

SCIENTIFIC AMERICAN

JUNE • 1941

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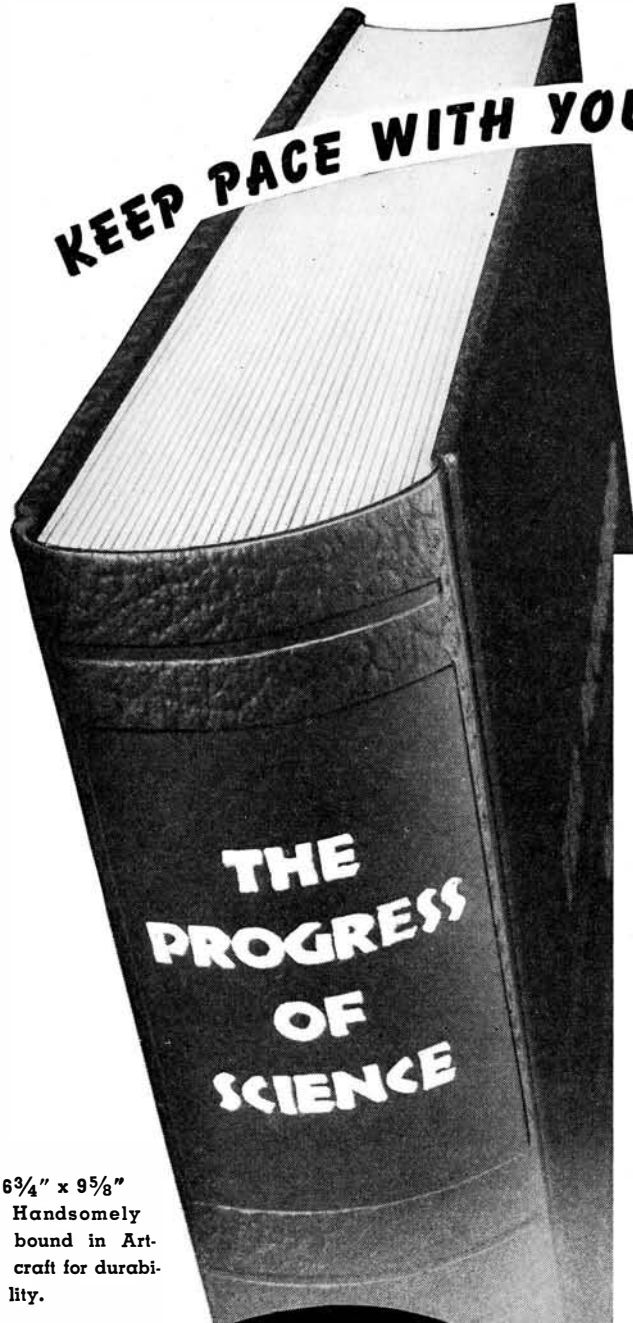
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AS AN INTEGRAL part of our system of national defense, the entire trucking industry of the United States has been organized to co-operate with the Army. The story of this organization and of the methods employed is told in the article starting on page 349 of this issue.

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SCIENTIFIC AMERICAN

Owned and published by Munn & Company, Inc.; Orson D. Munn, President; I. Sheldon Tilney, Vice-President; John P. Davis, Secretary-Treasurer; all at 24 West 40th Street, New York, N. Y.

NINETY-SEVENTH YEAR

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SCIENTIFIC AMERICAN, June 1941, Vol. 164, No. 6. Entered at the New York, New York, Post Office as second class matter June 28, 1879, under the act of March 3, 1879; additional entry at Orange, Connecticut. Published monthly by Munn & Co., Inc., 24 West 40th Street, New York City. Copyrighted 1941 by Munn & Co., Inc. Great Britain rights reserved. "Scientific American" registered U. S. Patent Office. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage. Illustrated articles must not be reproduced without written permission; quotations therefrom for stock-selling enterprises are never authorized. Files in all large libraries; articles are indexed in all leading indices. Subscription rate \$4.00 per year. Canada and foreign \$5.00.

Personalities in Science

DOCTOR DOISY, now 47 years old, is head of the Department of Biochemistry at St. Louis University. The most recent recognition of his many achievements came in February, 1941, when he was awarded the Willard Gibbs medal, one of the highest distinctions in chemical science, for first isolating and determining the chemical structure of vitamin K, the blood clotting principle.

In 1923, the same year Dr. Doisy joined the faculty of St. Louis University, he began research, in collaboration with Edgar Allen, now of Yale, on female sex hormones. Six years later he succeeded in isolating theelin, an estrogenic hormone, effective in restoring to equilibrium upset feminine endocrine systems. Since about 50 percent of all women will find estrogens useful as a remedy for nervous ailments occurring during middle age, Dr. Doisy considers the isolation of these hormones one of his most valuable contributions to medical science.

Five years ago Dr. Doisy, assisted by four expert chemists and one technician, began work on a new chemical problem. Baby chicks, when kept on a restricted diet, died of blood seepage. Why? Something vitally necessary was lacking. But what was it? For want of a better word, scientists had called it vitamin K. Dr. Doisy and his companions worked day after day from early morning till almost midnight to solve the puzzle, but it was not until 1938 that they had a substance pure enough to designate it as having characteristic vitamin K activity.

Vitamin K, a fat-soluble vitamin, promotes the production of prothrombin, a constituent of the blood which enables it to clot. The vitamin is present in green leaves, especially in spinach, alfalfa, and kale. If prothrombin is insufficient

to form a clot, blood will continue to flow from a wound until death ensues. Such prothrombin deficiency exists in newborn infants and in patients who have obstruction of the bile duct.

Of the more than 2,000,000 babies born in the United States annually, about 1.4 percent, or 28,000, die within seven days after birth, and specialists state that from 20 to 35 percent of these deaths are due to a lack of vitamin K. That means that about 8000 lives can be saved each year in this country alone by the use of this vitamin. Although Dr. Doisy was not the first to recognize vitamin K activity, he is the first to recognize two vitamin K's, K_1 and K_2 ; and the first to announce the chemical structure of each. As a result of this knowledge of their structure, he compounded a synthetic vitamin K_1 in the laboratory that is even more active than the natural vitamin.



EDWARD A. DOISY

Dr. Doisy received the gold medal of the St. Louis Medical Society in 1935, the Philip A. Conné medal of the Chemists' Club of New York the same year, and the St. Louis Civic Award in 1939. He is a member of the American Chemical Society, the American Society of Biological Chemists, the Society for Experimental Biology and Medicine, the American Institute of Chemists, and the National Academy of Sciences.

During his vacations, Dr. Doisy travels over the country in search of good fishing and the thrill of landing a prize game fish. Next to his love for angling, he has an energetic enthusiasm for shooting. Forming himself, his sons, and two bird dogs into an expedition, he likes to venture into the haunts of the quail. In his shorter periods of leisure he winds the driver, the niblick, and the putter on one of St. Louis' country club golf courses.

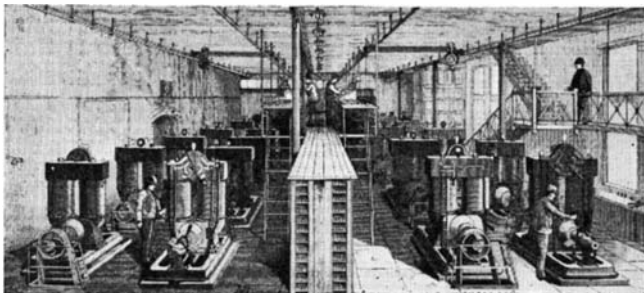
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of June, 1891)

TUNNEL—"The successful driving through of the tunnel beneath the St. Clair River at Sarnia, for the Grand Trunk Railway, under the direction of Mr. Hobson, of the A. S. C. E., is an achievement that will inaugurate an era of special activity in works of a similar character elsewhere. It is 6,000 feet long between the portals, 2,290 feet being under the river proper. It was driven through soft clays by a cylindrical steel shield forced forward by 24 hydraulic rams. . . The rams worked independently, and with such accuracy that after a year's driving at the rate of 8 feet per day, the two shields coming from opposite directions met exactly in line and level, having at no time varied more than two inches from true position."

POWER STATION—"The Edison Electric Illuminating Company, of Brooklyn, N. Y., have erected and put in operation an electric lighting station which in all its appointments ranks with the most advanced works of the kind in existence. . . The consumption of coal is brought down to a low figure, and perfected apparatus is provided



Dynamo room and regulating gallery

for ascertaining exactly what coal is burned. Thus a statement as to the pounds of coal consumed per electrical or mechanical horse power is entitled to the fullest confidence. . . The steam is supplied by eight Babcock & Wilcox tubular boilers. . . The dynamos are self-exciting and shunt-wound, and are built for an output of 575 amperes at 140 volts, but in practice are run at 650 amperes at 128 volts. Each one thus represents an output of about 112 electrical horse power and can supply 1,500 lights, representing a total of 21,000 lights in operation. . . The lamps are charged for at the rate of one cent per hour of use, and are replaced free of cost to the consumer as they fail. The well known Edison meter is used to determine the amount of consumption."

RAILROADS—"There were built in the United States, in 1890, about 6,344 miles of new railroad, giving an aggregate of 167,741 miles, or 44 per cent of the total railway mileage of the globe."

IRRIGATION—"A dozen irrigation canals are now completed, or under construction, with bed widths of 50 ft. to 70 ft. with main lines from 50 miles to 100 miles long, with as many more miles of laterals, and having capacities varying from 1,000 to 1,500 second-feet. Such canals will irrigate from 100,000 to 150,000 acres each, and will render habitable twice that area, supporting on an average 3,000 families each."

