SCIENTIFIC AMERICAN

AUGUST · 1940

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Vol. 163 No. 2

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Tanks— Capt. J. E. McINERNEY

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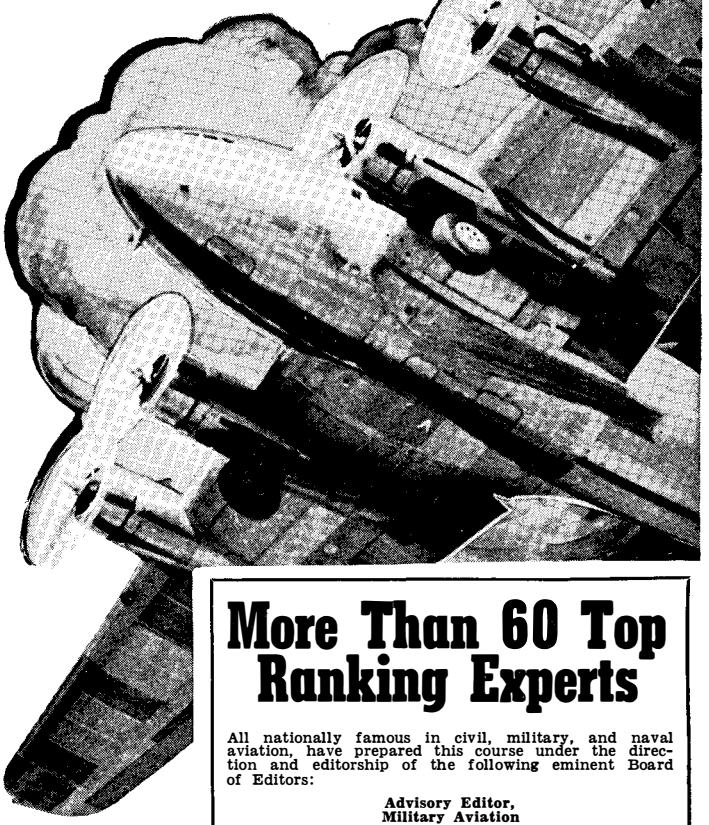

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SCIENTIFIC AMERICAN

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OUR Point OF VIEW

IN NEW DRESS

WITH this issue, Scientific American opens a new period in its 96 years of publication. Starting with a new cover design and modern, easier-to-read typography, we have evolved a new policy of editorial treatment that, we feel sure, will make Scientific American even more valuable to its readers than it has been in the past.

By segregating all editorial material into specific classifications, we are able to present a departmentalized magazine that permits the reader to turn immediately to those sections that hold the greatest interest to him and to find there the cream of the pertinent news. Then, at leisure, he can survey the other sections, knowing that under certain headings he will find specific types of information.

Preview "dummies" of the new Scientific American, sent to hundreds of readers, have been enthusiastically received. We hope that you will be equally pleased with the final and complete result. In any event, the editors will appreciate your expression of opinion, whether it be in the form of a bouquet or a brick-bat.—*O. D. M.*

ANTI-SABOTAGE

UPPERMOST in the thoughts of millions these days is the current problem of building up our national defenses. Yet in all the billions of words that have been printed on the subject recently, little or no mention has been made of what should be our *first* and most determined step. Too much emphasis cannot be put on the need for an Intelligence Service expanded to the point of superiority, in numbers and brains, over that of any possible future enemy.

We are a heterogeneous nation. Walking the streets past each of us every day are aliens, first generation descendants of aliens, and misguided "old Americans" who live under various delusions. This is not to say that these categories are all inimical to our interests. They aren't; some, indeed, even among the aliens, are better Americans than some sons of pioneers. But the numbers of these and the freedom of speech permitted them in our democracy make it difficult to identify them until after they may have done their mischief. And it must be remembered that "whispering campaigns" of propaganda can be a more serious form of sabotage than destruction of a powder factory or a power plant. Such campaigns have already started in some sections of the country.

Insidious work of foreign agents, with the connivance of residents, is going on under our noses constantly. Nevertheless, we want no vigilantes, no civilian rumor-mongering or tattling on our neighbors. It follows, then, that a vastly superior Intelligence Service should be organized and carefully trained. If this is not done, our national defense program will assuredly suffer all along the line from the work of numerous foreign agents now present in the United States.—*F. D. M.*

A DRY-DOCK NEEDED

A NUMBER of things stand out in much of the current talk concerning the need for adequate national defense. One is the fact that we are now building battleships having a tonnage of 45,000 and may eventually go to larger sizes. Another is the fact that New York City, because of its importance as a possible fleet base in time of war, and its excellent transportation facilities, should be equipped in every possible way to render it strategically efficient in case of war.

The shocking truth is that nowhere in the New York area is there a dry-dock capable of caring for our new 45,000-ton battleships. There is none which could take care of our two largest aircraft carriers, the *Saratoga* and *Lexington*. Yet in time of war these ships might be damaged near New York while defending the port. They could not then put in at New York or be towed in for the necessary repairs before going into service again. The New York Navy Yard dry-dock cannot take care of these ships, is 35 years old, and is up the East River behind bridges which might be bombed so as to block the exit completely. Indeed, in time of war, continued operation of this Yard might hang precariously in the balance.

The Port of New York Authority has recently urged the construction of a dry-dock of a size that would take not only our naval vessels but also the larger transatlantic liners. Such a dock might be constructed at Jersey City, Weehawken, Bayonne, or Brooklyn, but certainly should not be up the East River into which bridges might fall after being bombed. To us, a project of this sort seems a vital part of our national defense program. If that program is to be rounded out, the repair facilities afforded by adequate dry-docks in strategic positions are as necessary as the warships which will defend our shores. The service of the fleet will be handicapped if such facilities are not prepared for their use.—*H. T. R.*

HAVE SOME FUN

A PLAYGROUND exclusively for adults has met with great success in a recreational center near New York City. Here is equipment designed after that formerly used for children, but scaled up to meet the demands of grown-ups.

And why shouldn't mature people hop around on pogo sticks, enjoy the thrills of a see-saw, experience the forgotten joys of a sliding board, pump on swings to their hearts' content, all in the privacy of their own playground and free from the prying eyes and competition of youngsters? Psychologists tell us that the way to keep young is to do young things, to forget the cares and worries of workaday life, to be kids again. The flexible minds that conceived the playground referred to have done their share to make this possible in one small part of the world. Other municipalities will do well to copy.—*A. P. P.*

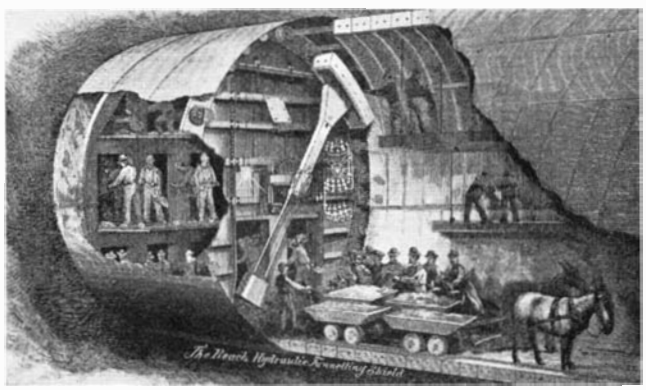
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of August, 1890)

DEFENSE—"The exposed and comparatively defenseless condition of our most important seaboard cities, in respect to foreign naval attack, has for years been the subject for talk in Congress, but up to the present time little of a practical nature has been done in the line of protection. It is true a few vessels of war have been ordered and some preliminary steps taken toward the manufacture of heavy guns for fortifications. But in regard to the systematic and permanent defense and safety of such important harbors and cities as Portland, Boston, New York, we believe no definite plan has been fixed upon, no material steps as yet taken."

TUNNELING—"A tunnel . . . to extend between Port Huron, Mich., on the American side, and Sarnia, on the Canadian side of the River St. Clair is being bored . . . by means of the Beach hydraulic shields. The walls of the tunnel are constructed of cast iron segments, thirteen of which and a key form the circle . . . The shield is the



invention of Mr. Alfred E. Beach, of the Scientific American . . . It consists of a strong cylinder somewhat resembling a huge barrel with both heads removed. The front end of the cylinder is sharpened, so as to have a cutting edge to enter the earth . . . By means of a system of hydraulic jacks capable of either combined or separate action, it is possible to govern the direction of the tunneling shield with the utmost precision, making it to ascend or descend in the earth, according to grade required, or travel on a curve of any desired radius . . . In the St. Clair tunnel work, each shield is circular, 21 feet 7 inches in diameter, 16 feet long, and is built of plate steel one inch thick."

GOLD TEETH—"American dentists insert in American teeth, each year, the enormous amount of 800 kilogrammes (about 1,800 pounds) of the precious metal, which represents nearly $450,000 . . . It appears that in less than one hundred years the American cemeteries will contain a larger amount of gold than now exists in France."

DEEP—"It has hitherto been supposed that the maximum depth of the Mediterranean was 10,785 feet, between Sicily and Sardinia. Lieutenant Magnachi, of Italy, has found a depth of 13,550 feet, between Malta and Candia."

MILEAGE—"The following is given . . . as the railway mileage at the beginning of 1889: Europe, 133,900; America, 190,000; Asia, 17,800; Africa, 5,200; Australia, 10,500; total, 357,400, as compared with 293,000 in 1884."

INDUSTRY MOVES—"The transfer of industries is one of the most strongly marked and distinctive features in modern industrial life. Its economic causes are to be found in the exhaustion of local supplies, the development of new areas, and the changing centers of commercial distribution . . . The deportation of manufactures from the Eastern States to the West and South will largely change the old centers of wealth and industry. These displacements may entail some local misfortune, and break up some time-honored establishments, but in a general and national sense the distribution of industries is an economic necessity and an industrial blessing."

TRAVEL HAZARDS—"Travelers on the Eastern Bengal Railway have placed before their eyes on entering the stations of the road a placard containing the following cheerful information: 'Passengers are hereby cautioned against taking anything to eat or drink from unknown persons, as there are many who live by poisoning travelers . . . When they reach a place convenient for the purpose, they poison the water or food of the passengers, who become insensible, and then they decamp with all their property.' "

SPEED—"In a recent lecture before a scientific club, Professor Elihu Thomson declared that much higher speeds than can now be obtained with steam locomotives are to be expected by means of electricity, and he considered from 100 to even 150 miles an hour possible. While in the steam locomotive there are reciprocating parts that must be put in motion, stopped, and reversed continually, in the electric locomotive we have simply a rotary motion, which makes it possible to run with economy at much higher rates of speed."

WORDS—"Eighteen words have come into the language —probably temporarily, most of them—to denote the act or state of electric killing. They are as follows: Electromort, thanelectrize, thanatelectrize, thanatelectrisis, electrophon, electricise, electrotony, electrophony, electroctony, electroctasy, electricide, electropoenize, electrothenese, electroed, electrocution, fulmen, voltacuss, and electrostrike."

RABBITS—"A recent report by the United States consul at Sydney, N. S. W., gives a vivid idea of the extent of the [wild] rabbit pest in Australia. The extraordinary fecundity of the animals under the climatic conditions . . . have caused the country to be completely overrun . . . Vast regions are devastated, and the grass and other herbage is devoured . . . The figure of five millions is given as the possible increase of two pairs of rabbits in three years. Yet even this is a low estimate of the possibilities . . . The average life of a rabbit is put at about nine years. The doe may have young eight times in a year, averaging eight each time. The first litter is produced when but four months old. The progressions based on these figures lead to astonishing results."

ELECTRIC HEAT—"Electrically heated flat irons are now made which are very serviceable. The flat iron is of the usual form, but made hollow. The interior contains a lot of coiled wires, through which the electrical current passes and heats the wires hot. The latter are arranged between protecting sheets of mica and asbestos. You turn a switch, and the flat iron at once heats up ready for use."

The Voice with a Smile

"We hold," says a well-known writer, "that the young ladies of the American long distance telephone wires make up what is probably the most efficient public service crew in the world. They have profound patience and that capacity for taking pains that some one once said is all that genius amounts to.

"We once called a fellow at a hotel in Philadelphia but he had just departed on an automobile trip in a westerly direction. A few days later the long distance operator caught up with him in a little town in Missouri and he was the most surprised man in all but one of the States of the Union. The exception was New York. We were the most surprised there. To this day we have no idea how the operator did it."

DAMON RUNYON
in the *New York Mirror*

BELL TELEPHONE SYSTEM

The Bell System cordially invites you to visit its exhibits at the New York World's Fair and the Golden Gate International Exposition, San Francisco.

STEEL CAVALRY OF MODERN WAR

A CHARGE of such modern tank cavalry, though a far less inspiring spectacle than a charge of regular cavalry, has a greater influence on the morale of the attacked. In time, however, the psychological effect is lessened, though their greater "manpower," or striking power per man, is permanent. Judging from present events in Europe, development of the inevitable successful counter to highly mechanized forces is still in the rather distant future. Whether this counter will be some new weapon or simply a sufficient number of opposing tanks, it is too early to say. However, it probably will be found in time.

MACHINES FOR WAR

Organization and Operation of Mechanized Forces of Our Army

CAPTAIN J. E. McINERNEY
Ordnance Department, U. S. Army

MECHANIZATION, as it refers to war, may be truly defined as the adaptation of the best-known mechanical developments of the existing times to the weapons of war. In recent years, the term has been restricted to the use of automotive vehicles for *combat* purposes. This article will deal with this conception of the term, and will not touch on the subject of motorization which relates to the vehicles of the army that are adopted for general purposes, such as hauling cargo, ammunition, personnel, and equipment, and for towing guns, trailers, and other wheeled equipment.

The development of combat vehicles carrying armament and providing protection for the crew has been a gradual one throughout the ages. History is full of attempts to design devices to permit the soldier to approach the enemy under protection at a reasonably rapid rate and with all the fire-power possible.

Naturally, the greatest advances were made in this type of equipment during the first World War. The conditions of the war in 1916 —that is, the use of the machine gun in conjunction with the trench and barbed-wire systems for defense—had so extensively increased the casualties of an attacking force that the war developed into a stalemate. It was impossible to take the offensive without an enormous force and without considerable artillery preparation which eliminated the essentials of the success of the offensive—the elements of surprise and maneuver. The employment of sufficient forces and their necessary equipment to conduct a successful offensive resulted in completely blocking most of the roads in any given sector to the extent of eliminating all freedom of maneuver.

It was soon discovered by the nations involved in the first World War that their resources of manpower were giving out faster than their munitions. To increase their

MILITARY SCIENCE

fire-power and to conserve their supply of men became the goal. It was realized that, with the conditions of the terrain as they existed after two years of war, a wheeled vehicle could not develop the required tactical mobility. Two commercial inventions greatly assisted in solving the problem: a track-laying device and the internal-combustion engine. The track-laying device was first adapted to a combat vehicle, called a tank, in England in 1916. The name "tank" was used to keep the development as secret as possible. With the development of the tank, armed and armored, the offensive was again restored, giving the attacker mobility, protection, and fire-power.

We can get some idea of what our World War leaders thought of the effectiveness of mechanized units from the numbers of tanks which were on order in 1918 for the projected offensives of 1919:

3 ton (Ford)	15,015
6 ton	4,440
Mark I	1,000
Mark VIII (Anglo-U.S.)	1,500
Mark VIII U.S.	1,450
Total	23,405

For our nation, mechanization has many distinct advantages. As the most highly industrialized nation in the world it will give us, as a result of our great production facilities, a superiority which cannot be approached by the non-industrial nations. An army which is mechanized will have on its side the necessary elements of surprise, maneuver, mobility, and fire-power, which are required for a quick and decisive victory. A nation not mechanized will have to fight a losing war or a long, costly, and inconclusive one with the resulting human, industrial, economic, and moral attrition.

It has been natural for us to follow, in a general way, foreign practices concerning the use and development of our mechanized units. However, our geographical and economic conditions are such as to dictate characteristics for our army which might be entirely different from those of most other armies. For example, the military tactics of a given country may have been dominated by the condition of its being hemmed in on all sides by potential enemies, requiring that they have fast mobile units which can be concentrated at any of its many frontiers on short notice. These conditions, therefore, might lead to the neglected development of extra-heavy tanks, and tend toward the adoption of light, fast-moving vehicles.

ANOTHER country, on the other hand, feels that her prime and foremost objective is to prevent an enemy from getting a foothold within her borders. Hers is mainly a defensive attitude, and this is reflected in the type of vehicles which are developed for their mechanized units; that is, a medium tank, heavily armored, of relatively low speeds and no great cruising ranges. This type is not as vulner-

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able to anti-tank weapons as the fast-moving vehicles.

Our problem is more nearly similar to that of a nation having extensive colonies requiring types of light, armored cars which have great cruising ranges and can be used not only in actual combat in a major war, but also in settling domestic troubles throughout the entire domain. When we consider that the theater of operations of the American army might cover the entire American continent it should be realized that our chief requirements are for light, high-speed, long-range, cruising vehicles.

Although many foreign nations, were active in developing mechanized units immediately after the war, very little was done in this country until 1925. It is true that we did maintain a number of light and heavy tank organizations equipped with the slow-speed, wartime vehicles. These units were mechanized infantry. In 1925, a board of officers was convened in the War Department, and as a result of its study an experimental mechanized force was assembled at Fort George G. Meade, Maryland, in the summer of 1928. Included in the equipment of this force were four light (7½ ton) tanks capable of a speed of 20 miles an hour, two cargo carriers with the same chassis as the light tanks, and two light and four medium, armored cars. Most of the other equipment had been procured during or after the World War.

THE results obtained with this experimental force were so encouraging that, in 1930, Congress appropriated funds to organize an actual mechanized force at Fort Eustis, Virginia. This force totaled 640 men; and included therein were representatives from every branch of the service.

In 1931, the War Department assigned a mechanized mission to the cavalry and directed that the mechanized force at Fort Eustis be demobilized and formed into a reinforced cavalry regiment. This was in order to permit the cavalry to develop its organization and equipment for the performance of its normal cavalry missions. Thus was born the mechanized cavalry.

There is a definite need for two distinct types of mechanized forces. The first should be highly mobile and capable of rapid advances so as to pass through enemy columns and to make flank or rear attacks.

An American medium tank. It is fast, well armed, and has good armor

These forces must be able to penetrate through thinly defended areas, or exploit a break-through made by the heavier fighting forces of infantry supported by infantry tanks, but cannot, because of their equipment, be required to deal with heavily defended positions. The second type should be equipped in such a way as to break through heavily defended areas. The first missions will be performed by the mechanized cavalry, and the second by the mechanized infantry.

The War Department Directive of 1931 prescribed the mission of the mechanized cavalry as follows: "Mechanized cavalry will be organized to fulfill the normal cavalry role, substituting the vehicle for the horse." This then requires that mechanized cavalry perform the following normal cavalry missions: Offensive combat, long distance strategic reconnaissance, fighting for the theater of reconnaissance, seizing points of strategic importance, tactical reconnaissance, pursuit, delay of hostile advances, exploitation and taking advantage of break or weakened positions in hostile battle line, and attacking enemy rear installations.

This War Department Directive did not in any way envision the complete elimination of horse regiments from our cavalry organization. There are still many conditions, especially in the western hemisphere, under which the cavalry mission can be better accomplished by horse troops than by mechanized units.

As a result of this Directive, the Seventh Cavalry Brigade Mechanized was developed at Fort Knox. It is composed of the following units: 2 regiments of cavalry mechanized, 1 regiment of artillery, 1 brigade headquarters troop, 1 ordnance maintenance company, 1 quartermaster maintenance company, 1 squadron of observation aviation, 1 medical troop, and 1 engineers troop.

It is planned to increase the mobility of the brigade by adding a reconnaissance and support squadron composed of a reconnaissance troop, machine gun troop, and a motorcycle troop. In addition to acting as a brigade reconnaissance unit, this squadron will also serve as a minor reserve and a small arms, fire-support unit.

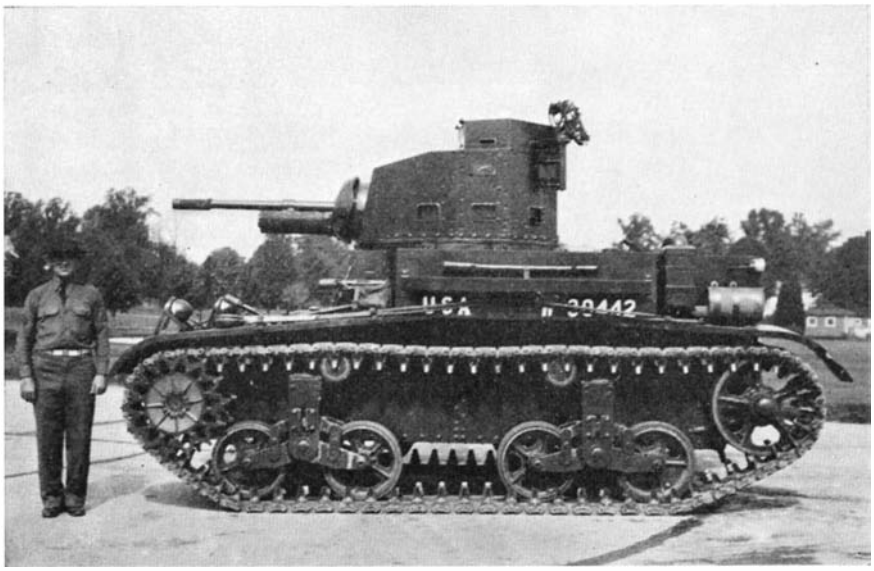
In order to increase the fire power of the mechanized regiment, a third combat car squadron will be added to each regiment. This will increase the number of combat cars in the brigade from 112 to 172.

The cavalry regiment is the smallest organization with the equipment and means necessary to perform the four principal cavalry missions, namely:

a. The reconnaissance troop mounted in scout cars equipped with caliber .50 and caliber .30 machine guns is charged with carrying out the necessary *reconnaissance* mission.

b. The combat car squadron mounted in combat cars with caliber .50 and caliber .30 machine guns and with ample armor plate for protection are capable of exerting vigorous *striking blows.*

c. Small arms support is furnished by machine gun troops



This light tank represents great improvement over its World War prototype

in scout cars.

d. A mortar platoon, mounted in vehicles somewhat similar to scout cars, firing smoke shells, provides for the *defense against hostile anti-tank weapons.*

It is interesting to note that our largest mechanized unit is a brigade. Most of the large foreign nations have complete mechanized divisions. The Germans have the panzer division; the French, a light mechanized division; and the British, armored divisions.

The mechanized cavalry will have their greatest opportunity of using their organizations to best advantage in open warfare. However, in cases where the enemy has been able to establish himself temporarily in a strong defensive position, it will be necessary to use mechanized units capable of exerting greater shock than the highly mobile cavalry units. This shock action will be delivered by the mechanized infantry.

The infantry is charged with the principal mission in battle and is essentially the arm of close combat and can, through the employment of its own weapons, act independently of other arms.

In order for the infantry to carry out its mission, it is furnished with tanks which are equipped with the proper armor, armament, and mobility. As a general rule, tanks will function in close co-operation and co-ordination with the foot soldiers, either by preceding or accompanying the assaulting echelons. When operating directly in front of the attacking infantry, tanks are closely followed by the foot soldiers. The visibility from tanks is naturally not the best, and defenders in many cases may be passed over by the attacking tanks. Under the protection of the advancing tanks, the infantry can properly clean up the advance areas and then permit the tanks to penetrate into the rear areas.

However, there will be cases when the defense is so thoroughly organized and equipped with anti-tank weapons that it will be necessary for a wave of heavy, armored and armed, relatively slow-speed tanks to precede the lighter and more mobile tanks. The former tanks are referred to as leading tanks, whereas the lighter tanks are classed as accompanying tanks. Leading tanks may operate in support of infantry regiments, or they may be attached to the regiment. When operating entirely within a regimental zone it is preferable to have leading tanks attached to the regiment.

Accompanying tanks are assigned to divisions and then may be attached separately to different units as small as a battalion. Our tank organizations are made up of tank regiments and separate divisional tank companies. Practically all the divisional companies are part of National Guard organizations, whereas the Regular Army units are tank regiments.

Light and medium tank regiments are practically the same in organization, with the latter having a slightly greater number of personnel. Both are composed of three battalions of three companies each, and the company in turn consists of three platoons. This represents the triangular type organization. Within each regiment there are 162 tanks, of which 135 are combat tanks, and 27 are command and staff tanks.

It is interesting to note that since the war started the French regimental tank organization has disappeared and the tank battalion is now the tactical and administrative unit. Outside of the mechanized division, tank battalions are assigned to GHQ Reserve or to the Army.

As the first requirement in allocating tanks is to furnish sufficient support to overcome any resistance that might be encountered and still have sufficient reserve strength to push on to further objectives, tanks should be used in relatively large numbers. The tank company may operate separately, but the tank platoon never does.

In deciding on the use of tanks, it is essential to give careful consideration to the nature of the terrain. In making a study of this problem, all possible information should be obtained from maps, aerial photographs, and by ground and air reconnaissance. Natural obstacles to tanks are rivers and streams which cannot be forded, marshes, fordable streams with steep banks, thickly wooded areas with large trees, and areas with closely spaced boulders. In open, rolling country, where excellent fields of fire are available to the defenders, the effectiveness of tanks is greatly limited.

SOME idea of the importance of proper reconnaissance may be obtained from the recommendation of Major General Walter C. Short, Commanding General of the Fourth Corps Area in discussing the lessons learned from the Corps exercises at Fort Benning. That recommendation was that a troop of mechanized cavalry be added to each of the streamlined divisions, the troop to have three platoons—one to be assigned to each of the combat teams of artillery and infantry for reconnaissance purposes.

In addition to a study of the terrain to determine the natural obstacles, it is essential that careful measures be taken to determine what obstacles have been set up by the defenders. Anti-tank weapons will be numerous in any case where the defenders have a day or two to become organized. Whether the guns will always be of the caliber to defeat the armor of the tanks might be questioned. As the armor plate of tanks gets heavier, there

will be a requirement for weapons of greater muzzle velocity maintaining the same mobility for the gun, or less mobile guns of larger caliber. The race between armor plate and the gun has been going on for years. In naval history it is believed that the gun has won out. In tank history there are enough different factors that influence the results that we may expect a different answer.

The following extract from an article by Major O. F. Marston in the January-February issue of *Field Artillery Journal* may be of interest. In speaking about anti-tank defense he remarked: "What results have been accomplished? At least the field artillery feels that, where indirect laying is used, covering zones and areas where zone fire is used on assembled tanks or other mechanized vehicles, the problem has been solved. However, where direct laying is employed, even the most optimistic are not agreed that a solution has been found; and the faster the tank moves the fewer there are who are in agreement on a solution to this vital problem. After talking with many officers and men, and after having had considerable experience with the problem for several years, and with the latest equipment now in the hands of our troops, the writer is of the opinion that the problem is far from solution."

There is no commercial demand for the types of vehicles which are required by our combat arms. The requirements of high speed for strategic mobility and for cross-country tactical mobility are such as to require specially designed vehicles. In designing these special-purpose vehicles, it is the policy of the Ordnance Department to use, as much as possible, commercially available units, such as engines, transmissions, and the like. In most of our combat vehicles, the weight and space factors of the power train units are of paramount importance. As much as possible of the total weight of the vehicle should be devoted to armor plate. Also, sufficient space must be provided in the fighting compartment for the efficient servicing of weapons, for the comfort and convenience of the crew, and for carrying ammunition, guns, radios, and other impedimenta.

THE lighter, high-speed, full track-laying vehicle used in our service is over ten tons. In order to get the required performance in our combat vehicles, it is necessary to have a power/weight ratio of not less than 25 horsepower per ton weight of vehicle. Commercially available engines in the automotive industry are not made with horsepower greater than about 165. Rather than design a special engine, which is an exceedingly long and expensive undertaking, the Ordnance Department has adopted commercially available engines from other fields for use in most of our combat vehicles.

Knowing the many advantages of the Diesel engine, such as reduced fire hazard, increased cruising range, absence of radio interference, and so forth, the Ordnance Department has not neglected the development of this type of engine. A number of Diesel engines giving the required performance for our combat vehicles have been procured. This type of engine is particularly well adapted for use in cavalry combat vehicles because of the increased cruising range—is almost double that of gasoline engine vehicles of approximately the same weight.

Of the full track-laying type of combat vehicles, our army is equipped with combat cars, light tanks, and medium tanks. We have experimented with convertible, or two-purpose, types of tanks and combat cars. The convertible type of vehicle is popularly known as the Christie type, named after Mr. J. W. Christie, an inventor who sold a number of experimental vehicles to the War Department.

Ready for action in Army maneuvers: tanks and scout and combat cars of 13th Cavalry Mechanized

In modern warfare, tanks and planes operate in co-ordination

From an engineering point of view, it is almost axiomatic that a convertible vehicle will weigh more than a single-purpose machine of the same performance and characteristics. It may be noted that none of the major powers except Russia have produced convertible tanks.

The light tank used by the infantry and the combat car with which the mechanized cavalry are equipped are similar in many respects. The engine, power transmission system (except the ratio of the final drive), the cooling system, steering and control systems, fuel and oil systems, and the electrical system are common to both. The chief difference is the thickness of the armor and the amount of armament. The combat car used by the cavalry has a requirement for a higher speed and less armor than the tank.

Tanks in the weight class above 12 tons and less than about 35 tons are considered medium tanks. The medium tanks used by our service have ranged in weight from about 15 tons to 20 tons. The French army is equipped with a number of medium tanks of about 35 tons in which are installed 75mm cannon.

Our army has not been furnished any heavy tanks since the World War when the Mark VIII tank, weighing about 40 tons, was developed.

In addition to the full tracklaying type of vehicle, there is a demand for half-track and wheeled vehicles. The half-track trucks and cars are part of the equipment of the mechanized cavalry and are used by the artillery attached to the mechanized unit as prime movers for light guns and for hauling ammunition. The wheeled vehicles are scout cars, also used by the mechanized cavalry, for machine gun and reconnaissance troops. The scout cars are four-wheel-drive vehicles equipped with armor and armament and have fairly good cross-country mobility and are capable of speeds on main roads of over 50 miles per hour.

