of the plane.

It is hoped that records of the intensities found under various atmospheric conditions and at varying heights from the clouds and at various plane speeds will be kept by the airlines using the instruments. This would provide research engineers with additional data for the study of lightning phenomena.

The instrument, consisting of a double-scale microammeter, glow tube, resistors and capacitor, is designed to register up to 400 microamperes.

## CANAL LIGHTING

Sodium Vapor Units For Cape Cod Waterway

**D**EAYS caused by fog and other adverse weather conditions have been practically eliminated in the Cape Cod Canal as a result of sodium vapor lighting. Saving 65 miles on the New York-Boston sea route, the canal, 7.7 miles long and 500 feet wide, connects Massachu-

setts Bay at Sagamore with Buzzards Bay at Bourne.

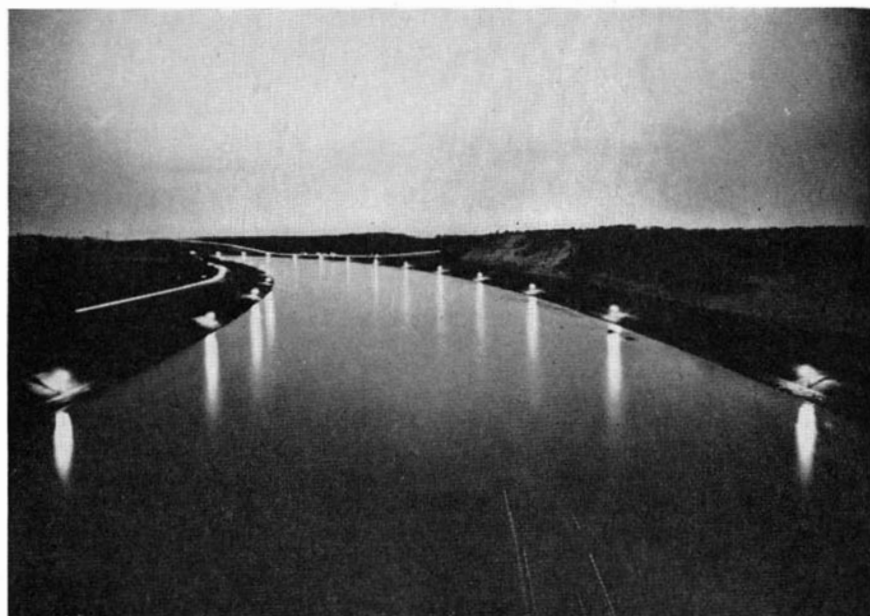
After considering various light sources, sodium vapor lamps were found best able to meet the lighting requirements during foggy or misty weather. For this purpose, the lamps have a distinctive yellow color that is not confused with other artificial lighting. Installed at 500 feet intervals and mounted on pole crook brackets, the luminaires are Westinghouse "Reflectolux, Sr." with bronze globe holders and fittings to withstand salt air. The complete installation consists of 146 units with 10,000 lumen sodium lamps. Circuits are sectionalized so that in event of failure in one circuit, half of the lights on each side of the canal will still be operating.

## STORED SEED

Germinate Even After Eight Years

**I**NTEREST in locating good seed stocks for 1942 plantings has focused attention on tests made in the seed-testing laboratory at the State Experiment Station at Geneva, New York, on seed oats and seed barley held in storage for as long as eight years. Several stocks of both oats and barley germinated 98, 99, and 100 percent, while other lots showed less than 90 percent germination, according to Dr. Willard Crosier.

While farmers are not likely to have to use seed stocks as old as these, yet in the spring of 1937 a



Sodium lights defeat fog dangers



large group of farmers in central New York found it necessary to use seed oats that had been in storage from two to four years. Evidence that oats and barley seed will retain their vigor and viability over comparatively long periods of time is reassuring in these days when the demand for increased production is so pressing.

## YACHT

### Ultra-Modern All-Metal Cruiser Makes Trial Runs

**Y**ACHTING and marine enthusiasts, as well as the Navy and the Coast Guard, are displaying intense interest in a new type of 45-foot yacht cruiser which recently made her maiden voyage of 168 miles at an average speed of 27 miles an hour. Powered by twin 315-horsepower engines, this new boat, the *Revere*, can attain a speed at full throttle of just under 35 miles an hour. This makes her one of the fastest cruising yachts of her size in the country.

The interest being shown in this new vessel is accounted for by her unique design. One of the factors



The streamlined *Revere*, an all-metal yacht of unique design

The hull, deck, and superstructure of the *Revere* are all made of cupro-nickel sheets just a bit over 1/12 of an inch thick. This material, of which Revere Copper and Brass, Inc. has made condenser tubes for naval and merchant vessels for many years, is known for its almost perfect resistance to salt-water pitting and corrosion. It is this resistance to corrosion that has helped to make possible the use of thin and light plates. In the past, metal boats have been forced to use heavy plates, resulting in high cost and loggy performance. In the design of the *Revere*, all of the metal was figured in design and strength calculations, it being unnecessary to make discounts in consideration of corrosion.

In the construction of the *Revere*, pre-shaped sections of the metal were laid according to plan in a previously prepared wooden form. They were then joined by welding, resulting in a "one-piece" boat.

The *Revere* is completely equipped with radio for both transmission and reception. Ten crystal-controlled transmitting and receiving channels, provided by a standard Hallicrafters marine radiophone, include those for ship-to-ship, Coast Guard, and ship-to-shore communications. This radio equipment offers automatic voice-controlled transmit-receive changeover, instant choice of services by simple selector switches, and operating simplicity approaching that of the ordinary home telephone. This radio equipment has a communication range of several hundred miles, in spite of antenna

limitations imposed by the boat's low lines and the midship location of the apparatus.

## ANCHOR

### Plastic Secures

#### Fastenings In Holes

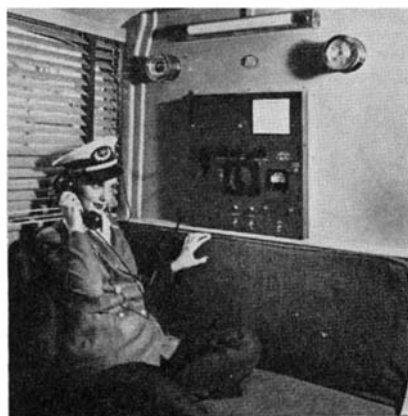
**S**CREWS, bolts, nails, and hooks can be held permanently in place in wood, concrete, plastics, and so on by the use of a new plastic material known as Sy's Plug. This material is used to fill holes, after which the fastening is driven into place. The plug is formed by rolling the plastic material between the fingers into a size that will fit the hole. It is then dipped into water and pressed into place. Then the screw or other fastening is driven into the plug, which hardens permanently to anchor the fastening in place. The plastic can be also used as a repair material for screw holes from which the threads have been stripped.

## TRUE "DRYS"

### Animals That Gain All

#### Needed Water Chemically

**T**HAT certain animals have solved the problem of living without drinking water is the contention of Ernest P. Walker, Assistant Director of the National Zoological Park, in the latest annual report of the Smithsonian Institution. Through long periods of evolution, he says, they have developed means of surviving with a minimum of mois-



Two-way radio equipment aboard the *Revere* is designed to use ten crystal-controlled waves

contributing to her speed is a completely new conception in hull shape, a conception that could never before satisfactorily be realized in a wooden boat. The *Revere* is of all-metal construction—hull, deck, and cabin—and hence her designers could build into her the optimum lines for speed and fuel economy without having to compromise with the limitations of a semi-rigid material. Thus the *Revere* incorporates without change the theoretical lines adapted from models tested at the Stevens Institute test tank.

ture so that today water seems abhorrent to them.

The most specialized of these animals are some of the rodents such as the pocket mice and kangaroo rats of the southwestern United States and the jerboas of Asia and northern Africa. "These animals," Mr. Walker explains, "live in regions where the rainfall is very scant over much of their range, and where water is practically unobtainable. They have, therefore, become adapted to living with almost no water or drink. During the very short time when there is green vegetation they may eat some of it. At other times they obtain no moisture except, perhaps, an occasional drop of dew. But their needs are adequately supplied by chemical processes that take place within their own bodies, where the constituents of dried seeds and other vegetable foods are converted into moisture by oxidation.

"I have often offered water to pocket mice, kangaroo rats, grasshopper mice, and other desert animals to make certain they did not suffer from lack of moisture. Almost invariably they refuse it, although occasionally they may sip a little and then not touch moisture again for months.

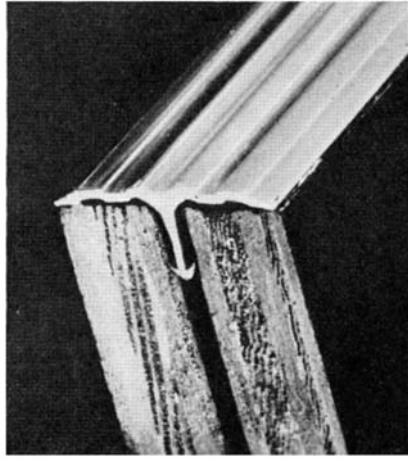
"One pocket mouse seemed greatly offended when I offered her water. On a few occasions I dropped a single small drop of water on her and was much amused at her violent antics of rolling in the sand to remove the offending substance from her coat. I am convinced that she never took water during two-and-a-half years. Very rarely did she show any interest in eating any moist vegetation. In the case of such a carnivorous rodent as the grasshopper mouse, the blood or body fluids of its victims would supply one of these animals with most of its required moisture."

## INTERLOCKING

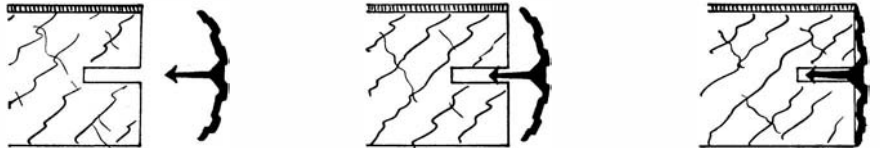
### Plastic Strips Replace Metal Trim

**E**XTRUDED plastic shapes are finding ever widening use in a variety of applications where they replace metals. One of the latest developments in this field is an edging material designed for use on tables, shelf trim, counter edges, and wallboard joints. Illustrated herewith, this new strip form, pro-

duced in long lengths, locks into position without the use of adhesive, screws or other means of attachment. Wherever a slot of the proper width can be provided, this "Interlox" section can be quickly and easily applied. When the material is pressed into place,



*Above: Extruded plastic trim in place. Below: How trim is held in position by barbed extension*



duced in long lengths, locks into position without the use of adhesive, screws or other means of attachment. Wherever a slot of the proper width can be provided, this "Interlox" section can be quickly and easily applied. When the material is pressed into place, the barbs hold it in position. The material used in the "Interlox" strip is Tenite II, produced by the Tennessee Eastman Corporation. It is available in a wide range of colors and has a horn-like toughness and a high luster. The surface is washable in soap and water, requires no polishing.

• • •

**GASOLINE:** Motor fuel for highway use totaled 22,000,000 gallons in 1940 and for non-highway purposes 2,000,000,000 gallons, according to state reports compiled by the Public Roads Administration.

• • •

## SEALING

### For Cracks In Water Jackets of Gasoline Engines

**S**UPPLIED in liquid form, a new sealing material for water jackets and radiators of gasoline engines is claimed to find and seep into cracks and then to congeal into a hard metal-like substance on contact with air. This material, known as Whiz Weld Metal, is claimed to

flow readily in the circulation system of the engine and not to clog water passages or circulating pumps.

## FROZEN COFFEE

### Process Reduces Bulk, Preserves Flavor

**D**ESIGNED to render a joint service to the packer, distributor, retailer, and consumer in the general food line, a new method of processing and packaging foodstuffs is the recent invention of John C. Donnelly. It involves a combination of two methods of preservation—rapid refrigeration and compression.

Immediate application of the process for public consumption will be confined to the coffee market. Coffee processed under the Donnelly patent will reach the consumer in cellophane-wrapped compressed and refrigerated blocks, each two inches by two

inches by one half inch, packed 20 to the pound. The consequent reduction in cubic displacement will cut distribution and storage costs.

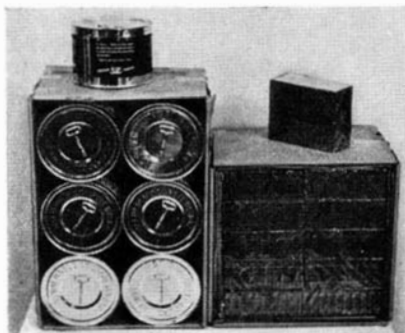
The reduction exceeds 50 percent, according to the inventor, who points out that an ordinary carton used for transporting 12 pounds of vacuum-tinned coffee will accommodate 30 pounds of the refrigerated product.

In its preparation, the coffee is first refrigerated directly from the roasting oven to a point 20 to 30 degrees below zero, Fahrenheit. A state of "suspended animation" is thus created, sealing the volatile oils in the bean itself.

While in this "anesthesia," the coffee is ground and compressed into blocks and maintained in the frozen state until it reaches the consumer. At home, it is again placed in the refrigerator. The volatile oils that account for the taste and aroma of coffee will retain their solidified state and the coffee will remain fresh indefinitely so long as it is kept in the refrigerator.

An added advantage claimed for this process is that the particles of the ground coffee are fractured by the compression in such a manner

as to permit a greater aqueous extraction, enabling the user to obtain 15 to 20 more cups to the pound than usual. It is estimated that the average user of coffee in the conventional form throws away 30 percent of yet usable cof-



12 pounds canned: 20 pounds frozen

fee in disposing of the "grounds", Mr. Donnelly points out.

Each individual unit of the new processed coffee is a measured quantity, thereby eliminating one haphazard operation by the consumer. Although in compressed form, it is sufficiently friable for convenient home use.

## TNT

Being Made 70 Percent From Petroleum

**D**EFENSE needs for TNT explosives are being supplied for the most part from toluene made by the petroleum industry, in plants now operating or that will be in operation within a few months. The annual production of toluene from the plants now operating and under construction totals 100,000,000 gallons, enough to make 1,000,000,000 pounds of TNT, with 70,000,000 gallons coming from petroleum and only 30,000,000 gallons from coal carbonization, the normal method of making this principal ingredient of TNT. Toluene from coal carbonization is strictly a by-product, and the yield is only 3 pounds per ton of coal. On the average, selected gasoline fractions yield 50 percent of toluene, with a few giving as much as 80 percent in the laboratory.

Two principal methods, extractive and catalytic, are available for the manufacture of toluene from petroleum. Certain crude oils contain enough toluene so that it can be separated commercially merely by an extension of the basic petroleum refining method, straight distillation or extraction. Much great-

er yields can be obtained, however, by the chemical conversion or synthesis of toluene from certain gasoline fractions of petroleum. The gasoline molecules obtained by distillation and cracking are further processed to cause a chemical alteration, resulting in toluene.

The petroleum fraction used for the catalytic manufacture of toluene is normally a portion of ordinary gasoline. Even doubling the present production so that 200,000,000 gallons of toluene were made from gasoline would have little effect on the supply of motor fuel, he asserted, because this huge amount of toluene, enough to make 2,000,000,000 pounds of TNT, would be less than 1 percent of the annual production of more than 25,000,000,000 gallons of motor fuel.