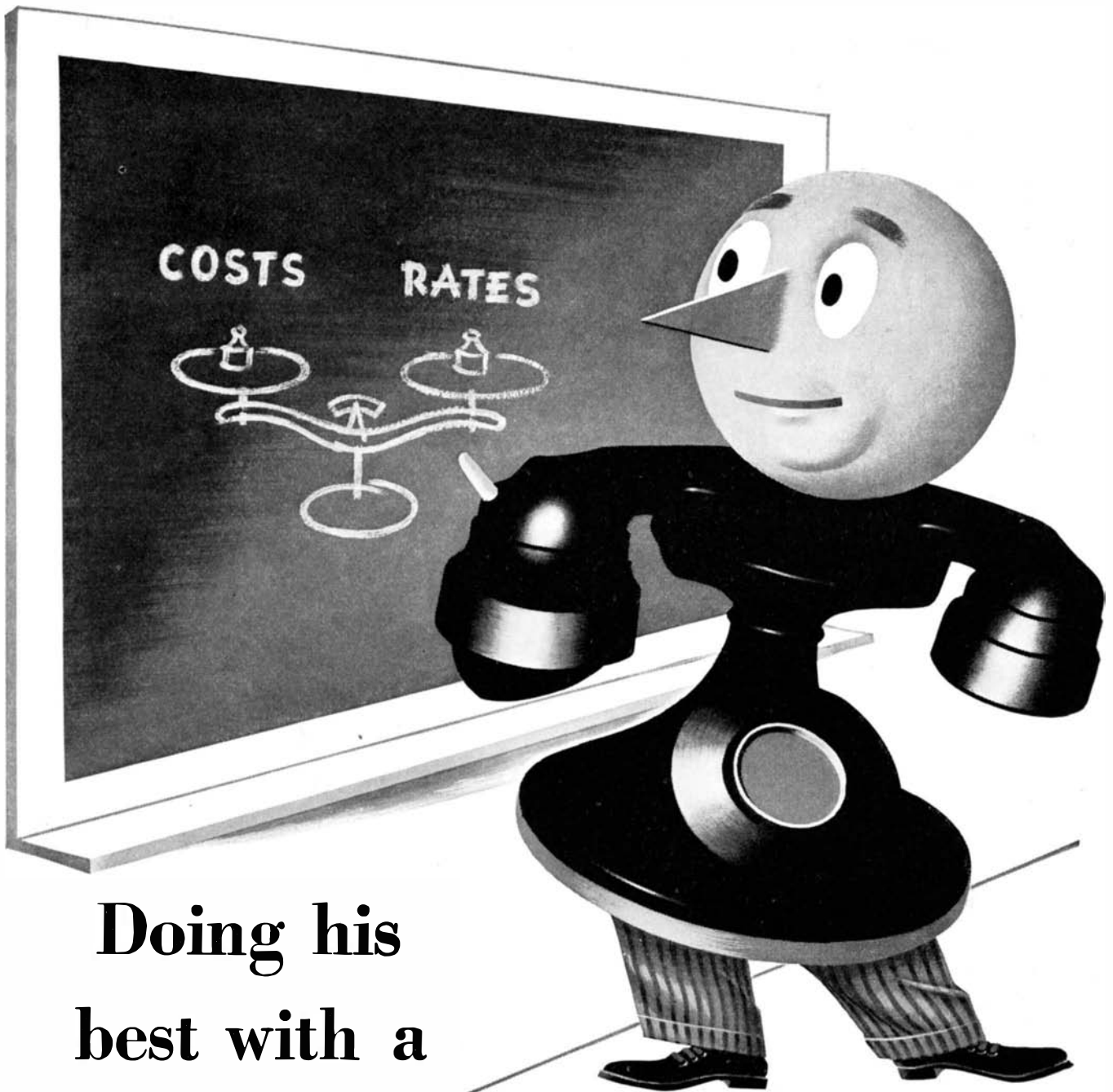
CAMPHOR—"Although the camphor tree is a native of China, Japan, and Formosa, the authorities of the United States Department of Agriculture state that it has been a subject of distribution by the department for nearly thirty years. . . While the camphor tree flourishes best in warm climates, it will stand 20 degrees of frost without being injured, and any locality where the thermometer does not show lower than 20° F. is fitted for the growth of the plant. . . Interest in the growing of camphor trees has recently been stimulated by the great increase in the price of gum camphor. This advance was caused by the quantities of the article which have been used in the manufacture of smokeless powder, and also by the increasing demand from makers of celluloid goods."

BIRCH OIL—"A profitable industry, and one of which but little is known to the world at large, is carried on among the hills of New England. It is the manufacture of birch oil. . . Birch oil has a market value as a flavor. It is used largely in the manufacture of confectionery and is sold, almost invariably, under a label that calls for the essence or extract of wintergreen. Pure extract or essence of wintergreen does not exist, nor is there any need of it, for the clarified oil of birch gives one a perfect wintergreen flavor, and it is so pungent that the smallest drop placed upon the tongue will blister it."

FLYING MACHINE—"Mr. Hiram Maxim, well known for his many ingenious inventions, has for some time past devoted considerable study to the subject of aerial navigation. . . Mr. Maxim says he has already expended \$45,000 on tests, and is now at work on a large machine of silk and steel, with a plane 110 ft. by 40 ft., with two wooden screws 18 ft. in diameter. A petroleum condensing engine will furnish the power."

ELECTRIC RAILWAY—"While electricity may not yet be able to take the place of steam as an economical motive power for railway trains, it is demonstrating its ability, when properly managed, of cutting into the business of existing steam railways. The latest illustration of this is to be found in the passenger travel between St. Paul and Minneapolis. Until recently the steam railroads have controlled this business, but an electric road is now running between the two cities, connecting with the street lines of both, and in the half year which it has so far served the public it has taken such a large portion of the patronage from the steam railways that the latter will probably withdraw from competition for the local passenger traffic between the two cities."

PROPELLER SIZE—"Screws for steamers used to be made as large as possible, it being the theory that the greater the diameter, the higher the speed. A vessel was placed on Lake Erie with a screw so large that it was deemed best to cast each blade in two parts, and then weld them together. During a storm all these blades of the propeller broke at the welding, reducing the diameter by more than two-thirds. To the surprise of the captain the vessel shot forward at a speed such as had never been attained before. Engineers then experimented with small propellers and discovered that they were much more effective than large ones."



Doing his best with a tough job

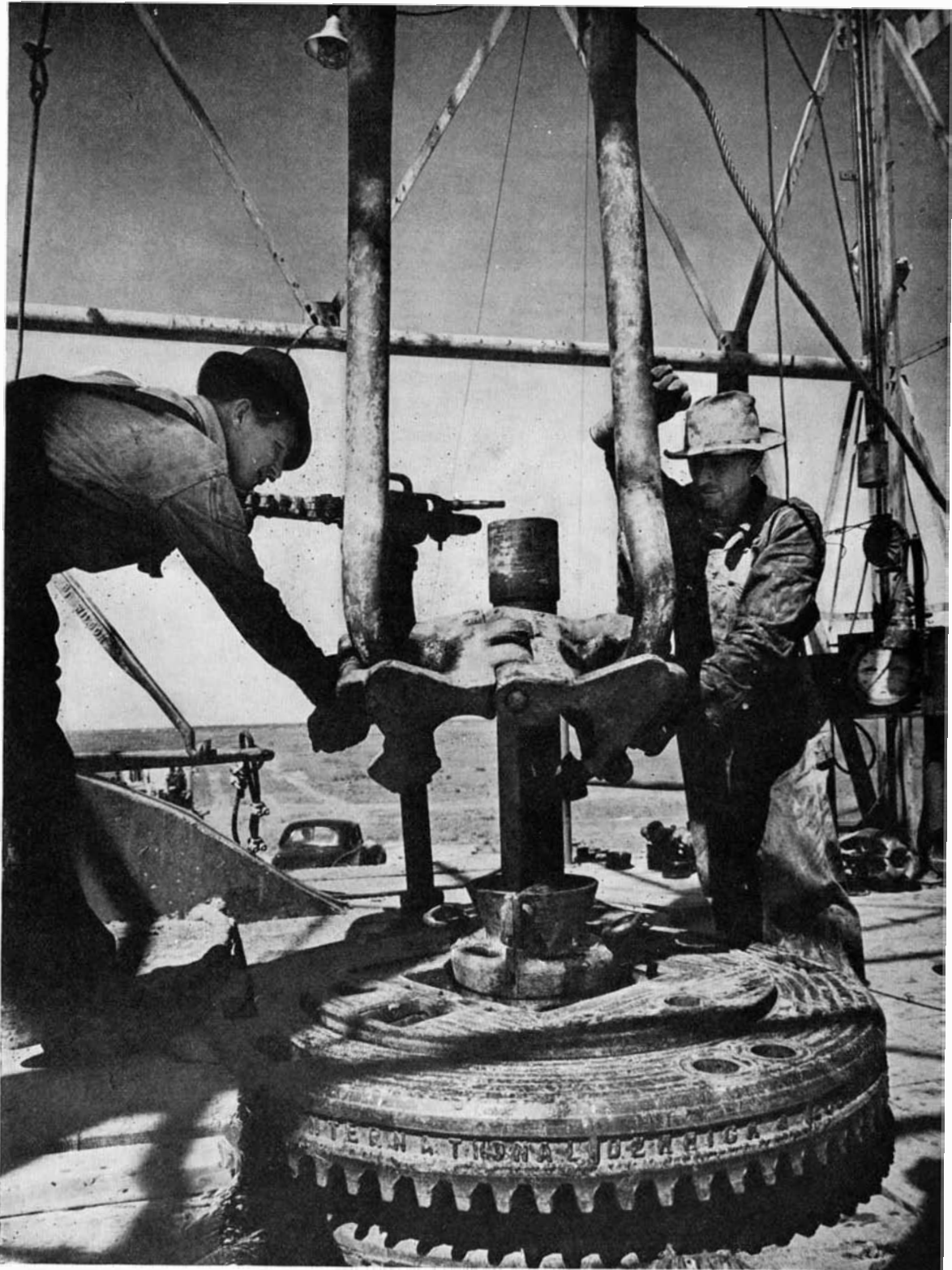
The hardest job of the Bell System is to give you more and better telephone service and yet keep rates low. It isn't easy to keep those two things in balance. Increasing costs and taxes make it difficult.