The recent events in the present war have clearly indicated that the old axiom, "Getting there fustest with the mostest men" still applies, but the tempo of all warfare has been greatly accelerated. However, it has also been shown that, "He that has mostest (mechanized vehicles) fustest will get there fastest." The machine has not entirely replaced the man in modern war, but a nation that is not industrially prepared for war is doomed to an uncertain fate, to say the least!

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TANKS

United States Deficient in Combat Vehicles

THE present war in Europe has shown the military effectiveness of large numbers of combat vehicles of several types, but the United States is sadly deficient in this arm of the service. In recent hearings before the Senate Committee on Appropriations, the following figures were given to show the strength of our mechanized forces.

	On hand May 1, 1940	Will be on hand upon completion of program
Light tanks, M2A4	10	734
Medium tanks, M2	18	194
Scout cars	485	1346
Combat cars (Infantry tanks)	114	208

These figures consider only the very latest models. We do have several hundred light tanks of earlier design but it is believed that these would have very little use except in training.

LARGER CRUISERS

New Type, Heavily Armed and Armored, Suggested

IT TAKES from three to five years, depending on urgency, to build one battleship in an American yard. In times of national peril, more effort is expended on construction of a larger number of small warships.

Under construction and planned for the United States Fleet at present are 10 battleships. Only two of these, however—the *Washington* and the *North Carolina*—have been launched, and each of these two will require more than a year to finish. Completion of the others is proportionately far in the future. Due to this situation, coupled with the war in Europe, it has been suggested that the United States build for the Atlantic a number of large cruisers of 20,000 to 28,000 tons. This would be an entirely new type of warship—fast, armed with 11-inch guns, and well armored against air bombs. It is believed that these ships will constitute a more efficient type for operation in coastal waters than our battleships but will be far more powerful than any present cruisers or the oversized, fast destroyers which may be built to support them.

Whether these new ships will be of the size indicated above or something smaller, Chairman Vinson of the House Naval Committee declares that their construction will not disturb the present building program.

Incidentally, that program probably will be greatly enlarged in the near future, perhaps before this issue is published. As we go to press, Congress is considering a plan to increase our Navy by 70 percent, giving us, by great odds, the most powerful navy in the world. If details are made available, we will publish them later.

Achievements in Textiles

Commonplace Fabrics with Superior Characteristics Given by Special Treatments

PHILIP H. SMITH

WHEN it becomes possible to remove shoe polish, inks, fruit juices, and cocktails from delicate silks and cottons by merely dunking them in a glass of water, you've got something. When a fabric so treated is immediately spot free and dry, you have, to be exact, a marvel of chemistry, not to mention a boon to housewives.

Brilliant achievement in the improvement of commonplace textiles has been all but obscured by the more sensational creation of synthetic fibers out of air, coal, and water, or from cow's milk. But there are now on the market cottons, rayons, and silks which repel water and resist spotting. There are fabrics which resist creasing to maintain their freshness for a long period of time, and there are woolens which won't shrink and are distasteful to moths. If fire-retardent finishes are desired on textiles, they can be had, and so can finishes which are unaffected by mildew, a serious problem at all times but especially so in damp climates.

The threat of synthetic competition can hardly be credited with all the progress in textile finishes. Research has been seeking a way to impart these several desirable properties for many years and success is the logical fruit of cumulative effort.

The public is beginning to learn of water-repellency but there is still confusion in some minds as to the difference between repellency and water-proofing. They are quite unlike. The former describes a treatment whereby fibers are rendered proof to water while the fabric remains porous; the latter calls for making the entire fabric surface impervious to water. Water-proofing is a much older art.

There are two common ways to obtain a water-repellent finish. One is to use a soap bath followed by alum or an aluminum salt to deposit an aluminum soap on the fabric. The other is to apply an aluminum or lead soap from an organic solvent. There is a more recent process wherein a wax emulsion in water is applied to a fabric in a single bath. These finishes were used first for outerwear garments, but varied applications have been made, realizing that repellency means freedom from water-spotting, because a water spot is nothing more than a local contraction of fibers which alters light reflection.

By applying water-repellent finishes to hosiery they can be made virtually splash-proof. Dirt is prevented from penetrating the fibers, so that a gentle washing or dusting will remove it. Snag-proof finishes for hosiery are usually wax emulsions which lubricate the surface to resist abrasion, but resin finishes are coming into use.

All of the foregoing processes leave something to be desired because they are impermanent. It is true that they lengthen time between cleanings and so increase fabric life, and repellency can be restored by incorporating products in the cleaning process, but this is troublesome. Today, permanency is a reality.

One manufacturer has developed a process which will survive about 10 cleanings, and he does a mail-order business in reviving repellency for a nominal sum. There is also a single chemical compound available which can be applied in four steps—impregnation, drying, heating, and rinsing—to render cotton, rayon, and silk durably repellent and do almost as good a job with acetate rayons and wool fabrics. The compound must be applied during the finishing process as it requires good equipment, but it is not a resin as one might suppose.

There is practically no limit to the application of this water-repellent product. It is now being applied to sport clothes, shower curtains, and outdoor furniture, often to replace water-proof materials. Because it leaves fabrics porous, it serves very well to treat undergarments, and the fact that it makes pressing less imperative promises its wide use for men's suits. Hence it may have wide application.

The synthetic resins have been seized upon by the textile industry and are being given quite a wide play. One of the first applications to come to the attention of the consumer was the "fused" shirt collar which won't wilt. This now widely used product is made by sandwiching cellulose acetate or other thermoplastic resin between layers of fabric. Resins also are used to prevent slippage of yarn in woven materials so that garments won't lose their shape, to bind colored pigments in printed fabrics, and to give a glazed effect to textile surfaces.

DIFFERENT types of resins are used to achieve special effects. Thus the methacrylate type can be used to give fabrics a "handle" which resists laundering and dry cleaning. It is also employed as a yarn size for viscose and acetate warps and for filling yarns of crepe fabrics, because it is easily removed and does not encourage bacterial growth as do casein, glues, and gelatine. Vinyl resins were the subject of a recent announcement to the effect that they serve excellently for water-proofing and moth-proofing with all kinds of fabrics, but this development is still young.

Crisp organdy apron that is water-repellent, permanently starchless

Crease - resistance, or crush-proofing as it is sometimes called, is a quality now imparted to cotton, rayon, and linen as an outcome of English experiments with urea-formaldehyde resins. Here the problem to solve was one of getting the resin inside the cellulosic material of the individual fibers, because an outside coating only produces a stiff and brittle cloth. The process requires impregnation of the cloth in a bath of resin components, urea and formaldehyde, with a catalyst, or a lightly condensed mixture, provided the condensation permits complete penetration. The fabric is then passed through a mangle to remove all excess liquid, and dried. After drying, it is heated to a high temperature to bring about polymerization, or the creation of large molecules from small ones. Then such chemicals as have not been rendered insoluble can be removed by washing.

Satin becomes practical for sports-wear when treated with water-repelling chemicals, as in this ski-jacket

Urea-formaldehyde resins have the capacity to alter the life and draping qualities of fabrics, to increase the fastness to fugitive colors, and to reduce shrinkage in washing. Rayons treated with them are given greater strength, particularly in the wet state.

The use of resins by the textile industry is still in its infancy, but for that matter, the resin industry has yet to mature. With approximately 150 different resins on the market and more being born by the minute, it requires much research to determine the benefits to be derived from any single one, or to select the best. Application of resins to fabrics increases their cost slightly and the textile industry is loath to add to cloth prices until the public demands certain properties and is willing to pay for them. Furthermore, an industry as old and as highly specialized as the textile industry is slow to adopt the new, but there is enough stirring right now to promise a wide use of resinous products.

During the past two decades a great deal of research went into development of fire-retardent finishes, but, one and all, the products had some practical disadvantage. The latest and most satisfactory process seems to be one employing ammonium sulfamate. It is claimed not to dust off, nor to alter the feel, appearance, and durability of fabrics. It will withstand ordinary dry cleaning, but not laundering.

Research to attack the problem of mildew and moths has been quite successful and both can mean the saving of millions of dollars resulting from cloth destruction. The most satisfactory agent for mildew control has been found to be salicylanilide. Customary practice is to impregnate the cloth with the chemical from an ammoniacal solution, and then dry it. With the evaporation of the ammonia, the insoluble agent is left dispersed throughout the fibers and threads. Among the several chemicals developed for moth-proofing, the best appear to be organic and inorganic compounds of fluorine or chlorine.

THE conquering of cotton shrinkage is too well known to warrant detailed mention here. It is enough to say that the mechanical process known as Sanforizing gives adequate control over what was once a knotty problem to the textile producer and a terrible nuisance to the consumer. More and more cottons are being pre-shrunk with this process and in time all cottons may be shrunk before sale. Installation of shrinking equipment has been taking place in mills all during the depression to satisfy consumer demand.

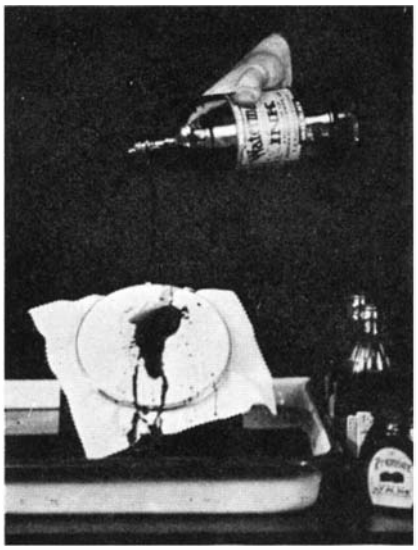
The shrinkage of wool has long been studied to devise some means for arresting it to make a more serviceable fiber. A solution to the problem seems to have been reached at last and perhaps the best evidence of success is the statement that all woolen socks distributed to the fighting forces of Britain are to be given the new treatment. Before discussing the process, however, it will help if we outline the phenomenon of shrinking.

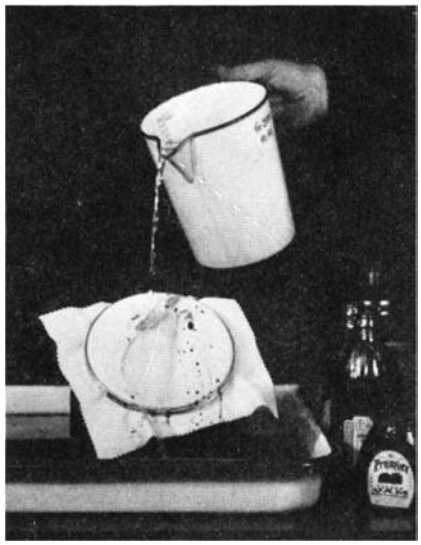
Photos: Du Pont Style News Service

Rayon velvet, made crush-resistant for practical wear

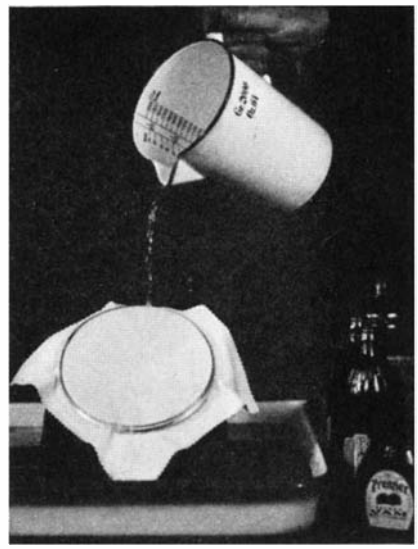
The individual wool fiber appears to be covered with countless small, overlapping scales which are responsible for the interlocking of the fibers, and, incidentally, for the property of felting which is utilized to make felt hats. When wool is compressed in washing, the fibers

Water-repellency at last makes an improvement in men's coats





Liquids which ordinarily stain are not absorbed by fibers of material which has been made water-repellent. In the tests shown in these photographs, ink was flushed off with clear water



become more and more entangled and close together more tightly, the process being repeated with every washing. Stripping the scales from the fiber will make wool unshrinkable but at the same time it shortens fiber life because they lose their protective covering. If a compromise is sought by removing scales only partially, there is a corresponding loss in shrink-proofing and this falls short of the goal.

The new process calls for applying sulfuryl chloride to the wool with the following claims as to action and benefits: The scales are not substantially removed but rather, their projecting ends are probably made to hold more closely to the fibers so that they are smooth and lose their felting propensities. It is also claimed that the fibers are uninjured.

Other processes developed to retard wool shrinkage are those using dry chlorine gas, and certain of the alkyl hypochlorites. But the claim for these agents is not as strong as those for sulfuryl chloride.

It is very evident that research work has been directed toward the improvement of old processes quite as much as to the origination of new ones. Water-repellency and crush-proofing, for example, are not brand new, but older processes were impermanent in effect. Once a fabric had passed into consumers' hands and had undergone its first cleaning, the bloom was off and there was little to warrant paying for so brief a pleasure. The most recent developments contribute a lasting quality value to fabrics and this represents a long stride ahead.

A still further step remains to be taken, however. At the moment, the use of one process pretty much excludes the use of another. The new permanent water-repellency process can be used in conjunction with urea-formaldehyde resins to make a fabric having two imparted qualities, but for the most part processes are mutually exclusive and that limits the number of advantages given to any single fabric.

For just about a century, people have been pondering the idea of printing fabrics in the manner of printing paper so that the color is applied direct, rather than to continue with the laborious process of printing with dyes which emerge as color only after a series of chemical treatments. To get a pigment that will strike into the fabric and make a permanent bond without spreading, that will be light-fast and wash, has eluded searchers for many generations. Such colors are now available—a lacquer type and a resin type. They are incorporated with pigments; and after printing, a drying process develops them. These new types of color are being used to print shirt materials in very large volume and the benefits are primarily those of eliminating developing processes to gain production speed.

There is hardly a phase of the highly specialized process of textile production which has not been touched beneficially by research. Most achievements thus far have small interest to the consumer because the only evidence of benefit is in the overall sense of obtaining better quality and better designed fabrics at somewhat lower cost. But the end is not in sight. Research came to the textile industry much later than to others and what we enjoy now is only a beginning.

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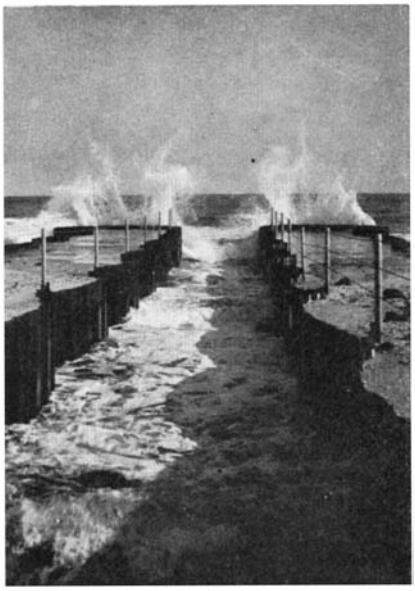
Metal from the Sea

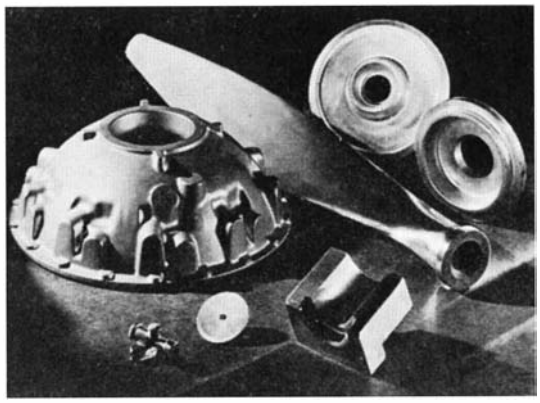
Plant Will Extract Light-Weight Industrial Metal, Magnesium, From Solution

For centuries, adventurous men have roamed the seas exploring the hidden depths for the wealth of sunken treasure. Little success has been theirs. Yet long before man even appeared upon the earth the sea was storing up treasures of a different kind—valuable chemicals and metals dissolved from the land by flowing water.

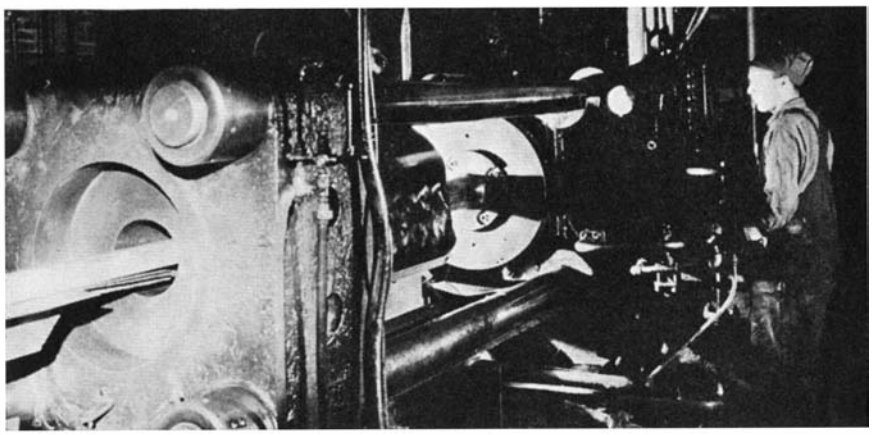
Some years ago a large plant was placed in operation at Wilmington, North Carolina, to extract some of this wealth-in-solution in the form of bromine to be used in preparation of anti-knock gasoline. Now the same company responsible for that plant is building another to extract the metal magnesium from the sea. This new plant, according



At left: Typical sea water intake which will conduct water to settling basins, the first step in production of magnesium from the sea



Below: Extruding an alloy of magnesium. It can also be die cast, sand cast, forged, and welded. At right: Airplane propeller blade and other aviation parts made of Dowmetal, world's lightest, strong structural metal



to a recent announcement by Dr. Willard H. Dow, President of The Dow Chemical Company, sole producers of magnesium metal in America, will be located along the Gulf of Mexico. At that point enough of the metal will be extracted from sea water to raise Dow's total magnesium production from 12,000,000 to over 25,000,000 pounds annually.

The growth of the infant magnesium industry in America has been amazing, considering that it had its birth in 1915—only 25 years ago. For that growth a great share of the credit goes to the founder of the company bearing his name, Dr. Herbert H. Dow.

The growth and development is significant because magnesium, third most abundant engineering metal in the earth's crust, is an important constituent of modern light-weight alloys which are being used more and more widely in aviation, bus, railroad, and general transportation industries as well as in the manufacture of light-weight tools and many other products. The reason for this wide use is that Dowmetal, a silvery alloy, is one quarter the weight of iron, only two thirds as heavy as aluminum, and is possessed of great strength, toughness, and durability. It is speedily fabricated by all common methods.

Each one of the oceans' 320,000,000 cubic miles of water contains something like 175,000,000 tons of chemical combinations of such materials as gold, silver, copper, magnesium, aluminum, calcium, bromine, iodine, and other valuable elements. It has been estimated that these materials in each cubic mile of water have a value of some five billion dollars if only they could be extracted. Bromine *is* being extracted and shortly the recapture of magnesium will begin near Freeport, Texas.

Up to now magnesium has been produced at Midland, Michigan, where the raw materials, from which the metal is extracted, is taken from the ground. Chemists say that it can be recovered from sea water with less effort than from the land because of the fact that the water has already done the preliminary job of washing the magnesium out of the soil.

The new plant will have a capacity of 12,000,000 gallons of sea water daily, yet that plant can operate for 300 years extracting the magnesium in just one cubic mile of ocean water. In that same cubic mile—it is actually more than 1049 billion gallons—there are about 5,700,000 tons of magnesium.

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BOND

Process Binds Rubber to Aluminum

DURA-BOND is a new process developed by Hewitt Rubber Corporation for bonding rubber or neoprene to aluminum, according to the *Aluminum News-Letter*. Adhesive strengths up to 750 pounds per square inch can be obtained, but the process should be restricted to products which operate at temperatures below 200 degrees, Fahrenheit.

This new process makes use of a chemical coating between the rubber and the aluminum which fuses the two materials together without diminishing the ability of the outer layers of rubber to be vulcanized. The metal needs no coating of hard rubber to make the soft rubber take hold, and brass plating of the metal is unnecessary.

Combinations of rubber and aluminum have wide application in the manufacture of sound-proofing equipment for machinery, in the production of spark-proof oil-suction hoses and fittings, and in pickling bath apparatus.

PORCELAIN-LIKE

Coatings Are Hard, Mar-proof, Resistant to Acids, Alkalis

Two new porcelain-like finishes have been developed by Toch Brothers Division of Standard

Varnish Works. Known as Kwickdry and Rockloid, both these finishes are hard and mar-proof, will not chip, flake, or crack. Yet they have remarkable flexibility and light, heat, and chemical resistance. Mild alkalis and acids do not affect them. They are resistant to most solvents and possess excellent humidity resistance.

The first of these two finishes, Kwickdry, is satisfactory for outdoor and indoor use. It may be used as a one coat system or over a primer, sprayed or brushed. It sets tack-free in 10 to 15 minutes and dries hard in one to two hours, or may be force dried at 140 degrees, Fahrenheit, for 20 to 30 minutes.

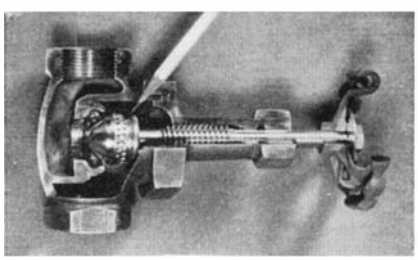
The second, Rockloid, is intended primarily for indoor coatings. It may be applied as a one coat system and baked at 350 degrees, Fahrenheit, for 10 minutes, or at a lower heat for a longer time.

STEAM CONTROL

Spinning Disk Prevents Valve Clogging

A NEW principle of steam control is incorporated in the Ostlind valve, which was announced recently. The valve is the invention of Joel Ostlind. The principle is said to eliminate the causes of leaky valves, rather than to resist them.

The Ostlind innovation is a spinning disk, which rotates up to 2000



Pencil points to turbine vanes

revolutions per minute for a moment preceding closing. The disk does not spin when the valve is "cracked," or while throttling. A reversing chamber directs the steam flow to turbine vanes just before the disk descends into the seat. The turbine vanes are shielded from the steam flow when the valve is open.

The spinning disk throws off scale and other foreign particles by centrifugal force, thereby preventing these particles from becoming caught in the line of seating. The disk hits the seat while spinning at a high rate of speed, and polishes the line of closure, creating a complete metal-to-metal contact between seat and disk, thus preventing "wire-drawing."

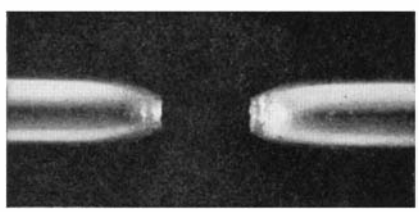
The disk is mounted on the spindle against a stainless-steel ball bearing, aligning the disk with the seat when closing.

BETTER COPPER

Made by Plastic Conversion Under High Pressure

ANNOUNCEMENT of the perfection of a new type of copper after a ten year research and development program costing well into seven figures was made recently by Wylie Brown, President of the Phelps Dodge Copper Products Corporation.

The new copper is known as "PDCP," and was created by research to meet the need of the elec-

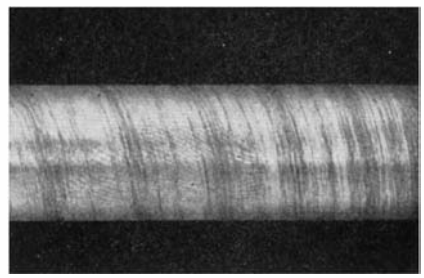


Ductility and smoothness of PDCP shown by rupture test

trical industry for a copper of superior characteristics. Greater conductivity, ductility, fatigue resistance, and surface quality are the outstanding characteristics of this modernized metal. It is free of the imperfections of ordinary copper, which, according to engineers, have been responsible for a large percentage of electrical failures.

The improved metal is made, without melting, from electrolytic cathode copper which is plastically converted by tremendous pressure in a reducing atmosphere at elevated temperature, into smooth, dense copper bar, rod, strip, or other desired commercial shapes. Basically of the oxygen-free type, it is the only solid copper in the world which is not melted subsequent to the electrolytic purification process. Hence, the intrinsic purity of electrolytic cathode copper is retained and enhanced.

One of the principal difficulties of engineers and maintenance men concerned with copper windings in motors and transformers, is the existence of surface imperfections in the copper which, by vibration and magnetic stress, eventually penetrates the insulation and causes failure by short circuits. These imperfections may originate in defects arising in the casting process and are normally present in the best commercial copper wire bars. In addition, slivers and oxides are developed during the process of



Twisting rod of new copper to destruction required 30 twists

hot-rolling the cast copper bars into rods, and are more or less inherent in the hot-rolling process. The new patented method eliminates not only the casting process, but also hot-rolling. It has, in consequence, made possible the production of a sliverless and dustless copper surface heretofore attainable only in the laboratory.

PDCP copper, in common with all other coppers, is not susceptible to heat-treatment in the sense that the ferrous people use the term: it can be hardened by cold work, softened by annealing. It does, however, anneal at a temperature between 100 and 200 degrees, Fahrenheit, lower than other coppers. In fact, protracted tests have shown that it will anneal slowly in boiling water at 212 degrees, Fahrenheit.

BY-PRODUCTS

Citrus Fruits Find Uses in Industry

A CONSIDERABLE amount of research has been conducted on the problem of finding a use for citrus fruit surpluses and wastes. As a result, many new products have been developed, among which are the wines and liquors announced in these pages some months ago, which were developed by the Bureau of the Department of Agriculture. Also, new and better types of citrus-fruit juices and oils have been developed. These by-products have found a ready market in industry, medicine, and agriculture.

Citrus juices are popular in the beverage and dairy industries. Citric acid from lemons, another best-seller by-product, competes

with Italian imports for use in beverages, lemon and orange oils for bakery goods, candy, and flavoring.

Sodium citrate is used by the dairy industry. Citrus pectin, from the white pulp of citrus fruits, adds creaminess to malted milks and soft drinks. Pectin has been found valuable, too, as a blood coagulant and as a stabilizer for the barium sulfate used in digestive X-ray work and as a detoxication agent. Pectates, close cousin to pectin chemically, have application in paper-treating, in rubber production (for creaming latex), and in quenching steel more cheaply.

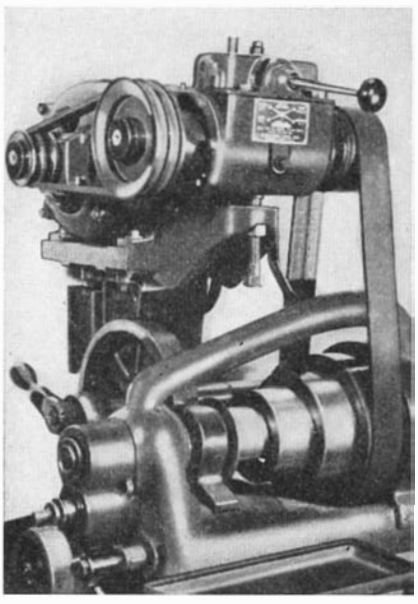
Soon to appear is a new vitamin, Vitamin P (citrin), prepared from lemon and orange derivatives, now being submitted for clinical use. "Squeal-of-the-pig" is citrus meal, made from the dried peel and pulp, fed to dairy and beef cattle, poultry, sheep, rabbits, and goats.

MACHINE CLUTCH

For Cone-Driven Machines

Makes Speed Change Easy

FOUR-SPEED transmissions for application to cone-driven machine tools are announced by the Western Manufacturing Company. They make changing from one speed to another as easy as when driving an automobile. There are three models—a "Master" for 1 to 5 horsepower, a "Major" for 5 to 10 horsepower, and a "Super" built to specification for machines requiring larger than 10 horsepower motors. It is built for heavy loads with the transmission case and covers of semi-steel castings and the gears and spline shafts of alloy steel, machined to close limits and ground. All of the moving parts run in an oil bath.



Four speeds

BALANCE

A LOW-PRICED, compact balance, that can be readily dismounted and stored in a laboratory drawer is announced by the Clay-Adams Company. This instrument has been designed to meet the needs of all balance technique, and at a price within the reach of the student in chemistry. It is supplied with brass weights.

In use, the upright beam support is inserted into a metal socket in the box and the beam placed upon it. An eccentric beam release brings the pans to rest. Capacity is 100 grams; sensitivity 5 milligrams; beam, 7.25 inches long with steel knife edge; support for beam is an agate bearing. Pans are 3.25 inches in diameter, and are notched to support test tubes.

SOLDERING

STAINLESS steel, beryllium alloys, brass, copper, bronze, and other metals may be easily soldered when Geko Acid-Free Soldering Compound is used. This is a new product developed by Geko Chemical Company.

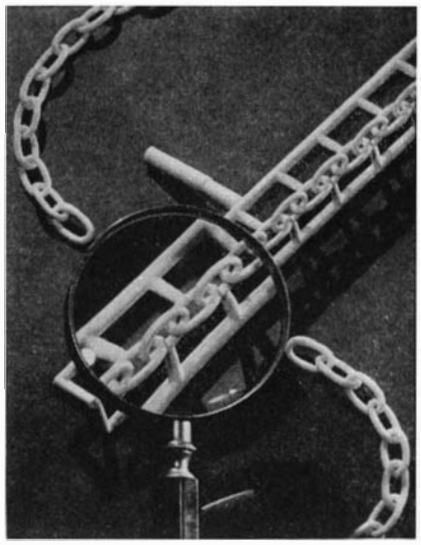
Geko is free of any mineral acid and is therefore non-corrosive if used according to directions. It makes the first cleaning of the metal unnecessary for it creates a perfect and lasting bond even on oxidized surfaces. It may be used with soldering iron, open flame, or even a match, as its melting point is quickly reached.