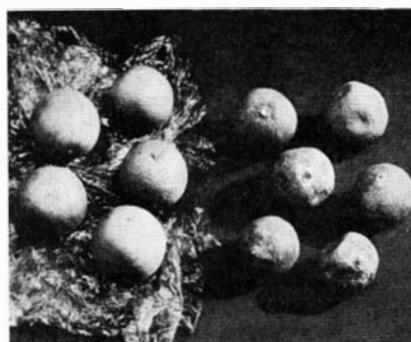
## FRUIT WRAP

Moisture-Proof Film

Preserves Fruit

**D**EVELOPMENT of a new technique in wrapping oranges and other citrus fruits, employing Pliofilm, makes possible the extension of preservation of these important products for months. Tests in the laboratories of the Florida Agricultural experiment station at Gainesville have demonstrated that grapefruit wrapped in this manner and stored at 70 degrees temperature for seven months retained its texture and juices, and seeds showed no indication of sprouting.

Pliofilm, the wrapping material used in the experiments, is a mois-



Plump, wrapped: Shriveled, unwrapped

ture-proof, transparent, synthetic plastic developed in laboratories of Goodyear Tire and Rubber Company, and is widely used for packaging food products.

The success of this application is due to the fact that the wrapping allows transmission of carbon dioxide with enough rapidity to

keep the fruit from suffocating, but transmits moisture vapor slowly enough to prevent loss of moisture, thus retaining the juices and fullness of the fruit and preserving vitamin content.

Because thin-gage Pliofilm can be used in a special stretch-wrap process which permits a small sheet of the material to be wrapped tightly around a large surface, application of the new development is feasible from an economic standpoint and also enhances the appearance of the fruit by giving it a glossy surface covering.

## RADIO MEN

Thoroughly Trained

In Four Months

**T**HOUSANDS of young men between the ages of 17 and 28 are becoming trained radio operators through enlistment in the Naval Reserve.



Receiving position for training

Not only are they obtaining training which will likely prove highly valuable on return to civilian life, but in the meantime they are helping the Navy to meet its urgent need for radio personnel, now a doubly important feature as United States participation in the war gets into gear.

With the concentrated training program developed by the Navy a man, even without previous radio experience, becomes a qualified operator ready for active service at ship or shore stations after only 16 weeks of training. He is then capable of copying code directly on a typewriter at a rate of 25 words per minute, has developed general familiarity with navy transmitters and receivers, has acquired knowledge of the fundamentals of visual and underwater signaling, and has been trained in basic naval subjects and routine.

Every effort is made to keep this training as practical as possible. This is carried even to the extent of providing at the schools groups

of complete receiving positions similar to those encountered in active service. These afford practical experience in tuning regular naval communications channels and copying actual naval dispatches from the air. The accompanying illustration shows one of a number of such receiving positions at the U. S. Naval Reserve Training School, Noroton Heights, Connecticut, each equipped with its own Hallicrafters communications receiver.

The Noroton Heights school alone trains 500 operators every four months and others distributed throughout the country are training thousands each year. These are men selected on the basis of aptitude or previous radio experience from among those enrolled at naval training stations.

• • •

**EYES:** Although parents with brown eyes may have children with blue eyes, very rarely do two blue-eyed parents have a child with brown eyes, according to the Better Vision Institute.

• • •

**PAINT CLEANER**

**Prepares Old Finished Surface For New Coat**

**W**HEN it becomes necessary to repaint a glossy or enamel coated surface, some means must be provided for deadening the gloss so that the new paint will bond to the surface. With a new material called Imperial Wil-Bond, this job is simplified. Wil-Bond is a clear liquid which is applied with a cloth to remove dust, grease, and wax. It also cuts the gloss from the surface and sets up a slight tack which insures a complete bond with the new paint. If the surface to be refinished is clean and free from grease, the Wil-Bond liquid need merely be added to the new paint before application.

**ALL-WHEEL-DRIVE**

**Replaces Ox-carts in Geological Service**

**F**ROM ox-cart to a modern all-wheel-drive truck is a pretty long jump, but nothing in between could do the job, according to Gordon Barbour, president of the



**Marsh buggy for geological operations in Bolivia**

Barvia Company of La Paz, Bolivia.

Mr. Barbour owns gold and oil properties far back in the interior of Bolivia where the only roads are ox-cart trails over mountain, marsh, and plain. As many as 20 oxen are employed in places to pull a single cart at speeds of 15 to 18 miles per day.

As a result of experience with a previous purchase of a Marmon-Herrington light delivery all-wheel-drive converted Ford, Mr. Barbour was convinced that a similar vehicle with much larger tires and other special features would be exactly what he needed to conduct geological surveys over his properties.

The vehicle finally developed presents a rather weird appearance, but from tests made locally,

• • •

**CAR AGE:** 43 percent of all the motor vehicles ever sold in United States are still in operation. 74 million cars have been sold up to the end of 1940, and 32 million are still in use.

• • •

there is no question but that it will render the service expected. Starting with a standard ton and a half truck, engineers proceeded with the same conversion to all-wheel-drive which has been done with thousands of similar units for industry and military services. But the change did not stop there. In addition to equipping the truck with a heavy duty winch and air compressor, both operated from a power take-off on the auxiliary transmission, two complete sets of tires were provided. The first set, for operation on paved roads, were 9.00 by 20's all around; while the

others were mammoth 13.50 by 24's, dual mounted on the rear wheels, to provide the extreme flotation and traction necessary for the worst imaginable cross-country operation.

**BEETLE CONTROL**

**Possibilities of "Milky Disease" Bacteria**

**I**NJECTING a tiny helping of "milky disease" bacteria into the body cavity of a Japanese beetle larva is a ticklish operation. If a fleshy little larva wiggles—and wiggle they will—the intestine may be punctured and the injected inoculum lost.

So United States Department of Agriculture entomologists have discovered a way to take the wiggle out of the larvae during this delicate operation—by anesthetizing them. S. R. Dutky of the Bureau of Entomology and Plant Quarantine has found that larvae may be anesthetized for a period of eight hours with little or no ill effect. He uses dry ice to furnish the carbon dioxide anesthetic.

"Milky disease," natural enemy of the Japanese beetle, is being tested widely by entomologists as a beetle-control measure in heavily infested areas. The bacteria are injected into healthy Jap beetle grubs, where they multiply. Bodies of grubs so injected are ground, mixed with talc, and dusted over the ground or placed in soil where grubs are feeding. A feeding grub takes up the disease germs which reproduce in tremendous numbers until there are enough to kill the grub. Grubs killed by the disease

(Please turn to page 88)



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You'll be amazed how quickly you can pick up ordinary conversation! Business and commercial terms soon become second nature to you! With Cortina "Learn by Listening" Records, you can progress as fast, or as leisurely, as you wish!

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# Our Search for the Supernatural

## Do Mediums Fear to Face a Scientific

### Investigation of Psychic Phenomena?

#### A. D. RATHBONE, IV

Secretary, Scientific American  
Committee for the Investigation of  
Psychic Phenomena

**I**T SEEMS fully apparent at this time that most mediums, psychics, and spiritists have no desire to attempt to prove once and for all that there exists a basic, truthful, scientific explanation of their so-called phenomena. Presumably, if the lack of collaboration which our Committee has thus far received in its investigation of psychic matters is any criterion, most producers of psychic demonstrations prefer to continue their activities in their own dimly-lit or darkened mediumistic parlors with their own groups of "believers" without benefit of public acceptance that the things that take place there are factual, and not hoaxes. Indeed, one leader in the psychic world, himself not a medium, has emphatically urged that all persons who claim supernatural power avoid our Committee and its earnest efforts to prove the truth, as though the idea of psychic research were a pestilence.

True, we have had demonstrations, we have had seances, but of none of them can it be said that anything of a startling or outstanding psychic nature presented itself. While we are beholden to those mediums who have come forward in an effort to co-operate for the benefit of the public by conclusively proving the existence, the presence, or the motivation of psychic forces, we must, nevertheless, conclude that the mediumistic world as a whole is fearful of the clear, cold light of a scientific investigation. It has been estimated that upwards of 50 million dollars yearly is paid to mediums, psychics, seers, fortune tellers, and others who claim occult powers by persons who seek answers to the query of what lies ahead, or to establish alleged "contact" with those who have passed on. This is big business, even in these days of fabulous figures, and it may be that there

is reason for the lack of co-operation to date.

When, last April, Scientific American joined forces with the Universal Council for Psychic Research in an effort to determine the truth concerning psychic matters, it was emphatically stated "that this proposed inquiry into psychic and spiritistic phenomena in no sense questions any form of religious belief, but is solely a scientific study to determine the true facts concerning what have been termed 'supernatural manifestations.'" In other words, this investigation is not a "witch hunt"; it does not seek to belabor, besmirch, or to expose any person or his belief. Rather, it is a conscientious attempt to settle an important question, one which, because of war and unsettled social and economic conditions, has become greatly amplified in the public mind. In times like these, far too many people turn to secret rites of cults or individuals in a desperate venture to satiate their craving for knowledge of the future; they are, unconsciously, perhaps, trying to allay a gnawing fear. This, we have maintained, is an attitude inimical to the national welfare; it is a dangerous trend—*unless* the claims of the psychics and the mediums are true!

**I**F IT IS possible to contact forces of which we now know nothing, and if those forces can be of assistance to individuals and to the nation in this time of peril, then, by all means, let us know more of them—let us make use of them in this national emergency. If mediums and psychics are, for some thus far unknown reason, persons peculiarly adapted to perform this service to the country, then let us enlist their services at once. *But*, before that action can be taken, they must prove beyond all question of a doubt that the ability they profess to possess to contact the "spirit world" is authentic; that their theories are tenable and truly applicable to the best interests of the public at large.

If the psychic forces do exist, if they can be contacted by specially gifted persons known as mediums who claim that certain physical psychic manifestations are proof of such contact, then beyond a doubt the fears and the worries of thousands of us can be alleviated by further knowledge of the occult. However, just as a man who joins our armed forces must demonstrate his physical and mental capabilities for such service, so must the spiritists, psychics, and other purveyors of mediumistic service prove their fitness to be publicly considered as an authentic source of knowledge of what transpires in another world or of what will transpire in this one. In this respect it is again and again emphasized that these statements do not refer to Spiritualism as a religion, nor to any other form of religious belief, the tenets of which may provide mental and spiritual solace, especially in times of severe trial. We are concerned only with those who, for compensation or otherwise, allege that they can produce psychical manifestations of a physical nature which are in turn interpreted as demonstrations of occult forces, or which are construed so as to give "messages," information, or to prognosticate the future.

**T**HE Scientific American Committee for the Investigation of Psychic Phenomena is a body originally constituted and consistently maintained to endeavor to ferret out the truth regarding spiritistic phenomena. To that end, six simple regulations were laid down to govern the activities of the Committee and any persons or organizations who might be willing to co-operate with the Committee, and an award of \$15,000 was established through the joint appropriations of Scientific American and the Universal Council for Psychic Research. (April 1941). In regard to the award, criticism has arisen that this is an objectionable feature, but it must not be forgotten that the announcement that a substantial sum is available for the unequivocal proof of what is today unproved is, in itself, evidence to all and sundry of good faith. Further, mediums or others who may join in our search for the supernatural might be put to expense or actual loss by working with us, and deserve remuneration, if and when the psychic premise can be followed with *quod erat demonstrandum*. Again, if



# Supernatural!

## *The World of Mysterious Phenomena*

**W**HAT are the strange journeys of the soul? Who speaks the words you hear within? Are the visions you glimpse, and which lift you to the heights, pranks of the mind or are they momentary glimpses into a world of phenomena of which man is yet in ignorance? Is there an intelligence which manifests in an extraordinary manner or can all unusual experiences be explained by natural law and order?

The word SUPERNATURAL rings throughout the world today as it has for centuries. But in this age an impartial investigation and a serious study of the unusual can be had. What greater fascination is there than that of the unknown? What greater enjoyment can be had than an inquiry into the mysterious? The greatest minds of all ages have put themselves to this task of investigation. Some oppose and contradict each other, but their findings constitute a wealth of knowledge.

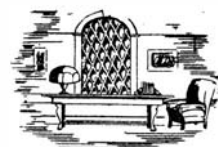
### *This Free Book of Daring Truth*

Behind every strange — eerie or weird — happening which we experience, lies a fundamental law of nature. The difference between fear and self-confidence is the understanding of these laws. *Once you know the cause*, the most unusual events or occurrences of your life, or of the world in which you live, are no longer mysterious. Have you wondered about the causes of hunches, and what accounts for the peculiar impressions or premonitions you have?

The Rosicrucians, a world-wide brotherhood of learning, will fearlessly present to you little known facts about yourself and these strange realities of life — which you can use in a most practical way every day — *here and now*. Send for the free explanatory book, "The Mastery of Life," which tells how you may receive such knowledge. This is an offer made to intelligent, inquiring minds. It is not an appeal to mere *thrill seekers*. Address: Scribe N. Z. Y.



The supernatural is the open door to a natural world of mystery.



Within the comfort and security of your home these strange truths are revealed.

## *The Rosicrucians (A M O R C)*

ROSICRUCIAN PARK, SAN JOSE, CALIFORNIA

*(Not a Religious Organization)*

## Are You

- putting your spare time to good advantage?
- one of the many who are seeking a new field to enter?
- seeking a means to save money wherever possible?

If you are, here is a practical solution to your problem.

### HOPKINS' CYCLOPEDIA OF FORMULAS

Is the foundation for the beginning of a fascinating hobby; the groundwork on which to build a practical knowledge of useful chemical facts.

Is the foundation for hundreds of suggestions for those who are seeking salable articles which can be manufactured at home profitably on a small scale.

If you want to save money on wines and liquors; your dyes, inks, polishes, soaps, paints and varnishes, adhesives, antiseptics, bleaches, cosmetics, etc.

You can profitably make them from the 15000 formulas contained in the 1077 pages of

HOPKINS'

Cyclopedia of Formulas

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any psychic feels that his or her services would be tainted by acceptance of the award, its donors will gladly make it payable to any charity or other beneficiary, duly and legally appointed.

As for the regulations, they are, as has been pointed out, simple in the extreme. We ask only that formal application in writing be presented to the Committee stating that any phenomena produced by the medium will be "accomplished solely by supernatural, spiritistic, or psychic agencies, and not through trickery, abnormal physical development, legerdemain, or mechanical devices." Certainly, if the medium sincerely believes he or she has psychic powers and has no need to resort to trickery—as many have been shown to do—there can be no objection to this requirement.

Naturally, demonstrations or attempted demonstrations must be performed in the presence of our Committee or such of its members as may be appointed by the Chairman, and, as a corollary, the Committee or its Chairman may request repetition of seances or demonstrations. Most important of all, perhaps, is the regulation that "demonstrators of psychic phenomena will be permitted to name and to work under their own conditions during the first seance or demonstration, so long as such conditions are compatible with the best interests of the aims of the Scientific American Committee." Obviously, the Committee, en toto or in part, cannot today journey to the Philippines, Mexico, or Brazil, as has been suggested by certain correspondents. Nor is it feasible under present conditions to hold Committee meetings here, there, and everywhere, but any medium or psychic who desires to appear before our Committee in New York City or its immediate environs will be welcomed.

IT IS extremely noteworthy that there are no test conditions placed on the medium at the first appearance before the Committee. He or she is entitled to demonstrate unmolested and unhampered, despite the fact that in some instances in the past, the mediumistic operations proved immediately to be transparent as fraud to one or more members of the Committee. Furthermore, even if test conditions are imposed at a later seance or demonstration, the Committee agrees "to the best of its ability to see that its conditions do not

hinder or inconvenience the medium or demonstrator." As Scientific American is the official publication of the Committee, its publishers reserve the right to present the findings to the public. Finally, it must be remembered that the present investigation does not incorporate telepathy, telepathic experiments, or any other form of mental phenomenon or demonstration.