But there is no end to trying. There is never any letting up in the search for a better, more economical way. All along the line, the Bell System believes in economy in business housekeeping. That is part of its obligation to the public.

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Robert Yarnall Richie photograph. courtesy Jones and Laughlin Steel Corporation

RUNNING A STRING OF OIL-WELL CASING

GEOLOGISTS constantly search for new sources of oil, for new methods of reclaiming more of the black gold that lies in producing or apparently exhausted fields, as told in the article on page 352 of this issue. Keeping pace with these scientists are the crews of workmen who drive ever deeper into the earth, following the leads of the geologists, ever developing tools and techniques that make possible faster drilling, deeper wells, safer operation.

OUR SEARCH FOR THE SUPERNATURAL—III

Demonstrations of Rappings and Ectoplasm Explained

A. D. RATHBONE, IV

Secretary, Scientific American
Committee for the Investigation
of Psychic Phenomena

IN ACCORDANCE with a decision of the Scientific American Committee for the Investigation of Psychic Phenomena, the medium, Rose Ann Ericson, was permitted a second opportunity to demonstrate her psychic powers during the evening of Monday, March 31. As surrounding conditions had not been deemed conducive to best possible mediumistic efforts on the occasion of her first attempt, reported in our May issue, the Committee endeavored to improve them. Through the courtesy of the Hotel New Yorker, a completely darkened fourth floor room was made available, and in the presence of 35 witnesses, including members of the Committee, representatives of the press, photographers, and guests, the seance began shortly after eight o'clock.

As in the previous instance, Madame Ericson was seated at a table in the front of the room, facing the audience. On either side of her, and each holding one of her hands during the demonstration, were seated Dunninger, Chairman of the Committee, and A. Paul Peck, member of both the Committee and the Universal Council for Psychic Research. Care was taken to examine adjoining rooms to see that they were empty and that all doors to these rooms were locked. Other members of the Committee were seated in the front row to facilitate observation, and a photographer was stationed in a position suggested by the medium and instructed to take flashlight pictures at moments to be designated by her.

The lights were extinguished, utter silence was requested, and the audience was invited by the medium to join in singing, accom-

panied by a phonographic reproduction of "Seated One Day at the Organ." A miniature, electrically lighted candle, placed on the table in front of her and heavily shrouded with a handkerchief, threw a faint glow on Madame Ericson's face. Following the first musical

PSYCHIC RESEARCH

● **Scientific American, in collaboration with The Universal Council for Psychic Research, offers \$15,000 to any medium who can produce a spiritistic effect or a supernatural manifestation under the rules and regulations published on page 210 of our April 1941 issue.** ●

rendition, the phonograph played "The Lord's Prayer," and the voices of some of those present blended softly in singing the hymn.

A moment or two passed. Then the medium's voice was heard, and the music and singing ceased abruptly. In a slow, calm, unruffled manner, Madame Ericson said that she could see a "gentleman and two young men. They have been over quite a while. They passed over in an accident. Does anyone recognize them?"

There was a pause, but no one answered. The medium then said she saw a young child with a speech impediment, that the person in the audience concerned with the child was not well. The initials of this person, she continued, "are J. K.—J. K.—is there anyone here with the initials J. K.?"

Mr. Joseph H. Kraus, member of the Committee, admitted the initials, but said that he could not recognize either the references or the description. Following a brief silence, Madame Ericson brought two other alleged spirit messages,

one for a man who acknowledged his initials were "D.D." and one for a lady with the initial "O." There was another pause, after which the medium announced she would endeavor to contact the spirit of Mrs. Amelia Earhart Putnam, which she claimed to have contacted before.

A brief interlude of music was followed by complete silence, in the midst of which two distinct raps were clearly heard by those in the front of the room. Then Madame Ericson's voice, now slightly strained, said, "Thank you, spirit." She then continued: "I am greatly troubled in the place where I am. I cannot give you full details. I am disgusted by the comments of Colonel Lindbergh; he forgets the time when he crossed the ocean in a shoe box." [It was now evident that this purported to be the spirit of the late internationally known aviator, Mrs. Amelia Earhart Putnam, speaking through the mediumship of Madame Ericson.—*Ed.*] "We must hurry to prepare—there is great danger. I am a loyal American and I can and will send forth my spirit to help. I must warn you, do not listen to the remarks made by someone who does not know the full extent of the situation."

THERE was a sudden break in the message from the spirit of the aviator as the medium said: "Keep your eyes to the right—to the right—out from the table. I see eyes, yes, there are eyes. Will you take a picture, please."

The dazzling flash of the photographer's camera light doubtless startled and momentarily blinded everyone in the room, but Dunninger spoke up quickly and said: "Where are these eyes? Did any

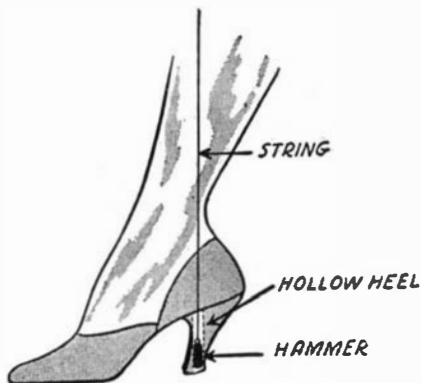


Although this picture was taken at exact instant "eyes" were alleged to be visible, neither audience nor camera visualized the phenomenon

member of the Committee see eyes? Did anyone see eyes?"

Mr. Kraus, who sat in the front row, stated he had seen something, that it appeared to be two lights, but that he could not be certain they were eyes. He added that what seemed to be lights might have been brought about by the after-effects of the flashlight bulb. The medium, however, asserted the entire form of the spirit had been clearly visible to her, but no one in the audience could substantiate the claim, nor did Madame Ericson describe the spirit's appearance.

Another short interlude of music was followed by a plea from the medium asking the spirit to "come over" and a statement to the effect that someone was making an "awful noise." There then ensued a period of silence followed by a single rap, then two raps, and a statement from the medium that she was finding it difficult to recall the spirit. Two more single raps



Another method of producing raps. Medium skilfully manipulates a string; hammer strikes

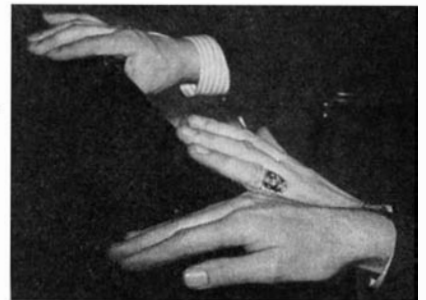
were heard and again Madame Ericson claimed that eyes were visible and that there was a strong psychic power extending directly across the table toward Dr. Thornwell Jacobs, the Committee member who was seated on the aisle in the first row. At the medium's request, two additional pictures were taken, after which an assistant asked that the lights be turned on.

MADAME ERICSON appeared to be tired, and during a brief rest period Dunninger again asked about the eyes. Had they been visible to anyone in the audience either on the first instance or the second? Mr. Kraus repeated he had seen two points of light, but that in his opinion they could have been after-reflections resulting from the flash bulb used in taking the photograph, and that he could see no resemblance to eyes. However, two people in the back of the room, later identified as Mr. Edward Rider, 121 West 72nd Street, New York City, and Mrs. D. Woods, 320 West 25th Street, also of New York, both asserted they had seen the eyes. These two witnesses were in the next to the last row of chairs and both were more directly in front of the medium than was Mr. Kraus, but no one else, not even those seated on either side of the aisles, and also directly in front of the medium, had been able to see any phenomena.

Dunninger then asked Madame Ericson if she could make one final attempt in order to test this apparent discrepancy. With the usual

preliminaries, the medium tried once again, although it was evident that she was under a severe strain, and once more there was a series of rappings, after which the medium said, "Thank you, spirit," and continued with, "I am contacting some one. This person is coming back for the last time and to an individual in the front row. Can anyone see the figure? It is very plain. Please take a picture." This was done and the last demonstration, of extremely short duration, was declared terminated as the lights were switched on.

In summing up the evening's efforts, Chairman Dunninger said: "Once more we will have to depend on the photographs to determine whether there was any psychic phenomena present in this room, and the photographs will, of necessity, form the sole and conclusive evidence of the presence of a pair of eyes, inasmuch as only two people out of the entire audience



With restraining hand resting on fourth finger of medium's hand, ring finger is still free

feel positive that this phenomenon was present."

Subsequent development of the negatives gave no indication of the existence of any form of psychic phenomena at the demonstration.



Report of the Committee on The Efforts of Rose Ann Ericson

THE Scientific American Committee for the Investigation of Psychic Phenomena later met to determine the degree of validity of such psychical phenomena of a physical form as had been demonstrated. Inasmuch as but two witnesses out of the 35 present claimed to have seen eyes, it was agreed that this did not constitute a sufficient number to warrant investigation of this phase of the demonstration, and it was felt that the surmise by Mr. Kraus, that the "eyes" could have been after-effects of the flashlight

bulb, was in all probability the correct version of the incident.

In view of the fact that the Committee is concerned only with psychic phenomena of a physical nature, the so-called spirit messages did not come within its jurisdiction, which left only the matter of the infinitely small ectoplasmic demonstration during the first seance—of which Dunninger had apparently been the only witness, due to the fact he sat next to the medium—and the spirit rappings heard at both seances, much louder and more frequently at the latter one.

"There are, therefore," Dunninger stated, "two things to be duplicated or explained through natural or scientific means—rappings and ectoplasm." Rappings, he explained, can be physically accomplished by several means, such as the use of the shoe against the leg of the table, or the manipulation of a large and heavy ring on one of the fingers. He called the Committee's attention to the fact that Madame Ericson's feet were neither bound nor in contact with those of any other person during either of the seances, and that she habitually wore a very heavy ring on her left hand, and had worn it on both evenings. In neither case, he pointed out, had she operated under test conditions, but had been given every opportunity to demonstrate her alleged psychic powers. Had she produced psychic phenomena of sufficient import to be observed by more than one or two persons, she would then have been subjected to severe test conditions.