LINKED PLASTICS

Ingenious Method for Molding Plastic Chains

WELDLESS chains of Tenite are an outstanding accomplishment in the art of plastic molding. They are the first plastic chains of this type, and were made possible by the molding properties of Tenite combined with an ingenious mold design.

The chains are shown in our illustration in both cast and finished forms. The mold design automatically eliminates any cutting, threading, and cementing of the links—operations that are necessary in making the more common welded plastic chains. Severing the links from the runners of the casting is the only finishing required.



Chain as cast and as finished

AUTOMATIC

Carbon Arc Process Makes Better Weld, Saves Time

AUTOMATIC carbon arc welding is reported to have many advantages in the construction of aluminum tank cars at the American Car and Foundry Company plant at Milton, Pennsylvania. The automatic process permits faster construction and a considerably better quality weld, together with marked freedom from distortion. This development was motivated by a desire to improve quality, not to lower costs which are practically unchanged because the increased flux cost cancels the labor saving.

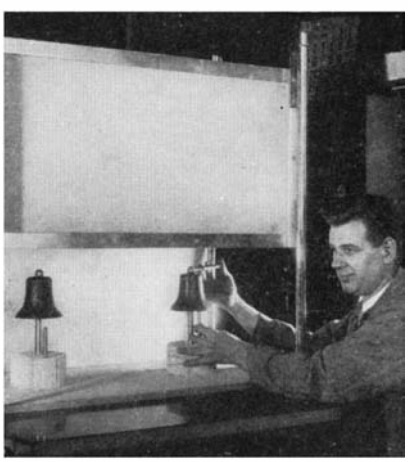
Since no beveling of plate edges is required, the full thickness of metal is utilized in the welding by simply butting the square edges together, greatly simplifying the set-up of the work. The welding time per tank is noticeably shorter than previous methods since the automatic weld is made in two passes instead of the three formerly used. The fact that automatic welding permits welds of complete overlapping penetration accounts for the greatly improved quality of the weld. The aluminum tanks manufactured by the American Car and Foundry Company have, for the most part, been utilized for glacial acetic acid service. This

is the basic material for the manufacture of rayon and non-inflammable film. Two of the aluminum tanks have also been put into service for carrying peroxide. These were constructed of 2-S (99.5 percent aluminum). The remainder of the tanks, for acetic acid service, were constructed of 3-S aluminum (97.5 percent aluminum).

RING

Comparison Tests of Metals Under Heat

A BELL made of ordinary materials gives off a dull thud when struck after being heated to a high temperature. A new metal, called K-42-B, developed in the Westinghouse Research Laboratories, gives off a brilliant tone under the same circumstances. This new metal is therefore being used for comparison tests of metals.



Test by ring

In our accompanying illustration a bell made of steel is shown at the left while one made of the new metal is at the right, both having been heated to a high temperature. While still very hot, the steel bell at the left gives off a dull thud because of the inelastic movement of its atoms which converts the energy of its vibrations into additional heat.

TESTING WELDS

Magnetic Dust Reveals Tiny Cracks

CRACKS which tend to develop during cooling of a welded joint can be dangerous even though extremely small, since large stresses that are set up in the vicinity of the flaw lead to the extension of the crack in the metal. One of the successful non-destructive means of testing welds for flaws is the magnetic method. Under suitable conditions very fine surface and subsurface flaws as small as 1 by 10^{-5} centimeters can be detected by this method.

The principle of the method depends upon the fact that the presence of a fault in a magnetized specimen will cause distortion of the magnetic field on the surface of the specimen. The magnetic susceptibility of the fault is much lower than that of the sound metal, and the flaw acts as an air-gap, the magnetic flux at this point being diverted into the surrounding material. The leakage field at the flaw can be more strongly detected the nearer the flaw is to the surface. The greatest depth at which flaws can be detected is about 0.5 of an inch.

Best results are obtained with a direct current magnetizing field where the flux passes through the flaw at as near 90 degrees as possible. The type of metal used will determine whether or not the magnetizing current can be turned off while testing the weld. The detection of flaws in the weld is accomplished by means of fine iron dust which is applied to the surface of the magnetized specimen. These particles will then move to a point where there is a large leakage field or a flaw. The dust may either be blown or sifted onto the specimen, or suspended in a suitable light oil which is poured or sprayed onto the specimen. The smoother the surface tested, the more clearly will cracks be shown.—*H. Hirst,* The Commonwealth Engineer *and* Highway Research Abstracts.

CORES

Wetting Agent Reduces Machining of Castings

NON-FERROUS metals can now be cast in smooth, fine cores at a considerable saving in time. This is accomplished by the addition of a small percentage of Sulfatate, a new type of wetting agent manufactured by Glyco Products Company, Inc.

The ordinary core for casting non-ferrous metals is usually a combination of silica, sand-clay binder, and linseed oil. This type of core is very rough and necessitates a great deal of machining to finish the casting. If after baking the core, it is dipped into a solution consisting of one pint of molasses, 10 pounds of graphite, one pound of Sulfatate, and water sufficient to make five gallons, and then re-baked, the core will present a smooth surface, and the casting made from it will require little if any machining.

The addition of the Sulfatate eliminates the necessity of hanging the core so that the excess molasses-graphite mixture will drip off. The core, when it is withdrawn from the solution, breaks cleanly.

CUTTING

Cemented Carbide Tools Now Standardized

PROBABLY every user of cutting tools has looked forward to the time when he could enjoy the many recognized advantages of cemented carbide tools without the necessity of a large investment in special tools. Although the longer service life of cemented carbide tools has proved that they do actually "lower the cost per piece," yet the necessarily higher price of specially-made tools has limited their use on short jobs and general tool room work.

Bonded edges of cemented carbide in a standard tool

Announcement has been made by the Wesson Company of a complete line of standard carbide cutting tools. At present, these standard cemented carbide tools include reamers, shell reamers, core drills, end mills, counterbores, and inserted blade milling cutters. They are produced by a process which has involved the development of a new treatment for shanks and bodies. An important feature is hardening at temperatures which do not injure the bond or the carbide insert.

INDUSTRIAL TRENDS

FLUORESCENCE

THE New York World's Fair offers a great spectacle of illumination; but, more than that, it has been a proving ground for new and improved lighting equipment. If full advantage were taken of the new light sources available and the general level of illumination were to be raised to adequate heights, lighting would be revolutionized.

Take just one item—the fluorescent lamp. Here is an efficient and practical source of daylight lighting. Invisible ultra-violet energy, produced by an arc, is converted into visible light through the medium of fluorescent powders lining the tubes. Older practice was to coat incandescent bulbs to strain out all unwanted rays, and this was inefficient. The new lamp produces about 40 lumens per watt, the household filament only 15 lumens.

Being unexcelled for color discrimination, the fluorescent lamp is used for matching leaf tobaccos, inspection and pairing of hosiery, and inspection of color proofs. Because powders can be selected to give different colors, progressive merchandisers have a new field for color utilization at their disposal. The lamp radiates only one fourth as much heat as an incandescent lamp, hence it has special value for the food industries and for show-case lighting of perishables.

The fluorescent lamp is a special purpose light, not a substitute. Many units are needed for high levels of illumination, despite the high lumens per watt, because the lamp is a low-wattage type. Equipment and installation costs are higher than for ordinary lighting, but an expanding use is bringing these costs down.

INFRA-RED DRYING

Not to be credited to any Fair is the infra-red drying lamp, now spreading through industry. Upwards of 35,000 of them are used to dry automobile bodies and, having proved their merit in that industry, they are now saving time in the drying of resins, inks, blueprints, paper, and latex. Small portable units have been developed for drying re-decorated wall surfaces and trim in buildings. These units reduce idle time of office space.

The radiant energy near the infra-red region of the spectrum has a peculiar penetrating quality. It goes right through a paint surface to dry it from the inside out. Thus no outer skin forms to retard the process. It works quicker on dark surfaces than light, on rough surfaces faster than smooth ones. No air circulation is required, hence the hazard of dust movement is reduced. Installation costs are relatively low because standard wiring and sockets are used.

RADIANT HEATING

Looks as though the same rays which dry the lacquers on automobile bodies would be harnessed to heat buildings. There are several radiant heating installations in this country, more in Europe, and commercial interests are getting behind it. There is much to recommend it for far wider use in this country.

The principles involved in radiant heating were discussed at length at the time of an earlier push (December 1936, page 335), but here is a brief résumé. Radiant heat is a wave of pure energy which warms objects without heating the intervening air. You feel it when you stand in front of a pot-bellied stove, a fireplace, or in the sun in the wintertime. In the path of these rays, man can be comfortable even though surrounding temperatures are low, because the rays are strong enough to prevent dissipation of bodily heat faster than it can be generated.

Early installations called for pipes imbedded in ceilings. Through these pipes warm water flowed, and the warmed ceilings radiated heat downward to envelop the occupants. A less common installation has metal wall panels heated with water, but this requires four heated surfaces per room. Newest idea is to imbed pipes in the floors. Water, heated to 85 degrees, Fahrenheit, flowing in pipes, is intended to produce a 65-degree room temperature which is adequate for comfort.

Claims for this type of heating are many and well-founded. Installation costs are higher than for convection heating, but there is a saving in fuel, running as high as one third, greater bodily comfort, better control of humidity. Complete concealment of heating apparatus is an added advantage. Offsetting to some degree the higher initial cost due to piping is a possible saving in cost of heating plant. Likewise, need for air-conditioning systems is virtually eliminated.

Apropos of radiant heating is a home-cooling experiment which simply reverses the process. Room walls are covered with two black panels and a layer of aluminum foil. The foil reflects heat to the black panels which absorb it, and both panels and foil are cooled to a temperature of 50 degrees by concealed pipes. A marked reduction in operating cost of air conditioning is claimed for this system.

SHOCKING NEWS

The extreme dislike for electrical shock which livestock manifest is the cause of some concern among woven wire fence manufacturers.

A single strand of electrically charged wire will keep horses, cattle, and pigs just where you want them. One or two good shocks will condition animals to give the fence a wide berth. Ergo, farmers are favoring the single wire instead of woven wire fence because of the generous cost saving. Actual installation figures are hard to get, but estimates of controller sales give a good indication. Sales have jumped from some 14,000 to 75,000 in four years and the total sales of controller devices, including home-made shocking devices, for this period is put roughly at 335,000. Probably no less than a quarter million miles of electrified fence is in operation.

How much of a headache is this for manufacturers? Not as severe as one might think. There is substitution which has cut into woven fence volume, but much of the electric fence is clear gain. The temporary use for utilizing pastures, making exercise pens, lanes, and after-harvesting gleaning areas, means additional wire sales. Also, the way is opened to fence large areas hitherto prohibitive from the cost standpoint. A rapidly growing use is for protection of existing fences. It will take time to strike a loss and gain tonnage balance. Meanwhile it is a boon to farmers and live-stock raisers.

— *Philip H. Smith*

Maestro of the Atom

Lawrence Had an Inspiration, So Science Now Has the Cyclotron for Smashing Atoms

LORING A. SCHULER

ONE night, 11 years ago, a young associate professor named Ernest Lawrence sat in the University of California Library, plowing through reports of experiments in physics. Mostly they were routine, but one caught his eye.

The experimenter had hitched together two long vacuum tubes, and the speed of the electrified particles had been measurably stepped up as they jumped from one tube to the other. Why, Lawrence thought to himself, only two tubes? If the fellow had hitched up ten, wouldn't he have got the impelling force of a million volts? — enough, perhaps, to smash atoms? But ten tubes in a straight line would be impossibly long. Why not, instead, a circular vacuum chamber, with two half-round shallow copper boxes, shaped like the halves of a pill box cut down through the middle, as electrodes? Oscillating electric current would shift rapidly from one box to the other; a magnet would straddle the chamber, at right angles. If his theory was correct, the same small voltage, used over and over again, would give charged particles a series of electric pushes, while the magnet would keep them going round and round in a compact spiral, something like the spiral on a phonograph record. And thus the hopelessly long device Lawrence had first thought of could be made practicable after all. The particles would go faster and faster, until perhaps they would pile up the speed needed to crack atoms.

That was the birth of the cyclotron, for which the same Ernest Orlando Lawrence has been awarded the great Nobel Prize in physics as the world's number one atom smasher.

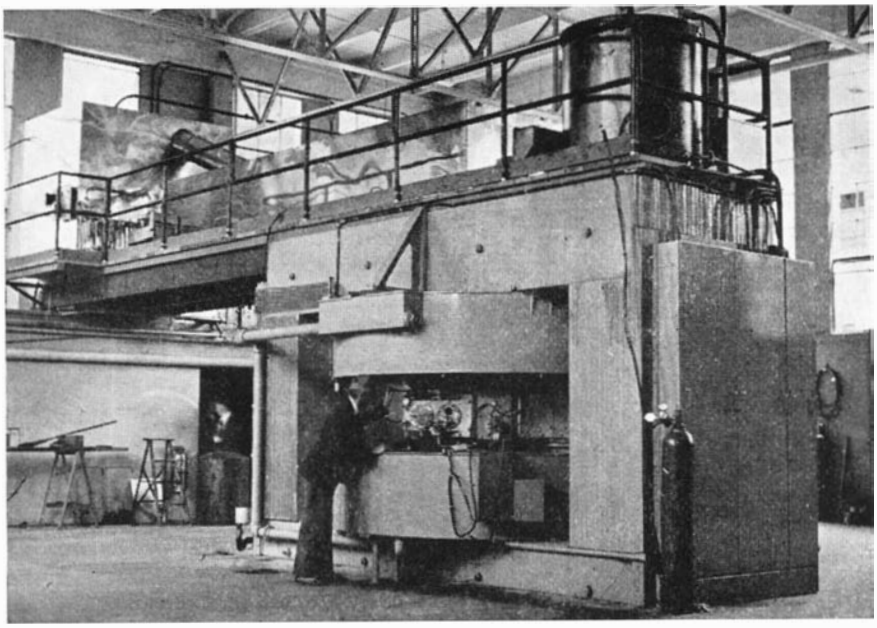
Today, with two huge cyclotrons that he has built at Berkeley — vastly bigger and infinitely more complicated than what he dreamed of that night in the library — he is helping to solve some of the most fundamental and mysterious problems of science.

And, in the unpredictable manner of scientific discovery, what started out to be abstract research is turning out to have such practical value that today medical doctors, chemists, biologists, botanists, entomologists and a great many other scientific gentlemen are all thumbing rides on the cyclotron because it promises to take them to places they have never been able to reach before. A powerful ray is under experimental use as a hopeful weapon against cancer. Artificially irradiated substances, with properties like those of radium, are being created for the study of growth and the treatment of various ailments, while in the field of agriculture plants are being made to tell how they absorb nourishment and make starch and sugar.

These are measurable gains in life and health and wealth. But there is much more, Lawrence knows, to be found beyond the frontiers that he has already explored, so now he is getting ready to build another atom-smasher, 20 times as big as his biggest, with which he confidently expects to be able to reveal Nature's secret source of energy, tap enormous new supplies of power for industry, and transmute the elements by this modern alchemy.

For 25 centuries, men of science believed there was a basic, indivisible particle of matter, the atom, out of which all things were made. Then, only a generation ago, evidence piled up to prove that each atom was like a tiny universe, with a nucleus at the place of the Sun, and electrons whirling round it much as Venus and Earth and Mars and Jupiter and the rest of the planets whirl around the Sun. All the electrons were identical.

FURTHERMORE, it was discovered that there were as many kinds of atoms as there were basic substances — hydrogen and oxygen and sulfur and zinc and tin and copper and silver and gold and radium, and so on to the number of 92 in all, which were called elements. What made each one different from the others in chemical properties was the number of electron planets that each individual atom had spinning round its nucleus sun. Hydrogen, for example, had one electron; oxygen had eight; copper had 29;



The 220-ton cyclotron at the University of California. The big chunky rectangle, with vertical pole-pieces in its middle, is the huge magnet. Between these pole-pieces is the main, "business" part of the apparatus, the circular vacuum chamber containing two electrodes, also the space where projectile particles are speeded up. Power source is on balcony

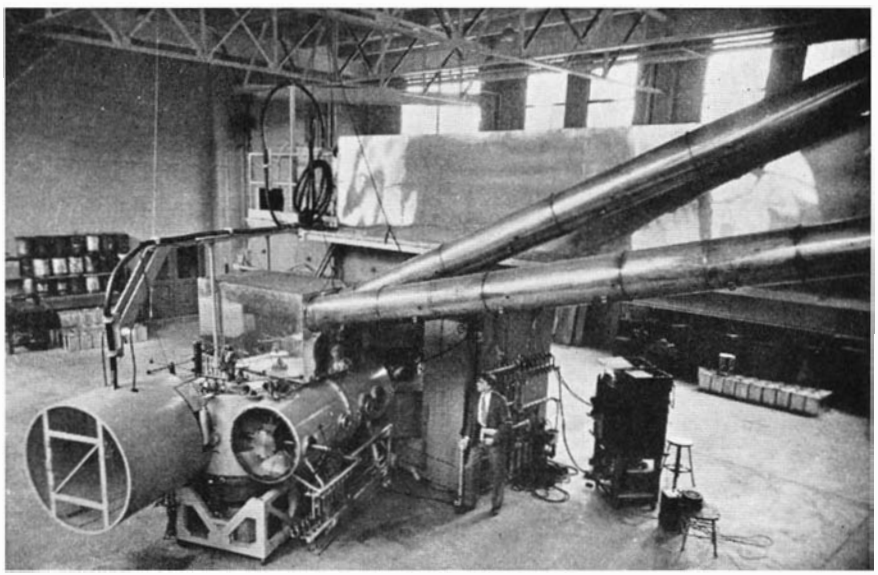
tin had 50; gold had 79; radium had 88, and uranium, heaviest of all, had 92. The elements are known in science by those "atomic numbers."

But strangely enough the electrons, which are charged with negative electricity, could be removed without essentially changing the character of the atom. It would still be an atom of gold or iron, for example. So, the researchers said, there must be something in the nucleus, with its positive electric charge, that we don't know about, and inquisitively they turned experimental guns against the little sun that was the center of each atom universe. Did the nucleus, too, have smaller parts? They found that it did, and named those parts protons and neutrons. And said that here at last were the elemental building blocks out of which everything in the world was made. Meat and potatoes, gold and iron, oil and water — all substances were made of the same protons, neutrons, and electrons, arranged in different patterns. That statement still stands, though Lawrence may find something else when he has built his bigger cyclotron.

But, it may be asked, how did the scientists themselves discover all this about particles which they could not see? Mostly by the painstaking accumulation of evidence. They could take photographs of the tracks of particles in motion, showing streaks like tiny comets; and they could "hear" two particles collide in a vacuum when the effect of their collision was amplified and converted to sound.

It is easy enough to strip the electrons from an atom. The ancients did it, though they didn't know it, in that first electrical experiment of rubbing amber with a piece of cloth. But smashing a nucleus is quite a different matter. More than 2,000,000 atoms could lie in a straight line across the dot over the letter *i*. And each nucleus occupies no more space in its atom universe than a fly in a cathedral. The protons and the neutrons are held together by forces of enormous strength. Here is the storehouse of atomic power. To separate the particles, so that the power could be released, would take prodigious energy. That was why Ernest Lawrence, back in 1929, was yearning for a million volts.

Scientists were pretty well agreed that only an atom could be used to smash another atom. If one lot of atoms, they figured, could be made into high-powered, high-speed bullets and fired at another lot of atoms, those that were hit might be smashed. The problem was how to get the necessary power and speed. A couple of German physicists built an elaborate apparatus to harness the lightning; they might have had something if they could have manufactured thunderstorms at will.



The same cyclotron viewed from the power supply house on the balcony. Nearer cylinder is a vacuum chamber down which particles finally speed

THE virtue of Lawrence's idea was its comparative simplicity. Along in the spring after that night when he made his first sketch in the library, he got around to making a model of the device, exactly following his original specifications. It was only six inches in diameter — a couple of D-shaped shallow copper boxes, mounted between circular pieces of glass and sealed with red sealing wax. But when the air was pumped out and a borrowed magnet was held at right angles to it and the current was turned on, particles actually did spiral round and round at increasing speed. The thing worked.

Later, he built another one, a little bigger, and that worked, too, with even higher velocity. Still, he wasn't smashing any atoms, but he was speeding up electrified particles to greater and greater velocities.

For this he needed a magnet of tremendous size, and, though maggets like that don't grow on trees, he was lucky enough to find one that had been junked in California when the Chinese government failed to pay for a radio broadcasting outfit of which it was a part. It weighed 74 tons.

There were exciting days and nights in the dusty old radiation laboratory at Berkeley while the first working cyclotron was being built. Discouragements when it wouldn't perform according to schedule; cheers when the difficulties were overcome. Parts melted off under the terrific heat that was generated, and were replaced by water-cooled contrivances. Lawrence was everywhere, driving his small crew of helpers, working like a madman himself, taxing even his own great ingenuity to devise ways of getting results without spending money.

But it worked! It really did smash atoms. It did more than Lawrence or anyone else had expected it would. Weirdly, it performed unexpected transmutations. Sodium, with an atomic number of 11, became magnesium, 12, by capturing a neutron out of a heavy-hydrogen nucleus that was shot at it. Aluminum, 13, became phosphorus, 15, by swallowing an electrified particle of helium. Nitrogen, 7, dropped a helium nucleus and became boron, 5, when it was bombarded with neutrons. There were even more complicated changes, and as time went on the laboratory workers found that they could make five different substances out of any element that they put under fire in the cyclotron — they could add or subtract one number or two, producing absolutely different elements, or they could make a variation of the original material.

Other things happened, too. After being bombarded by the cyclotron's fast-flying particles, all the lighter elements, at least, de-

veloped the curious power of throwing off rays, which only radium and its immediate family can do in nature. They were, in scientific terminology, "radioactive."

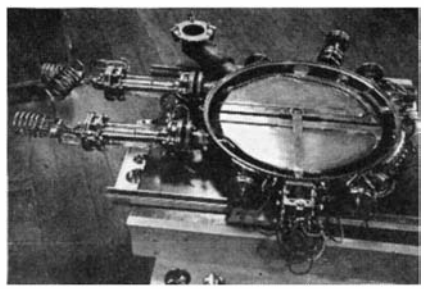
That calls for some explanation, which for the sake of clarity must start with the operation of the machine itself.

Into the very center of the cyclotron, between the two semi-circular hollow copper boxes, is admitted a stream of atoms of hydrogen or heavy-water hydrogen or helium. A tungsten filament ionizes them—that is, strips off the electrons, leaving the nuclei as naked positive charges. They are caught up by the alternating 80,000-volt electric field from the cyclotron's powerhouse. But as they start off in a straight line, the powerful electro-magnet swings them into an arc. Then when they dash across the gap between the two D-shaped boxes, the quickly reversed voltage picks them up and kicks them on again.

A HUNDRED or more times this happens. Round and round the ions spiral in ever-widening circles, picking up speed at each half turn while the voltage reverses some 20,000,000 times a second. It is the principle of the old rope swing—with the original 80,000 volts magnified by each hundred half circles of acceleration to 8,000,000 volts. And by the time they reach the outer edge of the copper boxes the particles are traveling at a speed of 18,000 miles a second, which is 35,000 times faster than a rifle bullet.

At the exit, a target is set up, smeared with sodium or phosphorous or some other element. The speeding ions strike the quiet atoms in the target, and, though the aim is inexact, two quadrillions — 2,000,000,000,000,000 — of bullets every second, concentrating on a target of two square inches, are bound to make some direct hits.

When an atom is "smashed," the protons and neutrons in its nucleus are rearranged. Here, for example, is an atom of boron. A physicist would draw the picture of its nucleus as a circle, with ten little spheres inside, five of them representing protons and five of them neutrons. The atom is hit in the cyclotron by a charged particle of heavy-water hydrogen, known as a deuteron, which may be drawn as a circle containing two little spheres, one a proton and one a neutron. The boron and the deuteron combine. There are now six protons and six neutrons, which make carbon. One substance has been transmuted into another. The new hot carbon throws off one neutron at once, in its effort to regain stability, just as boiling water throws off steam in an effort to get cool. But it still has an excess of energy, and some time later it will throw off still another particle. That is radioactivity.



The vacuum chamber unit removed from the apparatus, with its top off. Inside it are the two semi-circular, D-shaped electrodes, separated by a narrow gap and each supported by a heavily insulated support. Pipe fitting connects with the vacuum pump line. Next to right is the deflector, then one of four casters on which the entire unit may be rolled from between the pole-pieces of the magnet. Nearer the reader are the window for particle exit and the target holder

Some elements expel these excess particles almost immediately. Others let them stay for a while, and then toss them out, perhaps in a minute or an hour or a matter of years. Nature abhors instability, and each atom tries to regain the stability that it lost when new particles crowded into its family circle.

The cyclotron makes radioactive substances easily, and from many elements. The doctors pounced upon it quickly when that was discovered. Radium is very rare and very costly. It can be dangerous as well as beneficient. The artificial radioactive substances have a shorter active life than radium, which is an advantage because they can be used internally with less danger. And besides they cost a great deal less—a day's bombardment of a common salt produces radioactive salt that for a day or two will do the work of several hundred thousand dollars' worth of radium.

Twenty departments of the University of California are now demanding radioactive products from the cyclotron for their own studies. Biologists are using them to study growth and metabolism. Botanists are having fertilizers irradiated, so that they can find out how growing plants use these "labeled atoms." With radioactive carbon they are learning how plants combine carbon dioxide, water, and sunshine to make starch and sugar. In insect research, sodium is traced through the pests. In industry, radioactive hydrogen is helping to perfect petroleum refining, and radioactive salt can be used instead of radium and X-rays to find defects in battleship armor.

There's more and yet more. Beryllium atoms under bombardment give up neutrons in such great quantities that a healing ray, something like the X-ray or the gamma ray of radium, has become known. The doctors have already used this neutron ray with fair success to halt the wild growth of cancer cells in animals, and some of them believe it offers the most powerful weapon against human cancer that has yet been found.

BECAUSE of the medical value of both the neutron ray and the radioactive substances, a new cyclotron, with a magnet weighing 220 tons, was built on the Berkeley campus last year, and 35 other cyclotrons have been built in other states and other nations.

Lawrence's next cyclotron will be tagged for fundamental research, to unfold the secrets of atomic power and transmutation. Its construction will take three years, and will cost $1,400,000, of which $1,150,000 have already been given by the Rockefeller Foundation. Its magnet will weigh 4900 tons. It will generate 100,000,000 electron volts, perhaps much more. It will be built high in the Berkeley hills, and its operators will huddle in an underground control room, 150 feet away, when the machine is running.

So powerful an engine of atomic disintegration is dangerous as well as useful. Even the present big cyclotron—one twentieth the size of the one to come—is treated with respect by scientists. Five-foot-thick walls of lead and water protect them from flying neutrons.

When the cyclotron is running nothing moves except the atoms whirling in the vacuum chamber, and you couldn't see them even if you were at the heart of the machine. If you should stick your hand into the deuteron beam which is sometimes released as a spec-

tacular stream of bluish-lavender light you would be burned as if you had fooled with a blow torch.

Will industry eventually be able to harness atomic power? There are two ways in which this might conceivably come about. Both have been sufficiently proved to take them out of the class of pure theory; neither is at all near to the stage of practicability now.

The first is energy produced by fission, or splitting, of an atom. Within the past year, atoms of uranium 235, an isotope, or variety, of the heaviest of all elements, have been split by neutron bombardment, which divides them into types of other lighter elements, with the release of immense energies. On paper, the splitting of a uranium atom produces 50,000,000 times the energy release resulting from the burning of an atom of carbon in coal, though researchers quickly reduce this ratio to 17,000 because of scarcity and other factors. The released energy from uranium manifests itself as heat, and if enough could be had steam could be produced to run factories.

The trick will be to bring about what is called "chain reaction," which seems possible because when uranium 235 splits excess neutrons come out, and these, in theory, will attack other atoms and start a chain disintegration with a ceaseless and increasing flow of heat.

So much for theory. On the basis of facts now known, coal isn't likely soon to be supplanted by uranium. Only uranium 235 will split and very little of this has been purified; an increase in consumption would boost the price out of sight; and, last but not least, uranium has a disconcerting high-explosive quality—because of which the Nazis are trying to lay hands on all the uranium they can find.

THE other theoretical method of squeezing power from the atom is by annihilation. Two electrons will disintegrate into a wave of energy when they collide. From this, physicists reason that a far greater emission of energy would result if they could make the heavier protons and neutrons kill themselves off in the same way.

Lawrence has written: "A simple calculation according to the relativity theory shows that a glass of water, if completely destroyed and converted into useful energy, would yield more than a billion kilowatt hours, enough energy to supply a city with light and power for quite a time."

The released energy, if it could be produced at will, would be in the form of heat, which could then be used to make steam, to turn generators, to make electricity for the use of industry.

Lawrence also says: "When we can produce atomic projectiles of 100 to 200 million volts, we shall be able to unloose new energy, in light and heat. We shall have new riches perhaps more important than those we have already found. Radium gives off enough energy to raise its own weight of water to boiling temperature every hour, and it continues to do this for thousands of years. There is reason to hope that we shall find the means of releasing the vast store of energy in the nucleus of commoner substances. Indeed, this is more than a hope; it is already a likely possibility."

Co-workers in the laboratory call Lawrence the "Maestro." He is a big man, tall and broad of shoulder; with eyes that are always busy behind his low-set spectacles, and a big, wide, tooth-filled laugh. He plays a good hard game of tennis; has a cruising boat on San Francisco Bay that he won't take out unless there is rough water to make things exciting. Most of all he's curious and generous and honest, sharing each triumph of achievement with associates who love to work with him.

At 38, he is in the top flight of great physicists, and, as one friend wired him on the day the Nobel award was announced: "Dear Ernest, your career is showing promise."