IN THE past, through the efforts of Scientific American and other investigatory bodies, it has been conclusively proved that certain individuals who termed themselves "mediums" and who claimed to have contact with psychic forces had no such contact and had utilized mechanical appliances or other "human" means to produce their so-called phenomena. These people had accepted money from the public for their "demonstrations." This, however, is not to say that psychic forces do not exist or that they may not be contacted. Somewhere there may be a person or persons who have succeeded in one of man's ever-hopeful ventures—to determine survival after death, to communicate with the spirits of the next world, either or both accomplished with physical rather than mental evidence as proof. If such there be, let him now come forward and work in harmony and in full confidence with the Scientific American Committee for the Investigation of Psychic Phenomena. All that is sought is the truth, the scientific explanation concerning this age-old problem, but unless broader and more generous co-operation can be obtained in the future from the disciples of psychic belief, their silence and failure to cooperate can only be construed as too significant to need further comment.

There can be no doubt that the controversy of today over this question is essentially the controversy of 1000 B.C. translated into modern terms and given an up-to-date setting. It is, perhaps, too much to hope that it may ever be permanently settled, but it does not seem too much to wish for that our Committee may be instrumental in producing conclusions for this generation, conclusions that will be effective at least until this generation grows old and dies off, in favor of another generation with a shorter memory. To that minimum of effect our Committee will continue to bend its efforts.





## WHITE COLLAR MEN ARE STILL A DIME A DOZEN!

**L**OOK around your office. A few men have "arrived". They are the executives, earning big money. The others are what the top men in the company call "white-collar workers"—able, conscientious, hard-working—perhaps with specialized training, but they are nevertheless figuratively worth a dime a dozen.

**WHAT'S THE DIFFERENCE** between the executive and these "white-collar workers"? That's the question being asked by men who have hopes . . . men who want to climb out of the rut and into the top-flight class themselves. The answer is—*there's very little difference!*

Has the man who makes \$5,000 twice as much brains as the man who makes only \$2,500? Has the man who makes \$10,000 twice as much brains as the man who makes \$5,000? Of course not! And it would be amazingly easy for *many men* to transform an average salary into a large salary!

**HOW IT'S DONE!** The difference between success and merely "getting along" lies in executive training. In the old days, successful executives had to gain their ability through

long years of experience. But as business became more complicated, educators became business-minded. Many big universities added schools of business; the Alexander Hamilton Institute was founded—and since then has pointed the way to success to more than 400,000 men!

**HOW YOU CAN DO IT.** The Institute has organized and formulated the knowledge of the country's most successful business men. Co-operating with it are dozens of leaders like Edward R. Stettinius, Alfred P. Sloan and Thomas J. Watson. As a result, the Alexander Hamilton Institute offers you modern, up-to-the-minute training and information you would almost have to give your right arm to gain by any other method!



**CUSTOM-MADE TO SUIT YOUR NEEDS.** Please get this fact clear in your mind. *The Alexander Hamilton Institute offers a PERSONAL service, geared not only to YOUR particular needs, but to your particular needs TODAY—whether you are a young man just earning his first business laurels, or a busy corporation official who wants to keep up with rapidly changing economic conditions.*

**PUT IT UP TO US.** Why not prove to yourself that you have the first quality of an executive—the ability to make a decision? Write us for a free copy of that important little book, "Forging Ahead in Business". For many men this simple act has been a major turning-point in life!

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(Continued from page 82)

turn milky white, disintegrate, leaving little heaps of disease germs to be picked up by the next generation of grubs—and so on.

## MOBILE POWER

### Railway-Car Plants

#### For U. S. Navy

**T**HE Bureau of Yards and Docks, Navy Department, has ordered two 10,000-kilowatt mobile steam-electric power plants mounted on special railway cars from the General Electric Company to supply emergency power wherever its projects may require.

The mobile power plants will be the first of their kind to be built, but the turbine generators, boilers, and electrical equipment used in them will be apparatus of the types proved in service in regular industrial installations.

Each of the units will be housed in two specially built railway cars which can be hauled over the rails at speeds up to 40 miles per hour.

The power-generating car will contain a 10,000-kilowatt turbine-generator and its accessories, a condenser, and the necessary switchgear. The boiler and its auxiliaries, along with a starting engine generating set will be housed in the second car. A mobile substation, constructed on a standard car, will be used in conjunction with each generating unit to permit proper voltage to be obtained for any Naval Shore Establishment.

Engineers estimate that the mobile power plants can be put "on the line" within 24 hours after they are shunted into a siding.

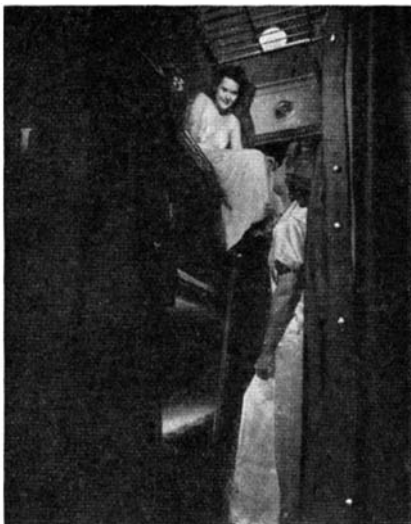
Bunker C fuel oil will be used to fire the boilers, and each unit will consume about three tank cars a day when operating at full load. A sufficient fuel supply for two hours' operation will be carried in the boiler cars of each of the units, however, so that they can generate power before the tank cars are hauled up and connected.

## COACH-SLEEPER

### Features New Economy

#### In Rail Travel

**C**OMFORT and economy for the railroad traveler are the two factors which influenced the design of a new coach-sleeper recently put into experimental use on several



Triple-deck berths

railroads by the Pullman Company.

The cars are completely new in design, being provided with a side aisle and a series of compartments. For daytime use these compartments are made up with seats for three passengers in the single units or for six passengers—in groups of three, facing—in the double compartments.

For night use, the compartments are converted into sleeping quarters for three in the single sections and for six in the double sections. Access to the center and upper berths is provided by a sturdy stairway-type ladder which is removed in the daytime set-up of the compartment. Each one of the berths is provided with a reading light and an individual control for

air from the general air conditioning system of the car. In each compartment is a wash basin furnishing hot and cold water, a dental faucet, a mirror, and an electric shaving outfit. In addition to these facilities there are two individual wash rooms and a toilet located in each end of the car.

These new cars accommodate 42 passengers in ten single compartments and two double compartments.

## TIME

### To Exact Second With New Wrist Watch

**T**HERE are many spheres of activity, particularly broadcasting, where time to the exact second is necessary. As a matter of fact, there is no timepiece of a portable kind that can keep time to the exact second for any very long period. Furthermore, in a conventional watch, when the stem is pulled out to set the minute and second hands, the action merely disengages them from the movement. The movement continues to run, and the second hand continues to turn. It has not been found practical because of high gear ratio to disengage the second hand from the movement. In a new watch just announced by Longines, however, pulling out the stem not only frees the hour and minute hand, but also stops the watch.

In remote broadcasting, where



Double compartment in new coach sleeper, set-up for daytime use

# AIR-RAID DEFENSE

## Calls for Specialized Knowledge Based on Practical Experience

**W**ITH virtually the entire civilized world in the throes of war, and air-raids a common topic of discussion everywhere, it becomes of paramount importance for everyone to inform himself on the subject. And the best source of information is England, where the populace has been subjected to over 500 raids from the sky.

Experience gained by that valiant nation has been incorporated in a number of books, covering the various aspects of the situation, and these books are now available in the United States. The most outstanding of these have been selected, and short descriptions of them appear below.

### CIVIL DEFENSE

*By C. W. Glover*

**I**NTO over 900 pages of text, photographic reproductions, and drawings the author has packed a vast amount of information on the whole subject of protection of civilians and their property from air raiders. Factual information is given about various types of bombs, how they function, and how best to combat their effects. The discussion of bombs covers high explosives, incendiary, and gas. Then follow exhaustive chapters on building construction in general, strengthening of existing buildings, air raid shelters of many types, air-raid precautions, organization of civilian defense units, and a vast amount of pertinent information. The illustrations greatly enhance the practical value of the text.—\$16.60 postpaid.

### THE HOME GUARD TRAINING MANUAL

*Edited by John Langdon-Davies*

**H**ERE are presented the basic facts that should be known when planning the organization of a civilian defense unit, whether the object be for combatting sporadic air raids or stemming actual invasion of military forces. The text, accompanied by a few drawings, covers such phases of the work as observation and communication, obstruction and demolition, rifles of various types, hand grenades, anti-tank and anti-aircraft warfare, discipline and drill.—\$2.60 postpaid.

### AIR-RAID DEFENSE

*By Curt Wachtel*

**T**HE subject matter of this volume covers more than its title indicates. It not only delves into the construction of air-raid shelters from all angles, but also considers such matters as the political and military concepts of totalitarian warfare, starvation, sabotage, mental and moral destruction, economic aspects, hygienic standards—in fact, practically all of the problems that must be faced intelligently by the population.—\$3.60 postpaid.

### PLANNED AIR-RAID PRECAUTION

*By Tecton*

**P**REPARED by a well-known British firm of architects, the text of this volume deals particularly with large-scale air-raid shelters designed to protect the population of whole cities from the dangers of air attack. The proposals made are based upon careful study of the problems involved and upon the application of engineering knowledge to the needs of the situation. A number of drawings illustrate the thorough-going text.—\$2.60 postpaid.

### AIR-RAID PRECAUTIONS

**T**EN separate parts make up this volume, all of them essential to a clear view of the whole subject. These parts cover: Rescue parties and clearance of debris; Organization of decontamination services; Organization of air-raid wardens' service; Structural defense; Communications and reporting of air-raid damage; Notes on training and exercises; Gas detection and identification; Protection of windows; Inspection and repair of respirators and oilskin clothing; Care and custody of equipment.—\$3.10 postpaid.

These books constitute a complete library of information of vital importance to every citizen of the United States.

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programs must be dove-tailed into a schedule controlled by the master station control clock, there is time lost and uncertainty on the part of the man running the remote show because he never knows to the second when he should be ready to go. This new Longines watch can be synchronized with



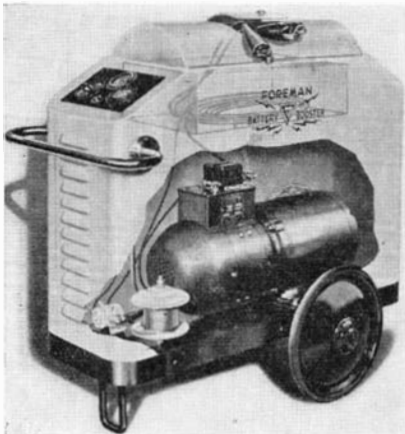
**Wrist watch that can be set to exact second**

the station control clock before the engineer goes on a remote job, in this way; when the second hand of the watch reaches the "12" position, the stem is pulled out, and the watch stops. The minute and hour hand are then set a minute or so ahead of the time shown on the control clock. When the control clock reaches the time set on the watch, the stem of the watch is pushed in, and the watch starts, synchronized to the precise second with the master clock. The watch is of conventional strap watch size, and under ordinary conditions will remain synchronized with the master clock for several hours, and operations can be carried out exactly as if the station clock was being consulted. Since the watch can be stopped, reset, and started as often as desired, it can also be used as an emergency timing watch.

**CHARGER**

**Portable Unit For Vehicular Batteries**

**S**TORAGE batteries for motor vehicles can be charged without the



**Auto battery charger**

necessity of removing the battery by using a new gasoline-driven portable battery-charging unit recently announced by W. D. Foreman. The gasoline engine of the unit is of the air-cooled type and is directly connected to a generator. The latter is provided with the necessary controls and a pair of cables that terminate in battery clips. The complete unit is assembled on a two-wheel truck. A fuel tank, air cleaner, and other essential accessories make it completely self-contained.

**FUEL ECONOMY**

**Stepped Up By Mixture Indicator**

**I**N VIEW of the present gasoline situation, all motorists and operators of trucks and busses will be interested in an instrument that makes possible a sharp reduction



**Maximum mileage indicator**

in fuel consumption by enabling them to secure maximum mileage per gallon of gasoline. This instrument is identical in operating principle to that of the Cambridge Aero-Mixture Indicator which enables pilots of thousands of Canadian, British, and American military planes and air transports to attain maximum cruising range through greater economy in engine performance.

Gasoline ignites only when mixed with air and it is the function of the carburetor of an automotive engine to mix these elements in the proper proportions for combustion. A mixture of 15 pounds of air with one pound of gasoline insures complete combustion. This ideal air-fuel ratio of 15 to 1 is not desired in general practice, even though economical in gasoline consumption, because the gasoline engine does not develop maximum power with such lean mixtures. Maximum power is obtained in the usual automotive engine with an air-fuel ratio of from 13.0 to 13.5 to 1.

Since no great loss of power results when the mixture is over-rich, the tendency is to set carburetors on the rich side—and the owner pays for the gas wasted. It is possible by analysis of the exhaust gas of a motor to accurately determine the composition of the mixture supplied by the carburetor. By the use of the Exhaust Gas Tester as a guide the position of the pointer on the scale of the Tester will show at all times whether or not the proper carburetor setting has been made. This small and compact portable instrument analyzes the exhaust gas while the engine of the vehicle is working either in the garage or on the road. Hookup merely requires one to insert the sampling tube of the tester into the tail pipe of the vehicle and the instrument shows instantly the air-fuel ratio and the corresponding percent completeness of combustion.

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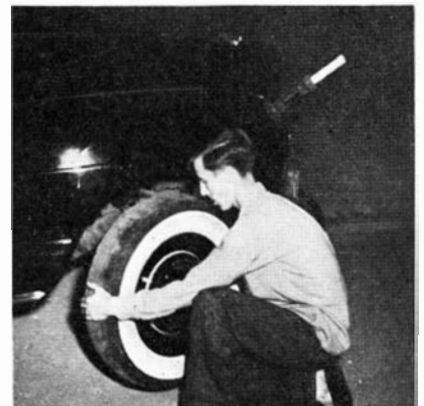
**RUBBER**—Production of combat airplanes alone requires more than 50 different articles made from natural and synthetic rubbers.

• • •

**ROD-LIGHT**

**Flashlight Combination For Emergency Use**

**A** COMBINATION torchlight-flashlight made with a 5 3/4-inch rod of "Lucite," methyl methacrylate resin, aids police officers directing



**One use for the new rod-light**

traffic and avoiding dangerous tie-ups, and provides a warning signal for motorists and truckers stalled at night in any kind of weather.

The "Lucite" rod is completely lacquered a brilliant red to give off a bright, penetrating glow, except at the end, which is crystal clear,



emitting a strong ray of light similar to that of a flashlight. The light may be attached to a fender with a suction cap. The plastic rod is reported to have high light transmission, to weigh little, and, furthermore, to be virtually unbreakable.

## CHINA STRUCK

### Oil Well Drillers

#### Find Pay Dirt

**T**EXAS oil-well drillers, who've been keeping a weather eye out for China, can relax now. It's been sighted. Researchers, doing a little prospecting on their own, have found it, spelled with a small "c," in abundant supplies of pay dirt, hitherto unknown in Texas—volcanic ash.

From this unique formation, there has been developed china tough enough for Army mess boards and fine enough to grace the governor's banquet table. The new porcelain, three times stronger than ordinary china and of an unequaled snow-whiteness, will tend to relieve the shortage of fine china imports from European countries, it is believed.