Using his foot and his own ring, Dunninger demonstrated how rappings could be produced, even though the hands of the medium had been held by himself and by Mr. Peck. In this latter connection



Dunninger demonstrates to Dr. M. Luckiesh, of General Electric Research Laboratory, and A. P. Peck how a medium may manipulate ring finger in total darkness, thereby producing rappings on edge of the table

he explained that the medium had several times asked him to turn on or off for her, as she desired, the small, shrouded electric light bulb which had stood on the table during both demonstrations, and each time he had complied with her request her hand had momentarily been free. She had not been requested to permit her feet to be in contact with those of others in order to prevent the use of her shoe against the table leg to produce rappings.

Dunninger explained that the effect of ectoplasm can be and has been accomplished in so-called spiritistic seances through use of a small vial or capsule, containing a concoction of such simple, everyday substances as glycerine, egg-white, and soap. Dioxygen, also, has been utilized. The tiny vial or capsule is easily concealed until the moment the medium desires to make use of it. Then, inserted in the mouth, or the capsule broken, the "mysterious" substance will appear on the lips. In the instance of Madame Ericson's first seance before the Committee, no one but Dunninger saw any evidence of an ectoplasmic substance, and as the medium's assistant had removed with her handkerchief the slight trace of foam from Madame Ericson's lips before Dunninger or anyone else could obtain a specimen for analysis, the Committee was in full agreement that the matter of ectoplasm needed no further

consideration at this time. It was decided, however, that should another applicant for the award at some future time produce an ectoplasmic type of phenomenon of sufficient magnitude and duration to be observed by properly attested witnesses, a complete study of the subject of ectoplasm should then be made.

At the conclusion of its discussion of the two seances thus far held under its jurisdiction, the Scientific American Committee for the Investigation of Psychic Phenomena unanimously agreed that the medium, Rose Ann Ericson, had produced no psychic phenomena that not been satisfactorily duplicated or explained through natural or scientific means.

● The interest already exhibited by our readers and by the public at large in our search for the supernatural is indeed gratifying. Many letters have been received suggesting projects or phenomena which our Committee might investigate. Among these are a house which is reported to be inhabited by a vampire spirit; an alleged "spirit photograph," valued by the owner at \$10,000.00, and other matters. As rapidly as possible they are receiving the attention of the Committee, and those that warrant further examination will be reported on in these columns in future issues. The Committee will at all times welcome letters, suggestions, and criticism, and acknowledgment will be made of such contributions as quickly as possible.—*The Editors.* ●



Showing how an unguarded foot may be used against table leg

A Skin Game in Metallurgy

Longer Life and Greater Productivity Given to Tools and Machines by Heavy Chromium Plate

RAYMOND F. YATES

CHROMIUM supplies a skin over other metals that metallurgists love to touch. When deposited over inferior metals, chromium supplies a hard coat of armor that not only resists most chemical action but also, when present in sufficient quantities, wards off blows and parries frictional wear with truly remarkable efficiency.

Some notion of the power of chromium to resist mechanical abrasion may be had from the fact that automobile bumpers carry a deposit of the metal only 1/200,000 of an inch in thickness. Now, however, we are not so much interested in the decorative uses of the metal as we are in its use as hard, wear-resisting armor plate for the protection of steel, iron, and certain alloys. Harder by far than even the hardest steels, close-grained, tough, and capable of withstanding high temperatures without surrendering any of its valuable properties, chromium serves as the armor to shield many of its lesser cousins in the metallurgical field.

Although attempts to deposit chromium electrolytically were made as early as 1835, little or no success was had until the late 1920's when Fink, of Columbia, turned his skilled and fertile mind to the problem. Sargent, of Cornell, had stimulated interest in the matter during 1920 when he read a paper on the subject.

Perhaps the metallurgists of the United States Government Printing Office were the first to recognize the value of heavy deposits of the metal ranging .002 inch or over. Steel engravings for the printing of greenbacks were protected against early failure by surprisingly thin deposits of chromium. At that time, however, the deposition of really heavy plates imposed problems that for a time appeared almost insurmountable. When deposits ranged beyond modest thick-

nesses, microscopic fissures would appear and adhesion also became precarious.

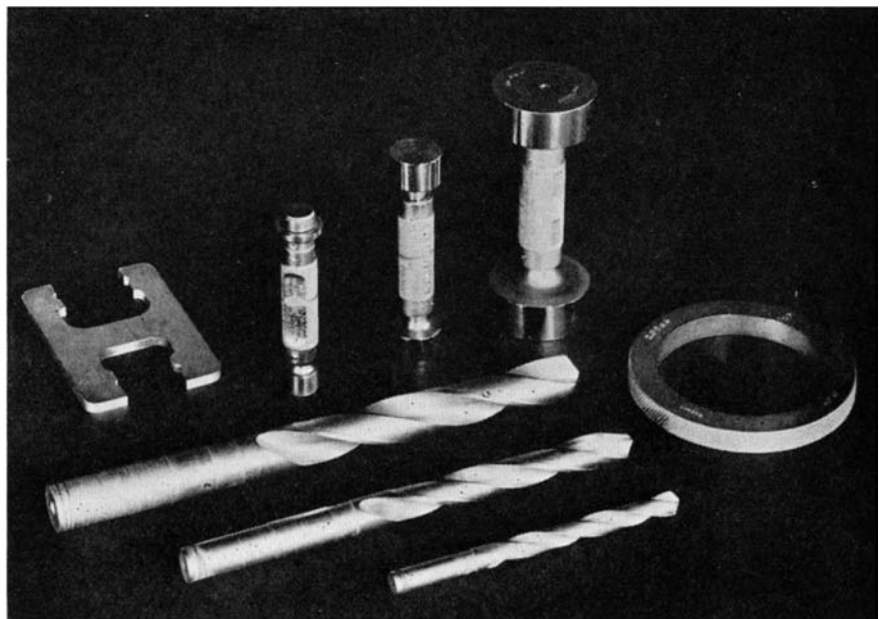
Within a few years time, the researchers hung up still another hide on the barn door and chromium became available for making deposits as thick as .025 of an inch—about twice the thickness of a Government postcard. It is such deposits of chromium that are today working new miracles in the machine and tool field. Strangely enough, electro-deposited surfaces of the metal are harder than the metal refined by other means. They may run anywhere between 400 and 950 Brinell, depending upon the conditions of deposition and the nature of the basis metal.

We can not hope to cover all of the applications and ramifications of our subject within the confines of this article; consequently we shall place emphasis on the more common uses of the metal. It follows also that the more common uses will naturally be the most important ones.

Dr. D. A. Cotton, of the Delco-Remy Corporation, was one of the early experimenters with hard-

chrome, as it is now called, and many valuable innovations in the use of the metal issued from his busy laboratory. At the present time, Dr. Cotton is saving his company about \$15,000 annually in reclaimed tools and gages alone. Plug, snap, and other types of gages are not only expensive but in a sense highly perishable. No matter how expensive the steel from which they are made, a few thousand applications finds them worn to the limit of tolerance. Until recently, it was necessary to discard worn gages and purchase new ones. Now, however, they can be placed in a hard-chrome tank for a short time and plated until they are oversize. They are then removed, ground down to size, and placed back in service actually better than new because they will not be reduced so rapidly. The process of reclamation may be repeated again and again and there is no reason why a single gage can not be used almost indefinitely. In such instances, really heavy deposits of the metal are not needed. They are usually less than .0005 of an inch. Yet even this extremely thin tissue of chromium puts up a far braver front than the finest grades of steel.

IT HAS been found that over 100 applications of hard chrome may be made in the average manufacturing plant—not only in the salvaging of worn parts but also in the preservation of accuracy, the reduction of wear on moving machine parts, and the increase of cutting and drawing efficiency. Nor



Snap plugs, gages, and drills are only a few of the tools of industrial production that gain longer life, greater efficiency, through hard chrome

is the process limited to old or used devices. Brand new files, after a few minutes treatment in the chrome tank, will cut 20 percent faster, last 400 percent longer, and show far less tendency to foul.

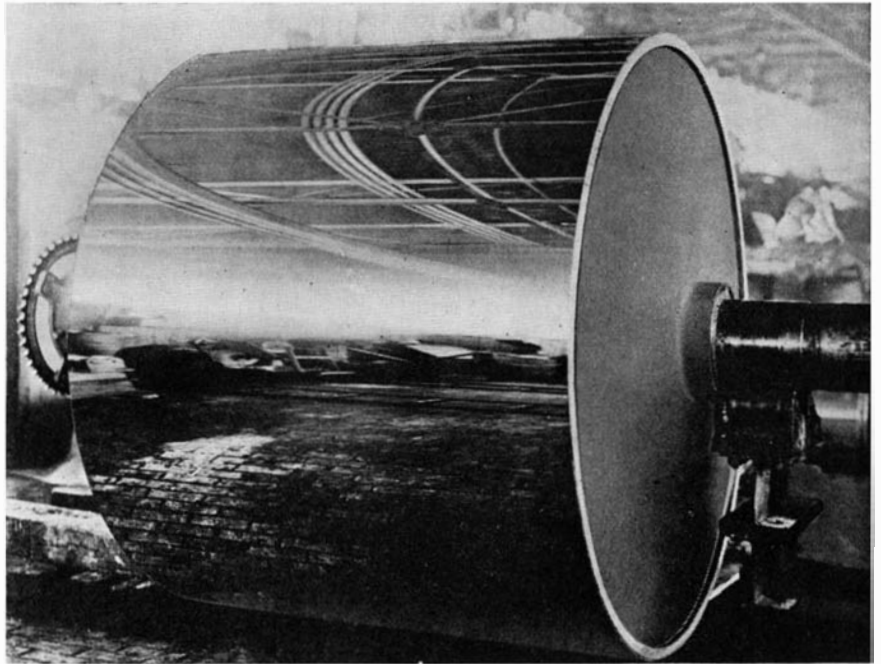
Among the more common tools benefited by hard chrome coverings are taps, dies, broaches, bur-nishing tools, drill jigs, hobs, rolls, chuck heads, cams, drawing dies, coining dies, header dies, and molds for plastic resins, rubber, and so on. In every case there are savings both in equipment and efficiency.