• • •

More About the Cyclotron

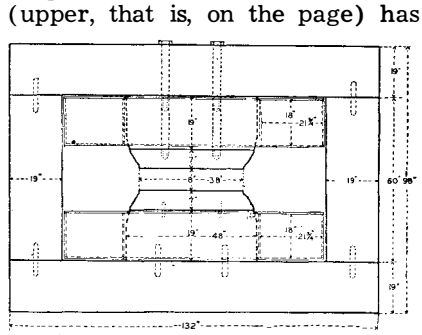
For Readers Who Wish to Look Further into its Technical Details

THE cyclotron is a sort of electrical slingshot for imparting high velocities to sub-atomic particles, in order to crack atoms apart by shooting these projectiles at them.

The accompanying drawings reveal the essential workings of the cyclotron. Inserted between the pole-pieces of the big powerful magnet, but otherwise not connected with it, is the vacuum chamber, shown in one of the photographs of the previous article. The two "D's," so-called by physicists because of their obvious shape, are semi-circular, hollow, shallow boxes, which *are wide open* along their straight facing sides. They do not touch the chamber. As the diagram shows at its left side, they are connected, as capacities, to a radio-frequency oscillator circuit, through an inductance.

To outline the essentials of the cyclotron let us assemble and operate it. First, the cover of the vacuum chamber shown in the photograph in the previous article is replaced and sealed, the chamber is inserted between the poles of the magnet and the interior is exhausted to a high vacuum. Then a small amount of some light gas, like helium or hydrogen, is allowed to enter the chamber. At the center some of its atoms reach a tungsten filament which, like any hot body, gives off electrons. Since this filament is maintained at a negative potential with regard to the chamber, these electrons are pushed off. They collide with the gas molecules and ionize them. These ions are to be the atom-smashing projectiles.

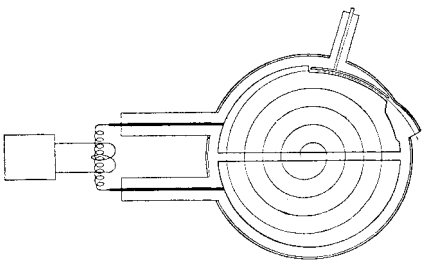
Now to "put the ball in play." One ion, a particle having a positive charge, is assumed to be near the center—about where the spiral starts in the diagram. At this instant in the operation of the high-frequency oscillator the upper D (upper, that is, on the page) has



Courtesy *Journal of the Franklin Institute*

Cyclotron magnet for the Biochemical Research Foundation

attained its maximum negative potential—perhaps 90,000 volts. Therefore the particle is attracted toward it. It does not travel straight toward it but is forced into a curve by the powerful uniform magnetic field passing vertically through the vacuum chamber lying between the pole-pieces. Because the D is hollow and has no wall along its parallel side, the particle does not hit the D, even when it reaches it,



Plan showing main elements of a cyclotron's vacuum chamber

but simply enters its open interior space. This space is practically field-free, but momentum carries the particle ahead and the magnetic field curves it on around. Just as it emerges from the D, the high-frequency oscillator has changed to its opposite phase and the particle therefore is drawn again across the gap, acquiring a doubled velocity as it is attracted.

The rest, for some 100 revolutions, is simply a repetition of the same performances—kick after kick that adds increment after increment of speed ("multiple acceleration") to the particle. Why doesn't it travel in a circle instead of an approximate spiral? Because the radius of its arc after each increase in speed is proportional to the new velocity.

All these things have been taking place actually at the rate of 20,000,000 swift kicks per second. Just as the long-suffering particle has decided that existence for it hereafter must be just one revolution after another, with no hope of ever attaining a permanent, fixed position in life, it has spiralled outward to the edge of the chamber. Here there is a plate charged to a high negative potential, perhaps 70,000 volts. This pulls the particle aside and it dashes through a mica "window," thick enough to exclude the outside air but "mostly hole" for smaller things, and flies at the atoms which it is to crack in the target chamber. This particle has not, however, been alone, for trillions of similar particles have accompanied it on the merry-go-round. How are they aimed at their target? They are not individually aimed at all. It is more like throwing stones at a neighbor's fruit tree in the dark when you were a boy —some of the stones hit some of the fruit.—*A. G. I.*

ELECTRON VOLTS

So Often Seen in Print — So Seldom Interpreted

WHAT does this peculiar term signify? Very loosely, velocity. To most of us, electron volts are a new variety of volts. How can volts mean velocity? Like many other common expressions, this is one that does not mean what it says: any more, for illustration, than F 4.5 or F 8 really means speed in a lens, instead of a ratio that can in turn be interpreted in terms of speed. The amount of kinetic energy acquired by an electron when it has been accelerated through a potential difference of one volt is an electron volt. So electron volts aren't a measure of speed, after all, but of energy. It is, however, one of our mental preferences that we like to think of kinetic energy in terms of something else that we can more easily observe—that is, speed. Should a newspaper reporter correctly state that "two cars met head on, with the liberation of so-and-so many foot pounds of kinetic energy," instead of "two cars met head on at 70 miles an hour," he would lose his job. It is true, nevertheless, that velocity itself never smashed a car or even an atom—the kinetic energy in an object moving at a velocity is what does the smashing.

To convert electron volts into miles per second requires nothing worse than doing a patch of arithmetic the size of one's hand; a complication in the calculations being the fact that the mass of a flying particle increases with its velocity (the "relativity" increase). When the particle attains velocities comparable with that of light its mass becomes considerably greater.

Another question is: "If the particles used in cyclotrons are not electrons but other particles, according to the atom-smashing effects desired by those who operate them, why is the term 'electron' volts used at all?" The electron volt as a unit of energy can be applied to other atomic particles because the charge on any such particle is an integral multiple of the electronic charge. Here are some examples of electron volts translated into terms of speed. An electron in a one-volt field would move at 369 miles a second, a proton at 8.69 miles a second, and a deuteron something over half as fast. These, of course, would be slow, lazy particles. In cyclotrons the speeds read more like scores of thousands of miles a second.

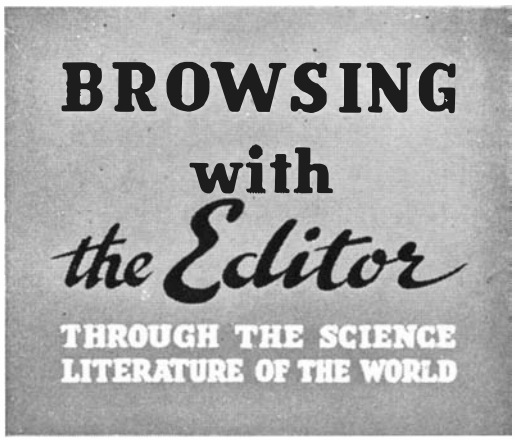
Sometimes confusing is the frequent terminology in sentences like the following: "The atoms of uranium 235 are split, with the release of 175,000,000 electron volts." Again the meaning is, simply, energy. It is easier for the physicists to state it thus than in such terms as horsepower, though this could be done, and it would be as scientific. Conversely, you could, after wrestling with some arithmetic, express the speed of your car in terms of electron volts, but it probably wouldn't impress the judge.—*A. G. I.*

RAMAN EFFECT

Theoretical Discovery Now Has Practical Value

ABOUT ten years ago an Indian physicist, Sir C. V. Raman, using refined equipment, discovered that the light scattered by individual molecules is not all of the same frequency as the incident light, but that a minute amount of this scattered light consists of different frequencies. When light strikes a molecule and the electrons interact with it, sometimes a fleeting change is caused in the vibrational state of the electrons. This sudden change causes the "springs" holding the atoms together to jerk and so, part of the time, makes the atoms vibrate. Thus, part of the energy of the incident light is converted into the vibrational energy, so that the light which leaves the molecule has a lower frequency than the incident light.

The differences between the incident frequency and the various scattered frequencies form a pattern, a "Raman spectrum," which is characteristic of the molecule doing the scattering. The appearance of the Raman spectrum of a mixture of different molecules may tell a chemist what molecules are present in the mixture, while the relative intensities of the lines in the spectrum indicate the relative amounts of each. A number of new compounds have been discovered in this way.



WORKER'S WEALTH.—Over half the "wealth" produced in motor plants goes to workers who build the cars.—Automobile Manufacturers Association, 366 Madison Avenue, New York, New York.

GRAPE-FRUIT OIL.—An oil with a nut-like flavor, useful in industry, cooking, and as a salad oil, is now being extracted from grape-fruit seeds—United States Citrus Products Station, Winter Haven, Florida.

FREEZING WATER.—Experiments prove that, contrary to a widespread impression, hot water does not freeze more quickly than cold water.—*Science,* p.384, (April 19, 1940).

CHAMELEON'S TONGUE.—A seven-inch chameleon can capture a fly 12 inches away without moving. His artillery consists of a tongue longer than himself, a lightning-like sticky-tipped weapon which is shot out of the mouth in much the same way a watermelon seed can be shot from between the fingers. Ring-shaped muscles contracting suddenly on a slippery, spike-like bone send the tongue forward.—*Natural History,* (May 1940).

OZONE, NO BACTERICIDE.—Ozone, regardless of where or how it is generated, has little or even no effect on bacteria or germs.—*The Journal of the American Medical Association,* p.1633 (April 27, 1940).

ANT FORTRESS.—A small South American tree, the barrasanta, is a fortress garrisoned by ants. A ferocious species of ants invariably live in its hollow stem and rush furiously out to attack any man or animal that disturbs the tree.—O. L. Haught, Smithsonian Institution.

SULFANILIMIDE.—Experiments have shown that sulfanilimide destroys disease germs by letting them kill themselves with the hydrogen peroxide they themselves create.—*Science Service,* (April 3, 1940).

SMALL OIL PRODUCTION.—"Since the foundation of the oil industry, the entire world's production of crude oil would not fill a hole a cubic mile in the earth."—Dr. Gustav Egloff, *Science,* p.535, (June 7, 1940).

KEEP GAS OUT OF THE EARS.—Rubber ear caps are now being made to protect wearers against certain war gases which, if allowed to penetrate the inner ear, would make decontamination extremely difficult. It is also claimed that . . . they will protect the ear drum from blast. —*India Rubber World,* May 1, 1940.

DANGEROUS AUTOMOBILE DOORS.—Each year about 300 persons in the United States fall to their death through doors of moving passenger automobiles which they open in order to slam them shut. The rush of air swings the door completely open, pulling the person out of the vehicle. —*Statistical Bulletin,* Metropolitan Life Insurance Company, April 1940.

WE'RE NOT SO HUNGRY.—During 1939, the average person consumed something like 100 pounds less food than the average person did in 1900. Today, electricity does work in factories, homes, and farms, which used to make people develop man-sized appetites.—Dr. O. E. Baker, U. S. Department of Agriculture.

NEW INDUSTRIES.—Fifteen million Americans now work at jobs which did not exist in 1900.—Everett S. Lee, General Engineering Laboratory, General Electric Company.

BETTER FREIGHT SERVICE.—Today's freight trains can do more work and do it better and in less time than those of 20 years ago. Freight cars average eight tons more in carrying capacity; locomotives average 43 percent more pulling power; and freight trains go 64 percent faster, on the average.—Association of American Railroads.

TO FIND MORE OIL.—Around 6000 geologists, geophysicists, chemists, paleontologists, and other scientific workers, are said to be engaged nowadays in the search for oil. —Thomas A. Boyd, speaking before The Franklin Institute, April 29, 1940.

FOREST FIRES FROM CARELESSNESS.—Only 10 percent of the forest fires that burn more than 34,000,000 acres every year are due to natural causes, such as lightning. The rest are man-caused.—The American Forestry Association.

RUBBER FROM HOME-OWNED PETROLEUM.—"In 1939, about 1,100,000,000 pounds of natural rubber were used in this country. Over 200,000,000,000 pounds of synthetic rubber could be produced from ethylene from the cracking process."—Dr. Gustav Egloff, *Science,* p.538, (June 7, 1940).

CHEAPER LIGHT BULBS.—In 1900, the cost of electric light bulbs was approximately one cent per candle power of light. In 1939, the cost was less than one sixth as much, and the power consumption less than one fourth as much, per candle power.—Dr. A. W. Hull, General Electric Research Laboratory.

NO SILVER.—There is no silver in nickel-silver. It is an alloy of nickel, copper, and zinc.—*White Metal News Letter,* May, 1940.

DIPHTHERIA DEATHS.—A record of no diphtheria during an entire year has been achieved by 32 cities in the United States.—*Science Service,* May 8, 1940.

TREATING SINUSITIS.—While there are various preparations or treatments that are of temporary palliative value in giving relief from the symptoms of sinusitis in some but not all cases, there is no known home treatment that is a cure or competent remedy for this condition.—National Better Business Bureau, Inc., May 24, 1940.

SAFE RAILROADS.—A person is safer on an American railroad train than in his own home, according to statistics. During the past 10 years, fatalities to passengers in train accidents averaged only one for each 1,498,000,000 miles run.—Association of American Railroads.

NICKEL USE.—Of the 210,194,000 pounds of nickel sold during 1939 by International Nickel, the United States alone consumed 101,200,000 pounds, or nearly half the production of the world"s largest producer.—*White Metal News Letter,* May, 1940.

CIVIL ENGINEERS.—One hundred years ago there were but two main types of engineers: "military" engineers concerned with the operations of warfare, and "civil" engineers engaged with problems of civil life. For a time, all engineering in civil life was called civil engineering, but soon major differentiations developed . . . .—*Engineering Opportunities,* by Dr. Karl T. Compton.

An Ideal Experiment

Taking the Moon's Temperature During an Eclipse Reveals a Phenomenally Big Drop

HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

"COLD moonlight" is poetry and fact in the same phrase. The Moon's light carries so little energy with it that, as a source of warmth, it is much less satisfactory than the English lodging-house fireplace which Howells once described as having "the capacity of a pint-pot and the heating capability of a glow-worm." But modern heat-measuring devices are so sensitive that the imperceptible heat of the Moon's rays may not only be measured with precision, but afford a basis for a reliable determination of the temperature of its surface.

There is no difficulty, in principle, in throwing the image of a planet, or of some portion of the Moon, upon one of the two junctions of a balanced thermocouple circuit, and recording the current set up by the heating of this junction by the incident radiation. In practice, a very high degree of manipulative skill is required, to construct the tiny thermocouples, to keep the galvanometer at the highest sensitivity, and to shield the whole circuit from the many sources of extraneous disturbance. Work of this sort was done years ago at the Lowell Observatory by Coblentz and Lampland, and at Mount Wilson by Pettit and Nicholson—who summarized their observations in an extensive catalogue of "radiometric magnitudes," calibrated so that from the entry for each star it was easy to derive the actual amount of radiant energy which the star sent to a given area of the Earth's surface.

The theoretical interpretation of these data is much complicated by the fact that the energy we can measure at the Earth's surface is much less than we would observe if there was no atmosphere above our heads—and if we could survive to make our measures. The Earth's atmosphere is tolerably (though far from perfectly) transparent to visible light, but highly opaque in many regions in the ultra-violet and infra-red. Hence we lose a great deal of the radiant energy from some bodies (most of all from the hot, white stars) and have to make allowance for this with much labor and pains. The worst of it is that the most powerful absorbing component of the atmosphere is water-vapor, and the amount of this varies from day to day and even from hour to hour. We can get a general idea of the amount of water-vapor above us by measuring the humidity of the air at the ground level—or at that of the observatory floor—by the ordinary methods used by meteorologists. If this air was a fair sample of the great atmospheric ocean which extends a hundred miles and more over our heads, we could proceed comfortably with our calculations; but obviously when the wind is from the north high up, and from the south low down, the surface air may be a poor sample of the whole.

LUCKILY, there is a "window"—or spectral region in which the air is nearly transparent—for wavelengths about 20 times as long as those of visible light. For longer waves, the atmosphere is entirely opaque, and for shorter ones it is full of regions of heavy obstruction.

This "window" comes just in the right place for the student of planetary temperatures. The heat carried by the sunlight reflected from the planet is, for such observations, only a nuisance. The heat given out from the planet's own surface is what is wanted. This radiation, coming from a surface at a temperature more or less like that of the Earth's surface, is carried mainly by long waves, while sunlight contains a great preponderance of short waves. Of the two clear spectral regions in the transmission of the atmosphere, one lets the sunlight through, little weakened; while the other is open to the planetary heat—though not wide enough to admit it all.

Our thermocouples, of course, measure the sum of both but it is easy to separate them. A microscope cover-glass, 1/150 of an inch thick, blocks out most of the long wavelengths, and a cell containing water between quartz plates obscures it completely—though both are substantially transparent to sunlight. By interposing one or other of these screens in the path of the rays, and repeating the measures, the energy cut out represents approximately that radiated from the warm surface of the planet, and that which still gets through, the reflected sunlight. Exact allowance for the small fractions of either one which are not completely stopped or let through is easy enough. Needless to say, the observations must be made with a reflector, so that the rays are not obliged to pass through any glass.

In this way the reflected sunlight is eliminated, and the corrected reading represents the heat which would be received from the planet itself if the sunlight could be cut off from it for an instant, before it had time to cool.

The amount of this heat evidently depends upon the size of the portion of the planet (in square seconds of arc) whose image falls on the thermocouple. Allowing for this, there remains a quantity which depends on the temperature of the radiating surface. If the surface was a standard radiator — or "black body" — and the atmosphere was not in the way, this quantity would be proportional to the fourth power of the temperature, and the rest would be easy.

Allowance for the loss in passing through the atmosphere demands laborious calculation, but can be reliably made (subject to the uncertainty of the humidity of the upper air). Whether the surface behaves like a standard radiator or emits less is sometimes doubtful; but the Moon is doubtless composed of rocks not much unlike igneous rocks on Earth, and these, for long waves, are not far from standard in their radiating properties.

The amounts of heat which

would be received, by a faultless detecting device, from a body of given size at various temperatures, observed through the Earth's atmosphere under standard conditions, have the following relative values:

Temperature			Heat
°K	°C.	°F.	Received
400	127	260.6	1000
350	77	170.6	583
300	27	80.6	285
250	—23	— 9.4	117
200	—73	—99.4	31
150	—123	—189.4	3.2
100	—173	—279.4	0.048

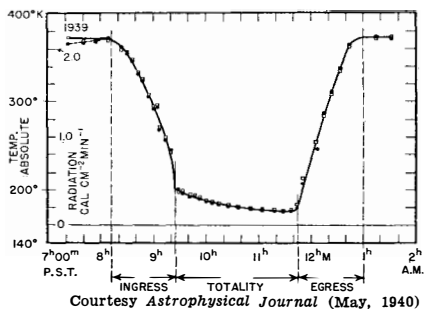
The influence of the transmission "window" is clearly seen in these figures. Were the radiation unobstructed, the heat received would be 16 times as great if the absolute temperature were doubled. Between 200° and 400° the ratio of increase is 32, from 150° to 300°, 88, and between 100° and 200°, it is 650.

EVEN at the higher planetary temperatures, a great part of the radiation is of such long wavelength that it does not get through the atmosphere. At lower temperatures a larger and larger fraction of the radiation goes over into this inaccessible region until at last only a beggarly remnant remains observable.

This adds to the accuracy of the measurement of planetary temperatures in the middle range, near 200°K., or absolute. At temperatures much below 150°K., there is very little left to measure, and at 100°K. only 1/80 of the already feeble radiation reaches the Earth's surface.

This makes it very difficult to measure the true surface temperatures of the remoter planets of our system, from Uranus outward, for a simple theoretical calculation shows that they are practically certain to be below 100°K.

Taking all these things into account, Pettit and Nicholson derive a formula — which runs twice across the page on which it is printed — in which all the corrections are included. Ten years ago, from a long series of measures on various parts of the Moon's surface, they derived consistent and reliable values for its temperature. The hottest part of the Moon is of course the "sub-solar point" where the Sun's rays fall vertically upon it. As we shall soon see, these rays have had plenty of time to heat it up in the week (measured by our time) since the Sun rose above the lunar horizon, and the surface is practically as hot as it would get if the sunlight kept on playing upon it forever. Under these conditions, the temperature rises to 374°K. (in centigrade degrees above the absolute zero), which is the same as 101° centigrade, or 214° Fahrenheit. At greater distances from this point, where the sunlight falls more



Courtesy *Astrophysical Journal* (May, 1940)

The Moon's radiation and temperature near sub-solar point

obliquely, the temperature gets lower, and the dark side of the Moon is extremely cold.

What would happen if the sunlight should be suddenly cut off? The surface, having no internal supply of heat of any account, would cool by radiation into space how rapidly?

Nature performs this experiment for us every time there is a lunar eclipse. The interposition of the Earth cuts off the sunlight—not instantaneously, but in about an hour. Under favorable circumstances, a given spot on the Moon may remain in darkness for more than two hours and a half, though the time during which the whole disk is obscured is about an hour shorter.

The faint reddish light refracted by the Earth's atmosphere into the shadow, which enables us to see the eclipsed Moon, is so feeble that the heat which it carries can be quite neglected, so that we have practically an ideal experiment.

Lunar eclipses, visible at a given observatory, with the Moon high enough in the sky to be well observable throughout all the phases, are none too common. Pettit and Nicholson observed one at Mount Wilson in 1927 (June 14) and the next one when weather and other conditions were satisfactory happened on October 27, 1939, and was well observed by Pettit. It was not necessary to use one of the great telescopes for the observations — a 20-inch reflector collected ample energy.

The sky was very clear, the weather steady, and the Moon high in the sky. Both a cover-glass and a water-cell were used to separate the reflected sunlight and radiated heat, thus enabling two almost independent sets of temperature determinations. The two are in excellent agreement. In the figure the squares mark the cover-glass observations, the dots those with water-cell. The point observed on the Moon was not quite under the Sun, and the surface temperature there, before the eclipse, was 99°C. As the Sun's rays were cut off, the radiation from the Moon fell rapidly — almost in exact proportion to the loss of incident energy. When totality began (for the observed portion of the surface) its temperature had dropped by 172° centigrade, and was —99°F. An hour later it was lower by 18°C., and, just before the sunlight returned, it was —97°C., or 144 degrees below zero Fahrenheit!

IF the Moon's surface were composed of solid rock, it could not cool so rapidly, for heat would be conducted up from the deeper layers, and prevent so precipitate a change. Only a loose agglomerate, like pumice or volcanic ash, could interpose so effective a barrier to the escape of internal heat. Such substances are just what one might expect to find on the surface of our satellite, so that there is no difficulty about believing this. Pettit calculates that the cooling during the recent eclipse, though amounting to a drop of 350°F. at the actual surface, involved mainly only the outermost inch of depth. A few inches deeper, the cooling must have been very small.

During the long lunar night, the surface temperature must fall very low. The slower alternation of these changes would cause their influence to penetrate deeper; but, could we visit the Moon, and find a cavern leading into the surface, we would probably find a nearly uniform temperature, 20 feet underground.

The Earth gets as much heat from the Sun as the Moon does, and has much longer to cool down every night than the eclipsed Moon is permitted. Were there no atmosphere or ocean on our planet, its surface temperature would probably undergo almost as extreme variations. It is in more than one way, therefore, that air and water make our world habitable.

The Temple of the Effigy

Evidences Unearthed in Ohio Afford Clear Proof of a Grisly Mound-Builder Rite

WILLIS H. MAGRATH
Affiliate, The Society for American Archeology

A PREHISTORIC stone eagle effigy, the only one of its type known, according to scientists, was recently unearthed inside an ancient mound, by Roy Saltsman, an amateur archeologist of Alliance, Ohio, assisted by the author.

The stone effigy, unique because of its position inside a mound, is part of the trappings of a prehistoric temple of worship, and has been evaluated by Richard G. Morgan, Curator of Archeology at the Ohio State University, as belonging to the Hopewell Culture of early Mound-Builders.

The mound, which occupies a commanding position on the hill overlooking the village of North Benton, in northeastern Ohio, was encircled by large sandstone slabs set end to end. Inside this stone wall, the former existence of a second wall of wood was indicated by the charred stumps of pillars which had supported a nearly circular building 70 feet in diameter. Entrance to the structure was on the west side, through a gateway wide enough to permit the passage of but one person at a time.

Inside the gateway was found a hard-beaten corridor bordered on either side by the black molds of the posts which had helped support the inner parts of the structure.

On either side of the corridor were lines of cremated burials—charred bones on raised, truncated earthen cones—together with crude stone altars bearing the marks of fire. On other squat clay cones, rested offerings of stone implements, mica, cannel coal, galena, and copper, while there were two bundle burials—bones previously buried elsewhere, exhumed and brought here.

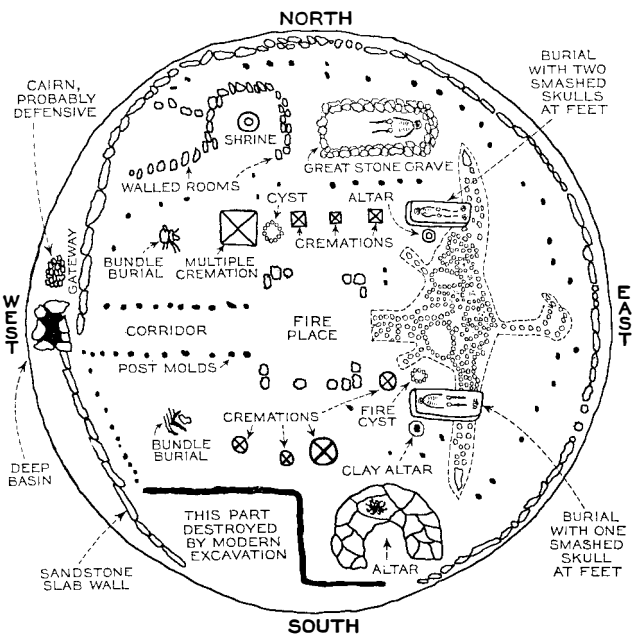
The corridor ended in a square fireplace, exactly in the middle of the temple floor, over which there would have had to be a hole in the roof to carry off the smoke of ceremonial fires and the stifling stench of burning sacrificial corpses.

Eastward of the fireplace, where the slanting light of the afternoon sun would strike upon it through the hole in the roof, was the fantastic eagle figure, made of white sandstone slabs resting on an understructure of molded clay. It measured 32 feet across the expanded wings and 16 feet from head to tail, and was headed toward the rising sun.

Overlying the eagle's wings two skeletons were found—the one on the south that of an abnormally large male, that on the north that of a female, the latter showing marks of disease. Both burials were accompanied by rich offerings of flint, bone, and metal.

Among the offerings placed with the male were a pair of spool-shaped copper ear ornaments and a platform pipe, the first such objects to be reported from this region. The inner portions of the ear-spools were lined with buckskin, secured by a twine wrapping about the mid-section, an apparent indication that these people knew the injurious effect of absorbing copper salts into the skin, and sought to avoid it. A hollow copper globe found with the female is perhaps unique.

These two burials, perhaps those of a king and queen, were distinguished by remarkable deposits of smashed human skull fragments strewn about the feet, apparently an instance of human sacrifice. This conclusion was reached with extreme hesitation, as it is not in accordance with finds made with other branches of the Hopewell Culture. However, a large horseshoe-shaped stone platform found near the eagle's southern wing tip bore evidence that seemed to admit of no other interpretation. This evidence consisted of a litter of smashed human skulls, together with incrustations of ceremonial red paint, upon the slabbed top of the structure. That wanton violence had been visited on these skulls was evident from the smashing of even such solid structures as the mastoid process, while splinters of bone had been driven down into the crevices between the slabs. Gashes in the soft sandstone indicated that the instrument used to effect this demolition probably had been an axe.



General plan of the Temple of the Effigy

THIS barbaric altar was examined in the clean light of open day, under conditions that must have contrasted strongly with its appearance when it was part of a mound-builder temple. Perhaps most of the rituals performed on it must forever remain a mystery, yet enough evidence remains to permit at least a partial reconstruction of what went on here when human heads were smashed and the gruesome fragments strewn at the great chief's feet. For when the great chief was stricken dead, this could indicate only that the gods were angry with the people, and it required atonement which, in the case of someone so exalted, called for human sacrifice.

Illuminated by fitful fires from the sacrificial altars, with such feeble shafts of sunlight as could penetrate the smoke reek, fantastically-garbed priests move about in the space before the curving altar, performing their offices.

The chalk-white slabs of the Eagle effigy catch the light and make a weird background for the figure of the dead chief lying upon a catafalque of sand.

Diagonally above his left shoulder boulders have been placed to form a circle, and now a fire burns brightly in this cyst. As the flames leap higher a priest moves forward, tossing in such personal property as the chief will not want to take with him on his long journey.

Occupying a similar position with respect to the right shoulder is a squat pyramid of molded clay. Upon the pyramidal altar is a greenstone hatchet, a great polished celt of schist shot through with sparkles of white and yellow mica, and several lesser implements. These are the tools the chief loved and the ones he will want to take with him when his soul goes outward bound toward the rising sun upon the strong eagle's wings.

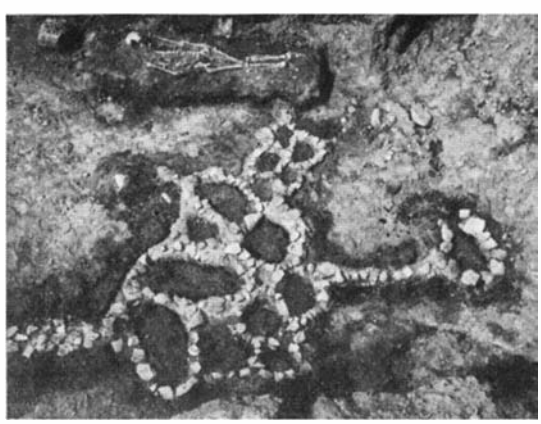
FARTHER back in this macabre chamber of sorrow—back beyond the supporting pillars and the lines of cremated burials—are the living nobles and chiefs, while the gloom-filled area along the temple wall is thronged with still other worshippers, all of them manifesting the most poignant grief.