## PAINT REMOVER

### Requires No Washing

#### Of Surface

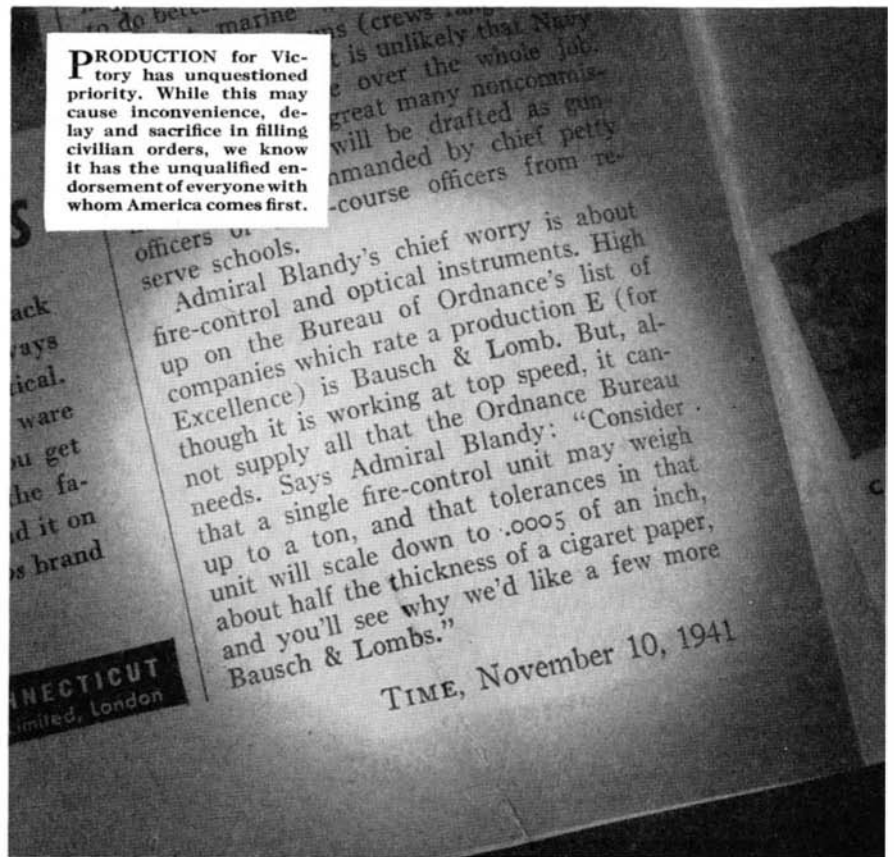
**P**AIN'T, enamel, lacquer, varnish, and shellac can be readily removed from surfaces that must be refinished, by the application of a new paint remover which requires no washing of the surface after use. The remover, known as No-Wash, is a liquid which remains wet after it is applied to the surface to be stripped. No-Wash and the surface coating are then removed with a scraper. No residue is left on the clean surface and hence no further work has to be done before the application of new paint. It is claimed that No-Wash does not raise the grain of the wood or injure veneer.

## HOME REPAIRS

### Pulverized Patching Material

#### Of Many Uses

**A**MONG the most trying of household problems is the repair of leaks in roofs, cellars, around chimneys and windows, and many other



## Why Bausch & Lomb?

**T**HE ability of Bausch & Lomb to produce the highly specialized optical instruments needed by the armed forces of the United States was not born of the present emergency. It has been acquired over eighty-nine years of research and unbroken experience.

Today the abilities and facilities and accumulated experience of Bausch & Lomb are being directed in their entirety to filling the needs of Production for Victory. Needed immediately are the instruments of which Admiral Blandy speaks—the rangefinders, binoculars, aerial height finders, and photographic lenses.

Vital as these are, there are others

equally essential which Admiral Blandy did not mention. Among these are the spectrographic and metallographic equipments used in the analysis and quality control of cartridge cases and armor plate, the contour projectors and the tool-makers microscopes for the fine measurements upon which mass production of tanks and airplanes depends. To help maintain health and efficiency, military and civilian, there are microscopes, diagnostic instruments and spectacles.

## BAUSCH & LOMB

OPTICAL CO. • ROCHESTER, NEW YORK  
ESTABLISHED 1853

AN AMERICAN SCIENTIFIC INSTITUTION PRODUCING OPTICAL GLASS AND INSTRUMENTS FOR NATIONAL DEFENSE, EDUCATION, RESEARCH, INDUSTRY AND EYESIGHT CORRECTION

places. Recently there has appeared on the market a material known as U-Mix-It which is claimed to give the answer to many of these problems. This material has been developed from a formula utilizing pulverized asphalt which has a melting point of over 250 degrees, Fahrenheit; by the use of various solvents it can be converted by the home user into a paint or a variety of putty-like substances.

Mixed with kerosene, gasoline, turpentine, or other solvent it forms a paint which can be brushed or sprayed, or, by com-

binning the pulverized asphalt with sand, cement, asbestos, or other fillers, a weather proofing and sealing compound can be obtained which may be applied with an ordinary putty knife or trowel. It is claimed that the mixed product has extraordinary adhesion for most of the materials to which it will be applied. Besides the repair problems mentioned above, the mixture can be used for preserving wood, for tree surgery, for lining fish pools, and for sealing cracks in tanks, dams, silos and so on. In all uses the material is said to be completely water-proof.

# Industrial Growth

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

### GLUE SPREADER

#### Industrial Unit

#### Holds Two Quarts

**F**OR spreading glue on large work surfaces, a new tool known as Glue Gun holds two quarts of liquid adhesive. The liquid is fed



For spreading liquid adhesives

to a head which spreads it to a width of one inch on the work. The head includes a corrugated roll and a doctor bar to insure uniform coverage.

### HAND GUARDS

#### For Protection of

#### Industrial Workers

**A** PRACTICAL finger guard, or finger stall, combining tough leather and flexible lastex, has recently been designed by the Industrial Gloves Company. This new safeguard is comfortable and durable, gives protection on fingers and thumb, in any combination, to buffers, polishers, sanders, grinders, operators of stamping-out presses, assemblers of small parts, book binders, trimmers, mechanics, and machine operators, both women and men. May be worn *under* glove for extra protection. If worn with leather on back of finger, Steel-Grip finger guard protects knuckles from raps, cuts, abrasions.

Another development by the same company is the new "finger-

less" glove which meets the unusual requirements of operators who must have complete freedom of the fingers—"touch" to sort or pick up thin sheets or small parts. Complete protection, however, is provided for the palm of the hand and between thumb and fore finger. In addition to being made of chrome tanned leathers, the glove is steel stitched which eliminates the possibility of ripping. The glove may be worn over the bare hand or over light-weight glove.

### HYDRAULIC VISE

#### Pedal Controlled, Capable Of Heavy Work

**P**RESSURES up to five tons between jaws, and the possibility of considerable savings in time and labor, are offered by a new hydraulic vise which has been developed by the Studebaker Machine Company.

The new vise is designed to speed up small press and cutting operations, as well as ordinary vise work, and is understood to have wide application on production lines, in tool rooms, and for maintenance work. It is operated entirely by foot control, permitting the use of both hands in setting up and removing work. The unit is self-powering.

Pressure to close the jaws is controlled by a foot-pedal pump arrangement in a pedestal mounted on the floor. The latter is connected with the vise proper by a steel tube which carries the hydraulic fluid to a ram behind the back jaw and thus moves it forward; the front jaw is stationary.

Stepping on one pedal moves the vise jaw to contact against the work while a second pedal applies pressure up to five tons and a third pedal releases the jaw.

Some of the different types of jobs the new hydraulic vise can perform are presswork, punching, bending, cutting, straightening, testing, and stamping. Because the operator can use both hands, exceptionally heavy work can be easily handled with a degree of

precision heretofore impossible. Also, due to the pressure exerted, certain special work can be handled, impractical for the ordinary vise.

### INSULATION

#### For Wires Makes for Smaller Motors

**T**HE efficiency of nylon as an insulator permits the manufacture of motors requiring 10 to 15 percent less space than those of equivalent capacity using conventional magnet wire insulation, with a corresponding saving in vital core metals like iron, it is reported by the Du Pont Company.

Motors such as those made for small power tools, fans, vacuum sweepers, refrigerators, pumps, ignition coils, generators, food mixers, voltage regulators, and other household and industrial appliances may incorporate enamel-like nylon insulation.

Nylon coating, it is said, provides insulation resistant to abrasion and cracking, has good dielectric strength, and is not adversely affected by any of the conditions of moisture, temperature, compression, or chemical action which such motors normally encounter.

### SOLDERING

#### Tool With Hinged Tip, Dual Heat Range

**A** COPPER tip which can be positioned at various angles to the handle is one of the features of a new electric soldering tool made by McKinley-Mockenhaupt Company. This construction also makes it possible to provide access to the heat element merely by removing a knurled cap without



Soldering — at an angle

having to take the tool apart. The point of hinging between the head and handle is so located that the tool remains in comfortable balance regardless of the angle of adjustment.

With this new soldering tool, it is also possible to increase the amount of heat concentration at the tip. By pressing a button in the handle and holding it down, input to the heating element is increased for quick temperature recovery or to assist in maintaining the required temperature on a given job. These tools are available in two sizes. The smaller size is rated at 100 watts at normal heat and 400 watts at fast heat; the larger size consumes 150 and 600 watts.

## SPRAY CONTROL

### Photo-Electric Cell Speeds

#### Shell Production

**A**UTOMATIC spray machines with photo-electric cell control are now being produced by the Eclipse Air Brush Company for use in coating the inside and outside of projectile shells in one operation. The shells are placed manually on a turntable and then automatically carried to a position in front of automatic spray guns that coat the outside, while an extension nozzle on another gun comes up to spray the inside. The action of the guns is controlled by the photo-electric cell so that there is no spray unless a shell is in position. It is claimed that this machine will handle 75mm armor-piercing shells at a rate of 500 an hour.

## DRILLS

### For Hardened Steel.

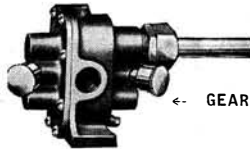
#### Chilled Castings

**A** DRILL which will cut hardened steel of any type, temper, or analysis is the latest development of the Black Drill Company. Known as the "hardsteel" drill, this tool has been used successfully on carburized, oil hardened, water hardened, cyanided, and nitrided pieces of high carbon, high chrome, and high-speed steels of every degree of hardness.

Hardsteel drills are made by a secret process. They are designed to drill, ream, countersink, and counterbore, and they will do so without tearing or annealing the steel on which they are used, leav-

## IMMEDIATE DELIVERY LATEST TYPE INDUSTRIAL & LABORATORY EQUIPMENT

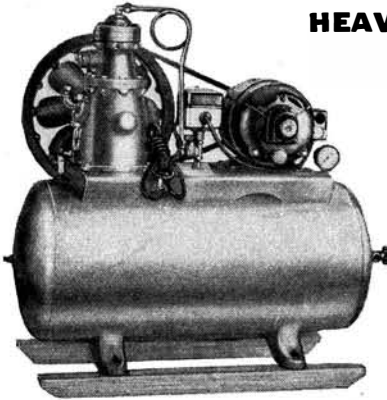
### BRONZE GEAR AND CENTRIFUGAL PUMPS



No.	Type	Inlet	Outlet	Price	With A. C. motor
No. 1	Centrifugal	1/4"	1/8"	\$ 6.50	\$25.00
No. 4	"	3/8"	1/2"	13.50	32.00
No. 9	"	1 1/4"	1"	16.50	35.00

No.	Type	Price	With A. C. motor
No. 1 1/2	Gear 1/8"	\$ 9.00	\$25.00
No. 2	" 3/4"	10.00	27.50
No. 3	" 3/8"	11.50	28.50
No. 4	" 3/8"	12.50	32.00
No. 7	" 3/4"	15.00	37.50
No. 9	" 1"	16.50	49.50
No. 11	" 1 1/4"	48.50	on request



### HEAVY DUTY TWIN COMPRESSOR

Complete automatic twin cylinder outfit fully equipped with a heavy duty 1/4 H.P. motor, air tank (300 lbs. test—150 lbs. A.W.P.), automatic adjustable pressure switch, gauge, check valve, safety valve and drainer, etc. Delivers 150 lbs. pressure. Displacement 1.7 cu. ft. per min.

Model S H T 1/4  
12" x 24" tank A.C. 110 or 220 v. 60 cycle **\$57.50**  
16" x 30" tank A.C. 110 or 220 v. 60 cycle **\$64.50**  
Large stock of air compressors, 1/4 H.P. to 20 H.P. A.C. and D.C., all voltages, 1 to 120 C.F.M. displacement, built for all requirements. Additional data on request.

### Exhaust Fans, Bucket Blade, G. E. A.C. 110 volt motors.

	RPM.	cu. ft. per min.	Price
9"	1550	550	\$12.00
10"	1500	550	13.50
12"	1750	800	18.00
16"	1750	1800	19.50
16"	1140	1650	27.50
18"	1750	2500	22.50
18"	1140	2100	32.00
20"	1140	2800	36.00
24"	1140	4000	42.00
24"	850	3800	45.00

Other voltages & frequencies available at slightly higher prices.

### ROTARY PUMPS FOR VACUUM AND AIR

Especially designed for laboratories, jewelers, dentists, doctors, hospitals, etc. Also for small gas furnaces.

No. 1, max. pressure 5 lb. ....	\$8.90
Complete with AC 110 volt motor	\$25.00
No. 2 max. pressure 10 lb. ....	\$13.85
Complete with AC 110 volt motor	\$30.00

### General Electric Immersion Heaters

Suitable for heating liquids, tanks, kettles, etc. (1 KW raises temperature 100°F 3 gallons per hour.) Fitted for 1 1/2" iron pipe thread. Can be used as 110, 220 volt or 3-heat 110 volt.

600 Watt ....	\$7.50	1200 Watt ..	\$10.50
750 " ....	7.50	2000 " ....	12.50
3000 Watt ....	\$15.00		

We have on hand a large variety strip (space) heaters. Quotations on request.

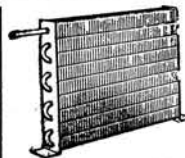
### Synchronous Motors

New Emerson 100th H.P., 900 R.P.M. 110 volt 60 cycle hollow 25/32 shaft vertical or horizontal mount, no base. Has many applications... \$7.50

### FORCED DRAFT BLOWERS COMPLETE WITH MOTOR

TYPE	H.P.	R.P.M.	CU. FT. MIN.	INLET	OUTLET	PRICE
0	1/20	1750	160	4 1/2"	3 3/4"	\$20.00
0 1/2	1/8	1750	350	6 1/2"	3 3/4"	22.50
1	1/6	1750	535	6 "	4 1/2"	28.50
1 1/2	1/4	1750	950	7 1/2"	6 "	35.00
1 3/4	1/2	1750	1900	9 1/2"	7 "	75.00

PRICES QUOTED ARE FOR A.C. 110 V. 60 CYCLES ONLY. OTHER VOLTAGES ON REQUEST.



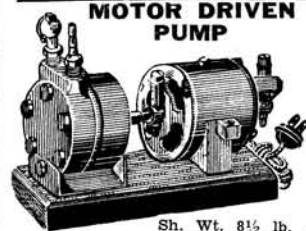
### "BUSH" CONDENSERS TINNED COPPER

Designed for refrigeration and air conditioning. Has many other uses. High heat transfer capacity and great efficiency.

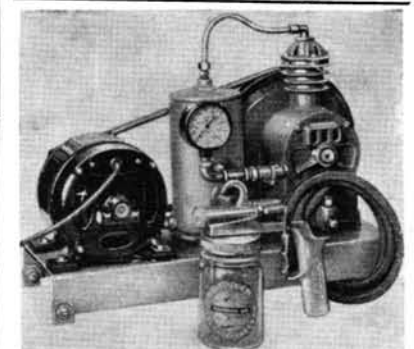
Sizes 7 3/4 x 12 1/2 .....	\$3.25 each
" 9 3/4 x 11 1/4 .....	3.50 "

Limited number of larger sizes on hand.