The manufacturers of certain machines are belatedly becoming cognizant of the superior qualities of chrome-plated surfaces. Many tools and other devices are now reaching the market protected by this metal.

As has been very aptly said, most metal working machinery represents what we might call "taking off" tools; the hard-chrome plating tank could very well be called the first "putting on" tool. With hard-chrome tanks coming into use in tool rooms all over the country, the machinist can easily get out of trouble in this way: He shuffles into the plating room, produces a chunk of steel from his coveralls pocket and says, "Say, Doc, can you put a half-thousandth back on for me?"

HERE is a story recently told. Work had been all but completed on a series of molds worth about \$6000. From the engineering department came word that a slight but important change in measurement was imperative; indeed it amounted to the difference between success and failure. Metal that had been cut away must be replaced. A few years back, the whole \$6000 worth of material would have been scrapped. Production would have been delayed and there might have been a change in personnel. Within three days time, however, and at a cost of about \$200, the damage had been repaired by chromium. The metal, in this case, had to be deposited to a thickness of .024 of an inch. This thickness requires about 80 hours of continuous plating.

Some of the feats now being accomplished by hard-chrome experts are almost beyond belief. A mid-western producer of automotive accessories found that, through unavoidable conditions, a 3/16-inch square hole in 24 dies had to be made smaller by several thou-



Used in paper manufacture, this 72-inch diameter steel drum, face area 13,570 square inches, is chromium plated and polished to a high luster

sandths of an inch. The job was done quickly, by chromium, with a saving of some \$10,000.

The hard-chrome tank is also helping the punch press and the die maker over tough spots. It was found that a blanking and forming die used to produce a stainless-steel cap for an ignition lock had an annoying tendency to tear the work on the radius. Failure to produce clean work occurred at the end of every 1500 or so operations. A little hard-chrome in the right area brought the production up to 20,000 before the trouble re-appeared.

Prior to chrome plating, the principle use of chromium was in alloys. It was far too hard and too brittle to be worked by any known machine methods. Even the best grinding wheels fought a losing battle with it. Electro-deposition, however, made chromium buckle down, so to speak. It brought it under control and permitted it to be used as a casing for less able metals. Even as far as the art has gone to date, that which has been accomplished can only be an insignificant part of what the future holds.

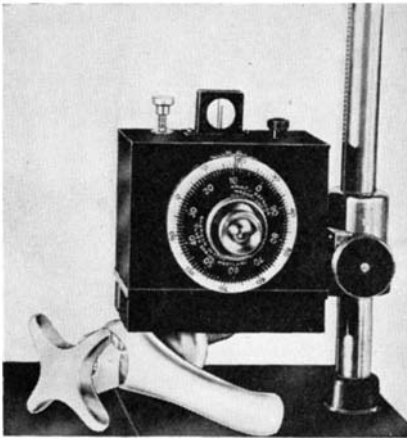
A little chromium goes a long way. As little as 1/100,000 of an inch of the metal applied to a new drill permits it to be used from five to eight times longer in drilling non-ferrous and plastic materials. Such inexpensive treatment creates desirable economies.

Pressures up to 6000 pounds to

the square inch are now being used in hydraulic presses in the plastics industry. Rams in the larger presses vary between eight and 14 inches in diameter and considerable expense is entailed in keeping the packing rings of such equipment functioning in a leak-proof condition. Even with normal eight-hour day operation, re-packing must be done monthly and the cost, to say nothing of the loss of the use of the machine, varies between \$130 and \$150. More and more, molders of plastic materials are turning to hard-chrome for help. One press, after having its ram plated with a thin deposit of this metal, remained in operation continuously for eight years without being re-packed.

CHRONIUM applied to draw dies not only permits them to hold up in service for a longer period but also prevents score marks and increases production. Punching dies of all types can be helped by chromium deposits. Up until a short time ago, however, it was thought that the extreme hardness and consequent brittleness of the metal would prevent it from being used successfully on dies of the shear type. However, this theory has now been pretty well battered down. Hard-chrome, placed over a large die intended for armature laminations has increased between-grinds production from 50,000 pieces to 150,000 pieces.

One finds chromium bobbing up



Thickness of hard-chrome plate is accurately measured, without destruction, by electrical gage

in the most unexpected places. It is now being used widely on soldering jigs but not alone to prevent wear. Due to the peculiar nature of the metal, other metals show little or no mechanical affinity for it. This is true of any kind of solder. The molten metal falls upon the chrome and promptly rolls off.

Often as little as an hour in the hard-chrome tank will produce sensational and fantastic results in prolonged life, increased production, and lowered costs. In making automobile horns, as an instance, it was found that a swaging die, used in the production of the horn proper, created trouble later in the welding operation. The engineering department finally overcame the difficulty by substituting a coining die. Here, however, a new headache developed. This die frequently galled and production was seriously interrupted several times daily. Some one in the plant thought of hard-chrome. The die was sent down for treatment. It came back a few hours later and proceeded to turn out nearly a million pieces without interruption before it was finally called out of service.

There are a number of mysteries about chromium and its ability to "take it." For instance, a very small difference in hardness readings on the scleroscope may mean great differences in wear resistance. A steel gage showing about 87 scleroscope reading will provide 9970 checks before the limits of its own tolerance has been reached. When such a gage is plated it may read as low as 97 and yet will stand up perfectly in service for 48,024 checks with wear at .0002 of an inch. Apparently the metal is not only hard and resistant; other

metals passing over move with minimum resistance and hence minimum wear.

It is not in the machine-tool industry alone that hard-chrome is making all of the progress. Indeed, its applications are broadening out so rapidly now that it would be difficult to estimate the number of industries where it has become a factor. It is known, however, that both the paper and textile industries are feeling some of the many benefits of chromium plating. Deposits on large, heavy steel rolls are made as thick as .020 and it is not unusual to have such plating

cost as much as \$6000 a roller. Several days of uninterrupted plating is required. Because chromium plating requires as high as 1000 amperes per square foot, these larger rollers are slowly revolved through a trough of the solution with only a few square feet exposed at a time. Thus is the current consumption kept within reasonable limits.

This is by no means the complete story of hard-chrome. It is enough, however, to show definitely that here is something comparatively new on the industrial scene that is indeed worth watching.

New Brazing Method Cuts Costs

Fusion Process at Arms Plant is Applicable Throughout Many of the Metal Industries

A. P. PECK

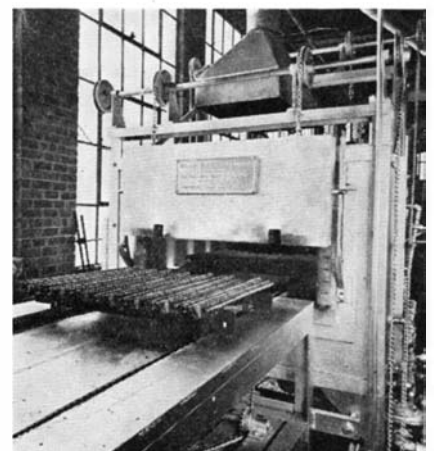
IN an endeavor to introduce mass-production principles into the brazing of shotgun barrels—a hand-soldering process on each individual gun until now—there has been developed a gas-operated brazing furnace for which application will be found in almost any branch of industry where fusion of metals is a necessary part of the manufacturing operations. This new furnace effects a union between shotgun barrels heretofore unequalled in strength, is so clean in its operation that most of the grinding, filing, and polishing formerly necessary in gun manufacture has been eliminated, and offers other potential economies to metal-working industries.

It all began when Frank T. Green, of the J. Stevens Arms Company, invited M. R. Utley and B. K. Walpole, of the National Gas Furnace Company, to design a mechanism capable of brazing 200 sets of shotgun barrels a day, thereby inaugurating the first radical change in almost a century of scatter-gun barrel construction. After accepting this challenge, earlier refused by other engineering and research organizations who said it couldn't be done, the furnace was constructed, installed in the Stevens factory, and experi-

mental operations were begun.

Today, the arms company, with the aid of the new brazing furnace, is turning out 400 sets of gun barrels a day, has eliminated a number of cumbersome operations, reduced labor cost 40 percent and, in producing the only all-brazed shotgun now manufactured, has cut down the "touching-up" operations on the joined sections by 80 percent. Outstanding among the improvements achieved by the new braze are the additional strength imparted to the barrels where they are fastened together, the cleanliness of operation, and perfect alignment of shell chambers and barrels.

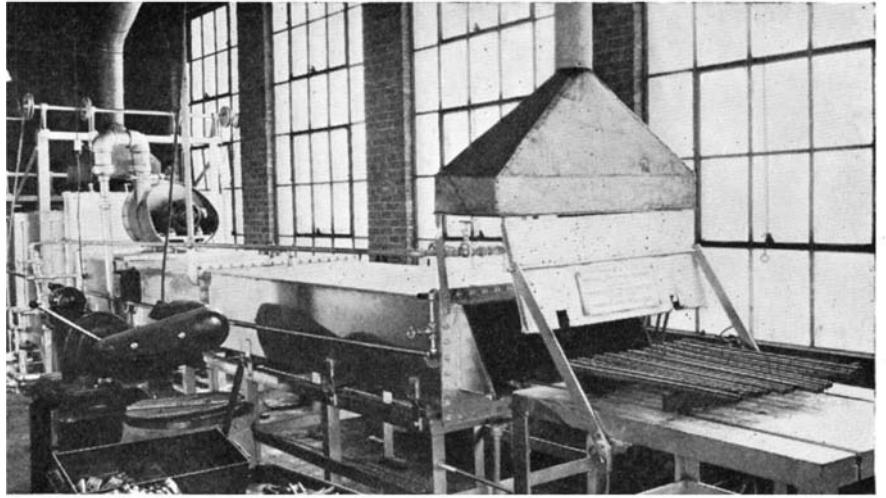
As many shotgun owners have



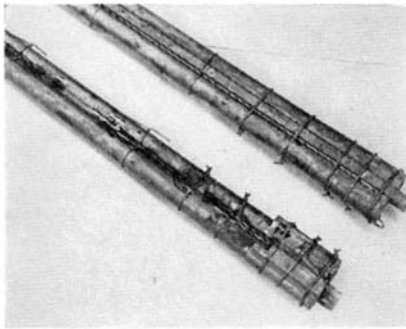
Tray-load of shotgun barrels entering new brazing furnace

learned to their sorrow, the soldered twin barrels of a shotgun will occasionally split apart at the rib under sudden changes in temperature. Intense shooting heats the barrels to a degree decidedly uncomfortable to the bare hand, and, under such conditions, when the metal has cooled too sharply and abruptly, the barrels have been known to split apart, or the connecting rib to come loose.