Behind the ceremonial, horseshoe-shaped altar, facing the worshippers, is the high priest, fantastically arrayed in towering head regalia, earlobes hideously distended with polished copper spools, swart breast hunt with gleaming shells and bear teeth. He has a pouch of ceremonial red paint, and his right hand grasps a massive greenstone hatchet.

The air pulsates with a barbaric rhythm of chants and drumbeats, interspersed at times by the wild shrilling of a Pipe of Pan. Guttural commands ring out and there is a commotion near the temple gate. In a moment stalwart braves enter, dragging a fright-drugged wretch whose mind is too palsied to realize fully what is about to happen to him in this stifling place.

The bedlam grows louder, rising to a supreme pitch as the climax of the rite approaches. The braves have dragged their victim to the curving altar, and are forcing him to bow over the slabbed top in supplication. Menacingly the high priest raises his hatchet, at the same time sprinkling sacred red paint upon the altar. In a moment that altar will be redder than with any ceremonial red paint. A hush falls on the crowd, the hush of emotional mesmerism, and in that moment of hush the blow falls, splitting the skull with a soggy impact, like the bursting of a rotten pumpkin. Again and again the hatchet strikes, till the thing that was a human head is a shapeless crimson pulp, and the body to which it was attached ceases its convulsive twitching and is still.

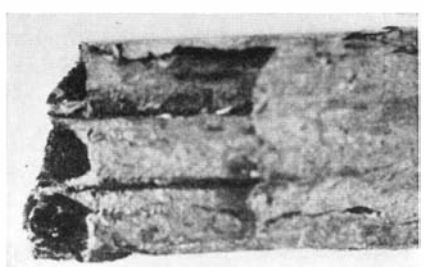
Pieces of smashed skulls strewn about the feet of the buried Indian queen's skeleton



Part of the eagle effigy, with one of the burials lying across its half concealed wing

Contemptuously the subordinate priests kick it aside, while the high priest sheathes his hatchet. Then the dripping head fragments are gathered up and strewn about the feet of the great chief. Much of the sodden debris is carelessly overlooked, and remains upon the altar, and there the explorers find it, centuries afterward, telling its long-forgotten story.

Even the Pipe of Pan, which must have played so important a part in the ceremonials, was found. It lay upon the breast of an aged man in the great stone grave north of the eagle, a beautifully made instrument, consisting of three bamboo tubes cased in a copper sheath of surpassing workmanship. Since it lay upon the breast of the skeleton, exactly over where the heart had been in the long past, the finger bones of the right hand still touched it, as though the Player of the Pipes had sought to protect his instrument from desecration even in death.



Pipe of Pan. Half natural size

The Pan Pipe of this ancient musician differs in several ways from the instrument of the classical peoples. Where the ancient Greek Pipe of Pan had seven or more tubes, this one has but three. And, while the classic pipe has tubes of graduated length, to produce different pitches, these people made the tubes all the same length, and controlled the pitch by inserting leather plugs at varying distances from the ends of the tubes. Thanks to the preservative action of the

The "man sign" found in the grave of the piper shown below

poison copper salts of the sheath, the thing has come down to us out of the past intact; we do not have to guess at it construction.

The very old man in the great stone grave was further distinguished by having at his head a large stone tablet engraved with a "man-sign" in relief. The "man-sign" smacks of Mother Asia, and is used in the ideographic symbols of the Chinese even to this day. Now, as for milleniums past, this symbol has meant "God" and "Great". If the "man-sign" meant the same thing with the builders of the Temple of the Effigy that it did with their Asiatic forbears, it would indicate that they followed an anthropomorphic type of worship. In this concept of religion God is pictured as a kind of superior human being, with the form of man—a relatively high culture.

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MOUND BUILDERS

No Longer are They A Complete Mystery

A FULL flowering civilization, not essentially inferior to that of the Aztecs in Mexico or the Maya in Yucatan, vanished without a trace in North America, probably a few generations before the first landing of Columbus.

This is the conclusion of Frank M. Setzler, Head Curator of Anthropology of the Smithsonian Institution, from an effort to reconstruct out of such scattered clues as are available the history of the Hopewellians, the mound builders of the Ohio and Upper Mississippi Valleys [see also details in the preceding article.—ED.]

From the results of more than a century of research, Mr. Setzler explains in a study just published by the Institution, a tentative picture can now be drawn of the ways of life of this mysterious people.

Construction of the large mounds, the surrounding earthworks and the hundreds of smaller mounds, he says, clearly required a dense population and a well coördinated society. This population must have had some stable economic basis. Even though direct evidence of maize is lacking, the practice of extensive agriculture must be admitted, because it alone could have supported the large population aggregates in which the Hopewell people obviously lived.

"There must also have been conscription of labor to construct mounds, which are 30 feet high, 150 feet wide, and more than 200 feet long. To obtain obsidian from the Rocky Mountains, mica from the southern Appalachians, copper from Wisconsin, and amphibians and fishes from the Gulf of Mexico, required time for exploration. Since most of the large mounds were built to cover the bodies of the dead, accompanied by their personal adornments and other objects, one can postulate a well-developed ritual, associated perhaps with a remarkable religious fervor. If a select ruling class existed, they dominated a very large portion of the Mississippi Valley. Copper head ornaments and colored woven garments decorated with fresh-water pearls and mica suggest insignia of authority. At least persons with such attire would be set apart from the rest."

This strange civilization, Mr. Setzler believes, resulted from the impact of two peoples, probably without definite conquest by either. A survey of the field shows the same culture, but in a simpler form, in the lower Mississippi Valley and around the Gulf coast.

No clue has yet been uncovered which permits the dating of this development more closely than sometime between the beginning of the Christian era and the coming of Columbus. There certainly were no Hopewellians left when the first white hunters and traders came into the Ohio Valley, for not a single artifact of European origin ever has been found in the mounds. In fact, the country was then inhabited by woodland Indians who had no memory of their predecessors, or even legends concerning them.

No evidence has been found which would indicate that any great catastrophe overtook the people. The whole civilization seems to have faded into extinction for as yet unexplained reasons.

EXAGGERATED

BECAUSE Cro-magnon man had a very large brain, he sometimes is glorified as our mental superior. From a study of his art, W. H. Riddell, in *Antiquity,* deduces that these Old Stone Age people, with 150 centuries less history behind them than we, had minds equal to those of a bright modern boy of 11 or 12 years.

The great stone grave is 11 feet long, six feet wide, and contains approximately 15,000 pounds of dry-wall masonry. Its slab top had caved in

What Makes An Aviator?

Intelligence, Adaptability, Physique, Mental and Physical Health Are Factors

JOSEPH G. LEVINE
Captain, Medical Reserve,
Flight Surgeon, U. S. Army

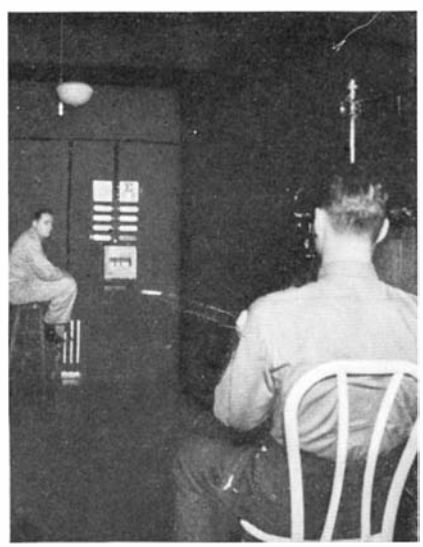
WHEN the question "What makes an aviator?" was put to a leading pilot, he waved aside the idea that any special genius was his or contributed in any way to the making of any flier. "I think that, in the future," he said, "anyone who can drive an automobile or motorcycle safely and efficiently ought to be able to fly an airplane in safety. Of course, in flying military, transport, and mail planes, perhaps something more is needed, but I do not think the idea that it takes an unusual man to fly is at all sound." Asked to name definite qualities necessary, he stressed particularly mechanical judgment. "It is the meticulous care concerning route and meteorology, and the intelligent handling of mechanical equipment that determines the pilot's length of usefulness in the air."

An experienced army flight surgeon often gets a "hunch" from his first glance at a prospective pilot and may predict to himself, as he follows the student through his training, what kind of flier he will become.

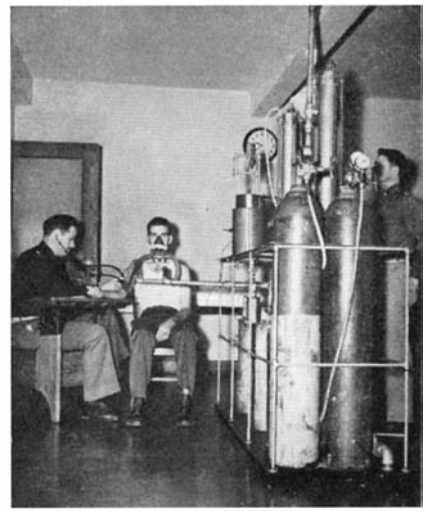
Of course the physical constitution of the flier must reveal no defects in all the essentials. The physical examination must be exacting, and is most difficult to pass; for he is subjected to extremes in flying. There can be no history of epilepsy, syphilis, respiratory disease, kidney disease, or any other ailment that may tend to be chronic and recur. The heart, lungs, and nervous system must be sound and free from any defect. Often it is necessary for the military pilot to change direction suddenly at terrific speed. This may cause abdominal pooling of blood and brain anemia in those having a faulty circulatory system, with the possibility that the ship might be out of control long enough for an unexplained crash to follow.

The eyes should be perfect or rendered so by a slight lens correction. There can be no color blindness, for keen vision is essential in determining terrain for landing, night flying, bombing, and in distinguishing military objectives at high altitudes. The glare of the sun from desert, water, and snow; rapid variations in oxygen tension; extremes in temperature and weather; and the roar of the motor all tend to aggravate any weak condition in the near-well individual and may even affect the normal pilot. This stress is tremendously increased during wartime flying.

Flying has a significant effect on the middle and inner ear. The magnitude of the ear problem in aviation may be judged from the fact that pilots suffer more frequently from disturbances of this organ than from all other occupational diseases combined. The conditions of flight which most affect the ear are changes of atmospheric pressure during ascent and descent, noise, and possibly vibration. It has been pointed out that, at the present time, the atmospheric pressure factor is increasing in importance as a result of the increased climbing ability of modern aircraft, while the two latter conditions are decreasing in importance as a result of recent advances in aircraft design.



Pilot operating the device that determines perception of depth



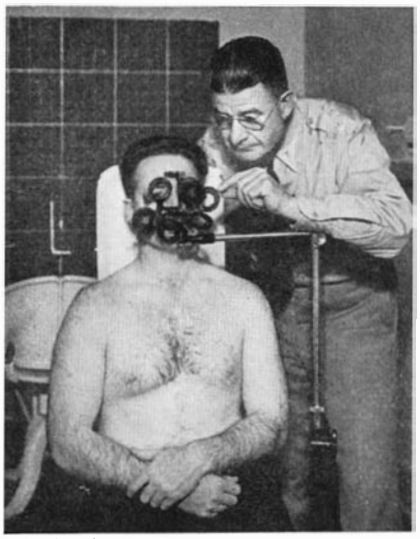
Test of pilot with equipment simulating different altitudes

From experience, it is known that certain types of physique may make for better fliers. Medically speaking, man is divided into three classes: the asthenic, athletic, and pyknic, or obese. Just as an external detail can betray subtle changes hidden deeply in the central nervous system, so may facial patterns and bodily conformations serve to guide the examiner in drawing up his estimate of the applicant's constitutional capacity. Asthenic, in this sense, does not mean frail but rather the lean and wiry type.

Most of the excellent fliers are known to come from the athletic group. This group consistently supplies the first-grade pilots that cannot be surpassed by those of any other nation in the world.

Yet it is observed that some of the superlative fliers are derived from the asthenic group. The more active glands of internal secretion of the man in this group perhaps speed up his metabolism or body processes. His reflexes and power of quick co-ordination are of the hair-trigger variety. He is often proficient in all sports where nicety of judgment, finesse, and polished skill are required. He may turn out to be a crack pilot just because he is a crank for perfection.

Men of the pyknic type are rather unsatisfactory. Their excess poundage is the visible sign of slower reflex activity. Many of them may become good pilots, but, as a general rule—to which there are exceptions—they do not make top-notch fliers. In emergencies they do not tend to do the right thing instinctively. It is not a question



Official photograph, U. S. Army Air Corps

Phorometer examination by Lieut. Col. A. W. Smith, for 20 years flight surgeon and pilot

of intelligence or courage. Flying is usually not the field where they excel, though they do succeed in many professions.

It has been brought out that many American pilots are descended from the Nordic race group. It so happens that pilots from this group are excellent aviators and are second to none of the other race groupings. The Nordic comes from a cold climate. He is blond, blue-eyed, and of athletic build as usually seen in the air service. There is often a piercing quality about his eyes, sometimes referred to indulgently as "eagle eye." That calm, hard, steady gaze is a quality of psychological import. He usually conducts himself modestly but confidently, is emotionally stable, intelligent, self-reliant, and of the "he-man" type.

The remainder, or minority, of the aviators are drawn from the Alpine and Mediterranean racial groups, and an occasional one from other groupings. Their fitness for aviation varies, though not always as we imagine. For example, Courtney states: "A common notion abroad is that Japanese are poor fliers because 'they have no sense of balance; because their nervous reflexes are too slow'." But a Japanese army flight surgeon reminded him that most of the balancing acts we used to see in vaudeville were given by Japanese. "In fact," the surgeon said, "we are endowed with certain racial virtues advantageous to flying. We are small and used to cramped quarters. We are agile, deft, strong. Our greatest difficulty is neither mental nor emotional, but defective vision, which is a national problem."

It would be rather unfair to conclude which racial group makes the better fliers. Indeed, it is not likely that Nature has made any particular geographical belt the breeding ground for birdmen. The flying type is perhaps evenly divided among them all. What is needed is the soil or opportunities of education and proper flying training to develop them.

Military aviation is the field primarily for the young man. The most suitable ages are between 20 and 30, preferably around 24. When one has learned to fly in youth, then, with the constant increase of flying experience, he can safely carry on to middle age. Flying has become a reflex act with him now, and continued experience compensates for the gradual deterioration that comes with age. Of course, when any factor develops that impairs his powers of co-ordination, it is then that he should wisely withdraw. The man in civil life, who learns to fly at the age of 30 or later, learns with the same difficulty as one would who takes up swimming at that period. He is more easily fatigued and must be given his flying instruction in small doses. His knowledge and aptitude in the later years tend toward the synthetic variety.

The pilot-selecting process, from the viewpoint of personality study, is of great importance. The only son, who has been pampered by his fond parents, must always be the center of attraction to be happy. During flying training, he may not do well because of the discipline, and may not get along with his fellow fliers. On the other hand, the young man who has been educated in the school of hard knocks and perhaps has been the leader of his gang as a boy, is to be looked on approvingly. Extraneous worries, which have to be probed for, are responsible for a number of failures. It is by searching into his past life and learning how the student pilot conducts himself in all situations that one can foretell with any degree of certainty how he will act in the future.

In selecting the finished pilot for wartime activity, the temperament of the aviator is taken into consideration. For pursuit or attack aviation, the flier must be aggressive, with calculated, reckless daring and a flair for action with an enemy. In bombardment aviation, the more deliberate and calmly courageous pilot is chosen. He must fly level over his objective for a definite period in order to drop his bombs accurately, despite the anti-aircraft shells that are exploding perilously close and the enemy pursuit planes that are on his tail.

Flying skill is always influenced by the degree of conscious fear that is disturbing one's judgment. The pilot is always pitting his skill against the elements; and, in wartime, against his enemies. It is this constant combat, this game or risk, that is the exhilarating recompense to those who become accomplished aviators. Eternal vigilance is the price necessary for him who invades the realm of the eagle.

A very definite type of young man is cut out for military aviation, just as in any other line of endeavor. The inherited qualities of the mind, tempered by education and experience, with the sum-total of studied foresight and precaution, determine the true flying type.

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50,000 AIRPLANES

How We Can Build Planes at a Rate of 20,000 a Year

IT is not yet settled whether the airplane can beat the battleship; but it seems definitely settled that air supremacy means winning a war whether on land or sea. Colonel Lindbergh and Winston Churchill were right when they warned the nations that German aviation was superior to military aviation of all other nations and that this constituted a menace to the world at large. The President is right when he asks for 50,000 airplanes for our national defense, and advises building 20,000 military and naval aircraft in one year.

But can we build 20,000 airplanes a year, even with our vast industrial resources? Yes, provided .... Army and Navy methods of selecting prototypes and placing production orders are greatly simplified and accelerated; Army and Navy methods of inspection and approval are simplified and accelerated; Our trade schools, vocational high schools, and other schools make a great effort to train vast numbers of mechanics; Our trade unions remove their restrictions on the number of apprentices or other means of entry of new men; Our trade unions co-operate in speeding up the national effort of defense; Our universities train

the engineers that will be required in great numbers; The Allied commissions immediately impart all their war-gained information to our Air Services; Our Chief of Air Corps and our Chief of the Bureau of Aeronautics use the dictator's methods in boldly selecting certain types, and in boldly concentrating on those types, and in making up their minds quickly to guide the aviation industry; Our constructors, with permission of military and naval authorities, follow the German plan of building planes and engines which will last 100 hours instead of 5000 hours because the war-time life of a plane is far shorter than the peace-time life of an airplane—we must maintain performance, maneuverability, and gun fire at the sacrifice of durability.

The nation as a whole must willingly shoulder the cost of this program. Congress should appoint a special aviation committee to function energetically and rapidly, and undertake no super-critical investigations. It is better to arm in the air, with mistakes, than not to arm at all.

Our young men must seize the opportunities now being offered for flight training, remembering that the pilots are the decisive factors in modern warfare and that it is somewhat pleasanter to be in the dive bomber than to receive its blasts on the march.

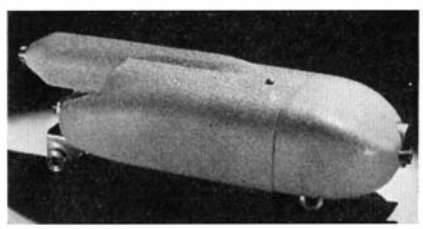
Above all, those concerned must remember that a co-operative, energetic spirit is imperative. Difficulties of production, subcontracting, machine tools, materials, engine bottlenecks, and all other difficulties will vanish provided the people of the United States, Congress, Army and Navy, and manufacturers, all understand that a stupendous effort is necessary.—*A. K.*

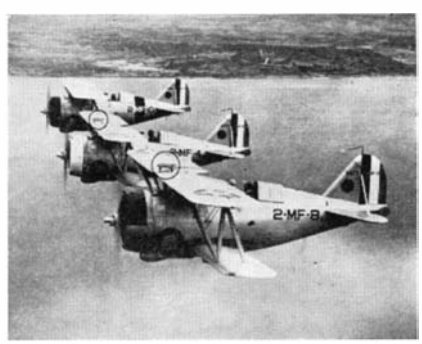
CAMERA GUNS

Two Types Permit Economical Aerial Gunnery Practice

WITH the greatly increased speeds of modern military aircraft, aerial gunnery has become increasingly difficult. The difficulties are apparent when one considers that both target and the firing platform not only move at tremendous speeds but also indulge in violent maneuvers. Accordingly, our own air services and the air services of other countries are more and more resorting to training with the camera machine gun. To H. K. Yulke of *Fairchild Aviation News* we are indebted for an account of this interesting equipment.

Two types of camera machine guns are now in use, one for fixed installations and the other for movable installation. The movable camera gun simulates as closely as possible the weight, size, appearance, and method of manipulation of the regulation Browning or Colt aircraft machine guns. The fixed camera gun is operated like the ordinary fixed machine gun, but bears no similarity to a real machine gun; it is mounted above the wing, near the leading edge.

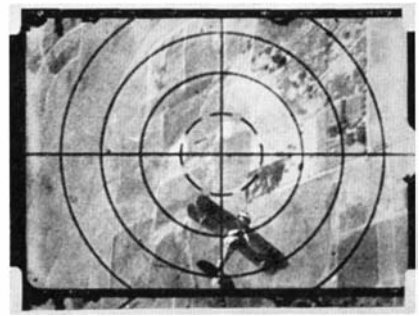




Above: Fixed type camera gun, and, below, cameras (in circles) mounted on upper plane wings

Some 4000 Fairchild camera guns are used throughout the world, and their development over a long number of years has been a matter of very skilled technique. Loading the film takes but an instant and is extremely easy; it is impossible to load incorrectly. In actual operation there is a maximum of simplicity. The camera starts to operate as soon as the trigger is held down. The methods of trigger control are exactly the same as in real machine guns — by pressure of the thumb in the case of the flexible gun and by handgrip pressure on the trigger switch attached to the airplane control stick in the case of the fixed gun.

A rotary disk shutter is employed and a small glass plate, on which are engraved the concentric circles of the reticle system, is located between the shutter and the focal plane. Each film magazine has a capacity of 25 feet of 16-millimeter film, sufficient for 700 shots or exposures. The recording mechanism consists of a split-second watch and celluloid data card mounted on a removable panel, and four small incandescent lamps for illuminating the watch and data card at the instant of exposure. Motive power for operation of the shutter tripping mechanism is provided by means of a strong spring.



Film frame from camera gun

In the reproduced enlargement of a single film frame, taken during a violent mock combat, it is quite clear that the attacking plane from which this picture was taken was in a steep dive upon the target plane.—*A. K.*

CRASH TRUCKS

Pick Up Aircraft After Crashes or Forced Landings

A NEW and unusual type of crash truck is being built for the Air Corps by The Corbitt Company. These units are to be used in salvaging aircraft that have made forced landings on ground from which they are unable to take off, or aircraft that have crashed. They are believed to be the largest of the type in the world, consisting of a 198-horsepower tractor unit equipped with crane and hydraulic jack, and a trailer 55 feet in length. The capacity is 15 tons.

At the scene of operations, the tractor is unhitched from the trailer and then moves around to the side to lift the plane aboard the trailer by means of its crane and hydraulic jack. If the plane is in soft ground, the tractor may stand on hard ground some distance away and pull the trailer in toward it by means of winches.

The transmission has five speeds forward and one in reverse in two ranges, thus giving a total of ten speeds forward and two in reverse. Furthermore, the tractors are six-wheel drive.

Is Your Pet Dentifrice Safe?

Most Dentifrices Are Good but Many of the Claims Made Are Not Justified

ALBERT G. INGALLS

FEW of us accept the daily war communiques literally. Most of us discount their obvious untruths and exaggerations, if any, and mentally fill in omissions where we think they are not altogether frank. Even though their writers should wish to do so, they find they cannot stick to prosaic fact, because the competition is so intense. They discover also that the calculated inaccuracies are accepted by at least some of the people.

In the long-standing "war" of trade between makers of dentifrices the competition also is intense. Some of these makers similarly have discovered that not all of the public appreciates frankness. Even the intelligentsia aren't always too intelligent when it comes to evaluating claims for merchandise. Therefore, not all the claims for dentifrices have been altogether frank, either.

This is not, however, one more "awful grievance" article, since most of the nationally known dentifrices are safe. Sometimes—generally, in fact—the grievance lies only in the extravagant claims made for the dentifrice.

Just what can a safe dentifrice reasonably be expected to do? First, what are some of the things it cannot do?

No dentifrice, safely or otherwise, can keep the mouth germ-free. If it could kill the germs it would damage the mucous membranes of the mouth, and even if it could kill the germs without this damage, its effect would be transitory because the saliva would soon wash it away and more germs would come in. Besides, we are not as frightened about germs as we used to be.

Similarly, dentifrices cannot prevent acid mouth, because their effect is so transitory. Moreover, it is entirely normal for the human mouth to be acid. Just a matter of physiology.

No dentifrice can prevent tooth decay. Even after an immense amount of research, science has not fully reached the answer to the question of the cause of decay in teeth, but present indications point strongly toward something related to the diet. The immediate cause, however, is the chemical action of acids on the teeth. These acids form at inaccessible places in the teeth—most often between the very close, tight folds in the chewing faces—through the work of microörganisms on foods. Brushing the teeth may help, but even brushing them with the best dentifrices cannot stop decay, since it does not remove the cause.

Nor can any dentifrice prevent, competently treat, or cure pyorrhea. This is a job for a dental surgeon—often a difficult job at that.

HALITOSIS! Bad breath. How can a dentifrice competently treat this? It is caused sometimes by stomach disorders, sometimes by nasal or sinus disorders, infected tonsils, decayed teeth or other diseases, and is therefore only a symptom, not a disease. Treating halitosis with a dentifrice is therefore merely "treating the symptom," something the old doctor tells the young doctor never to do. Of course, a dentifrice that would really cover up halitosis even if it did nothing else, would be a real boon to the world—almost as great as would have been Vice-President Marshall's famous good five-cent-cigar—if only it would last more than a brief time after its use.

Really insidious are claims for tooth whiteners, since these preparations contain acids — hydrochloric acid, for example. Nor will they always whiten teeth, since some teeth never were white to begin with. Teeth vary in hue just as complexions do, and just as naturally.

Massaging the gums with dentifrices may do a limited amount of good, since it stimulates the circulation, but it is the massaging that does the good. This is not, however, a fully competent treatment for hardening the gums.

Use powders because your dentist does! This sounds logical but dentists do not use powders because of any inherent superiority due to their dry form. In fact, the dentist makes a paste of the powder he uses, by first wetting it. Toothpastes also contain powder. Dentifrices are put up in paste form, generally with glycerine as the carrying liquid, because this is the form in which the public can most conveniently use them. This is not to argue against tooth powders but only against some of the claims made for them.

Dentists deny that the glycerine in toothpastes softens the gums, as some makers of powdered dentifrices have said. Concentrated glycerine is, of course, always thirsty: it seeks water (is "hygroscopic") and will take it wherever it can get it, but the small amounts used in brushing the teeth are not considered by dental authorities to be a menace or a danger. The argument, therefore, that glycerine softens the gums is empty.

Having subtracted these main items from the total that have been claimed for dentifrices, what real values are left?

To begin with, the toothbrush itself is the most valuable factor in mouth hygiene. The dentifrice is its junior assistant. Most dentifrices contain two principal ingredients designed thus to assist: one is soap, or a soap substitute. The other is an abrasive. Abrasives must be mild, and not as hard as the teeth. A third and liquid ingredient, often glycerine, acts as a vehicle, as previously described, and a flavoring agent, the fourth, helps make us want to brush our teeth when we feel lazy, as most of us often do.

Soap and abrasive — together these do a lot, but a dentifrice won't cure spavins. Makers who claim little more than that dentifrices help cleanse the teeth—and there are some who do—hit closest to the simple truth, and for this alone a good dentifrice is more than worth to us what we pay for it.

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BLEEDERS

New Substance Clots Blood Instantly

BLEEDERS, from new-born babies to patients on the operating table and even, in many cases, hemo-

philiacs suffering from the hereditary bleeding disease, can now be saved by two death-defeating substances presented by Dr. H. P. Smith, State University of Iowa.

One of the anti-bleeding substances is a new preparation so powerful that, when sprinkled on a wound, it stops bleeding by clotting the blood "in the twinkling of an eye." It is obtained from beef blood. This material is so fast in action that it will clot blood in one second. It is not yet on the market and the supply is still limited but surgeons at the University of Iowa have already used it, with "quite encouraging" results, to stop dangerous oozing of blood during major operations. This oozing, which is difficult if not impossible to stop by other methods, is especially troublesome in operations on the brain, liver, and bone. When the material is available generally, dentists will also be able to use it to stop bleeding after teeth are drawn. For hemophiliacs, such as the Spanish Count of Covadonga, who recently bled to death from injuries following an automobile accident, the new thrombin may prove life-saving.

Thousands of new-born babies and older patients suffering from obstructive jaundice can be saved from bleeding to death by the other substance which Dr. Smith discussed—vitamin K. This vitamin not only stops bleeding but, if used properly, will prevent the bleeding, Dr. Smith emphasized. The vitamin was discovered by Prof. H. Dam of Copenhagen. Its chemical identity was determined and it was prepared synthetically by scientists at the St. Louis University and the University of California. It was first used to treat patients by Dr. Smith and by doctors at the Mayo Clinic. —*Science Service.*

THEELIN

To Speed Knitting of Broken Bones

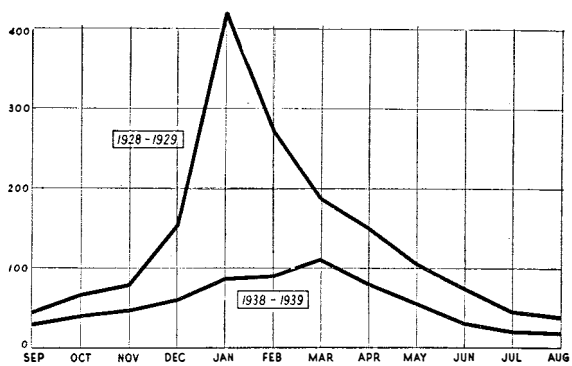
KNITTING of broken bones, especially in elderly women, may be speeded by treatment with the female sex hormone, theelin, Dr. G. A. Pollock, of the Mayo Foundation, declares as a result of studies of the effects of theelin on broken bones in laboratory animals.

Women over 60 years of age get so-called "broken hips" with "striking" frequency, Dr. Pollock points out. The condition, although popularly known as a "broken hip," is actually not a break of the hip but of the neck of the thigh bone near where it is joined to the hip. A change in the bones of older women suggested a relation to the cessation of ovarian function in women past 50 years. Several other scientists, Dr. Pollock found, had also noted a relation between female sex hormones and bone formation.—*Science Service.*

LICKED?

New Drugs and Methods "Encircle" Pneumonia Germ

IF 1938 and 1939 can be taken as representative of an established situation, the pneumonia season—winter—has suddenly lost much of its dread, according to data assembled by the Metropolitan Life Insurance Company. New serums, sulfapyridine and allied drugs, have abruptly cut the winter peak mortality from pneumonia to about a quarter of what it was —as the accompanying graph shows.