### MOTOR DRIVEN PUMP



Sh. Wt. 8 1/2 lb. .... \$5.00  
Complete with motor ... 20.50



Ideal spraying outfit for all liquids such as paints, enamels, etc. Can also be used for cleaning, tire inflating, and general purposes. Equipped with General Electric 1/4 H.P. a.c. motor. Quincy air compressor, adjustable safety valve, and 100 lb. air gauge. A heavy duty Plummer spray gun with 15 feet of hose. Weighs only 60 lbs. Price **\$45.00** Complete and ready for operation.

**PIONEER AIR COMPRESSOR CO., Inc.**  
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## ONE-ROOM APARTMENTS THAT "LIVE" LIKE THREE ROOMS

Living-room, to dining-room, to bedroom... presto changes that take place easily and gracefully... in apartments designed for greatest "livability" on *conservative budgets*. Surprisingly reasonable leases by the year, season or for shorter periods. Also "Town House" suites in 2, 3 and 4 rooms.



1. This attractive living-room . . . ↗

2. becomes, magically, a dining-room . . . →

3. and, finally, a sleep-inducing bedroom. ↘



Inspection invited.  
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### THE WALDORF-ASTORIA

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## —SCIENCE IN INDUSTRY—

ing a smooth, burnished surface within the hole.

They have been used as salvage tools, for drilling holes in dies, tools, and pieces of machinery which have been hardened and cannot successfully be annealed for machining; but their most important uses occur in production. Though hardsteel drills are a new invention, they have already eliminated many expensive grinding and machining operations, and are coming into more general use as production tools.

They have been adapted to a number of unusual uses. They will ream chilled castings without noticeable wear, they will cut manganese steel with ease in spite of its work-hardening qualities, they will drill fired porcelain without chipping or breaking it, they will cut sheets of pure carbon, and they will penetrate baked enamel without cracking it.

They will not draw their own temper in any such difficult jobs, and when they do show wear, they can be ground with ease on an ordinary wheel.

## BRUSH

For Cleaning Area

Around Rivet Holes

**A**TINY brush, no bigger than a finger, designed particularly for the aircraft industry but applicable to many other industries, has been developed by the Osborn



It cleans around holes

Manufacturing Company. The little tool, used to clean a small area around rivet holes, bolt holes, and so on, speeds up such work and makes it possible for one man to do the work previously requiring several.

All internal and external metal parts of a plane are coated with



zinc chromate paint. Where a good metal-to-metal bond is required to eliminate hazard of fire or radio interference, due to static discharge, the paint must be removed from around rivet and bolt holes.

When it is realized that there are approximately 1,000,000 rivets and numerous bolted connections in a \$50,000 military plane, many of which require a metal-to-metal bond, it isn't surprising that entire crews of men, using older methods, were required to work 24 hours a day preparing surfaces.

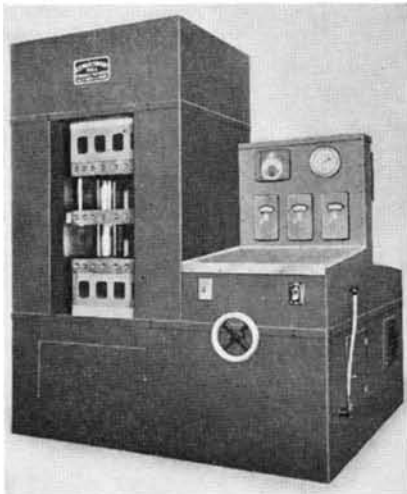
An analysis led to development of the new brush. It is a tiny end-brush made of wire and incorporates a special pilot rod to fit into the hole. Tests prove that the brush does not clog, that it does the work better, and that it speeds up the operation tremendously.

## PRESS

### For Laboratory and Experimental Work

**D**ATA on temperatures, pressures, and required current input can be readily determined during the operation of a new hydraulic press designed for experimental and laboratory work.

This unit press, which includes three electrically heated plates in the pressure-applying section, is



Electrically heated

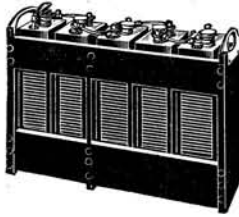
particularly applicable to pressure molding on a laboratory scale. Operation of the press is simplified; a handwheel adjusts the pressure and a single operating lever controls the press movements. Temperatures as high as 850 degrees, Fahrenheit, can be obtained on the pressure plates.

A complete set of instruments are mounted on a panel, in front

# IMMEDIATE DELIVERY

## U. S. ARMY & NAVY SURPLUS ITEMS

### EDISON STORAGE BATTERIES



Cells are reconditioned and in excellent condition. Complete with solution, connections and trays. Prices below are about 10% of regular market price. Average life 20 years. Two-year unconditional Guarantee.

A-4	Amp.	Hrs.	150.	Ea.	\$6.00
A-6	"	"	225.	"	6.00
A-7	"	"	262.	"	7.00
A-8	"	"	300.	"	7.00
A-10	"	"	375.	"	8.00
B-2 (J-3)	"	"	37.	"	5.50
M-8	"	"	11.	"	2.00
L-20	"	"	13.	"	2.50
L-40	"	"	25.	Pr.	4.00

All cells 1.2 volts each

Above prices are per unit cell. For 6 volt system use 5 cells. 12 vt.—10 cells, 110 vt.—88 cells. Note: On all cells 75 amps. or less an additional charge of 10% is to be added for trays.

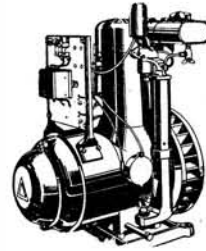
### U. S. Army Lighting Plants, New

Gasoline Driven.

"Delco" 1000 watts, 120 volt direct current generator. Single cylinder, 4 cycle air cooled 2½ inch bore, 5 inch stroke, 1400 RPM, battery ignition. Weight 340 lbs.

Price .... \$200.00

Additional data on request



### Build Your Own Searchlight

#### U. S. Army Parabolic Searchlight Mirror Precision Quality



DIA.	LENGTH	GLASS THICKNESS	PRICE
11 in.	4 in.	¼ in.	\$15.
30 in.	12½ in.	7/16 in.	75.
36 in.	18¼ in.	7/16 in.	125.

Made by Bausch & Lomb & Parsons. Perfectly ground and highly polished.

A few 60 in. slightly used metal mirrors on hand.

### SEARCHLIGHTS

- 1 24" G.E. Carbon Arc, rebuilt, Vert. & Horiz. adj. .... \$250.
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**Drawing Sets, 12 Piece High Grade**  
Pocketbook style, case 9" x 4" velvet lined. No. 2570 ..... \$10.95

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Pocket type. 360° Limited Quantity..... \$10.50

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Bronze jewel bearing. Leather case. 2¾" diameter, 1¼" high 360°..... \$2.95

**U. S. Army Watchcase Compass "Taylor"**  
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### K & E ALIDADE

Keuffel & Esser Alidade, Brass, black finish, beveled edge, 10½ in., graduated to 5000 meters. Folding Sights, with hair line, 40 divs., (Div. equals 10 miles), with spirit level. Price ..... \$5.00

### HAND CLINOMETERS, PENDANT

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**BAROGRAPH, FRIEZE, 7 Day Graphic, 7 Jewel movement, 28 in. to 31 in. atmos. pressure by 20ths. 8 Vacuum Cylinders 3¾ in. dia. hinge cover glass front, mahogany case price ..... \$55.00**

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**U. S. Army Aircraft, solid brass telegraph and radio transmitting key, large contacts. .... \$1.9**



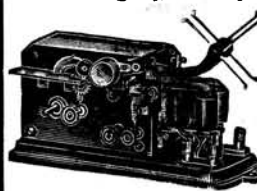
### NICHROME WIRE

in stock  
SIZES FROM #39 to .001

### MAGNET WIRE

SIZES #18 to #42 in stock  
COTTON OR SILK COVERED  
ONLY. May we quote you

### Telegraphic Tape Recorder



Written code on paper tape. Double pen permits recording two messages. Rebuilt & finished.

like new \$55.00

Reconditioned \$37.50

### TRANSMITTING CONDENSERS,

MICA,

operating volts 12,500, cap. .004. Dubilier, new \$12.50  
Dubilier, used \$7.50  
Wireless spec. new \$10.00  
Wireless spec. used \$7.50

Condenser, Dubilier, mica, op. volts 8,500, cap. .004 ..... \$7.50

Condensers, Murdock .022 mfd. 5,000 volt .. \$2.00

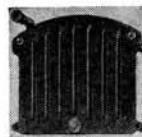
**U. S. NAVY LEYDEN JARS**  
Copper plated capacity .002 operating volts, 12,500 Height 14" diameter 4½". Price... \$4.50

### U. S. ARMY TELEGRAPH SET

Signal Corps telegraph key and sounder mounted on mahogany board. Operates on 2 dry cells. .... \$5.95

### HEAVY DUTY RHEOSTATS VARIABLE

Ward-Leonard Vitrohm, Capacity 15 amp. max., 5 amp. min. Res. 6 ohms. .... \$7.50  
Various sizes in stock



### U. S. Navy Divers Lantern

Electric 150 watt, any voltage, solid cast brass. 300 lb. test. Weight 12 lb. Price.. \$8.50

### TELEPHONE SWITCH DIALS

"Kellogg" 4 terminals, 10 digits. Diameter 2½", new ..... \$3.50

### ANTI-CAPACITY SWITCHES

Made by Western Electric. Double throw switch with 12 terminals—equivalent to two double-pole, double-throw switches. All contacts are of platinum plate. Original price \$3.50 each. Stp. Wt. 1 lb. Your Price.. \$1.50

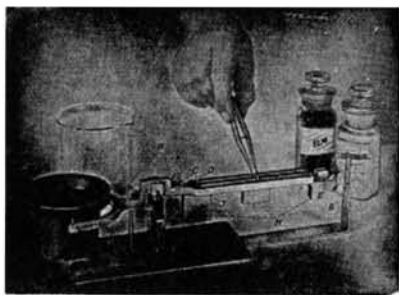


### GLASS MERCURY TUBE SWITCHES

3 amp. .... \$1.25 10 amp. .... \$2.25  
6 amp. .... 1.95 20 amp. .... 2.95

MANHATTAN ELECTRICAL BARGAIN HOUSE, INC., Dept. S. S., 120 Chambers Street, New York City

## An Accurate Balance at a Price Within the Reach of All



Sensitive to 2/50 gram  
 Weighs up to 100 grams  
 Compact—No loose parts  
 Modern, durable construction  
 Small convenient size  
 Handsome streamline design

Now permissible for auxiliary use in drug stores (N. Y. C. Serial B17.)

*Never before a balance with all these exceptional features!*

**Finest Quality**—Made of tested materials. Its construction will appeal to laboratories desiring the best equipment. The Bakelite cup is unaffected by practically any substance that can come in contact with it: the tool steel knife edge and agate bearing will give long life and accuracy.

**Extreme Sensitivity**—Weighs to one decimal point farther than the usual low-priced counter scales and serves nearly every laboratory purpose short of precise analysis. The capacity of 100 grams is ample for the delicate

weighings made in the usual course of teaching, organic synthesis, experimental work, compounding, photographic work, etc.

**Compact-Convenient**—Does not monopolize a laboratory table. Placed on the desk of the busy technical executive, it will soon become indispensable.

Its small size makes it possible to carry it on inspection and testing trips at a distance from the laboratory. It is small enough to be carried under the arm or in an overcoat.

Graduated in either the Metric System (grams) or the Apothecary's System (grains, drams and ounces). In ordering, please indicate which of these you desire.

**BENNETT BALANCE—\$8.00 plus 40c Postage**

*Tech Editorial Service, 26 West 40th Street, New York, N. Y.*

## VICTORY IN WAR

### *Calls For Skilled Workers*

#### Increase Your Knowledge of the Machine Trades With These Outstanding Books

**Blueprint Reading for the Machine Trades**—by Fortman and McKinney. A very practical and easy-to-understand book. Contains many helpful "Quiz" questions with answers included.—\$1.60.

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For Sale by

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

## —SCIENCE IN INDUSTRY—

of which is a desk surface on which the operator can make his notes, while keeping constant check on the progress of the work.

### WAX

#### New Synthetic Used in Paints, Polishes

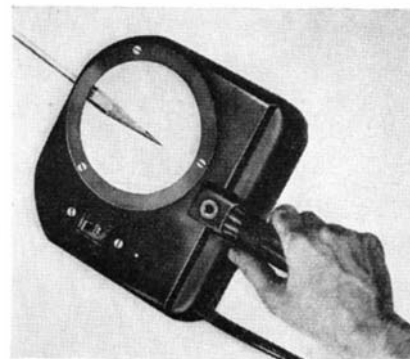
**R**ECOMMENDED as a flattening agent for paints, varnishes, and lacquers, a new synthetic wax made entirely from readily available domestic raw materials has been developed by the Glyco Products Company, Inc. This wax, known as S324, is hard and light colored, and has a melting range of 103 to 106 degrees, Centigrade. It is soluble hot in most oils and hydrocarbon solvents and is soluble in the cold with ethyl acetate.

This new synthetic wax is compatible with most other waxes and with resins. A stock gel can readily be made which can be added to the varnish or to the surface coating as desired without the necessity for expensive grinding operations.

### SHIELDED GLASS

#### Illuminated Magnifier For Inspection

**A** NEW illuminated magnifying glass, shown in use in one of our illustrations, is being used in a number of industries for inspection purposes. Weighing only 17 ounces, and equipped with a comfortable handle, it can be used almost as easily and flexibly as an ordinary magnifying glass. Lenses available give double and triple magnification. The housing and handle are made of light metal, single or double sockets being provided in the housing for one or two electric lamps. Attached to a corner of the housing is an extension cord and plug leading from a conveniently located toggle switch.



Weights only 17 ounces

# Military Rockets

## Anti-Aircraft Traps, Rocket Shells, Weather Study, Airplane Starters, are Possibilities

### ALEXANDER KLEMIN

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

**W**RITING in the *Military Engineer*, H. Franklin Pierce, President of the American Rocket Society, suggests several war uses of rockets. It is possible to criticize some of the suggestions and some of the methods recommended, but it must be admitted that the article is valuable and thoughtful. In the struggle with aggressor nations, every possible type of weapon should be canvassed.

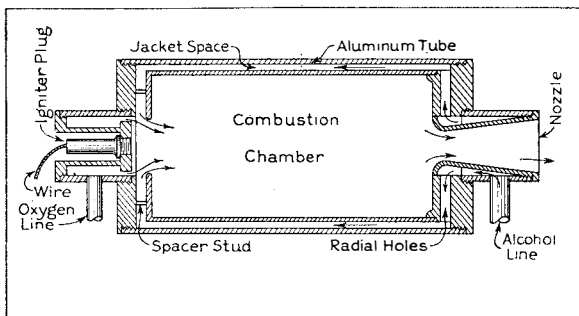
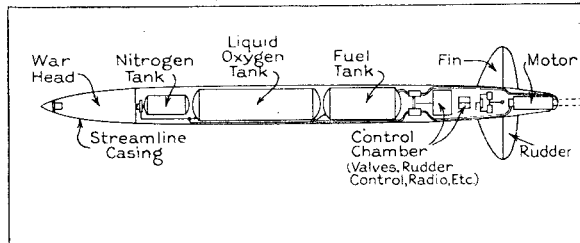
What would a simple rocket for military use look like? Rocket and

second diagram, is merely a combustion chamber provided with a nozzle for the escape of the exhaust gases whose reaction provides the driving force of the motor without the intervention of propeller or other device. Fins at the rear give stability during flight. A control chamber could be equipped for radio reception and wireless control of the rudder and hence of the direction of travel. Nothing very formidable in all this, though a rocket is not cheap as compared with a shell.