A tension load of about 60 pounds has been capable of pulling the rib loose from the old solder braze. In making such tension tests, sections one-quarter inch long were sawed out of the barrels midway between breech and muzzle. Each section was tested by suspending



A tray of shotgun barrels comes from furnace about every fifteen minutes



Left: Ready for brazing. Right: Barrels emerge clean, free from burrs

one barrel from a fixed bar and applying a static load by hanging weights from a hook secured to the other barrel section, the load being gradually increased until the joint between the barrels gave way. An average of the test loads indicated a tensile strength of about 60 pounds for the joint. Not so with the new process. Under similar tests it was found that excessive pressure would tear the metal of the barrels themselves before the braze would let go.

As to cleanliness of operation: Pitting of the metal, often excessive under the old 2000 degrees, Fahrenheit, process, has been entirely eliminated, as has also warping of the chamber section. Grinding and polishing the brazed barrels and butts to eradicate pits, burrs, and lead spots is no longer required. The tedious hand-filing and cleaning-up process, always a necessary evil in shotgun barrel manufacture, is now as antique as a muzzle-loading matchlock. Furthermore, it has been found that this trait of "sanitation" is particularly acceptable in the building of the over-and-under combination rifle and shotgun, which incorporates a .22-caliber rifle barrel and a .410 bore

shotgun barrel in the same firearm. For obvious reasons the rifle barrel must be rifled before its marriage to the shotgun barrel, yet when one of these combinations comes out of the furnace, and subsequent light pickling tanks, the barrel interior is so perfect that it is only necessary to hand-wipe it, and the grooves and lands of the rifling are as clean as the proverbial hound's tooth.

The furnace utilizes ordinary illuminating gas and brazing is accomplished at a relatively low temperature, the "atmosphere" within the furnace being in reality a by-product of the burned gas used for heating, but the secret of the process lies in perfecting control of both temperature and time to the Nth degree. The rate of cooling after the braze has been completed is fully as important as control within the furnace itself, so great care is taken to maintain the correct degree of heat throughout the long cooling chamber and properly to time the cooling period.

To accomplish this a number of carriages are moved along a grooved track by an endless chain. Five of the carriages, each with its load of gun barrels, are in the 32-foot long apparatus simultaneously, one being in the furnace proper

while four are in the cooling chamber. Through months of arduous trial and error, during which thousands of gun barrels formed the basis of experimentation under the sharp scrutiny of experienced barrel inspectors, it was learned that the entire process requires about one hour for five loads, depending on the type of barrels, from entry into the oven proper to exit at the end of the cooling chamber. As each carriage transports from 10 to 15 double barreled shotguns, it will readily be seen that after all these years a method has been found to apply mass-production methods to brazing operations in the shotgun industry.

SKILL and care are needed in preparing the barrels for brazing, there being seven separate pieces in the complete assembly. As the breech of the barrel is heavier than the muzzle, because of the presence of the breech lug that later becomes part of the breaking and locking mechanism, and as thickness of barrel walls varies from butt to muzzle, the location and tension of the encircling wires shown in one of the photographs are important factors. They, together with judicious use of heat equalizing bars and shields, help to counteract the variations in expansion and contraction of the different thicknesses of the metal, but, again, the real key to the process lies in absolute perfection of time and temperature control.

A special brazing alloy, which flows easily at even lower than the critical temperature of barrel steel, and a flux which fuses by capillary action, are placed at points along the joined sections of the wired barrel assembly. This brazing alloy, it is said, is as costly per

ounce as is the customary solder per pound, but as less of it is needed, as there is practically no waste, and because of mass production and reduction of operations, the total material cost per gun has actually been reduced.

The actual building of the furnace did not present so much a problem of manufacturing as it did one of lengthy research and engineering. Thus, 140 years after Eli Whitney evolved the first principles of American mass production to fulfill his contract for United States Army rifles, the arms industry is again responsible for a manufacturing process, the possible applications of which are relevant to almost any branch of industry where fusion of metals is a necessary part of the operations.

FOIL SUBSTITUTE

Coated Paper to Replace

Aluminum

MORE and more is going to be heard in the near future about methods and materials for replacing those substances which are essential for national defense and, of course, aluminum is the metal which is foremost at the present moment in this particular respect.

Aluminum foil has been widely used by the packaging industry in the past, consuming a considerable amount of this vital strategic material. Now, however, there has been introduced by the Reynolds Metals Company a substitute for this foil.

The finish of the new product is

equivalent to a matt-finished aluminum, silver, gold, or colored stock, and is produced by coating a hard finished paper board with an aluminum powder compound made from scrap. This coating in turn is covered with a clear or colored plastic finish. It is stated that while this new finish actually costs more than does aluminum at present prices, the manufacturers believe that it can eventually be produced at comparable cost.

MATTING

Tested on Floors

Soaked With Oil

NEOPRENE floor matting, designed specifically for use where it might be exposed to oil, has proved its worth in a test installation where more oil is present than is ordinarily found in any industrial location—the oil processing rooms of an oil refinery.

In this test, strips of rubber and neoprene floor matting were installed in two locations where oil would be present on the floor to the greatest extent.

The first location was the floor in front of oil can filling machines. Here the mats were constantly subjected to spillage from the machines and were walked upon by the workmen. At the end of three months the standard rubber mat was quite changed in that the material was soft and spongy. The neoprene mat did not appear to be any different in appearance or condition than at the start of the test. These facts are indicated to some extent by photographs of the corners of the

two mats which show exactly how the mats looked when they were taken from the floor.

A second set of mats — rubber and neoprene — was placed beside a grease cooker. During the period of the test, three months, both mats were subjected to heat, oil, soda lime, and considerable traffic from steel-wheeled trucks. At the conclusion of the test the neoprene mat did not appear to be affected by this severe service except for indentations caused by heavy drums which stood upon it throughout the test. The rubber mat was very soft and it had deteriorated badly in spots.

After the mats were removed from the test location, they were turned over to the laboratory where accurate measurements further demonstrated the value of the neoprene products for this type of service.

Inasmuch as this test subjected the matting to service considerably more severe than that usually encountered, it enabled a rapid determination of the comparative value of the neoprene matting. The results demonstrate the superiority of neoprene for use where petroleum oils and greases are present in appreciable quantities.

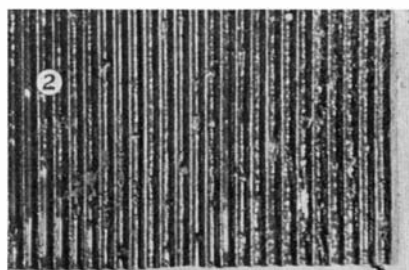
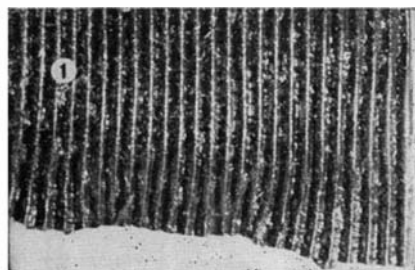
MOLDING

Extruded Plastic Replaces

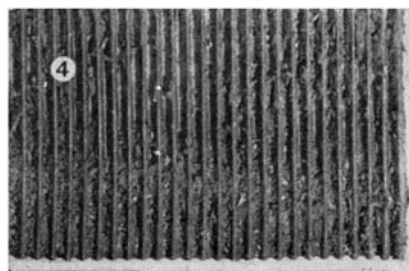
Metal Strip

THE diversion of aluminum and other metals to purposes of national defense has resulted in many substitutions of other materials. In the past, extensive use has been made of extruded aluminum and bronze for moldings of various kinds. Cover moldings for joints and corners of walls made of sheets of wallboard, plywood, and so on, have hitherto been made principally of these two metals, as well as of chromium-plated steel. To replace these, there is now available an extruded plastic molding that is being turned out in shapes duplicating the metal strips formerly used. One of the plastics used for this purpose is extruded Tenite, the finished molding being designed so that it will hold itself in position.

Since this material hardens simply by cooling, the molding can be rapidly extruded in any desired shape and immediately coiled or cut to length. It is produced in finished form; no further processing or shaping is necessary.



Comparison tests of rubber and neoprene matting. See the text



Because of the design of Tenite molding, it is possible to place the plastic along the seams and fit it into the cracks. Once inserted, the molding is held firmly in position by a flanged portion of the strip which prevents the plastic from loosening, just as the barb of a fish-hook prevents the hook from being readily withdrawn.

These plastic moldings are produced in a wide range of color which gives the architect great freedom in design. The color is an integral part of the plastic and will not chip or wear off.

CHROMIUM TEST

Salt Spray Checks

Plating Efficiency

SALT spray, notorious enemy of practically all bright or plated metal surfaces, is being used to test chromium plated parts for automobiles. In the Pontiac plant it is reported that all such parts are placed for 24 hours in a salt spray cabinet, during which time a continual spray of cold water containing a 15 percent solution of brine plays on the parts. The least evidence of rust after this 24-hour exposure is sufficient cause for rejecting any part.