Comparison of pneumonia mortality cycles

"Certainly," says the company named, "the experience of these last two years augurs well for the future. We have good reason to be optimistic, in the light of the new methods for pneumonia treatment now being rapidly extended to all parts of the country. Just a short time ago serum therapy was used in only a few cities and states. But now the advantages of serum are generally known and applied. Perhaps even greater successes may be expected from the recent advances in chemotherapy. The full possibilities and limitations of the new drugs have not yet been defined, but the use of sulfapyridine and allied drugs has already yielded most gratifying results. It may be that the most efficient form of treatment will be found to combine sulfapyridine and serum."

BRAIN WAVES

Practical Uses for Laboratory Discovery Steadily Increase

BROADENED use of brain-wave detection already has aided surgery, anatomy, and physiology, according to Dr. Ralph W. Gerard, associate professor of physiology of the University of Chicago.

The noted neurophysiologist and pioneer in the study of brain waves —tiny electrical currents continuously emitted by the brain—enumerated recent advances through brain-wave study. Detection of brain-wave irregularities aids diagnosing and locating brain tumors. It makes possible, too, the detection of epilepsy in its first stages. The anatomist can detect the nerve tracts which carry stimuli from various parts of the body to the brain, while the physiologist attempts to find out the why and how of brain waves, and has at least partly succeeded.

Recent research on brain waves has revealed that the temperature of the brain cells increases the rate of their electrical rhythm, possibly with some bearing on the use of artificial fever in treating insanity; that sedative and anesthetic drugs producing sleep slow the rhythm, while caffeine steps up the waves to more than ten times their normal size.

BLOOD RAYING

Infected Blood Now Taken Out, "Sun"-rayed, Put Back

BLOOD poisoning and some other infections are being treated by removing some of the patient's blood, giving it a quick treatment with ultra-violet rays, and returning it to the body at once. Dr. George Miley, Philadelphia physician, recently announced the method's success.

This is not in itself a new treatment but one that previously failed: the rays did not reach clear through the blood treated. Success resulted when a system of baffles kept the blood turbulently turning over.

Why Universal Fingerprinting?

Desirable Features of System Far Outweigh Erroneously Imagined Criminal Aspects

FREDERICK KUHNE
Former Sergeant, Bureau of Identification, Police Department, City of New York. Author of "The Finger Print Instructor."

THERE are only two reasons why anyone should object to the enforcement of a universal fingerprint law: Either he wishes to cover up some past wrong-doing, or he is afraid that sometime in the future he may be guilty of a violation of law. In either case he knows that registered fingerprints could well be the means of bringing him to justice.

On the other hand, every honest and upright person, citizen and alien alike, should welcome a universal fingerprint law. Through its enforcement would come many personal as well as national advantages, the most important of which are outlined in the following paragraphs. When these advantages are fully appreciated, there should be little opposition to universal fingerprinting; indeed, there should be increased demand that such a system be inaugurated with a minimum time loss.

It is undeniable that much of the popular opinion against universal fingerprinting arises from the erroneous impression that fingerprinting is indelibly linked with crime. That it has been of tremendous value to law enforcement officers in connection with criminal cases is, of course, true. But it must not be overlooked that the lessons learned in this work can be and have been applied in non-criminal work to the great benefit of the honest private person. Fingerprinting, proved an infallible system for establishing identity, has made possible positive identification of amnesia victims, unknown dead, missing persons, and so on. And who can foresee when some accident, some unpredictable event, will make such identification desirable in his own case?

Fingerprinting of all military forces during World War I, plus the voluntary filing of several thousands of prints in the Civil Division of the F.B.I., has done much to lessen public objection to the system. There is still a large majority of residents of the United States, however, who feel that compulsory registration of fingerprints would violate their constitutional rights. Hence the following summary of some of the favorable aspects of universal fingerprinting and recording under government control.

Such a system would do away with the present expensive method

Persistency of fingerprint ridges is demonstrated by these two prints: one at left was taken in 1892; one at the right in 1922

of taking the census every ten years. The records would give a continuously corrected census of the nation, divided by states, counties, cities, towns, and villages.

It would also give a complete record and control of the movements of all persons in the United States, whether resident or entering or leaving. It would prevent the deported from re-entering and the fugitive from leaving the country. It would prevent the falsification or forging of passports and would serve as a deterrent to other infractions of the law.

With universal fingerprinting in force, any national emergency could be met with little loss of time. The records would make possible a speedy call to arms and would prevent draft dodging. Furthermore, those in authority would be able to compile records showing the exact numerical strength of every classification of persons, together with ages, occupations, and other important information.

Record files of a universal fingerprinting system would be of great value to the post office. From them could be obtained correct addresses for improperly addressed mail, thus materially reducing the amount of mail sent to the dead letter office and hence reducing the cost of maintaining this office.

Civil service applications could be acted upon with speed and accuracy from the data supplied by fingerprint files. With this information available, it could be definitely known at all times that only honest persons would secure appointments to this important service.

Couple the foregoing with the more obvious applications of universal fingerprinting to the curtailment of criminal operations and we find a multitude of favorable reasons as against the few and erroneously conceived unfavorable reasons.

Establishment of a universal fingerprinting bureau might appear to be a gigantic proposition. It would be, however, an undertaking no greater than our present system of handling the mails, and the cost would be negligible. Post offices, which are equipped to serve every resident of the United States, could be used as headquarters for fingerprinting those who reside within each postal district. Thus there would be no additional expense incurred so far as office space is concerned and the money saved, by abolishing some of the present activities which would no longer be necessary under universal fingerprinting, would more than pay for the additional help required to handle the routine of fingerprinting.

THE system of enforcing universal fingerprinting could be worked out through the post offices in somewhat the following manner: All present residents would be required to report within a specified time to their local post offices. Here two sets of fingerprints would be taken, one to be forwarded to a central bureau at Washington, D. C. and the other to remain on file in the district post office. When a resident moves out of a postal district, it would be compulsory for him to notify the postmaster to this effect, giving the date of his removal and the address to which he is moving. Upon receipt of such notification the postmaster would then enter such changes on the fingerprint record and would also notify the central office. If a resident is to move to some other point within the same postal district, the duplicate print would remain in

the local office. If, however, the new address is within another postal district, the print would be forwarded to the postmaster of the new district so that the record would be complete at all times.

Of course, it would be a necessary part of a universal fingerprint law that each resident of the nation should be required to carry an identification card containing appropriate data. This card should also bear a simultaneous plain impression of the right index, middle, and ring fingers, similar to those now used by banks and the postal savings department.

Thus it will be seen that a universal fingerprinting system could well be established in the United States with a minimum of expense and a maximum of desirable results. The advantages that would accrue to the average resident would, indeed, far outweigh any residual feeling that he might have regarding the criminal taint of fingerprinting, particularly so when he realizes that this taint is one that should long since have been discarded as having no foundation in fact.

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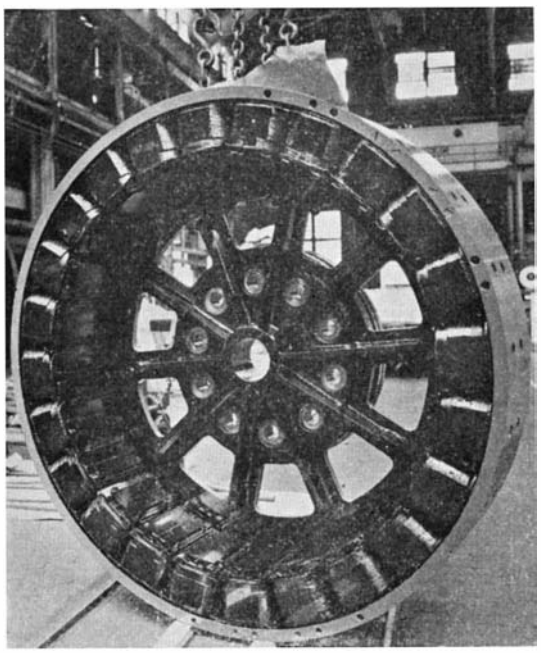
HEALTHIER PLANTS

Vitamin-Hormone Stimulant in Powder Form

FROM the Horticultural Department of the American Chemical Paint Company comes news of the commercial production of a vitamin-hormone stimulant, Transplantone, for plants, that not only invigorates old roots but also multiplies the production of new ones, reduces the loss which frequently occurs with transplanting operations, and reduces wilting. It is applied to rooted plants to add to existing root growth and to force their general growth.

Transplantone is a water-soluble powder impregnated with Vitamin B-1 and other parts of the Vitamin B fraction, plus root-promoting hormones. The hormone initiates root growth and plant physiologists assert that the Vitamin B chemicals are necessary for the maintenance of their growth. That it is quite concentrated is obvious for it requires only one level teaspoonful to a gallon of water to make a stock solution which is then further diluted. Seedlings may be lightly sprinkled weekly, or it may be applied to plants set out in the soil, whether they be trees, shrubs,



Engine vibration in marine installations is not transmitted to the ship's propeller when this new type of electric coupling is used. Built by Westinghouse, the coupling consists of an armature connected solidly to the engine shaft and a field connected to the gears that turn the propeller. These two rotating parts are separated by a small air gap; when the armature is rotated by the engine, magnetic forces are set up which turn the field (shown at left) and hence turn the propeller shaft of the ship

vines, annuals, or perennials. In the case of plants which are set out without a ball of earth, the manufacturer recommends that the roots be soaked in the stock solution for an hour. Treatment usually results in vigorous and extensive root growth and this, in turn, requires more frequent watering than is ordinarily necessary.

The manufacturer further claims that, owing to frequent clipping, grass is unable to produce enough vitamin and hormone naturally for the roots and that watering with an ounce of stock solution to three quarts of water will improve turf quality. Sods similarly treated before being set in place will also readily form new roots.—*C. F. Greeves-Carpenter.*

HEROIC CASTING

Largest Ever Cast in Stainless Steel

A BRIGHT new symbol of America's free press, the first heroic sculpture cast in stainless steel, was unveiled recently on the facade of the Associated Press Building by Nelson Rockefeller, before a distinguished assemblage. Kent Cooper received it for the Associated Press.

This 10-ton plaque of bright metal was made from the winning design in the Rockefeller Center-Associated Press open competition for a sculpture symbolizing news and the press. Its designer was sculptor Isamu Noguchi.

The 23-foot by 18-foot model, sculptured by Noguchi in plaster, was but a beginning for eight months of labor by engineers, metallurgists, molders, machinists, and polishers who blazed new trails in perfecting the technique that made possible the jump from a few hundred pounds, the largest preceding art work cast in stainless steel, to this titanic 10-ton bas-relief.

Completion of this panel marks several "firsts" in the artistic, architectural, and metallurgical fields. Noguchi is the first American artist to use cast stainless steel as a sculptural medium, and the Rockefeller Center architects are the first to demonstrate the use of a light-reflecting metal to replace the traditional light-absorbing stone and metal decorations of buildings. The General Alloys Company, pioneers in stainless steel, solved many technical problems involved in casting this panel which is twenty times larger than any previously cast. The work involved the engineering of special equipment, the development of synthetic sands to withstand the terrific heat of the molten metal, and powerful precision grinding machines to achieve "invisible" joints in the finished plaque.

FLOOR SEALER

Finish Penetrates Wood Grain, Gives Protection

AN attractive and durable finish for unfinished floors has been put on the market by American Asphalt Paint Company. The manufacturer claims that it furnishes absolute protection against dirt, water, grease, and constant wear.

Through its active penetration into the wood, this new finish, which is called Valdura Floor Sealer, seals the grain and gives a waxed and polished appearance, with no surface coating to wear off. Therefore, floors finished with it are said to retain their original color, or natural wood finish.

Valdura Floor Sealer can be applied with a mop or a brush. One coat only is needed, and one gallon covers about 800 square feet of floor surface. Three or four hours drying time is all that is necessary before the floors are subjected to foot traffic. The sealer may also be used to advantage on logs, knotty pine, creamery churns, and other unfinished wood.

BATTERY CONDITION

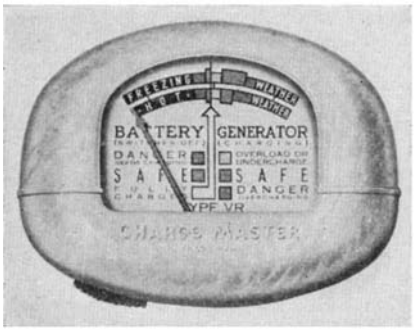
Indicator Shows When Battery May Fail

TO protect car owners against the yearly toll of battery failures due to overcharge or undercharge, an accurate, dependable "battery condition indicator" has now been refined and made available for use on the dash of any automobile as an accessory.

This new instrument — called Charge-Master — indicates to the car driver the state of charge of his battery when at rest. When the generator is charging, the instrument shows promptly any variation in battery charge, in generator performance, and in load (such as radio, heater, and so on) on the electrical line. It shows overcharge and undercharge — each of which may shorten the life of the battery and, if pronounced or continued over a long period of time, may disable it beyond repair.

Charge-Master installs on any car, bus, or truck in about 10 min-

Arrow points to battery condition indicator on motor-car dash



For storage battery protection

utes. The wiring is simple. The instrument is self-illuminating whenever the dash lights are turned on.

Car owners too often have unfairly blamed good batteries and good service men for sudden battery failures and repair costs due to heretofore unindicated overcharge or undercharge. This new device lays the blame where it should be, tells when to turn on or turn off the electrical load from radio, heater, lights, and other equipment in order to hold line potential and battery charge within safe limits until a preferred service man can be reached for timely preventive service.

DUST MASK

In an attempt to provide adequate protection against air-borne dusts, pollen, or certain bacteria which annually cause untold suffering and the loss of millions of dollars, an American Optical Company research scientist — W. H. Lehmberg — has designed an exceptionally light and efficient filtering device for wearing over the nose and mouth to protect the respiratory system.

Weighing only an ounce and a half, and excluding particles of dust as small as a micron — 1/25,000 of an inch — the device was developed to give comfortable protection to those working in dusts; persons allergic to pollens causing hay fever or asthma; and doctors, nurses, and patients exposed to certain air-borne bacteria.

The high filtering efficiency of the new respirator is actually needed, because silica dust now generally considered harmful to the lungs is approximately five microns or less in size; common pollen grains which cause hay fever and asthma range in size from 10 to 100 microns; and bacteria are approximately one micron.

The effectiveness of the new mask, which is lighter than any

other of equal efficiency, is due to four factors: A new method of making the filter unit, resulting in an extremely large, efficient filter area for the size of the mask; a new and efficient exhalation value; a new self-equalizing double headband which holds the mask securely but comfortably against the face regardless of the position of the head; and a facial design that enables one to wear the device with perfect comfort.

FOLDING BICYCLE

For Ease in Carrying

THOSE of us who were growing up in the days before the automobile era may wish that when we were young there had been available a folding bicycle such as the Compax Sports Traveler recently announced by the Westfield Manufacturing Company. Not only may this bicycle be taken apart in 15 seconds without the use of tools, but, because it has no top-cross bar, the one model fits adults and juveniles of both sexes. Because of its compactness when folded up, it can be carried conveniently in automobiles, busses, trains, and

Simple joints for folding

other conveyances. That is an important advantage in these days when many people must travel to the country for their cycling.

The single cross bar of this bicycle, running from just beneath the handle bars to a point on the rear half just above the sprocket, has a slip joint with a single nut for tightening. The machine breaks apart at this point so that the two wheels may be folded together while the handle bars will swing downward for greater compactness.

PEEP-SIGHT

Gives One-Way View Through Front Door

ALARMED by the appalling growth of attacks on housewives by criminals who ring doorbells and force their way inside when the door is opened, police throughout the country are warning women and all householders in urban areas to be on constant guard against this menace.

Various protective methods, such as doorchains and special latches have been suggested, but a very

Protection for the housewife

effective new device is an ingenious affair called the "Protective Eye."

This safety device takes the form of a handsome and entirely innocent appearing door-knocker. In its center is hidden a bulls-eye of "one-way glass," making a tiny window which enables the housewife to look out and see any caller without that person being aware of the inspection. Having surveyed the caller, she can refuse to answer the summons or open the door as her judgment dictates.

The secret of the "Protective Eye" lies not only in the inconspicuousness of the glass but in the fact that it has one-way vision. That is, you can see outside from the inside, but not inside from the outside.

TREE PROTECTION

Spray Coat Reduces Dehydration

A NEW tree spray called Protex is being offered by Protex Industries, Inc. It was first successfully used at the New York World's Fair, and officials praise it highly as a spray to reduce dehydration and obviate excessive pruning. It does not wash off the tree and prevents excessive transpiration without restricting respiration. The makers recommend Protex as being superior to burlap, straw, or other wrappings in extreme temperatures. In addition to a winter Protex, a summer consistency is also available and is designed to prevent sun scald or scorch. The product is a rubber compound and forms an elastic coating that reflects the rays of the sun, thereby preventing wide extremes of temperature.—*American Forests.*

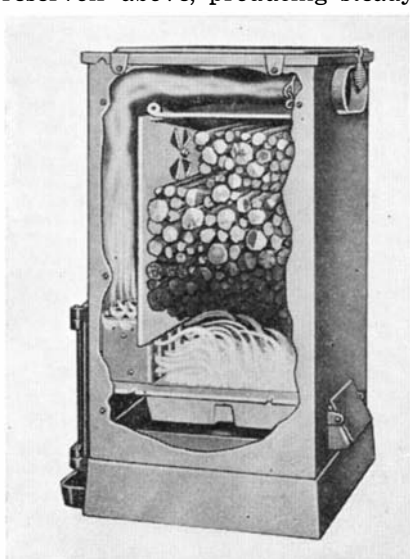
WOOD STOVE

New Principle Achieves 90 Percent Efficiency

DEVELOPMENT of a new type wood burning stove, capable of heating two or three rooms and requiring filling only once or twice a day, is regarded by New England foresters as bringing new hope to farm woodlots which have long suffered for lack of a suitable market for cordwood.

The new stove, developed by the Connecticut Forest and Park Association in co-operation with Prof. Lauren E. Seeley, Yale heating expert, burns wood at an estimated 90 percent efficiency. Because of a radically new design, the heater operates on the principle of "destructive distillation," burning both gas and charcoal formed in its operation.

A cord of hardwood has fuel value approximately equal to that of a ton of hard coal. The heater, shown in our illustration, will hold about two and one-quarter cubic feet of wood, or more than 50 pounds. Small-diameter trimmings from sawmill operations or from "weeding" the family woodlot are recommended in preference to the larger chunks commonly used in wood stoves. As wood is burned in the combustion chamber at the bottom of the stove a fresh supply is dropped automatically from the reservoir above, producing steady



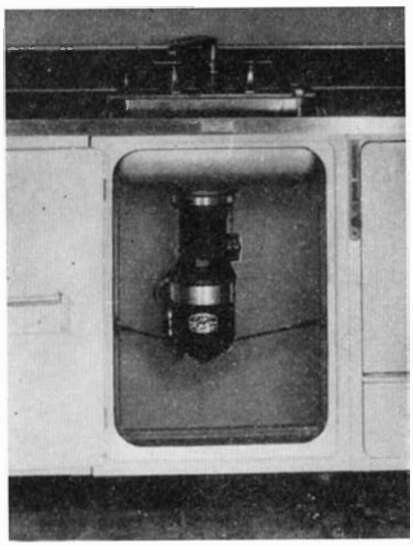
Note the fuel reservoir in this efficient wood burning stove, for homes, garages, and camps

heat for long periods without reloading.

Prof. Seeley estimates that the heater will generate heat sufficient for two or three rooms in cold weather—for an eight-hour period without attention. In mild weather the heater will easily run more than 24 hours without attention.—*Science Service.*

GARBAGE GRINDER

A NEW under-the-sink garbage shredder has been developed by the In-Sink-Erator Company. It is designed to eliminate the unsightly and smelly garbage pail, for all garbage is simply dumped into this device and when the motor is



switched on the garbage is so ground that it may be washed down the drain. This includes such things as bones and fruit pits.

The shredder head on this device, which is powered by a 1/4 horsepower motor, operates alternately in one direction and then in the opposite, so that garbage is cut either into very tiny pieces or pulverized. It is connected with the house wiring system and requires during the very short time it operates only about as much power as the average electric iron.

ELECTRICAL HAIR BRUSH

WHILE it is not possible to say definitely whether vigorous brushing of the hair has any great retarding effect on the advancement of baldness, such brushing is often recommended to stimulate the scalp and give tone to the hair. For those who believe that stimulation of the scalp does assist natural growth of the hair, the Hershey Manufacturing Company has just developed a power-driven

scalp brush. The several rows of bristles are so driven, at 5000 strokes per minute, that a definite cyclic sequence is maintained.

There is at present a professional model of the Vitabrush; a portable model for home use will soon be available.

COTTON WRITING PAPER

DETAILS are as yet unavailable as to the new process for making a high quality writing paper directly from cotton — low-grade cotton, at that — but the development work was done by the U. S. Department of Agriculture in co-operation with the Writing Paper Manufacturer's Association. Provided that the process is a commercial success and paper can be made cheaply enough to create a big demand for it, then this should solve a sizeable part of the problem of what to do with America's surplus cotton.

LIFE-SAVING SUIT

Seals Up Water-tight and Warm

A LIFE-SAVING suit of a new design has been invented by a Swedish engineer, Count H. G. Mörner. The Mörner life-saving suit is made of water-proofed fabric, closed in front by a special rubber "zip"-fastener. The suit — boots and mittens being all in one — is put on as an overall in less than one minute, the inventor claims, but it is intended to be worn by seamen all the time, although open, while the ship is in a danger zone. Its buoyancy is due to a special kapok-wadded waistcoat, sewn into the suit, which keeps the shipwrecked floating, even if there should be a leak in the suit. Besides keeping the person afloat, the suit warms him while he is in the water, and it also prevents him from freezing to death if and when he is rescued in lifeboat or raft.

Designed for seamen, this life-saving suit is quickly closed by means of a "zip" fastener

Count Morner and life-saving suit with kapok-wadded vest

ROCK-PILE RESERVOIRS

Ancient People Collected Drinking Water on Rocks

THE British dew ponds described in the *Industrial Bulletin* of June, 1938, were not the only means of extracting water from a moisture-laden, but stingy, atmosphere. According to a recent issue of *Discovery,* medieval townsmen of Theodosia, a Black Sea port on the southeast of the Crimea, obtained sufficient water for a flourishing city by erecting, on the near-by heights, great piles of broken stones upon which the moist breezes from the sea would condense some of their water. Thirteen of these piles, connected with the city by a system of sandstone pipes, supplied 16,000,000 gallons of fresh water daily and permitted Theodosia to become the most important port on the north coast of the Black Sea.

Barbaric conquerors permitted the stone piles to become overgrown with vegetation, which destroyed their effectiveness. It was

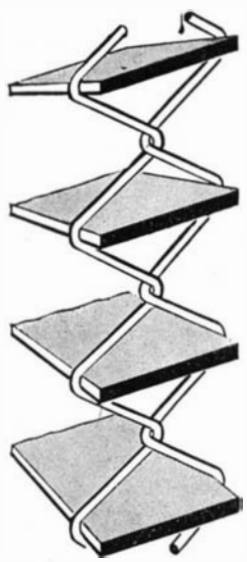
not until the later nineteenth century that the purpose of the piles was again learned and efforts made to restore them to usefulness. Modern engineering methods were not, however, immediately successful in duplicating the empirical work of the original builders; one attempt to do so failed and thereafter political conditions prevented further efforts.

Successful construction of both dew ponds and stone condensers depends upon secrets which are not yet common knowledge. Yet the theory of their operation is simple and a determined effort might cut through the time-fostered traditions of failure. Successful operation would bring life to many an arid seacoast locality and to coral islands whose porous substructure will not permit retention of water, even though rainfall is ample.—The *Industrial Bulletin* of Arthur D. Little, Inc.

SCREEN

Dazzle-Damping and Insect-Proof

THE newest thing in window screen materials is something like a miniature Venetian blind. Called Koolshade, it is made of horizontal flat strips of bronze, woven together every half inch with vertical bronze wires. The spacing is the same as in the standard 18-mesh screen and is, therefore, equally insect proof.



Section of bronze wire-and-strip window screen, enlarged 20x

The horizontal flat strips serve to kill some of the glare of brilliant summer skies, but let in plenty of light horizontally.

CAMERA ANGLES

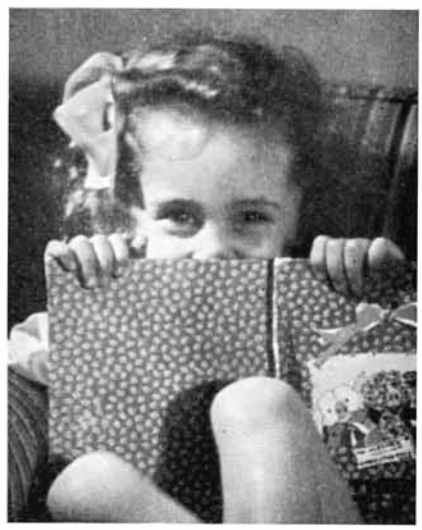
Conducted by JACOB DESCHIN, A.R.P.S.

Light Control With an Electric Meter

THE mere purchase of an exposure meter of the photo-electric type, today generally regarded as the most efficient method of light measurement available to the practical photographer, is by no means a guarantee against incorrect exposure—unless the meter is properly used. It is not enough merely to point the meter; it must be pointed toward the subject with due regard to the angle at which the meter is held and its distance from the subject. Furthermore, many workers fail to take advantage of the various methods by which the photographer may truly obtain the full control of exposure that his meter can provide for him.

Beginners usually start off by deciding on the particular subject matter they wish to photograph, pointing the meter in that direction and adjusting the camera settings in accordance with the reading thus obtained. What happens? If it is a landscape with beautiful clouds in the background, the foreground is frequently under-exposed. If it is a portrait, outdoors or indoors, the face is either over-exposed or under-exposed, depending on the brightness or darkness of the background.

The reason lies in the fact that a camera view encompasses a variety of light intensities, which may range from very dark shadows to very bright highlights, whereas the meter is calibrated at a definite reflection factor. Therefore, because the meter encompasses more or less the same area as the camera, when held at the camera position it will take in a great deal of light from the sky, as in a landscape, and much less from the foliage, etc. The result is an "average" measurement that is of no use at all because the light from the sky will be relatively so strong that it will greatly overbalance the light coming from the foreground. As a result, the sky reading is favored and under-exposure for the landscape proper is bound to result. Similarly, in the case of a portrait outdoors, a reading from the camera position will take in the background and surroundings as well.

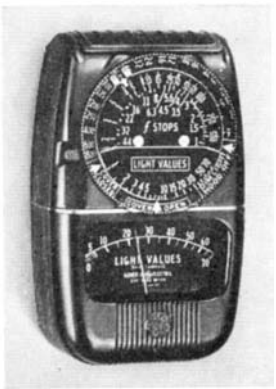


Book was lowered to take a reading of shadow side of face

". . . approaching the subject closely, regardless of camera position . . ."

If these are much brighter than the subject, as in the case of a sky or a sunlit wall, the portrait subject will be under-exposed; if, as in the case of a background of dark foliage, they are less brilliant than the subject, the latter may be over-exposed.

Since the objective in light measurement is to obtain a proper reading for the most important part of the subject and to allow the exposure latitude of the film to take care of the rest, it must now be clear that in order to get a well exposed landscape, or portrait, the light reflected from these



Latest in meters

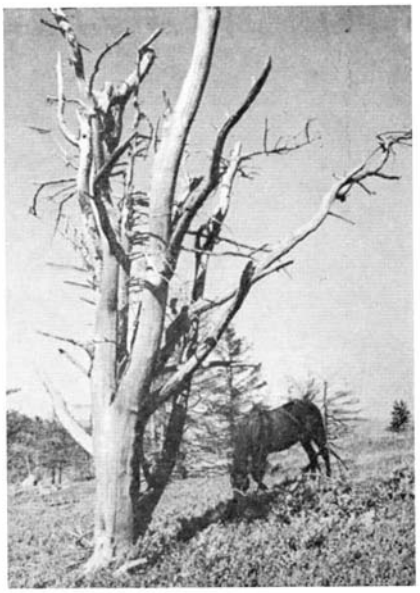
subjects *alone* must be measured. This is usually accomplished by tilting the meter slightly, toward the landscape, excluding the sky, in the one instance, and approaching the portrait subject closely enough with the meter, regardless of the camera position, to include within the meter angle only the face of the person being photographed. A convenient rule for taking readings of objects at close range is to approach the subject to within a distance equal to the width of the subject.

Sometimes, however, it is not possible to approach the subject closely enough for proper reading. In such cases, the substitution method of meter measurement is used. If there is a tree or a house in the shade across the water that you want to include in a particular view, all you have to do is take a reading from your own clothing or from a tree nearby and use this reading for the exposure.

Where it is not possible to obtain a meter reading of the direct reflection from the subject, it is useful to read the incident light, that is, pointing the meter towards the light source itself. In the latest meter to appear on the market, General Electric's Type DW-48, provision is made for making readings of this type direct. A self-multiplier is incorporated in the calculator which automatically multipies exposure when the meter is used for incident light measurement in very dim light. (See "What's New" for fuller description of this meter.)

How other electric meters may be calibrated for use in reading incident light is suggested in the following experiences of C. W. Gibbs, A.R.P.S.

"In my experiments, I used the Mini Photoscop. This meter is calibrated in American Scheiner figures. In my first trials a Kodaflector was set up exactly six feet from the subpect. Two small flood bulbs were employed. The meter was held near the subject's face and pointed toward the lights. The meter reading was 9. This value was jotted down and then a series of exposures was made on Super XX film. The films were developed in X33 for the correct time to give a gamma of .7. Upon examination it was found that the exposures were fairly good through a range of from 1/250 at *f*/2 to 1/250 at *f*/5.6. Setting the meter to these exposures and then seeing what film speed was equivalent to a reading of 9 it was found that these exposures would have resulted from a setting of 17 and 26. For normal use, then, we would consider the Super XX to have a speed half way between these two values. If the light were dull or if we were compelled to shoot at a higher speed than normal, we could see by setting the film speed to 26 if we would get a good negative or if it would be thin. If the latter, we could compensate to some extent by prolonging the development time."