Now as to the various possible military uses of rockets:

Today's three-inch anti-aircraft shells are not very effective and

Layout of a military liquid-fuel rocket of the type discussed in the text



Schematic section of a rocket motor, showing combustion chamber, nozzle, ignition arrangement, and so on

motor are schematically illustrated in the diagrams, reproduced by courtesy of the *Military Engineer*. The rocket derives its power from the combustion of alcohol or gasoline in combination with liquid oxygen. The two propellants are carried in separate tanks of simple construction. A third tank carries compressed nitrogen, admitted to the fuel tanks through a suitable regulator, and producing pressure which forces the fuel into the rocket motor through a system of valves and feed lines, at a pressure of about 300 pounds per square inch.

The rocket motor, shown in the

do not reach the required altitude. The German bombers were able to reach London again and again in spite of a tremendous concentration of anti-aircraft guns, which were slowly brought into position beforehand and whose fire was tremendously expensive. Rockets, "fired" from a light launching rack would be more mobile, they could reach great altitudes, and they could carry aloft trapping devices such as a wire mesh provided with parachutes. A rocket barrage would be a formidable obstacle.

A rocket starts from the ground with zero velocity and accelerates



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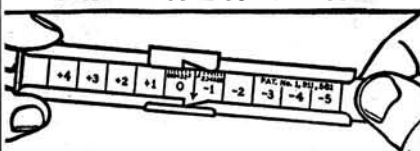
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as long as its fuel lasts. After the fuel is used up it behaves like a shell. Thus a rocket could readily be designed to reach 30,000 or even 40,000 feet. Perhaps there is here a formidable weapon against enemy bombers? The author recalls that the rocket played a part in destroying Napoleon's invasion fleet against England. Perhaps large rocket shells could become a species of long distance artillery?

Another application of the rocket which has received much attention is its use in weather prediction. A rocket of the liquid fuel type could carry a radiometeorograph, rise to altitude more rapidly than a sounding balloon, and would return for refueling with the aid of a parachute. Another advantage of a rocket over a sounding balloon would lie in more ready recovery of the apparatus.

Finally, the rocket, inefficient as it is for propulsion at the present speeds of the airplane, could be used to give an enormous thrust to planes at take-off and thus permit our long distance bombers to be greatly overloaded.

There are many difficulties, and space will not permit their lengthy discussion. Yet it must be admitted that these are not idle visions but serious, well thought out, plausible suggestions which deserve to be carefully considered by our military authorities.

**FLYING BOAT**

Could Fly Non-Stop to Europe and Return

**I**N 1910, Glenn L. Martin flew a rickety looking single float seaplane in the first extended over-water flight from the California mainland to Catalina Island and back. More than 30 years later, Ken Ebel, Glenn Martin's chief engineer tested the world's largest flying boat.

Mr. Ebel is one of those rare persons who combine the talents of a

designing engineer with the skill of the best and most scientific pilot. His ability to gage the results of his own design work is of inestimable value to the aviation world.

The new ship, the XPB2M-1, is powered with four Wright Cyclone engines of 2000 horsepower each, and can fly non-stop to Europe and back and drop a sizable load of bombs somewhere on the way. It has a span of 170 feet, an interior as large as a 16-room house, and carries a crew of 11 men with assignments to such duties as navigation, piloting, radio, and gunnery. Its weight is 140,000 pounds which is second only to that of the latest Douglas bomber, the B-19.

The great patrol bomber behaved beautifully on its first flights. The photograph indicates the clean lines of the hull. Marked chine lines have disappeared in the effort to reduce air drag and the straight sides of the hull blend nicely into the high wing. No tip floats are visible; presumably they have been retracted into the wing.

—A. K.  
*Despite the recent trial-flight accident to the XPB2M-1, this ship, also known as the "Mars," bids fair to take its place among the world's finest. The fact that the ship, with one engine aflame, was quickly brought under control and safely landed; the further fact that members of the crew were able to crawl into the damaged wing and extinguish the fire, indicate superior design.—Ed.*

**SKYFARER**

Only Two Controls, Plus Tricycle Nose Gear

**A** RECENT and interesting addition to the ranks of light planes is the Skyfarer. By skilful utilization of aerodynamic principles, the Skyfarer achieves a large degree of immunity to the stall and the spin. In fact, it is placarded as incapable



The Martin XPB2M-1 — 8000 horsepower



An interesting light plane, the Skyfarer

of spinning, but that is too much to hope for under every conceivable circumstance. Let us say, rather, that the risk of a spin is very much reduced.

In small planes, flaps are not as a rule incorporated, yet the Skyfarer has them, and the designers were perfectly right in using for a light plane an accessory which has proved itself so useful in larger machines. The rudder is eliminated, so that there is one less flying control, and the student has only to use a wheel, back and forth for elevator control, turning for steering just as in an automobile.

The ability to operate on two controls, thus making it easier to learn to fly, is achieved in somewhat the following manner: The plane is banked with the ailerons in the usual manner, whereupon it side-slips towards the lower side. The wind strikes the over-size tail surfaces from one side, and the plane automatically goes into a turn. Of course, the two-control system, which has been known for many years, has disadvantages to balance its simplification. A plane using this system has not quite the maneuverability of the three-control airplane. Also, there are times when the pilot would not only like a rudder, but would also like a powerful emergency rudder if he could get one.

The General Aircraft Corporation is to be congratulated on adding still another valuable feature to the Skyfarer, as a rule found only on larger machines—namely, the tricycle nose gear. With the tricycle nose wheel, landing in a side wind loses much of its terror. The machine may land side-wise, but the front wheel immediately castors into the direction of mo-

tion, so that the plane is soon running quite normally along the ground. All tendency to "ground loop" is thus avoided.

The Skyfarer is very roomy, and exceptionally well equipped for a low-power plane. There again we are fully in accord. The low-power plane should be just as comfortable, just as well equipped as is the low priced automobile, with brakes, hydraulic shock-absorbing struts, a full line of instruments, and so on.

With two occupants, a 75 horsepower Lycoming engine and enough gas for a long trip, the top speed is 100 miles per hour. With flaps down, the landing speed is only 45 miles an hour. There is provision for 40 pounds of baggage and 20 gallons of gasoline.—A. K.

## LIGHT PLANES

Can be Useful in  
National Defense

**W**HEN the war ends, we shall see an enormous increase in private flying, with many of the Army and Navy pilots clamoring for small planes to continue what will become their avocation. But is there any reason why we should be pessimistic regarding the small plane even under the present conditions? Not at all. The private plane owners can render real service in completing our national defenses, by reconnaissance, by ability to fly quickly anywhere to render aid, and in a dozen ways supplementing our more official defense system. And the light planes have shown real possibilities in Army maneuvers in Tennessee. Taylorcraft, Piper and Aeronca companies donated light

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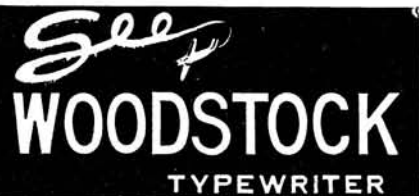


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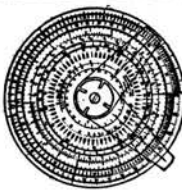
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planes for these maneuvers, and their performance convinced the War Department fully of their utility. The requirements and achievements of these light planes, from an Army point of view, is that they shall be capable of short-range liaison flights, approach the hovering speed of the autogiro, and have ability to land in and take off from extremely small spaces. Flaps and slots are utilized to the fullest. The machines are generally two-seaters with a 65 horsepower, four-cylinder engine as the power plant.—A. K.

**RESCUE LAUNCHES**

**Patrol the Sea for Fallen Airmen**

**T**HE R.A.F. has a small navy of its own in the form of rescue launches, constantly cruising the sea, even in the worst weather, and ever on the alert for airmen who have dropped into the ocean. These 53-foot long launches are propelled by three Napier aero-engines of 500 horsepower each and have a top speed of 40 miles per hour, a cruising speed of 32 miles per hour. At maximum speed they have an endurance of 12 hours (sufficient to cover about 500 miles), but their cruising range is considerably greater.

Because these launches are frequently attacked by German aircraft, they carry defensive machine guns, and rescue crews have often drifted helplessly for hours in heavy seas after their engines had been damaged by German fire. Sometimes this miniature navy operates in waves 30 feet high, when they can only see a few yards

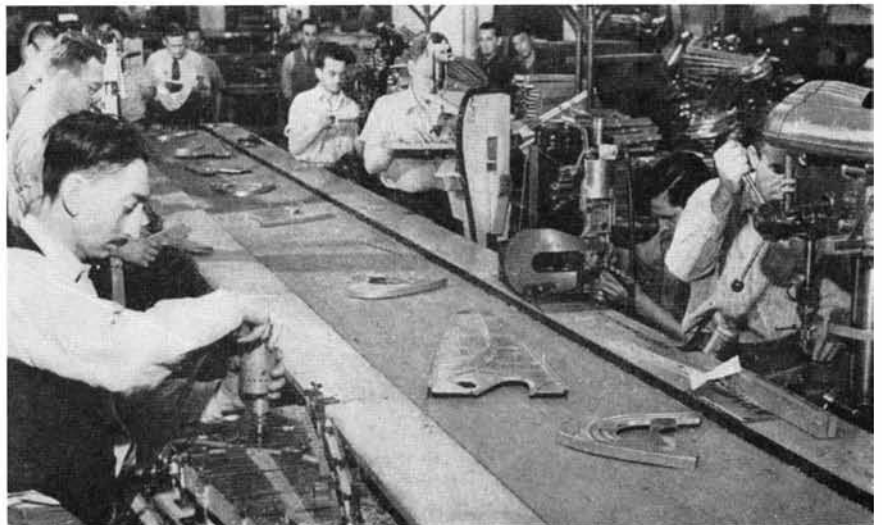
ahead. Aircraft help them to spot drifting airmen and a criss-cross pattern system is used for final location. These fast craft carry first-aid outfits, life belts, restoratives, and have to navigate very carefully at times to avoid mine fields.—A. K.

**ASSEMBLY LINE**

**Speeds Up Production of Airplane Parts**

**O**NCE upon a time the aircraft mechanic was a romantic person who, with three or four others, built a rickety craft which carried the leader of the small crew aloft on perilous and fame-capturing flights. Now the Glenn L. Martin Company has installed the belt-conveyor line shown in one of our photographs. Of course, time is saved, less skilled men find employment, and the weapons against aggression come faster. But gone will be much of the romance.

Here is how the new method of making certain sub-assemblies operates: "Two or more assemblymen at the head of the belt pace the line. Before them are jigs in which the pre-formed or pre-shaped pieces are fitted together and the first drilling operations performed, vari-colored patterns telling instantly the size of the drill to be used. The pieces are then laid on a belt and the drill-pressman picks them up, drills the various holes. Farther along the riveting machine operators fit certain pieces together and rivet them. Another man burrs the rivets. Still farther along other workers fit parts of the sub-assembly together, and finish the job. — A. K.



Airplane parts on an assembly line

# CAMERA ANGLES

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

## Kodacolor Prints

**C**OLOR snapshots even with a box camera, the long-awaited boon for the amateur with modest equipment, are here at last through the medium of Kodacolor roll film, a new color product just announced by the Eastman Kodak Company. Made public by Dr. C. E. K. Mees, the company's Director of Research and Development, the new process is hailed as "the greatest achievement in photography since George Eastman pioneered and introduced the first black-and-white roll film in 1889."

Kodacolor is a complete new process and is not to be confused either with the recently announced Kodak Minicolor prints from 35mm and Bantam size Kodachromes, or with the now obsolete process called Kodacolor which was introduced some years ago by Kodak for an entirely different additive process of color photography used for amateur color movies.

Designed especially for the millions of Marys, Janes, and Johns in this country who have been waiting ever since photography was a pup to see their prints in color rather than black-and-white, Kodacolor is available in six standard camera sizes, exposures numbered 1 to 6, with supplementary numbers for "split-frame" cameras. These sizes include: 120 (2¼ by 3¼ inches); 620 (2¼ by 3¼ inches); 116 (2½ by 4¼ inches); 616 (2½ by 4¼ inches); 122 (3¼ by 5½ inches), and 127 (1½ by 2½ inches). Price per negative varies with size from 20 to 40 cents each. Prints are 40 cents each in any size.

Literally, picture-making with Kodacolor roll film amounts to snapshots in color because, just as with ordinary black-and-white film, the amateur exposes his film as usual in any ordinary camera and receives in return, as with black and white, negatives and prints. The only difference, aside from that of price, is that the prints are in full natural color instead of black-and-white. As with black-and-white negatives, inspection of the color negatives will show light areas of the subject as dark and vice-versa. In addition, the negative will contain colors, not the true colors that will appear in the final print, but colors complementary to those in the actual subject. A red sweater, for example, will be blue-green in the color negative.

Kodacolor has a rather fast emulsion speed, about Weston 20, which makes it adequate for use with box cameras in good sunlight as well as for relatively rapid action at large stops when using faster lenses. The basic exposure in good sunlight for

average subjects, Eastman reports, is  $f/8$  to  $f/11$  at  $1/50$  of a second.

As with Kodachrome and Minicolor prints, exposed rolls of Kodacolor film must be sent to the Eastman plant in Rochester, through dealers and photofinishers, for processing and printing. Negatives to be printed are either selected by the customer after being returned or the choice of negatives suitable for printing is left to the judgment of the company.

The size of the final print is fixed at 2⅞ inches wide. Since the negatives are smaller than this, in most instances, this will mean a slight enlargement, except in the case of the 3¼-inch width of the 122 size, which will be slightly reduced to conform. The length in all cases will, of course, be proportionate to the enlarged width.

In explaining Kodacolor, Eastman gives the following technical data:

"Processes of color photography involve invariably the preparation of three pictures, each taken by one of the primary colors—red, green and blue-violet—and then their recombination to form the final color picture. In the Kodachrome process, the three pictures are taken one over the other on three layers of emulsion. The film is coated four times. The bottom layer is sensitive to red light and registers the red picture; the layer above is sensitive to green light; the top layer is sensitive to blue light, and a yellow filter is placed between the top layer and the two lower layers, so as to protect them from the blue light.

"After the film is exposed, the images of the three layers are developed, and then these images are converted into positives produced in dye by what is known as the 'coupler' process of development. The dyes are put in one after another by three successive treatments with developing solutions containing the proper couplers, so that when the film is finished, the bottom layer, in which the picture was taken by red light, contains an image formed in blue-green dye; the middle layer contains an image form in magenta dye, this being the color which is complementary to green; and the top layer contains an image in yellow dye, yellow being complementary to blue. In this way, a color picture is obtained.

"Some years ago, the Kodak Research Laboratories conceived the idea of working out another process in which the couplers are contained in the emulsion layers, not dissolved in the gelatin layer itself, but dissolved in very small particles of organic materials which protect them from the gelatin and, at the same



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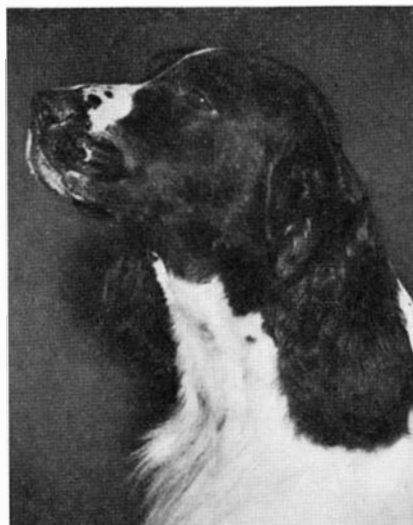
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time, protect the silver bromide from any interaction with the couplers. In this manner, the couplers are held out of contact with the silver bromide until the film is immersed in the developer. Then the oxidized developer penetrates the particles and there reacts with the coupler and forms the dye inside the particles suspended in the emulsion. This process has now been perfected and introduced to the public under the name of Kodacolor.