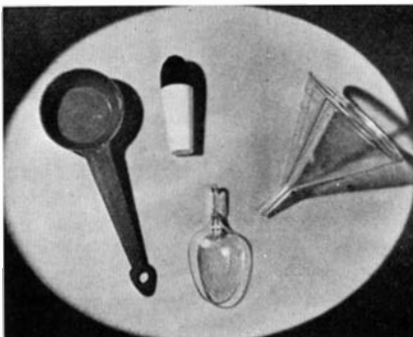
A sidelight on these tests is that it has been determined that the depth of chromium plating has but little bearing on its ability to withstand rust. Smoothness and freedom from tiny breaks or pinholes are the most desirable qualities of chromium plating.

METAL SAVING

Plastics Fill Needs

in Many Fields

STILL another example of the substitution of plastics for metals is that recently announced by the



Formerly made of metal

Closure and Plastics Division of Owens-Illinois Glass Company. This organization is now manufacturing, out of plastic materials, many items which formerly were available only in aluminum.

Among the most recent of the products which fall in this category are a polystyrene funnel, standardized teaspoon for medicinal dosages also made of polystyrene, a plastic measuring spoon for coffee, and a two color inhaler of opaque plastic which already is in use in the field of proprietary drugs.

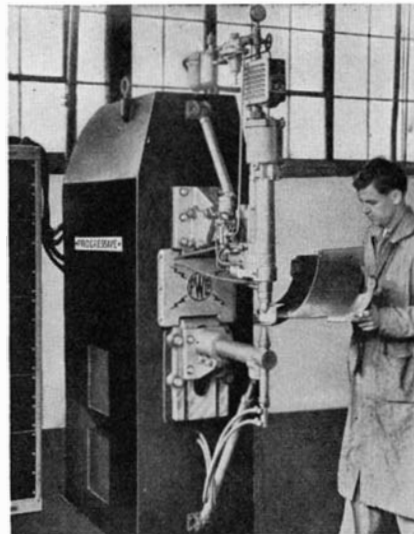
Officials of Owens-Illinois say future developments in this field are limited only by the imagination of designers and the ability of manufacturers to keep up with the demand for new molds.

PRODUCTION WELDING

High-Speed Process for

Aluminum Alloy

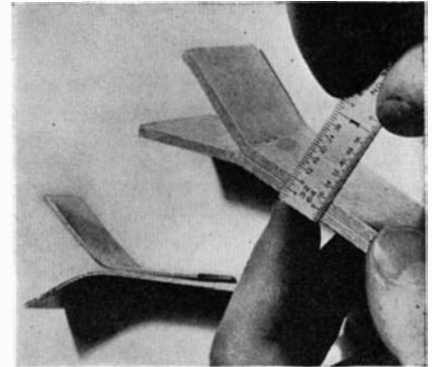
A NEW high-speed production process for spot welding aluminum sheet for aircraft use features



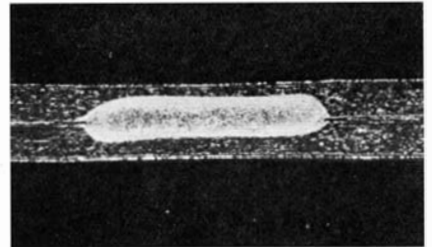
Simplified, standardized welding

extreme flexibility of equipment. Announcement by the Progressive Welder Company says that the process permits welding of aluminum sections as thick as 1/4 of an inch or of the thinnest weldable sheet on the same machine with a minimum of adjustments on the part of the operator.

Capable of producing spot welds far beyond the strength required by government specifications, the new process involves economical equipment and does not require any special skill in operation. Welding speeds are comparable with those



Above: Range of aluminum welding; two samples welded by same machine within a few minutes of each other. Below: Photo-micrograph of weld shows freedom from cracks, blow holes



customarily used with welded sheet steel and are limited only by the speeds at which the work can be moved between welds.

Uniformity of welding is claimed as one of the desirable features of this process, a microscopic examination showing the welds to be virtually free from cracks and blow holes.

There are many problems involved in successful welding of aluminum, particularly in production work. The metal has a low electrical resistance and therefore requires a large amount of current to obtain a satisfactory weld. Since the plastic range of aluminum is extremely short, the current must be "on" for only a short interval. Also, welding pressure must be accurately controlled and balanced with the current flow in order that excessive surface indentation does not result in the metal being welded.

The new process consists, essentially, of passing the current through a converter, which eliminates the negative portions of the alternating-current wave. The resulting pulsating current has a time cycle of 300 degrees instead of the 360 degrees. The current then passes through the welding transformer. The resulting secondary current wave form is ideal for welding aluminum. The current rises to its maximum almost instantly, stays at this value for

practically the entire duration of the weld, then drops to zero in an extremely short period of time.

Welding pressures are obtained through an air-operated pressure cylinder which is mounted on the upper arm and actuates the upper welding electrode, and are so handled as to provide a "follow-through." To provide a closer and more positive connection between welding transformer and work, an air-operated secondary shunt clamp grips the upper electrode after the work is under welding pressure.

Automatic repeat timing, which allows sufficient interval between welds to re-position the work, permits making any number of welds in succession automatically.

REFLECTOMETER

Photo-Electric Instrument

For Industrial Use

MEASUREMENTS of color, apparent reflectance, and specular gloss are used in the ceramic, paint, textile, paper, and chemical industries to help describe in numerical terms the true appearance of materials. A multipurpose reflectometer to measure these quantities photo-electrically has been designed by R. S. Hunter, of the Photometry and Colorimetry Section of the National Bureau of Standards, and is described in the Bureau's Research Paper RP1345.

Of the many different uses of the apparatus, the following are noteworthy: The instrument measures the apparent reflectance, the hiding power, and the opacity of paints, papers, and porcelain enamels. Measurements with it will help in evaluating the efficiency of soaps and detergents for cleaning fabrics. With the proper spectral filters, the device may be used in determining the magnitude and character of color differences between samples which are similar to each other in color. Settings with these filters provide a basis for evaluating the whiteness, yellowing, fading, bleaching, bluing, and tinting strength of textile materials. With different filters, chosen to transmit narrow spectral bands, the reflectometer may be used for abridged spectrophotometry. The values of specular gloss measured with the instrument are used to evaluate the shininess of surfaces and to classify paints and other materials for gloss. With an attachment which has



R. S. Hunter working with the multipurpose reflectometer

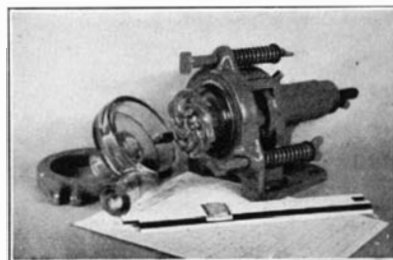
been designed, the instrument will measure the transmissions of non-diffusing liquids, glasses, and plastic samples.

In the reflectometer, two light beams from a single source are directed along separate paths to two photo-cells. For each sample tested, there is a photometric adjustment to restore equality of currents. The amounts of photometric adjustment are measured on direct-reading scales, one of which is used for apparent reflectance and the other for specular gloss. Because of its high precision, the reflectometer is especially suited for measuring small differences in apparent reflectance, gloss, or color of nearly identical samples, thus eliminating guess-work of the human eye, and providing accurate measurements for industry.

GLASS PUMP

For Handling Corrosive and Other Liquids

ACENTRIFUGAL pump in which all parts are made of Pyrex and which has a capacity of 10 gallons per minute has been perfected and is now available for small laboratory



All glass

installations and pilot plant services. This pump is a junior model of a similar type of larger capacity which has already proved itself in active service. It is highly desirable where corrosive liquids are to be handled, or where liquids which are pumped from one point to another must be kept chemically uncontaminated. A mechanical seal replaces the conventional stuffing box, and a safety unloading device eliminates the possibility of fracture of the glass case.

This pump, designed to handle hot acids or brine cooled liquids with equal facility, should offer the solution to many chemical process and food plant problems.

GRID MAKER

Automatic Machine Makes

Vacuum Tube Parts

IMPROVED efficiency in manufacturing grids used in radio tubes has been achieved by a new automatic grid machine perfected by the RCA Manufacturing Company. The machine produces grids ready for use, except for cleaning.

The new grid machine is a fully automatic device as compared with the lathes used for winding grids under the older method. Full-turn grid spirals are made by welding half-section spirals to side rods to form a single grid unit. Grids are vital tube electrodes. The number of turns and the pitch of their windings must satisfy rigid geometrical requirements. These characteristics vary with individual tube types. Once adjusted for a

particular grid construction, this machine turns out highly accurate grid coils.

The lathes formerly used fabricated the grids continuously in short strips. It was necessary to heat and stretch the side rods, cut the strips apart, and remove the excess turns of wire between each grid. The new machine simplifies these operations and, in addition, avoids the wire waste inherent in the older, slower, less efficient production method.

The new machine makes grids by welding formed wires to the side rods at a single operation. The welding operation is controlled by radio tube circuits to assure the exact amount of electric current for the exact time required to make perfect welds of all the grid wires to the side rods. Water-cooled electrodes perform the welding operation. A variable-speed motor is used to drive the machine so that it may be adjusted to the most efficient production speed for each grid type.

DOOR CONTROL

Photo-Electric Installation

Saves Money

SAVINGS as high as \$30 per day in operating costs are claimed as the result of the recent installation of photo-electric control on the doors of the receiving and shipping department of the Brown and Wil-



Door-control equipment which saves heating and operating costs in a processing factory

liamson Tobacco Company. To this may be added substantial savings in heating costs as a result of having the doors automatically close after use.

With the shipping and receiving departments operating on a 24-hour-a-day basis, their six huge doors must be continually opening and closing to allow for the passage of incoming loads of leaf tobacco and outgoing shipments of cigarettes and smoking tobacco. These doors were previously operated manually at comparatively high cost, both in actual operating expense and in time lost in signaling for the doors to be opened.