Extreme brightness range such as this requires care in exposure

Any given scene may receive several different exposures, each of which will be considered correct for the result wanted, and this without regard for the general over- or under-exposure of the full image. A subject reflects highlights, shadows, and middle tones. If the brightness range is longer than the latitude of the film can take in at once, the worker has a choice of three procedures. He can read the shadows or the highlights or the middle tones and use each reading as a basis for exposure of the whole. The fact that film has a tone range from 1 to 128 is used in a practical way on the dial of the Weston exposure meter. Besides an arrow provided for normal readings, there is a letter *U* and an *O* at either end of the indicator scale on the dial. By using this meter to read

Fifth Annual Scientific American
AMATEUR PHOTOGRAPHY CONTEST

OVER $1200 IN PRIZES

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

36 PRIZES *PLUS* Three Special Awards

DIVISIONS IN WHICH PRINTS MAY BE ENTERED

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

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

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

IN **EACH** OF THESE DIVISIONS THERE WILL BE AWARDED SEVEN MAJOR PRIZES AND FIVE HONORABLE MENTIONS. WINNERS OF THESE PRIZES BECOME AUTOMATICALLY ELIGIBLE FOR THE THREE SPECIAL AWARDS.

RULES of the CONTEST

1. The groups will be judged independently on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.
2. Prints must not be smaller than 5 by 7 or larger than 11 by 14 inches. **All prints must be mounted,** otherwise they will be returned immediately.
3. Photographs must be packed properly to protect them during transportation.
4. Non-winning entries will be returned only if sufficient postage is included when the prints are submitted.
5. Each entry must have the following data written on the back of the mount: Name and address of contestant, type of camera, and film, enlarger, and paper used.
6. Contestants may submit no more than two prints in each group, but may enter any or all groups. In no case, however, will more than one award be given to any individual contestant.
7. Prints must be in black and white. Color photographs are not eligible.
8. Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher.
9. Scientific American reserves the right to purchase, at regular rates, any non-winning entry.
10. No entries will be considered from professional photographers.
11. All entries in this contest must be in the hands of the judges by December 2, 1940. Results will be announced in our issue dated February, 1941.
12. The contest is open to all residents of the Western Hemisphere who are not in the employ of Scientific American.
13. In fairness to all contestants, failure to comply with any of the above rules will result in automatic disqualification.

THE PRIZES

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

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

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

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

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

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

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

HONORABLE MENTION

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

2nd. Three Mimosa Perkino developing tanks.

3rd. Three Raygram Wood-Chrome Tripods.

4th. Three Fink-Roselieve Audible Timers.

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

THREE SPECIAL AWARDS!

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

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

THE JUDGES:

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

Address all Entries to

Photograph Contest Editor, Scientific American

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

the extremes of brightness in a subject and then setting the *U* instead of the "normal" arrow, or the *O*, depending on which end of the subject brightness range is to be favored, a reasonably correct exposure will be obtained that will take advantage of the full scale of the film.

A last word. You may follow these suggestions and still go wrong. However, before you start blaming the meter, ask yourself the following questions:

1. Am I using the correct speed rating for the film?
2. Is the shutter working properly?
3. Was the resulting negative correctly developed?

Behind the Speedguns

THERE is much more to a Speedgun than may appear on the surface, as a visit to the Speedgun Corporation's plant in Bloomfield, New Jersey, has convinced us. For one thing, more than 600 separate parts are required for the assembly of the various Speedgun models. To produce these, the Speedgun engineers employ 150 special tools, one of which is a tube-cutting machine that not only saves several burring operations in cutting dural and brass tubing, but is capable of slicing two-inch tubing to lengths as short as 10/1000 of an inch. The Speedgun engineers design and make their own tools in many instances, thus making the plant independent of outside sources of supply.

The development division of the plant, under the supervision of Philip K. McGall, inventor of the Microswitch, is carrying on the work begun ten years ago by S. Mendelsohn, of the Speedgun Corporation, in developing new techniques in synchronization design. Many of the models turned out by this division are never seen by the general public, but the facts learned are incorporated in the design finally chosen for inclusion in the finished commercial product. The research is pursued not only for the sake of perfecting designs for current requirements, but also to keep a weather eye out for future needs and developments.

One of the items that will see the light of day in the near future is the Multiflector, a reflector-magazine holding six No. 5 G. E. "Mighty Midget" bulbs; these are mounted on the gun in the usual way and the lamps flashed either individually or in unison, depending on the number of switches thrown. A special carrying case holding six of these Multiflectors will be available, thus making it possible for the photographer to load 36 bulbs at once and never handle a single bulb until they have all been flashed. "On the fire" is another gun, to be known as the Superspeed, which will fire 12 flashbulbs one after the other and which can be operated either on or off the camera.

For accurate testing of shutter synchronization, a Speedgun Timer has been made available to newspaper offices and will soon be ready in sufficient quantity to be placed in centrally located agencies throughout the country. The tester works at 1/10,000 of a second and permits ready testing with every assurance of certainty as to the result.

Portraits With A Spectacle Lens

GET your optician friend to make you up a spectacle lens of a focal length your camera will accommodate, mount it in a square of cardboard of the right dimensions to fit the front of your camera, and try your hand at soft-focus portraits. The results may surprise you. The illustration is an example. Notice how the highlights spread out into the shadows and a general softness of outline prevails over the entire face. Sharp pictures are not always the best pictures, particularly in the case of portraits; a soft picture such as this may often be superior.

With a spectacle lens

Fine-Grain Developer Formula

A FINE-GRAIN formula that appeared in the older issues of the "Gevaert Formula Book" is reprinted in the current issue of the *Gevaert Sensitizer*. It consists of only metol and sodium sulfite made up as follows:

Metol ..... ¼ ounce
Sodium sulfite—
(anhydrous) ..... 3½ ounces
Water to make ..... 32 ounces

Development is for 20 minutes at 65 degrees. Distilled water is recommended. The developer is said to keep a very long time.

National Photonews Weekly

A WEEKLY journal of news and comment concerning matters photographic and cinematographic has recently made its appearance, with headquarters in Washington, D. C. An-

CAMERA ANGLES

nounced as "a national publication for amateur photographers," it is published every Saturday under the editorship of Don Bennett. The publication states that it "welcomes news of the activities of camera clubs and individuals and manufacturers interested in amateur photography," and asks that in submitting copy having a time element, the contributor should allow for the lapse of one week's time. The publication should be addressed: National Photonews Weekly, Editorial Office, News Building, 1013 Thirteenth Street, N. W., Washington, D. C.

Labels on Bottles

One of the most vexing darkroom problems is how to make labels stick on bottles. If some way were found to prevent sloshing water or other liquids over the label, there would be little trouble, but as this usually appears to be unavoidable, it it necessary to provide a means of protecting the label under all circumstances. A suggestion is offered by Morris Germain, A.R.P.S., that he claims has worked for him for a long time. He takes a few sheets of undeveloped glossy printing paper and, by the ordinary darkroom printing safelight, immerses it in the regular fixing bath. After the paper has been "fixed out," he turns on the white light, washes the paper in the usual way and then allows it to dry on a ferrotype tin. He then cuts the paper up into the sizes he needs and letters the paper with black waterproof ink. When the ink has dried thoroughly, he wets the paper again, squeegees out the excess water, applies ordinary library paste on the back and attaches it to the bottle. The last operation is a coating of spar varnish.

New Reflex Case

A sole leather, velvet-lined carrying case for the new Brownie Reflex Camera is being offered by United Camera Exchange of New York City.

The case follows the styling and design of similar cases made for more expensive cameras of the candid type, and features a drop front allowing full freedom for the finder and taking lens; it also has a die-cut window in the rear so that film exposure numbers can be seen as the film is wound. The cord furnished by Kodak as a part of the Brownie Reflex is used as the carrying strap.

For Nature Shooters

Shooting insects and other small creatures frequently offers obstacles because they cannot be kept in one place long enough for the necessary critical focusing (close-up lenses being required) and relatively long exposures. One worker got out of the difficulty by placing the insects in a bottle and then injecting into the bottle a small quantity of illuminating gas from the kitchen gas jet. The creatures become dulled and as a re-

sult move very slowly. It is a simple matter then for the photographer-naturalist to place the insect where he pleases and to take his time about focusing and shooting. For the information of the tender-hearted, the effect is temporary and after the gas wears off the insect moves normally again.

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WHAT'S NEW

In Photographic Equipment

MOORE "LONG FELLOW" ENLARGER ($50 without lens): Features coolness, compactness, versatility. Both enlarger and baseboard mounted on 90-inch chromium plated tubular upright. When not in use, enlarger and baseboard may be swiveled against wall. Suction ventilation of lamphouse, aided by insulation of lower condenser from body of lamphouse, results in negative being absolutely cool. There is no material rise in temperature, even if negative is left in enlarger for period of several hours without any air circulation other than that provided by enlarger itself. Enlarger employs metal sleeve bellows. Equipped with three lens boards, recessed, flat, and protruding to take all normal focal length lenses up to and including 6-inch. Employs double condenser system, 4½-inch condensers removable for cleaning. Position of light bulb adjustable. Equipped with plastic light filter for use when focusing on paper. Focusing by micrometer gear. Will take negatives 35mm to 2¼ by 3¼ inches and any 2¼ by 3¼-inch portions of negatives up to 11 by 14 inches. Wooden baseboard, crack-proof, warp-proof, measuring 20 by 30 inches, may be rotated through 360 degrees, vertically or horizontally, allowing for any desired distortion or correction. Two brackets furnished with 90-inch upright for attaching to side wall or floor and ceiling. Regular table model also available called "Short Fellow" ($40 without lens).

BROWNIE REFLEX ($5.25): Miniature twin-lens reflex camera for beginner. Large, brilliant, efficiently hooded reflex view finder; image remains visible during exposure. Takes 12 pictures 1⅝ inches square on No. 127 roll. Size of camera: 4¾ inches high; 3 1/3 inches wide; 2¼ inches through. Compact design without projecting fittings. Automatic self-cocking shutter with bulb and instantaneous settings, and plunger-type release. Lens good quality meniscus of correct speed for daylight snapshots, as well as snapshots at night with high-speed film and Photoflood set-up. Fixed focus.

GENERAL ELECTRIC TYPE DW-48 EXPOSURE METER ($21): One-hand operation made possible by special calculator arrangement; spring-actuated hinged cover, new locking device. Meter calibrated to measure

light in standard foot-candles. By means of incident light and hinged cover, single scale on meter covers range of sensitivity from 0.05 to 1700 candles per square foot. New feature permits locking calculator after reading is taken so that calculator adjustments will not change if meter is put in case or pocket. Other features: simplified calculator for still, color, and movies; self-multiplier on calculator which automatically multiplies exposure when meter is used for incident light measurement; film values up to 800; F stops from *f*/1 to *f*/44 and shutter speeds from 1/2500 of a second to 100 seconds. Accompanying each meter is 110-page data book giving film values, filter factors, Photoflood and Photoflash data, paper speeds, and formulas.

RECOR FRESHMAN PHOTOGRAPHIC KIT ($11.95): Outfit includes camera, enlarger, rolls of film, roll-film developing tank and all necessary darkroom accessories: chemicals, enlarging paper, film safelight, thermometer, film clips, trays, and so on. Manufacturer says: "While primarily designed for the youngster and beginner in photography, it will also appeal to the more serious minded worker as providing a practical groundwork in the fascinating hobby of photography."

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. **I am planning to make an enlarger. My largest size negative will be 2¼ by 3¼ inches. In consulting a table I find a 4½-inch focal length lens requires a distance of 6¾ inches from negative to lens for a two-times enlargement. Could I use a single extension camera (4⅛-inch focal length) for the lens and bellows by fitting a light-tight box on the back of the camera?—C. R. W.**

A. The arrangement you suggest sounds practical enough because you will have sufficient leeway in your bellows for the necessary adjustment for a wide range of magnifications. It is important, of course, that the box you construct fits snugly over the back of the camera and permits no light to escape around the connecting edges.

Q. **Where or from whom could I get specifications on the many lenses that are on the market for the miniature enthusiast to choose from? Details I want to get include the type class of the lens, good characteristics and limitations, diameter of circle of confusion, degree of color correction, method of focusing, size of plate covered at full and at reduced aperture, and so on. Such a jumble of names (Ektar, Cintar, Triotar, Tricor, Elmar, Hektor, Zenor, Hypar, Dagor, etc., etc.) means so little to me.—W. L.**

A. Some of your questions are answered in scattered sources, but we

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do not know of any one complete reference where information such as you want may be obtained. However, the individual manufacturers or distributors are always glad to supply such information on request. Their addresses can be obtained from magazine advertisements or from your regular photographic dealer.

Q. **Enclosed are a couple of vest-pocket size negatives and a couple of commercial prints. I know the composition isn't so hot and the lighting is terrible, so don't bother to card me out about that. However, a strong magnifier on the negatives shows a lot of detail that does not show up in the prints. Now the question: Could an old bird like me (fiddling with cameras for forty-odd years) do any better if he got a hundred dollars' worth of equipment and spent his spare time in the cellar? Is there any likelihood of better results if I were to do the work myself instead of sending them to a finishing plant?—H. A. H.**

A. That depends on the plant to which you send your films. Some of them are first rate. In general, however, you could probably do much better in many instances because you would be able to give the work more time. The negatives you enclose seem rather contrasty and should have been developed in a soft-working developer because of the contrasty lighting employed. You would know this and would be willing to use the proper developer for the type of exposures made. This is one great advantage of doing the work yourself. As for the prints, a softer paper might have helped matters some. In general, it is far better that the serious worker do the processing himself. The results will be more satisfying because the worker will be able to give each print the care and attention that the average finishing plant does not have the time for; the prices they get would not justify the effort.

Q. **I have a Contax III with a f/1.5 lens. Can I use it in an enlarger of the Kodak type?—Dr. H. D.**

A. We do not know which of the Kodak miniature enlargers you have reference to, but, provided it will accommodate a 2-inch lens, you should be able to adapt it to the enlarger. Of course, a special lens flange will be required.

Q. **I have a 2¼ x 3¼ Speed Graphic and I use an Abbey battery case and reflector for the built-in focal plane synchronizer, with Press 40,000 flash bulbs. I shoot at 1/225 at f/8 and the exposures are perfect, but when I drop the exposure down to around 1/100 the density begins to fall off at the bottom of the negative.—M. K.**

A. The Press 40,000 bulbs should not be used with shutter speeds slower than 1/200th second, according to the advice of the manufacturers. This speed—or greater—permits the focal plane shutter to traverse the film while the light is at its peak.

YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

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

It's Called "Targo"

SOME will nick-name it "back-yard skeet," some may call it "vest-pocket trap," but the Mossbergs have termed their latest innovation "Targo," and all who try it will sing its praises from the standpoint of good gun fun and excellent wing shooting practice. The best part of the story is that, following their principle of providing shooting enjoyment for more people through good equipment at moderate prices, O. F. Mossberg & Sons, Inc., have arranged to offer their new combination gun-and-trap, together with miniature pigeons to be used with .22 caliber long-rifle scatter shot shells for indulging in the sport of "Targo" at so nominal a figure as to make the game available to all. For less than $25 you can own the gun, the trap, and even a net to save undusted pigeons from breakage when they hit the ground. Your operating costs will be equally low, for the .22-caliber shot shells can be had for 50 to 60 cents per box of 50 and the clay birds will be much less than one cent apiece.

Cocking

Loading

The Mossberg Model 42 TR "Targo" gun is in reality two guns in one, for each comes with what is known as a "Rifle Adapter Tube." This is a rifled section of .22 caliber barrel, 5 inches long, which replaces a length of "Targo" gun smooth-bore barrel, and which, by an ingenious new method of rifling, converts the "Targo" gun into a .22 rifle which is claimed to be as accurate as though rifled throughout. Furthermore, there is a 7-shell capacity clip in the forearm below the chamber which makes a bolt action repeater out of the gun, shooting any standard .22-caliber solid ammunition.

"The Targo" gun is built on the Mossberg "Master" action, walnut finish stock with molded trigger guard with finger grooves and molded buttplate. It is 43½ inches long, weighs about 5¼ pounds and balances nicely with or without the trap. It has a 22-inch round, smooth-bore barrel, and when fitted with the 8-inch "Targo" tube equipped with a special choke ring to prevent the shot from balling and coming out as slugs, it gives a nice, even pattern.

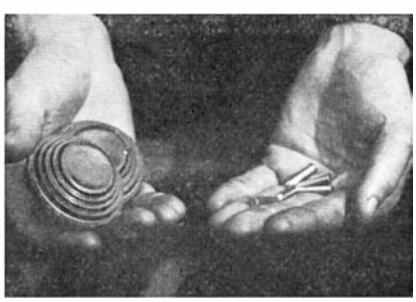
The "Targo Trap" weighs 14 ounces, is attached to the barrel just ahead of the forearm, is easily removed and will fit almost any single barrel .22-caliber smooth bore or .410 bore shotgun. The trap cocks effortlessly, is released by the fore finger of the left hand while the gun is at either skeet or shoulder position. The swing of the trap as it throws the "bird" is not sufficient to produce an appreciable sideways recoil in the gun. To the contrary, the backward thrust is scarcely noticeable as the target sails through the air in any direction desired by the shooter, and it will be at once understandable that the variety of angle shots possible are almost legion. An adjustment on the spring permits you to vary the flight of the targets, making the shooting easy or difficult, as you like.

The "Targo" targets are ½ normal size, will break on impact of the tiny .22-caliber pellets up to 50 feet, and are packed in lots of 200 in special break-proof cartons developed by Mossberg. When the Mossbergs say "break-proof," they mean it. During a recent visit to the factory, Walter Pierson told us of some of the tests to which target-loaded cartons had been subjected. They threw the packed cartons down the factory stairs, pushed them out the window, dumped them off fast moving trucks and generally kicked the poor things all over the lot. Even when they finally found a packing method which enabled the targets to survive such blitzkriegish treatment, they weren't

Releasing

satisfied. When you receive your first carton of "Targo" targets, you'll find a few extra for good measure and as a sort of "just-in-case" precaution. Furthermore, five unbreakable targets, made of rubber, are a part of each "Targo" trap outfit. These are used in distance and direction experiments with the trap, thereby saving a lot of clay pigeons.

The "Targo" net, insurance against ground-smashed pigeons, is 20 feet square, is easily set up on 6-foot posts and has a mesh fine enough to catch



"Targo" birds and shells

and save undusted birds, but large enough and sufficiently flexible to permit the netted targets to be drawn through the net from below. With or without the net, "Targo" is a new sport to be enjoyed just about any place, including an open field, the golf or gun club, or even a large back yard. The 120 to 130 pellets of a scatter shot .22-caliber shell are very tiny and are unlikely to cause damage when properly used, but as it still takes only one pellet to ruin an eye, don't forget the tried and true Commandment of Safety, "Never point a gun at anything you do not want to shoot." All-in-all, we believe "Targo" has unlimited possibilities for fun and helpful firearms practice. Want a "Targo" booklet?

Clean Barrels Shoot Better

It's a strange indictment against the gunning fraternity that about 98 percent of the enormous annual repair bill for guns is traceable to the owner's neglect. The introduction of noncorrosive ammunition led not a few to the belief that, save for an occasional patch and oil, the barrel cleaning chore was a thing of the past. True, noncorrosive shells will not rust the tubes, but they are primarily intended to knock over game or skeet targets, not to *prevent* rust. Likewise, the little problem of leading is still with us, and for some reason scattergun owners seem more prone than riflemen to rely only on oils, greases, and rags to remove lead, perhaps on the theory that the new powders fired through a clean bore with no rifling eliminate the necessity of this operation.

In view of the extensive array of shotgun cleaning agents available, all at a very nominal cost, there is really no reason why shotgun barrels should not receive the best of care with the result that patterns will be improved, kills will be cleaner, and the gun will last longer. As every gunner knows, lead in barrels retards and mutilates the pellets, causing them to sheer away from their normal flight and ruin an otherwise effective pattern.

Not long ago we mentioned a new shotgun cleaning device known as the "Ferret Cleaner," and we have since observed that it has met with widespread approval from scattergun men. Like other tube-scouring implements, the Ferret is designed to remove lead deposits, and not to be used to the exclusion of a good oil, or grease, and a rag. But, unlike the old style wire bristles, the Ferret "shaves" the lead from the barrels instead of brushing it off, often a not too effective process.

Composed of flat, bronze alloy wire, soft enough to prevent gun barrel injury yet hard enough to get at the lead, the Ferret is tapered at both ends to permit passing through the choke in both directions, either on the cleaning rod or on a stout cord. It is self-sharpening and works even better after having been used a few times. As the coiled, flat wires are formed into a tapered, cylindrical shape, it is unnecessary to impart a revolving or rotating motion to the rod when running it through the barrel.

A recent letter from T. R. Walker, of The Dairy Specialties, Inc., manufacturers of the Ferret, stated: "Since we have been making Ferret cleaners we have been surprised to find that many men who have used guns for years do not realize that they have lead in their gun barrels. When they clean their guns with a wire brush and patches, they polish up the lead until the gun looks clean. Then, when a Ferret is run through, and they see the amount of lead which is removed by the bronze wires, they are unable to believe their eyes." All we can add is that we continue to use a good grade of oil for cleaning and lubricating, that we "Ferret our guns" religiously after shooting and that we believe the combination provides good insurance for longer lasting firearms and few, if any, repair bills resulting from neglect of our guns.

Aluminum Creels

We've often wondered why someone didn't make a creel of aluminum, and now along comes Messrs. Smith & Focht with their "Ideal Creel," which appears to us to be very well named, indeed. Weighing but a few ounces more than our old reed

basket, the "Ideal" is 12 inches long, 8¼ inches high in back, 6-1/4 inches high in front, and 6 inches wide. It is extremely durable and the sprayed, brushed aluminum finish not only gives the creel an attractive appearance, but also prevents sun flash.

Best of all, to our notion, is the conversion of hitherto waste and useless space into additional convenient

"Ideal" for stream anglers

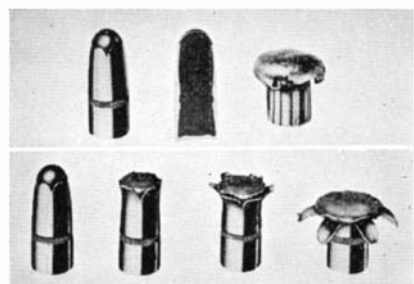
storage places for important items for the stream angler. Besides the well-ventilated fish compartment accommodating eight pounds of fish and equipped with drainage openings which will not drain on the user's clothing, there is a tackle compartment. This has spaces for fly books, leader box, fly oil, line dressing, skeeter dope and a built-in, removable bait box. There is also a drawer for sinkers, hooks, leaders, minnow rig, and other small items. Inasmuch as we're one of those fishermen who isn't happy unless he can lug along everything but the kitchen sink, and as we've wished often for a place to carry our camera, we think we're going to like the Smith & Focht "Ideal Creel." Would you like a descriptive folder?

POT-SHOTS
At Things New

STOEGER ARMS CORPORATION has just brought out its latest publication, an attractive 24-page book entitled, "Stoeger Gun Stock Guide." It offers complete information concerning remodelings, gunsmith specialty tools, Peerless actions and barrels, Peerless remodeling of military and sporting rifles, American and French walnut stock blanks, blueing equipment, standard targets, and many other items of interest to the amateur gunsmith. This new book is not to be confused with the annual "Shooters Bible," published yearly by The House of Stoeger, for the new one stresses tools and materials for remodeling and other gunsmithing activities. For more than 50 years A. F. Stoeger, Founder and President of Stoeger Arms Corporation, has been widely known for his helpful service in connection with American and imported guns and accessories. Long an expert gunsmith himself, he subscribes to the school of thought that every gun owner should intimately know each part of his gun and how to care for it.

FEDERAL CARTRIDGE CORPORATION offers new wadless crimp shotgun shells in trap and skeet loads only, in 12, 16, and 20 gage. An increased number of folds in the crimp tends to reduce initial pressure and prevent deformation of pellets. All well-known good points of Federal loads have been retained in new shells, including hot, snappy primer; locked-in base; cone-shaped base wad; reasonably soft, tough paper case; "old reliable" hair-felt cushion wads; clean, bright, uniform shot. Federal also offers new rifled slug loads for shotgun use in 12, 16, and 20 gage, and .410 bore. Likewise new are 28-gage loads in 2⅞-inch hi-brass cases, with numbers 4, 6, 7½ chilled shot, and in skeet loads with number 9 chilled shot.

REMINGTON ARMS COMPANY offers new, soft point "CoreLokt" bullet equipped with notched jacket tip, which controls mushrooming, provides uniform expansion and makes it readily recognizable. Heavier base of jacket prevents disintegration, locks lead core, retains compact mass of non-disintegrating bullet to full depth of penetration and energy. The "Core-Lokt" soft point starts mushrooming



"Core-Lokt," showing notches and expansion; also vise test

immediately, expands to approximately twice original caliber at hunting ranges, retains same ballistics as regular soft point bullets in comparable weights. Simple pressure test in ordinary vise shows how special notching of jacket provides directional spreading lines for perfect expansion. The "Core-Lokt" soft point costs no more than ordinary soft points, is available in 14 sizes: .25 Remington; .25/35; .30/30 (2 bullet wgts.); .30 Remington; .30/40 (2 bullet wgts.); .30/06 (2 bullet wgts.); .300 Savage; .303 Savage; .32 Special; .32 Remington; .35 Remington.

FLASH!! — Colt's Patent Firearms Manufacturing Company have just sent word that the long-awaited "History of Colt Revolvers" by Charles T. Haven and Frank A. Belden is on the press and will be ready September 1st. This 700-page volume with 500 illustrations, handsomely bound with embossed cover, will prove a reservoir of information of daily value to every collector and lover of firearms.

Our Book Corner

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EXTRA - SENSORY PERCEPTION AFTER SIXTY YEARS

By J. B. Rhine, J. G. Pratt, Burke M. Smith, Charles E. Stewart, and Joseph A. Greenwood

At last there is a complete account of the research conducted to date on extra-sensory perception (thought reading, telepathy, clairvoyance), all the important scattered data having been brought together here within two covers. This book is a summary of what has been achieved so far, a reference work covering the field as a whole, a treatment of all the evidence, a guide to the literature of the subject, a condensation of the greater bulk of it, and a handbook of methods. It includes a digest of 56 articles of criticism of experiments in extra-sensory perception, mainly as made by psychologists, in which these are dealt with without emotion or heat; in fact, the whole work is characterized by a commendable kind of calm, in view of the degree of superheat that has been connected with the subject. This book is a solid, serious study; there is nothing fluffy about it, but it is not heavy. The parts involving mathematical analysis are sequestered in 21 appendices, for readers who yearn to delve. (463 pages, 5½ by 8½ inches, eight illustrations.)—$2.85 postpaid.—*A. G. I.*

SCIENCE FRONT 1939

By F. Sherwood Taylor, Ph. D.

Chapters on science and plant growth, chemotherapy, sex and the steroids, the stuff of life, cancer, shock treatment for schizophrenia, making oil from coal, television, liquid helium, inside the atom, quartz clock, polar aurora, our view of the universe, together make up this most readable review of recent science—much of it, not quite so recent, however, as 1939. (301 pages, 4¾ by 7¼ inches, 52 illustrations).—$2.60 postpaid.—*A. G. I.*

THE FLY TYER'S HANDBOOK

By H. G. Tapply

Whether or not you tie your own flies, this publication should be in your library. Through word and picture it tells you more about flies and fly-tying in one evening than you could assimilate in years of desultory study on the stream. Written for the beginner in a successful endeavor to reduce fly-tying to its simplest form. The author, who is Editor of *National Sportsman,* and a fisherman par excellence, clearly disproves the common fallacy that tying one's own lures is a difficult art. (71 pages, 5½ by 7 inches, 56 illustrations.)—$1.10 postpaid.—*A. D. R., IV.*

PRINTING INKS

By Carleton Ellis

Quite technical in many of its parts, this volume by a noted industrial research chemist covers completely the subject of printing inks. General discussion: the history of printing inks, vehicles used, dryers, modifiers, pigments, drying oils; and then various types of ink, preparation of matrices, printing ink problems, testing; and, finally, a chapter on paper for printing. Composition formulas, tables, and graphs make some parts rather heavy. Bibliographies, in the form of footnotes on almost every page, add up to an enormous total of references. (560 pages, 6¼ by 9¼ inches, illustrated.)—$7.10 postpaid. —*F. D. M.*

SCIENCE WITH SIMPLE THINGS

By Raymond F. Yates

Simple home experiments of an elementary physical nature, for keen lads of about 14 up, are described in this book. It has chapters on energy and the world we live in; experimenting with heat; aerodynamics; sound; light; electricity; home weather bureau instruments. Yet this is not a textbok—is not conventional or formal—but tells what to do, then chats about the significance of each thing done. (245 pages, 4¼ by 8 inches, 70 illustrations.)—$2.60 postpaid.—*A. G. I.*

MATHEMATICS AND THE IMAGINATION

By Edward Kasner and James Newman

Previous experience with Scientific American readers' interest in books of this type strongly suggests that many of them will read this one avidly. It isn't a textbook—nothing so stodgy as that—but deals entirely with aspects of mathematical thoughts that are romantic and fascinating to the mathematical minded type of man. The senior author is Professor of Mathematics at Columbia and one

—OUR BOOK CORNER—

of the "Big Six" in the field. The junior author is a mathematical New York lawyer. Chapters deal with names, numbers, assorted geometries both plane and fancy, paradoxes, chance, rubber-sheet geometry, and many things similarly out of the commonplace and therefore sure to interest the imaginative thinker. The style is plain, natural, chatty, sometimes witty. (381 pages, 5¼ by 8 inches, 169 illustrations.)—$2.85 postpaid.—*A. G. I.*

MODERN CAMPING GUIDE

By George W. Martin

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By Nat A. Barrows

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By E. J. Tangerman

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them are given in both word and picture. Indeed, the book is extremely well illustrated with plates showing finished work of all kinds and hundreds of design types, symbolisms, and conventionalizations. (289 pages, 6½ by 9½ inches.)—$4.10 postpaid. —*F. D. M.*

GETTING MORE OUT OF LIFE

By Joseph Jastrow, Ph.D., LL.D.