"The new Kodacolor process, however, differs very markedly from Kodachrome although it is essentially of the same character. The film is coated with the three light-sensitive layers as well as a yellow filter layer. In each of the emulsion layers are suspended microscopically small particles of organic compounds insoluble in water, and these particles contain the couplers required to produce the dye appropriate to each layer when they react with the oxidized developer. After exposure, the film is processed with a developer of which the oxidation product will react simultaneously with all three couplers and thus produce a dye image along with the silver image in each layer. After the silver has been removed, a negative is obtained composed of dyes in which the image is not only negative as regards light and shade but in which all the colors are complementary to those of the original subject."

### Dog Photographer

**A**N OLD cotton blanket for a background, simple lighting, and a 35mm camera to make many exposures in quick succession, if necessary, is all the equipment Arthur S. Mawhinney, F.R.P.S., uses to make the dog portraits which have now made him famous. A selection of 70 of his portraits of famous dog champions of the larger breeds was recently hung in the American Museum of Natural History in New York, under the auspices of the Oval Table Society of New York.



Stingo of Shotten of Greenfair

A characteristic Mawhinney dog portrait is reproduced, the result of patient assistance on the part of Mrs. Mawhinney, who has the sometimes difficult task of posing the dogs. We are told that it sometimes takes as much as an hour or longer to get the attitude and expression the Mawhinneys want.

Mr. and Mrs. Mawhinney have traveled more than 5000 miles to photograph champion dogs in shows and kennels and the prints represent breeds from every part of the world except India.

### Synthetic Snow

**C**ORN flakes were used by Castle Films in a recent 16mm movie, made for amateur projection, to



Snow on the Window

simulate the appearance of snow. The effect looked realistic and completely convincing. The reproduction shows one scene from the movie in which the stunt was employed.

### Our Contest

**A** COMPLETE report of the results of the Sixth Annual Scientific American Photography Contest will be found on page 104 of this number. Although a total of 36 prizes, valued at over \$1100, was awarded, space limitations do not permit us to reproduce all of the winning pictures. Thus we are presenting only the first-prize pictures in the three divisions. Names of the successful contestants, however, together with their geographical distribution, are given on the page mentioned above.

### Color Cartoons

**O**WNERS of 8mm and 16mm motion picture projectors may now purchase color cartoon films for home projection, according to an announcement by Castle Films. The company announces "the successful reduction and duplication of color prints for the first time for home movie fans."

Costing no more than the price of unexposed color movie film, the new

films bring to home screens the variety and added interest of commercial color fun cartoons produced in Hollywood, reduced for home projection. The first subjects include "Jack Frost," "Aladdin's Lamp," "Old Mother Hubbard," "The Pincushion Man," "The King's Tailor," and "Mary's Little Lamb."

**Films Train  
Defense Machinists**

"CUTTING a Spur Gear," a 16mm sound movie film showing "the what of machine tool use, so a man can give his whole attention to the how," and prepared under the direction of the United States Office of Education as the first of a series of more than 50 machinist and industrial training films, is now available to industries, schools, and other organizations.

The film library channels of the Bell & Howell Company, Chicago, are being devoted to the loan and sale of copies, the company announces.

**Lighting Problem Solved**

A NEW YORK CITY commercial photographer, John Muller, called upon to make a photograph for reproduction purposes of a new spotlight (the Fresnel Photospot described in What's New, this issue),



No retouching

achieved the fine result here shown by means of light exclusively and without the help of the retouching artist. The difficulty with this type of photograph is in the illumination of the black exterior so that it can be properly reproduced, at the same time illuminating the lens without burning up the carved details of the Fresnel pattern.

For this particular job, six lights were used in all—three floods and three spots. One spot was directed on the background to create a small circle of light sufficiently large to surround the subject and provide the necessary separation from the background. Other lights were placed in front and in back of the subject. For the inside of the lamp itself, the regular projection bulb was removed and

a projection bulb of the "built-in" reflector type (half-silvered) was used instead, with the silvered part turned around to face the reflector. The rest of the housing interior was covered with white paper. The illumination from the silvered lamp therefore struck the reflector first and was then diffused throughout the housing by the white paper lining, giving the desired non-directional result that illuminated the Fresnel lens softly and evenly.

**Report on Pictorialism**

IN PREPARING its annual report on pictorial exhibitions for the year July 1, 1940, to June 30, 1941, the 56th volume of the American Annual of Photography (1942), shows a perceptible drop in the number of exhibitors. For the tabulated year, the total number of exhibitors came to 7560, compared with 8928 for the year 1939-1940, and 13,746 for the year 1938-1939. Eleanor Parke Custis was found to have been the most prolific of all exhibitors during the period, with 146 prints shown in 55 salons. Frank R. Fraprie, who exhibited 118 prints in 54 salons, came second. Dr. Max Thorek was declared to be the most prolific exhibitor of the past five years, having shown 1053 prints in 317 salons. The highest rating of all exhibitors for the year went to Leonard Misonne, of Belgium. Harvey A. Falk, of New York City, took second place.

**Uses for Glycerine**

AIR bells on films during development may be eliminated by adding 1/5cc. of glycerine to each liter of solution, according to "Glycerine Facts," publication of the Glycerine Producers' Association. Another suggestion is the following formula for a print varnish, which lends brilliance and durability and is especially suitable for use on bromide prints:

- Borax ..... 30 grains
  - Pale shellac ..... 60 grains
  - Sodium carbonate ..... 10 grains
  - Glycerine ..... 30 minims
  - Water ..... 1 ounce
- Boil and allow to cool, then add:  
 Alcohol ..... 1 ounce

Add a small quantity of whiting or powdered punice to precipitate the gum wax. Shake well at intervals and allow to stand for several days. Decant and filter the clear liquid. Bottle until needed.

**Club Program Planning**

ALL work and no play makes camera-club membership a dull thing, is evidently the thesis serving as the basis of Agfa-Ansco's "Report of a Survey on Camera Club Program Planning," which the company offers gratis to all camera clubs. The programs, based on information gathered from 1300 leading camera clubs in the United States, are divided into infor-



HERE are some of the new VICTOR Lighting Units for 1942 — smart, efficient, capable Fotoflood and Fotoflash equipment which will serve you well for many years. There are more than FORTY Victor units from which to choose! Shown here are, top: No. 620-S Twin Fotoflood for No. 2 lamps with 11-inch "Diffuser-Flectors"; left: "SM" Synchronizer for Speed Midget and other Midget lamps; and right: the ever popular "250-S" Clamp-on for No. 2 lamps. Prices are reasonable — and the quality typically VICTOR. Write for new descriptive folder. It's free.

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# WINNING PICTURES in Scientific American's 6th Annual Photography Contest

**A**N OUTSTANDING exhibit of amateur photography." "The best display of its kind ever brought together." "The amateurs whose work was entered in this contest out-do the professionals at their own game." These and similar comments were voiced by those who viewed the exhibit of photographs from which the judges selected the final prize winners in the Sixth Annual Scientific American Photography Contest. These winners can take justifiable pride in their success, since they were up against stiff competition.

Space permits reproducing only the three first prize winners and a list of the names of the others who earned awards. Needless to say, the reproductions do not do full justice to the originals, yet so fine was the photographic quality of them that it is retained to a great degree even when the pictures are greatly reduced in size.

## Division I

- First Prize:* Dr. Irving B. Ellis  
Piedmont, California
- Second Prize:* Edward Canby  
Dayton, Ohio
- Third Prize:* W. J. Harvey  
Hollywood, California
- Fourth Prize:* Truman B. Gordon  
Oil City, Pennsylvania
- Fifth Prize:* Mrs. Eldean Olsen  
Santa Monica, California
- Sixth Prize:* A. J. O. Romero  
Bronx, New York



First Prize—Division I

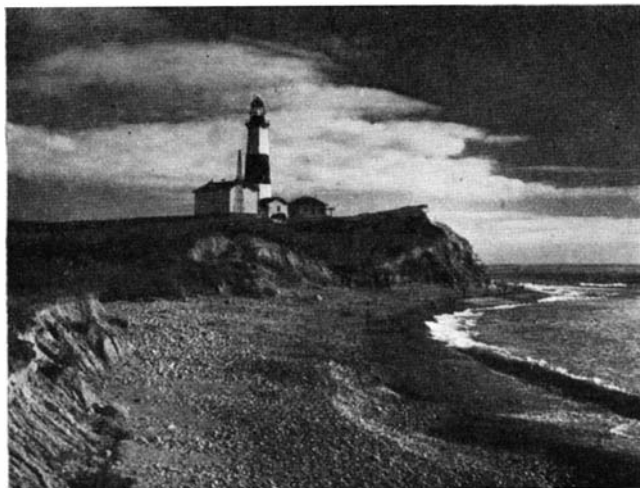
- Seventh Prize:* Arthur VanVictor  
Detroit, Michigan
- Honorable Mention*  
Henry M. Blatner  
Albany, New York
- Burnis McCloud  
Denver, Colorado
- Arthur E. Haug  
Chicago, Illinois
- Mrs. Eugene Landess  
Fayetteville, Tennessee
- William Dennin  
Chicago, Illinois

## Division II

- First Prize:* Robert Desme  
Brooklyn, New York
- Second Prize:* James Jenkins  
Arcadia, California
- Third Prize:* Janet Weston  
Atlanta, Georgia
- Fourth Prize:* Mrs. Allen L. Sutter  
San Francisco, California
- Fifth Prize:* John Hansen  
Brooklyn, New York
- Sixth Prize:* Dr. I. K. Moorhouse  
Beaumont, Texas
- Seventh Prize:* Edward L. Gockeler  
Saranac Lake, New York
- Honorable Mention*  
J. P. Whiskeman, Jr.  
Van Nuys, California
- W. Brooks Hamilton  
Lexington, Kentucky
- B. W. Leroy  
Portland, Oregon
- Tom Peterson  
El Paso, Texas
- Thomas O. Sheckel  
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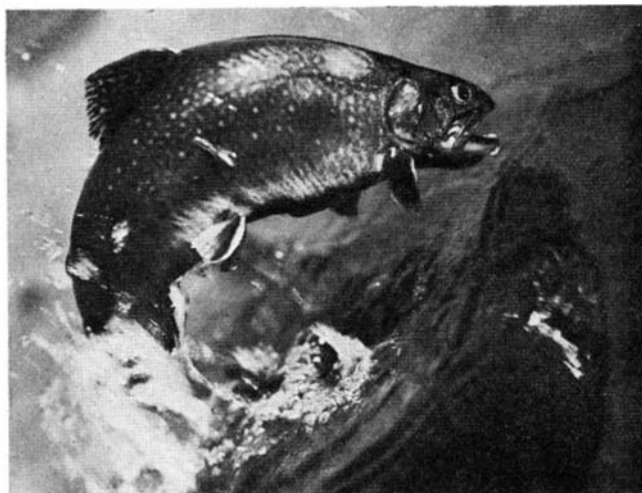
## Division III

- First Prize:* L. C. Sefting  
Allentown, Pennsylvania
- Second Prize:* Allen L. Sutter  
San Francisco, California
- Third Prize:* Tyrus T. Tanimoto  
Honolulu, T. H.
- Fourth Prize:* La Vern Frost  
Crystal, Michigan
- Fifth Prize:* Harold B. Stoddard  
Westfield, New Jersey
- Sixth Prize:* Charles Brennen  
Trenton, New Jersey
- Seventh Prize:* Dr. S. A. Bobrov  
Ossining, New York
- Honorable Mention*  
Elmer L. Onstott  
St. Louis, Missouri
- Hilda Ferguson Hampfler  
Kennett Square, Pennsylvania
- Charles H. Mundorf  
New York, New York
- C. W. Mattison  
Camp Hill, Pennsylvania
- C. Chester Lasell  
Oneonta, New York



First Prize—Division II

## First Prize—Division III





mal and formal programs, the former participated in by all members, the latter conducted by a single person or small group. The report includes detailed plans and suggestions for more than 40 ideas that have been tested and found successful.

In its survey, the company found that membership ranged from a group of three or four all the way to 20,000, the latter claimed by KYW Camera Club. The Railroad Camera Club, with a membership of 12,000, and the Kodak Camera Club, with 2064, came next in the list. In all it was found there are more than 5000 camera clubs in the country, the bulk of the clubs having a membership averaging 25 to 50 members.

**Cork Efficiency**

**A** CORK can be a useful article only if it is properly handled. If you have had trouble getting a cork to stay firmly in a bottle neck, try soaking the cork in melted paraffin. You will find the cork will then fit better and last longer.

**Club Auction**

**T**HE problem of surplus equipment owned by its members was recently solved by a local camera club by inaugurating the idea of periodic auctions. At these sessions, the members bring in whatever equipment they find they no longer have any use for, and the items are sold to the highest bidder. Outsiders are invited to participate. The result has proved generally satisfactory to both seller and buyer.

**"Repair That Camera"**

**T**O MAKE the most of what you have, in view of national defense demands, the Eastman Kodak Company is urging a "Repair That Camera" campaign for American photographers.

"There are 19,000,000 cameras in active use in the United States, and there are probably more than 5,000,000 others on shelves, in closets and bureau drawers," a Kodak executive states. "Although there may be a shortage in some types of cameras, there's no reason why these older units cannot be brought back into service and put to practical use."

A 25-percent reduction in repair costs on all Kodaks during the months of January, February and March, is announced by the company to start things going.



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EXTENSION FLASH HOLDER FOR KODAK SENIOR SYNCHRONIZER, MODEL E (\$14.55): Equipped with rubber insulated cord for extension to 20 feet from camera. Similar to battery case, equipped with ball joint and clamping bracket having rubber pads. Flash bulbs may be operated from release of synchronizer or extension holder.


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CRAIG FIRE-STONE WATER FILTER (\$3.75): Operates regardless of power or water pressure. Has two fittings to accommodate all faucets. Extra filtering stone. Metal parts triple chrome-plated to guard against corrosion. Maximum flow of two gallons per minute.

KODAK DENSIGUIDE (\$1): Compact calculator for estimating gray scale densities on suitably prepared negatives. Especially useful in making color separation negatives and color prints.

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## A Monthly Department for the Amateur Telescope Maker

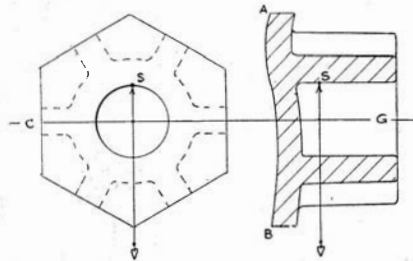
Conducted by ALBERT G. INGALLS

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

**L**AST month, in this department, Dr. J. A. Anderson, physicist at the Mount Wilson Observatory and Executive Officer for the 200" mirror now being completed at the California Institute of Technology, began a two-part article describing the work of the past five years on the mirror. This month he completes the description. This is the first detailed technical revelation of the difficulties that have arisen in the long years of work on the big Pyrex disk, and of the methods used in defeating them.

Three years ago this department urged Dr. Anderson to describe what was going on, also to state when the work would be finished. He wisely replied: "Dates I can not give yet," and he added, "I shall refuse to describe a job until it is completed, but you may be sure that my article will be in your hands within ten days of the completion of any one stage."

This promise was kept recently



Drawings by Russell W. Porter

Figure 5: Theoretical hexagon

when the stage of bringing the surface to a sphere, preparatory to parabolizing and figuring, was completed. The account proves to be something of a now-it-can-be-told story, for there were troubles. Yet anyone who has ever made even a small telescope mirror could have predicted this — there always are troubles, some of them almost interminable; while in pioneering a mirror of unprecedented size, such as the 200", they were all the more expectable. Those that were encountered now turn out to have been even more puzzling than the best of the tales circulated orally by "Old General Rumor." Yet they were conquered and the project moves successfully toward completion — when? This still is unknowable — for a telescope mirror is finished when it is finished. Dr. Anderson's account, continued from last month, follows:

"Optical tests of the 200" mirror were at first made with the mirror tipped up so its optic axis was horizontal, using therefore only the one component of the supporting levers. Later on, tests were made with the axis pointing about 4° above the horizon, so that both components of

supporting force would be in action. In the later stages of figuring the mirror was made to rest on the supporting system while polishing was in progress.

"The first optical test of the mirror, in September 1938, revealed a fair spherical surface with some zonal and other errors, the chief of which was astigmatism. Measurement of the latter showed that the radius of curvature of a vertical plane was a millimeter or so shorter than that of a horizontal section. Rotation of the mirror about its axis in the testing position showed that the astigmatism did not rotate with it — in other words the radius of curvature in the vertical plane remained shorter in all positions of the mirror.

"More refined measures revealed another surprising fact — namely, that at times the vertical astigmatism would have slightly different values in two orientations 180° apart. Running down the cause of this behavior required considerable time after it had been demonstrated to our satisfaction that the phenomena were real and not simply errors of measurement. A linear astigmatism of the order of 0.05", with a not very smooth mirror surface where errors of measurements would average 0.01" or 0.02", does not seem so very bad — and the 180° effect of about 0.01" might very well be considered accidental — as it was in fact until continued improvement in the figure reduced errors of setting to a few thousands of an inch. Anyway, both of these effects which had been noted in the early tests turned out to be real and correctable, though it must be confessed that it took a year or more to discover their nature and cause.

"The cause of the vertical astigmatism lies in the structure of the mirror itself, combined, of course, with the method of internal support. Suppose the mirror is tipped up so that its axis is horizontal. Its weight then is carried by the 36 levers whose points of contact are in the rib structure and something like four or five inches behind the continuous front of the mirror. Let us think of one of the hexagons (Figure 5), into which we divided the mirror in the previous discussion, as made up of two parts: first, the solid front curved plate and second, the ribs. The front plate is about twice as stiff in a vertical plane as the rib system is.

"If now the support point were located at the center of gravity (actually, on the axis of the 'pocket'), the half of our unit below the center of gravity would be in tension, so that it would stretch; while the part above

would be in compression. Also, the deformation of the ribbed part would be twice as great as that of the solid front. If the undeformed front surface were a plane, it would, under this deformation, become slightly S-shaped vertically; that is, the upper half would be slightly convex, the lower slightly concave. Since, instead of a plane, we have a spherical surface in the undeformed condition, the deformed condition will consist in the addition of a very weak convex cylinder to the upper half and a similar concave cylinder to the lower half of the unit. Taking now the whole mirror, each of the 36 parts would be similarly deformed, but there would be no general deformation of the surface as a whole.

"Return now to the actual case. See Figure 5. The supporting point is on the upper surface of the 'pocket', which lies some 6" or 6½" above the center of gravity. The part A that becomes convex is therefore 6" shorter than the lower part near B, which becomes concave. So we may say that, on the whole, the unit is concave; and when we now add up the 36 parts we find, in addition to the local deformation of each unit, a general (net) vertical concavity of the whole surface, which is what has been observed. The diagrams of Figure 5 will perhaps aid in under-

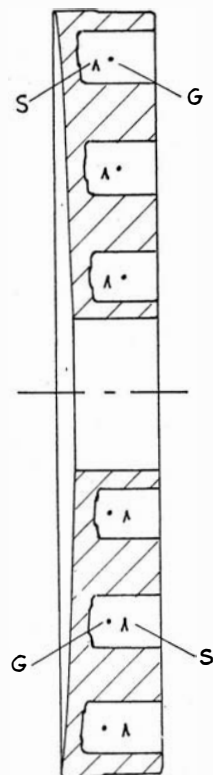


Figure 6: Cause of astigmatism

## TELESCOPTICS

standing this. The local deformations of each unit are of course present, but they are so very much smaller than the net deformation that, provided the latter is small, the former will be too small to be observed.

"If, in Figure 5, the support *S* could be located on line *CG*, curve *AB* would be symmetrical about *CG*, and the net curvature of *AB* would be zero.

"Clearly the effect just discussed will be absent, or have zero value, when the axis of the mirror is vertical. As the mirror axis is tilted toward the horizon, the effect will vary as the sine of the zenith distance. To correct it, a system of 12 gravity-operated 'squeeze levers' were applied, acting on the outer edge of the disk near the back, which, when the axis of the mirror is horizontal, act so as to correct the error. Since their effect also varies as the sine of the zenith distance, the compensation will be correct in all positions of the axis.

"The second phenomenon mentioned above—that is, vertical astigmatism in two orientations 180° apart—is caused by a maladjustment of the supporting levers, and, like the one just discussed, is absent when the mirror faces the zenith. Let us again consider the mirror tipped up, with axis horizontal, and assume that the supporting levers such as *S*, Figure 6, in the upper half are on the average so adjusted that their supporting points are somewhat in front of the center of gravity surface in the mirror, while those of the lower half are misplaced in the opposite direction. Reference to the same figure will make it clear that, in the assumed position, the radius of curvature in the vertical plane will be lengthened, while if the mirror is rotated 180°, the radius will be shortened by the same amount. Here the remedy is obvious.

"In order to test for astigmatism when the mirror faces the zenith, the arrangement shown in Figure 7 was employed. The light source and the knife-edge are, as usual, near *CC*. The plane mirrors *MM*, at 45°, are 8" in diameter. By rotating the large mirror the zone indicated by the dashed line may be tested for astigmatism. By adjusting the counterweights of the 'lifting component' of the supporting levers, any observed small amount of astigmatism may be removed.

"The work of making the mirror surface a satisfactory sphere having a radius of curvature of 1335.7" was completed in August, 1941. Parabolizing by alternate fine grinding and polishing was started August 30, and is now very nearly completed 'in the rough'; meaning thereby that the radii of zones are very close to the calculated values. The long work of smoothing and final figuring still remains to be done.

"Testing will be done near the

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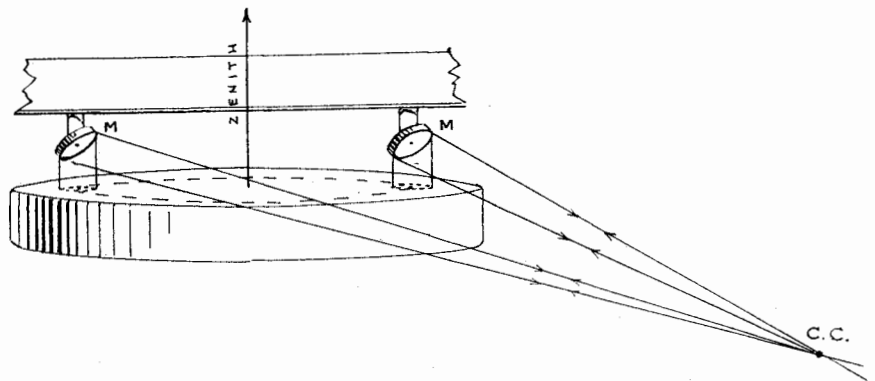


Figure 7: The method for testing by zones for astigmatism

center of curvature, using a method worked out by Dr. F. E. Ross and the author. The method is new as far as we are aware; however, it would not surprise us if it should prove to be 'old as the hills' — for no complete search of the literature has so far been made. The method is shown in Figure 8. The lens *L* is so designed that, when the light source is placed at a point between its focus and the lens, the spherical aberration at its virtual conjugate focus is such that the conjugate focal points for different zones of the lens coincide with the 'centers of curvature' of the corresponding zones of the paraboloid. The light source is shown on the axis. To the right of the lens the rays travel along the normals to the paraboloid, whence they are returned along the normals and would converge to the source — but, by the aid of the half-silvered plate *P*, the returning light is brought to the knife-edge as shown. The source and knife-edge may be interchanged.

delphia, published in the "Transactions of the American Society of Mechanical Engineers" for May 1940, wherein he states that "there appears to be no metal which, when polished and examined even under low powers of the microscope, will present a surface of uniform appearance even remotely approaching that of well-polished glass."

Needs is not an amateur telescope maker but an engineer who undertook an extended research on the influence of boundary films of lubricant in machine bearings, and performed his experiments between two circular metal flats. In order to prepare for these experiments he first had to learn, from scratch, how to make the flats used in it, and in this he was aided to some extent by "A. T. M." (The pun about "from scratch" was unpremeditated but any who have been through the mill would perhaps vote to leave it in.) Needs continues:

"The metal surfaces invariably

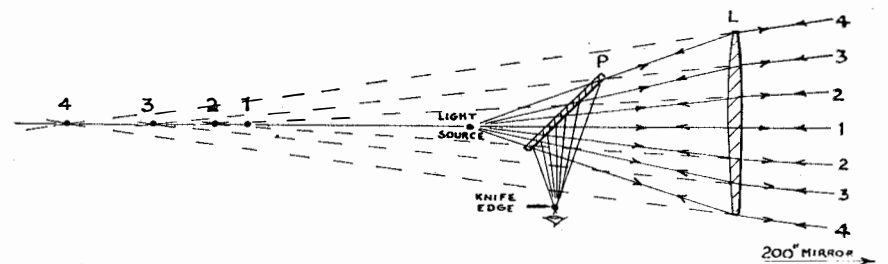


Figure 8: Testing method to be used in the final figuring

"The author wishes to express his deep appreciation of the assistance given him by Russell W. Porter in the preparation of this article."

**E**VER make a flat? Then you know the application of this verse, written by Anon Y. Muss:  
An old man who lived in a cave  
Knew how to make fringes behave.  
If he moved his head closer,  
And the fringes grew grosser,  
He knew that the work was concave.

contained pits or non-metallic inclusions, iron carbides or traces of manganese in the form of gray spots with well-defined but irregular edges. Experience finally seemed to indicate that the best surfaces were produced by high-speed tool steel or a high-chrome tool steel. The chrome steel is corrosion-resistant and will hold its shape over long periods of time but it warps badly during the hardening process and is somewhat difficult to polish."

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RELATION TO BUILDING CONSTRUCTION AND OPERATION, by Frank B. Rowley, Axel B. Algren, and Clarence E. Lund, is a 70-page technical bulletin which considers the subject of its title in both insulated and un-insulated houses. Request Bulletin No. 18. *University of Minnesota, Minneapolis, Minnesota.—40 cents.*

### PHOTOGRAPHY AS AN EXTRA-CURRICULUM

ACTIVITY, by C. B. Neblette, is an eight-page folder available to teachers and school administrators. *Rochester Athenaeum and Mechanics Institute, Rochester, New York.—Gratis.*

### CLIMATE AND MAN

is the 1941 Year-book of the United States Department of Agriculture, and this year its 1248 pages are devoted entirely to weather and climate, largely in relation to crops but still so broadly as to be of value to all country-minded persons. It contains detailed data on the climate of each state. *Superintendent of Documents, Washington, D. C.—\$1.75.*

### TRAINS

is a year's volume of a new magazine devoted to subjects of interest to railfans, now in its second year of publication. Contains an index of the articles published in the 12 bound numbers. *Kalmbach Publishing Company, 1568 West Pierce Street, Milwaukee, Wisconsin.—\$2.50.*



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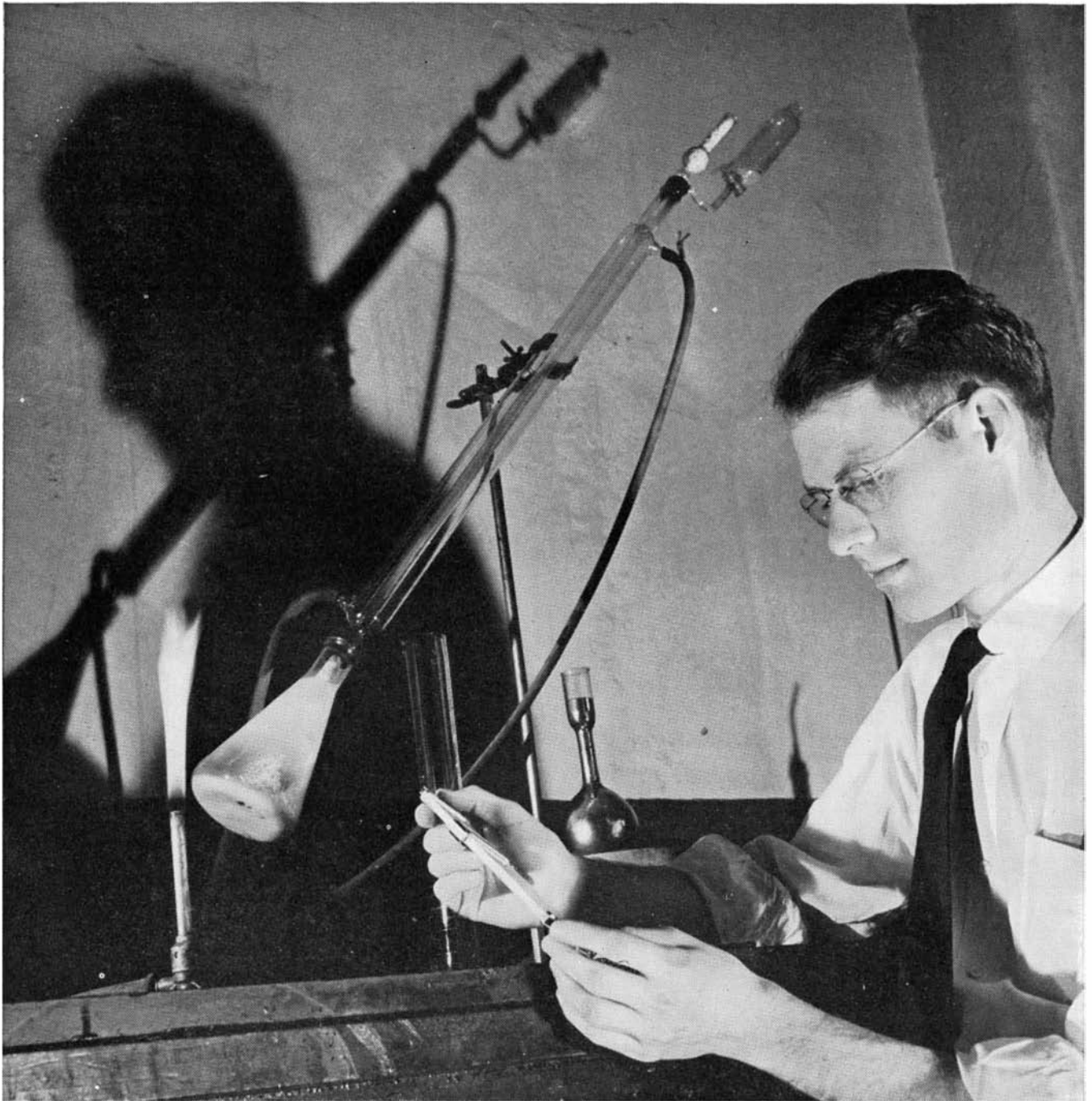
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