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THINGS A BOY CAN DO WITH CHEMISTRY

By Alfred Morgan

IF your son has a "feeling" for science, this volume will give him a start by showing him how to do the many simple tricks with simple chemicals which we oldsters did as boys. How to make crystals and then use them for such things as simple barometers; exploring the uses of litmus paper with vinegar and baking soda; extracting nitrogen from the air by using a candle and a jar; freezing kerosene; running a small steam engine with dry ice; burning aluminum powder; making a battery with a lemon, a strip of copper, and a strip of zinc; and numerous other similar experiments are fully described in simple terms and illustrated in this volume. It would give a boy a solid groundwork in chemistry. (288 pages, 5½ by 8¼ inches.)—$2.60 postpaid. —*F. D. M.*

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By Alex Laurie

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

MONKS, like thousands of other mortals, are now making their own telescopes. From the Society of the Divine Word, Techny, Illinois, comes the following:

"Even in the crowded curriculum of studies at St. Mary's Major Seminary, astronomy has its place and holds an attraction for many a student. Its study serves a definitely practical purpose, since most of the seminarians will one day labor in foreign mission fields, where astronomical knowledge will supply in many ways what these primitive countries do not—aids in regard to time, in regard to nautical determinations, in surveying, and in exploration, to mention but a few.

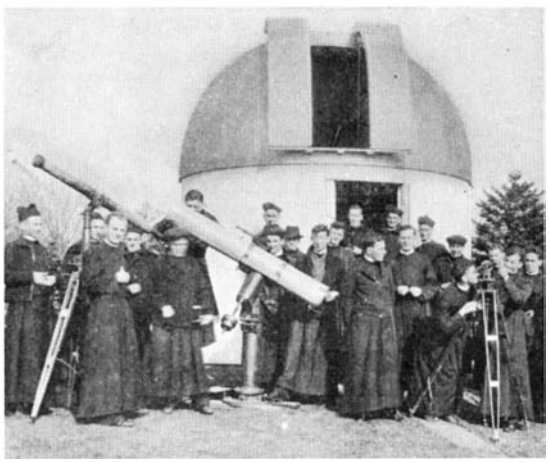


Figure 1: Astronomy class, St. Mary's

"A few years ago an observatory (Figure 1) was built at Techny, housing a 110 mm. refractor, a comet-seeker, the structure having been designed and constructed by the Brother Monks. But this telescope soon proved inadequate for the interest and enthusiasm of the star-gazers, and it was deemed advisable to construct a larger one, 8" in aperture, the work being done under the direction of Father Francis Neuhaus, S. V. D., one of the seminarians. Meanwhile, Brother Corsinus, S. V. D., an able mechanic, was busy constructing a well-balanced mounting, shown in the center. With a surprising minimum of cost, the reflector was completed, and now serves to great advantage, not only to bring more of the heavens within grasp, so to say, of the students of astronomy, but also to render celestial photography possible because of the new telescope's greater light-gathering power.

"Work on a 12½" mirror for a still larger telescope is now under way."

AMATEUR telescopticians, ten or twenty thousands of them, have now felt their way into about all the related arteries and capillaries of optics and astronomy. One such ramification is sun-dialling, and under sun-dialling come sun-clocks. Just what is a sun-clock?

Invented by W. E. Cooke, government astronomer of New South Wales, Australia, the sun-clock was described in this magazine in August, 1928, also August, 1935, by R. W. Porter. A ring, or sometimes a C-shaped portion of a ring (Figure 2), carries a lens on the sunward side, and on the other an analemma, the familiar 8-shaped curve of the equation of time. By turning a thumbnut with the fingers, until the Sun's image falls exactly on the analemma, hands taken from an ordinary clock are mechanically actuated through gear trains and the standard time is read on the clock dial—direct and not by a shadow, as in a sun-dial. There is, of course, no running clock *movement*.

Working from the articles by Porter, cited above, Fred Ferson, 414 Reynoir Street, Biloxi, Mississippi, has made the sun-clock shown in Figure 3, and states that "careful construction and adjustment afford time within one minute, likewise the date. The base casting has four leveling screws and carries a second casting which supports in a curved slot a short, stubby, curved main standing arm. This can be slid circularly and clamped for latitude. At the end of this stubby arm is a rigid, hollow stud carrying the gear box and clock face and big, curved, rotatable fork. The fork has in its upper horn a slot in which is mounted a little lens of 8" *f.l.* The analemma is inscribed on a sheet brass plate bent to a radius equal to the *f.l.* of the lens (its radius of curvature is therefore nearly twice that of the fork—study Figure 7 if "nearly" is not at first clear) and attached to the lower horn. To find the time at any desired moment the large thumbnut extending, in Figure 3, below and to the left of the gear box is turned with the fingers, and gears with ratio 1, 2, and 24 do the rest; that is, 24 revolutions of the handwheel will rotate the minute hand 24 times, the hour hand twice, and the fork once. When the Sun's image is made to bisect the analemma curve the clock hands will automatically point to the hour and minute, also giving the date." Ferson will lend further details of construction to those seriously interested.

Figure 2: Porter, sun-clock

Figure 3: Ferson's sun-clock

Even now, more than a decade after he made his first sun-clock (Figure 2), Porter still composes new variations on the original theme and then makes the clocks. Figure 4 is one of these, as set up in his door-yard at Pasadena. "It consists," he writes, "first, of a spherical Pyrex flask carrying all the optical parts and the clock face, on which is also engraved the analemma. The entire unit is encircled by a grooved equatorial ring sliding on a segment below, which is fastened to the base. The equatorial gear used was a 32-pitch rack bent to fit the groove of the equatorial ring.

"In adjusting the polar axis parallel to that of the Earth, a tubeless telescope, consisting of an eyepiece and objective, is fastened to the sphere at the poles of the encircling equatorial ring. The field of view of the eyepiece contains just the apparent orbit of Polaris about the true pole; so that, by estimating the hour angle of Polaris by the stars in the Big Dipper and Cassiopeia, and using the base

screws, the polar axis of the instrument can be directly fixed.

"I find that the time can be relied on well within one minute. The glass flask was resorted to in order to protect all essential parts from the birds, who seemed to feel that I had made a gadget for their special benefit. The neck of the flask and a part of the sphere were removed with a 'biscuit cutter' (simply a cylinder of sheet metal) and abrasive. The plate of the clock, having nearly twice the radius of the sphere, was spun to its required curvature. All the machining was done on a wood-working lathe and drill press in the pattern shop here at The California Institute of Technology. Figure 5 is a photograph of another spherical globe sun-clock made earlier and partly similar."

And still another! Some months after the above descriptions were received, there arrived from Porter a note (Figure 6) and the following description "The clock to be described is about my tenth design and its performance has been so satisfactory that

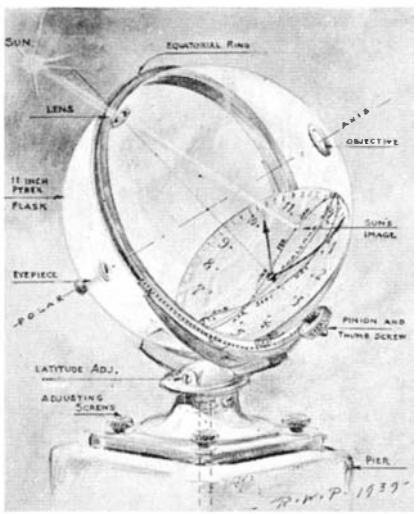


Figure 4: The bird fooler clock

I have decided to call it quits and turn the information over to those who may wish to have a gadget in their gardens demonstrating an interesting problem in celestial mechanics.

"The drawing (Figure 7) is a meridian section through the instrument and for economy of space I have inserted, or superposed, the clock face in the central area, but its true position is shown in Figure 8.

"*A* is a 12-liter Pyrex flask (Corning Glass Works—it cost $3.50), whose neck *B* has been removed with a biscuit cutter. The flask is remarkably spherical.

"To this sphere are attached the lens *C* and the brass strip *D* on which is pasted the analemma.

"In the space removed by the biscuit cutter is the clock dial *E*, carrying a minute hand. Behind the clock face is a reduction gear box operated by the thumbnut *F*. Only two pairs of stock, 32-pitch spur gears (Boston Gear Works, Cat. No. 1-G 159, 161, 177, 179) are necessary to make the minute hand revolve 24 times during

one revolution of the sphere. This clock and the gear case are fixed rigidly to the base ring *H*, supported on three adjusting screws *I*, *I*, *I*, 120° apart, and these screws rest in a circular groove cut into the plate *J* which, in turn, is securely fastened to the pier.

"The polar axis *L* of the instrument is created and maintained by the glass sphere resting in ring *H* and revolving around the stud *M* by means of a pin *N* engaging a slot in the sphere. To save an extra pair of gears for the hour hand, this pin *N* serves equally well to indicate the hour. The stud *M* has an inclination to ring *H* (horizon) equal to the latitude of the location, shown here as 40°.

"In operation, by turning the thumbnut, the sphere is rotated until the Sun's image falls on (and bisects) the analemma, and standard watch time is taken directly from the clock face. A small portion of the analemma is shown at *O*, with the Sun's image as it would fall on the 15th of May, the portion opposite covering July and

Figure 5: Another similar type

August. Should the image be made to fall on the center line at *P*, the clock would read apparent or sun time. But *PO* happens to be the equation of time, so that, by using the analemma, standard time is obtained automatically. Furthermore, any deviation of the observer's position east or west of the central line of the time zone in which he resides is corrected by resetting the minute hand. This is, of course, a constant.

"The analemma is marked off in five-day intervals, so that the day of the year is given, as well as the hour and minute. It is easily drawn from data in the nautical almanac.

"I have found that the best illumination of the Sun's image is produced by an *f*/80-or-90 lens. In the clock here described the focal length is 10" and the lens ⅛" in diameter.

"Adjusting is done with a small temporary telescope, as previously mentioned. By using the three adjusting screws *I*, Polaris may be brought to the required hour angle (see *Q* in upper, left hand corner). The telescope is removed (next day) and replaced by the sphere and clock unit.

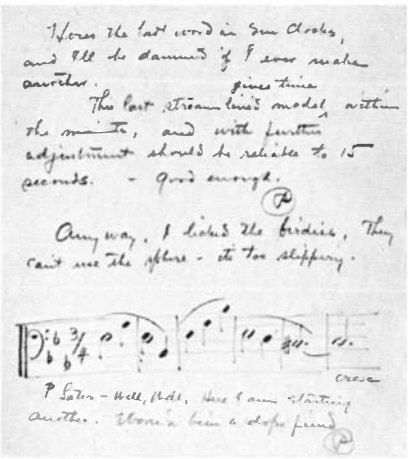


Figure 6: An addict's confession

"Finally, so that the instrument may be removed and taken indoors at any time and replaced without disturbing its alinement, a positioning stop *R* is provided, which is simply a strip screwed to *J* and against which the south adjusting screw rests."

The above description of a sun-clock, by Porter, is more detailed than those in the earlier, 1928 and 1935, articles referred to farther back, hence the would-be maker will not gain by hunting them up. An enlarged photostat of Figure 7 is available, for a small sum, from the editor.

Builders of such things as sun-clocks will occasionally hear this objection: "What real, practical good or use is the thing, when we all own watches?" To a man having that type of mind a sun-clock is no good at all, and one suggested answer is simply, "None." This should stall him, completely. To other types, however, such a thing is not only a pretty thing to own, but it visibly and tangibly demonstrates our precise knowledge of the Earth's motions in space, and thus the value is mainly intellectual.

If this nation is dragged into a war, facts stated by Carl L. Bausch, of the Bausch and Lomb Optical Co., Rochester, N. Y., in an article on "Optics and Defense," in the May-June, 1940, number of *Army Ordnance* (Mills Bldg., Washington, D. C.), may interest readers of this department.

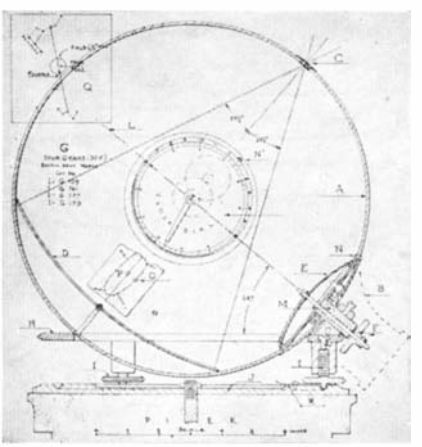


Figure 7: Porter's final (?) job

TELESCOPTICS

Mr. Bausch states that "Bausch & Lomb is now making 24 types of optical glass . . . . The present monthly capacity is about 10,000 pounds per month . . . . Practically all materials now used in glass making come from domestic sources, with the exception of nitrates which come from Chile in their crude form and are purified here . . . . The choke point in glass making is no longer the procurement of sufficient and suitable melting pots. The bottleneck has been transferred from the manufacture of glass to the manufacture of optical parts and to the assembly and adjustment of the instruments . . . . We could increase the output of our instrument plant five times in dollars-and-cents value of product in the first three years of an emergency . . . . It would be necessary to work three 8-hour shifts or, preferably, two 10- or 12-hour shifts. We would have to add 4000 more employees to our payroll . . . . During the recent years of depression, mechanics have not been trained as they were previously, and I think it is safe to say that the available supply of trained mechanics today is less than

Figure 8: The same as Figure 7

it was in 1917 . . . . Without skilled labor available, it will be necessary to recruit younger employees into our organizations to increase production, as young workers learn a new job much faster than mature ones . . . . These (the 4000 new employees) will be divided as follows: Glass plant 200; optical parts work 1000; manufacture of mechanical parts 1000; assembling and adjusting 1500; toolmakers, etc., 300."

Asked whether amateur opticians, such as read the present pages, could be used, Mr. Bausch replied: "We already have a couple men in our precision optics division who came through the amateur telescope makers' channel. We believe, everything else being equal, that a man who has had experience in making reflectors for his own use will be more valuable to us as an optician than one who has not had a try at it."

On to Rochester, you am-optical patriots—in case Uncle Sam fights!

STELLAFANE convention, Saturday, August 10. Porter coming.

LEGAL HIGH-LIGHTS

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

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

A Reminder

IMPORTANT changes in the Patent Law become effective on August 5, 1940. After that date an application for a patent cannot be filed more than one year after the invention has been made public either by being described in a printed publication or by being publicly used or sold. Prior to this change applications for patents could be filed within two years after an invention has been made public. Another change in the law, forming a corollary to the above change, provides that claims cannot be copied from issued patents for interference purposes more than one year after the granting of the patent.

Loop Hole

THE Federal Trade Commission is not empowered to restrain unfair methods of competition or unfair and deceptive practices in intra-state commerce even though the unfair practices adversely affect interstate commerce, according to a recent decision of a Federal Circuit Court of Appeals.

The Commission had instituted proceedings against a candy manufacturer charging him with using or promoting a lottery in connection with the sale of its candy. The manufacturer sold assortments of candy to dealers. In each assortment there were candies having differently colored centers and the purchaser of these candies was entitled to receive, free of charge, a larger piece of candy.

In a prior case the United States Supreme Court had sustained the contention of the Commission that the sale of candy assortments of this type constitute an unfair method of competition and upheld the power of the Commission to restrain such sales in interstate commerce. In the present case the manufacturer confined his sales of the candy assortments to the state in which he was domiciled. Under the circumstances the unfair method of competition did not take place in interstate commerce.

The Commission proved that the candy assortments were sold in competition with the product of other manufacturers who were engaged in interstate commerce and it was contended that the unfair method of competition in question adversely affected interstate commerce. The Commission argued that it was empowered to protect the interstate commerce of the competing manufacturers by restraining the unfair methods of competition of the manufacturer proceeded against, even though these methods were employed solely in intra-state commerce.

The Court fully considered the contention of the Commissioner and did not deny that the unfair methods of competition adversely affected interstate commerce. It concluded, however, that the powers of the Commission were limited by the Federal Trade Commission Act to restraining unfair practices in interstate commerce. In this connection the Court stated:

"The only practices with which the Commission may concern itself are transactions in interstate commerce. The Commission's authority is to be found in the act which created it, as amended. The purpose of the act was to supplement the Sherman Anti-Trust Act, * * * and to prohibit practices which were unfair and destructive of competition in interstate commerce."

Doubtful

A PATENT interference is a proceeding in the Patent Office to determine which of several contending parties is the first inventor and as such is entitled to receive a patent for the invention. The usual interference involves two or more applications for patents. However, at times an interference involves a patent and one or more patent applications. When the interference is between applications for patents the burden of proof of the junior party—that is, the last party to file an application—is the same as in an ordinary civil suit and it is only necessary for the junior party to prove priority of invention by a preponderance of evidence. However, when the interference is between an issued patent and a patent application filed subsequent to the issuance of the patent, the burden of proof of the junior party is the same as in a criminal case—namely, the junior party must prove priority of invention beyond all reasonable doubt.

The importance of this distinction is illustrated by a recent interference involving a patent and a patent application. The proof of the junior party in the interference in question depended to a great extent upon oral testimony and upon certain drawings. The drawings contained additions and changes and the witnesses were unable to state exactly when the additions and changes were made. The Court stated that the witnesses were

unquestionably men of good character but pointed out that there were certain weaknesses in the evidence—namely, the original model or device embodying the invention could not be found and was not produced and the drawings relied on admittedly included changes and additions. Under the circumstances, the Court concluded that there was at least a reasonable doubt that the junior party was the first inventor and on this basis awarded priority of invention to the owner of the patent. In reaching its decision the Court made the interesting comment that if the junior party were only required to prove his case by a preponderance of evidence then they would be justified in deciding in favor of the junior party.

Paper Rolls

A PATENT for an improved press roll in a paper-making machine was held to be valid and infringed in a recent suit in the federal courts. The patent related to a press roll made of crushed or ground stone held in a binder of vulcanized rubber. Prior to the patent, press rolls in paper-making machines were made of iron, wood, various alloys such as brass, and also granite. The Court found that each of the materials previously employed in press rolls gave rise to difficulties. Thus the granite was too heavy, the brass would score and damage the paper, and the wood would crack.

The Court found that the patented roll solved the problems presented by the rolls previously used and concluded that the patent was valid. In an attempt to invalidate the patent the infringer cited certain earlier patents relating to rolls used in fruit presses and clothes wringers. The Court refused to consider these patents on the grounds that they related to a remote and non-analagous art.

Unprotected Panties

IN a case of human interest—but one which will certainly not affect the destinies of the world—a Federal Court held that a copyright cannot be obtained for a pair of rubber panties. Suit was brought for infringement of a copyright relating to a folded greeting card containing the representation of a traveling bag on the outside and a pair of rubber panties pasted on the inside. The defendant's card differed from the copyrighted card in details but was similar in essentials. The Court found that there was nothing new in the representation of a bag on the outside of the card and that this feature was not protected by the copyright. The Court also held that there was nothing "of literary or artistic production in the pants, any more than in a cigar or a safety pin attached to a card" and concluded from this that the panties were not subject to copyright protection under our laws.

CURRENT BULLETIN BRIEFS

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

TRADE MARKS, LAW AND PRACTICE OF, is a copyrighted reprint, in 24-page booklet form, of an address before the New York County Lawyer's Association. The discussion details the problems of trade mark selection, protection, and use—what can and what cannot be used, protected, and why. *Sylvester J. Liddy, 24 West 40th Street, New York, N. Y.—Gratis.*

AGFA FORMULAS FOR PHOTOGRAPHIC USE (revised edition) is a 32-page booklet including more than 45 formulas which have general photographic application. The booklet lists formulas for developing, fixing, short-stop, toning, reducing, intensifying, and desensitizing solutions. A valuable section is devoted to a detailed but simple description of the chemistry of development, with new information on developer exhaustion and time-temperature compensation. *Agfa Ansco, Binghamton, New York, or through photographic dealers.—10 cents.*

ARTIFICIAL LIGHT AND ITS APPLICATION is a 296-page spiral bound book which gives up-to-date information on the latest lighting practice. It was written by experts, in clear and comprehensive manner, for lighting engineers, students, and laymen. Over 400 illustrations are used to show recent developments in fluorescent, electrical discharge, and incandescent light sources. *Advertising and Sales Promotion Department, Westinghouse Lamp Division, Westinghouse Electric and Manufacturing Company, 150 Broadway, New York, New York. —$1.25.*

USE AND ABUSE OF WOOD IN HOUSE CONSTRUCTION, Miscellaneous Publication No. 358, is a 24-page thoroughly illustrated booklet which will be of interest to present and prospective home owners. It presents practical facts regarding wood in building construction, accompanied by a large number of photographs. It covers the entire subject from cellar to shingles. *Superintendent of Documents, Washington, D. C.—10 cents (coin.)*

VENETIAN BLIND MANUAL is a 24-page illustrated catalog that presents specifications, standards, and design data on venetian blinds and their installation. It deals with both wood and metal blinds. *Chicago Venetian Blind Company, Michigan at 39th Street, Chicago, Illinois.—Gratis.*

PHOTOELECTRIC ANALYTICAL METHODS is a 24-page bulletin which contains abstracts of a large number of recently published technical descriptions. The exact details are given for the applications of these methods with one particular type of Photometer. *Wilkins-Anderson Company, 111 North Canal Street, Chicago, Illinois.—Gratis.*

HOW TO CUT COSTS AND INCREASE PROFITS is a saw manual edited for those whose work involves production processes which necessitate the use of saws. It is specifically concerned with the "Speedmatic" saw for use in building, shipping, maintenance, manufacturing, and so on. This saw is a high-speed, power-driven, but hand-guided, portable device. *Porter-Cable Machine Company, Syracuse, New York.—Gratis.*

PATTERSON PEBBLE AND BALL MILLS is a 32-page illustrated catalog of high-grade machines for use in the fine-grinding field. A large number of types are illustrated and described and their uses are dealt with briefly but clearly. *Patterson Foundry and Machine Company, East Liverpool. Ohio.—Gratis.*

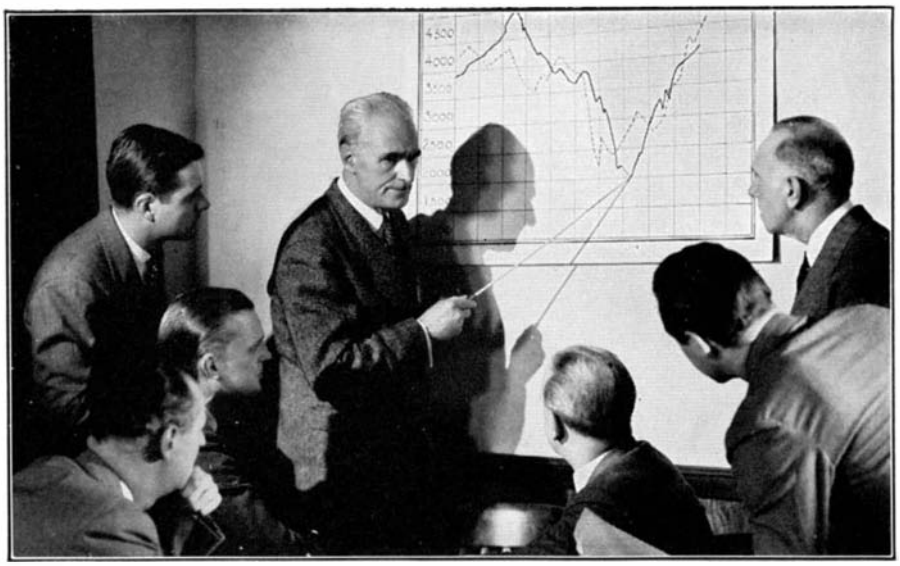
ROADSIDE DEVELOPMENT is a 64-page typewritten report of the Joint Committee of the Highway Research Board and American Association of State Highway Officials. It deals largely with the work which is being done to beautify highways in the United States and to protect them both functionally and in relation to adjacent land use. It takes up such matters as zoning of roadside businesses, the limited use of roadside signs, and so on. *Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, D. C.—50 cents.*

UTILO FILTERS AND COMBINATION LENS SHADES is a 14-page booklet devoted to a description of American-made optical glass color filters, supplementary lenses and combination lens shades. In addition, the booklet provides a comprehensive guide to the use of filters and supplementary close-up lenses under various conditions. Filter factors are given for Eastman, Agfa, and Gevaert films. Fully illustrated in color and black and white. *Photo Utilities, Inc., 10 West 33rd St., New York, New York. —10 cents.*

RAILWAY LITERATURE FOR YOUNG PEOPLE is a bibliography of books and periodicals that is designed to answer many inquiries which are received by American railroads regarding various phases of operation. *Association of American Railroads, Transportation Building, Washington, D. C. —Gratis.*

THE GLUED LAMINATED WOODEN ARCH is a 124-page illustrated booklet that deals specifically with this particular type of construction, citing advantages and disadvantages and showing many of the functional applications. Technical Bulletin No. 691, U. S. Department of Agriculture. *For sale by the Superintendent of Documents, Washington, D. C.—20 cents (coin).*

Printed in the U. S. A. Press of the Wilson H. Lee Company, Orange, Connecticut.



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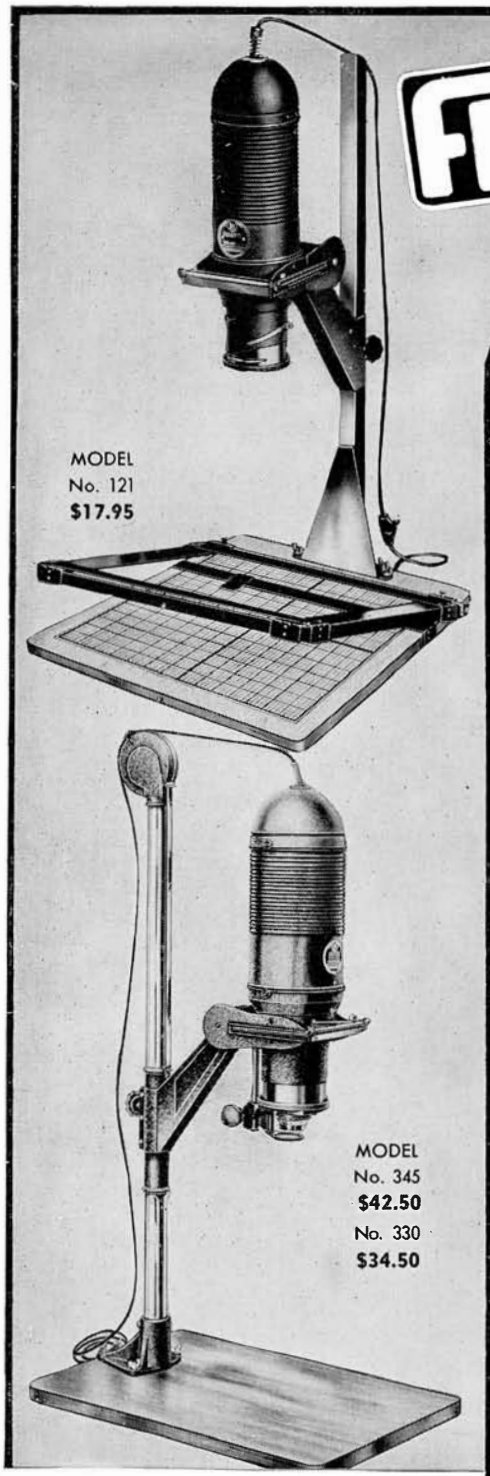

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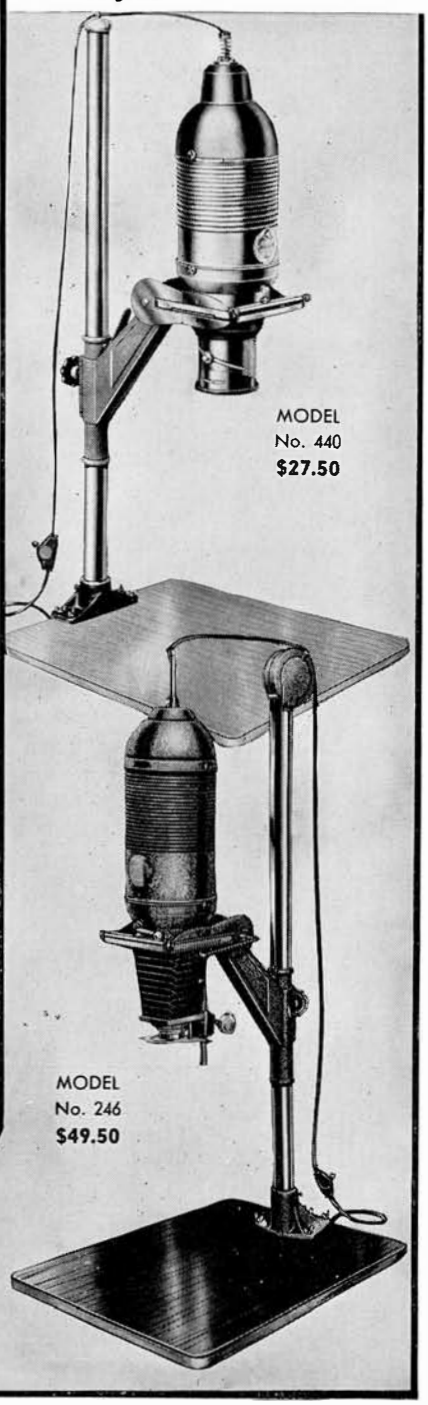

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