The previous expense of heating these departments was also very high because the doors opened directly to the outer air and the slow manual operation of them allowed much heat to be lost. In fact, the doors were sometimes allowed to remain open continually, there being no time to operate them.

These facts not only resulted in higher costs, but also made it difficult to maintain comfortable working temperatures for employees of the shipping department.

PURIFYING

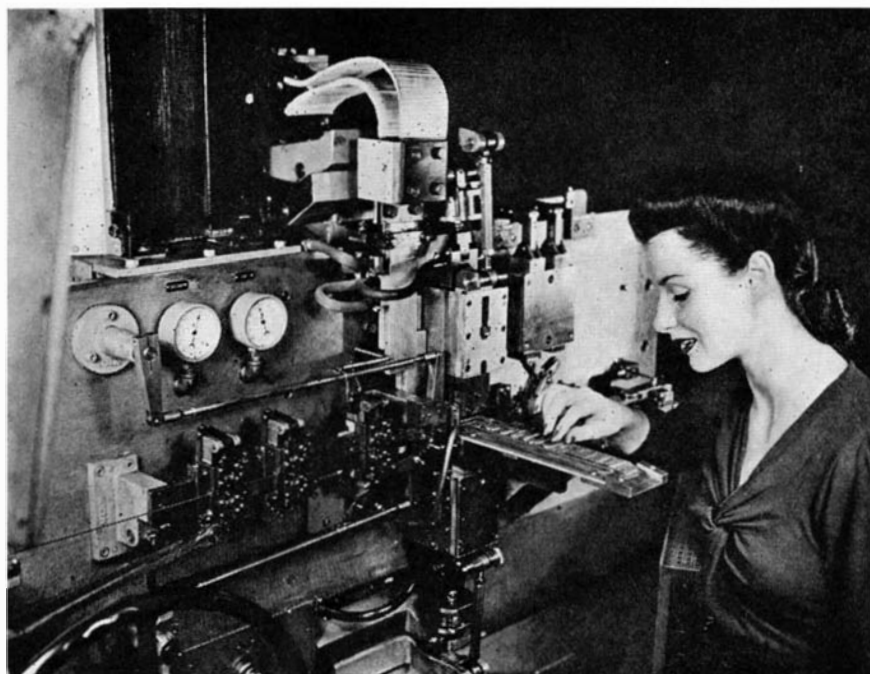
Plastics Remove Impurities from Water. Other Solutions

PLASTIC resins, previously rated in terms of plastic properties and chemical inertness, are now being selected for physical rigidity and chemical activity.

It has been found that certain synthetic resins, such as those derived from phenol (carbolic acid) and formaldehyde, are capable of removing from water those ions which give rise to hardness, such as calcium, magnesium, and iron. The resins remove these undesirable ions by the process known as base exchange. That is, the sodium atoms associated with the resin lattice exchange themselves with the hardness-producing ions in the water, whereby the resin absorbs the calcium, magnesium, and iron, and the non-hardness producing ion goes into solution. This reaction is familiar in the zeolite process of water softening, which is employed industrially and in homes to soften hard water.

Just as in the zeolite process the mineral is revived by the use of common salt, when exhausted, so the resin is reconditioned by a similar treatment. However, whereas the zeolite process was limited to waters which were essentially neutral in reaction (because the silicate lattice of the zeolite was itself disintegrated by the corrosive action of acidic or alkaline water) the stability and resistance of the new synthetic resin ion exchangers permits their use in water of all kinds. The mechanical and thermal stability of the resins is such that they may be employed at temperatures near the boiling point of water, as in the purification of hot solutions, without loss of capacity or efficiency.

Heretofore, natural and artificial silicates have been used in most water-purification equipment and while these inorganic materials are useful for "softening" water, they tend to increase its alkalinity and become saturated quite rapidly. Special resins of the phenol-formaldehyde type, on the other hand, can be tailor-made in order to remove selected impurities, have a



The machine that makes possible high-speed vacuum-tube manufacture

greater purifying capacity, and resist breakdown under the corrosive elements in the average water supply.

CORK

American-Produced Bark

Holds Promise

CORK obtained from cork oak trees growing in California has proved under laboratory tests to be as good as, if not superior to, the imported product. This announcement was recently made by Dr. Giles B. Cooke, of the research staff of the Crown Cork and Seal Company, in *Industrial and Engineering Chemistry*.

"Cork is obtained from Portugal, Spain, and the other countries that form the shores of the western Mediterranean, being indigenous to the soil and climate of this region," Dr. Cooke points out. "Since the days of Plutarch and Pliny the world's supply of raw corkwood has come from this limited area. However, it is possible, and now appears very probable, that before many years the United States, which consumes more corkwood than any other country, will produce its own cork requirements.

"Climate and soil are two important factors which have restricted the growing of cork to those countries where it is native. Fortunately, the soil and climate of many parts of California are very similar to those of Spain and Portugal. The rolling terrain of California's sheltered valleys provides excellent growing conditions for the cork oak."

The time required for cork trees to reach productive maturity has retarded efforts to grow cork in new places, Dr. Cooke explains. "The first stripping of the cork oak is made when the tree is about 20 years old and subsequent strippings follow at eight or ten year intervals.

"The first cork removed is known as virgin cork and is of inferior quality and suitable mainly for insulation purposes. Cork from the second stripping is also of a low grade and has limited uses. It is with the third stripping, when the tree is from 35 to 40 years old, that good cork of commerce is obtained. Cork trees usually live for about 150 years, although many trees have been found that were much older.

"From time to time efforts have

been made by the Federal Government to establish the cork oak in the United States. As far back as 1858 cork acorns were obtained from Spain and distributed by the Patent Department (the Department of Agriculture was not established until 1862) for planting.

"Some cork trees were grown in Florida, Arizona, and California, but many of these died from storms or lack of care. Later, about 1880, another attempt was made to introduce the cork oak, and acorns were distributed to suitable places throughout California, Arizona, and certain of the southern states. Scattered cork oaks can be found which have survived from this planting.

"A large planting of cork acorns was made at Chico, California, in 1904. Many trees are living from this effort and the Chico grove today constitutes the largest single area of cork trees in the United States. Natural propagation and plantings by interested residents are responsible for an unknown number of cork oaks.

"The California cork trees which were recently stripped are of several ages. Some from the Chico grove were 35 years old and some were from the planting of 1858. Others were of ages between these extremes."

VACUUM CLEANER

May be Used for "Wet" or "Dry" Cleaning

A HEAVY-DUTY vacuum cleaner which is equally adaptable to wet or dry cleaning is equipped with a system of baffle plates and filters. The motor and mechanism are com-



Versatile vacuum cleaner

pletely protected from moisture so that under no circumstances can the cleaning blast harm the mechanism.

This high-powered vacuum cleaner, known as the Black and Decker No. 95 Vackar, has been designed both for automotive and industrial use. Power is supplied by a one-horsepower motor driving a three-stage centrifugal fan. The sealed vacuum pull is 65 inches, and the draw is 60 cubic feet of air per minute.

With both inlet and outlet hose connections, the device can be used either as a vacuum cleaner or a blower. A thorough filtering of air provides completely clean air for blowing operations.

The entire unit is self-contained, it rolls easily over rough floors on ball bearing casters, and the 15-foot flexible hose easily reaches out-of-the-way corners.

STOPS DRIP

Spray-on Compound for Metal Surfaces

A SPRAY-ON plastic compound, containing specially treated cork particles, is now available for eliminating condensation drip from ceilings, walls, pipes, cabinets, and other surfaces. This type of drip, caused by temperature variations which bring about condensation of atmospheric moisture, is frequently damaging to raw materials, food products, furniture, and so on. Hence it can, if permitted to continue unchecked and with no effort to reduce its undesirable effects, become a costly problem in many locations.

With the new compound, known as Insulmat No. 595, positive protection against drip may be had at reasonable cost. It is applied with air spray equipment to any metal surface, and is self-bonding, requiring no priming coat, adhesive, or supports. It is claimed that one coat, $\frac{1}{8}$ inch thick, is sufficient to eliminate condensation drip completely. Tests made at Purdue University have shown that this material withstands intensive vibration, has ample adhesiveness for the purpose, is odorless, and forms a satisfactory protective coating.

Possible uses of Insulmat include applications in freight cars and cargo ships, in trucks and trailers, and in industrial plants on cold air-conditioning ducts, cold-water pipes, and so on.

INDUSTRIAL TRENDS

SOME CALL IT "STREAMLINED"

Just what is this thing called "industrial designing?" To some it is what they please to call "streamlining," completely missing the point both of the procedure and of their own term. To others it may merely mean changing the design of a product—be it mousetrap or turbine, typewriter or welding machine—to make it more pleasing in appearance.

To those who have had experience with industrial design, even in the smallest degree but sufficient to grasp the fundamentals, it is a definite trend of modern industry toward a combination of principles, all of which add up to an ultimate product that does its job in a better manner, is easier or more economical to produce, has greater eye-appeal and sales-appeal, and that, in a word which has been badly abused, is functional in design. Thus we find that the subject becomes many-sided. While the original intent in industrial design may have been to beautify a product, it quickly was seen that there were more important things to be done by the application of intelligent thinking that went beyond an end product which merely served a specific purpose.

When an industrial designer tackles a job, he brings to it a knowledge that is usually far broader than that of the engineers who worked out the essential details of the original product. This knowledge, plus an active imagination and a freedom from the conventions of the past, enables him to see possibilities that those closer to the job have overlooked. All this, of course, is no reflection on the men whose work it is to search out fundamentals, to evolve new products, new engineering principles. As a matter of fact, until such groundwork has been accomplished, the industrial designer frequently has little or no work to do. It is after the need for a certain product has been determined, and methods have been found for filling that need, that he comes to bat to boost the score of the home team.

Although industrial design has invaded almost every field of endeavor, redesigning, functionally, a multitude of things from huge power-plants to safety pins, from high-powered tractors to fountain pens, there are certain basic principles of the art that must be kept in mind. These involve a thorough-going study of the product, its purpose, its market, and the methods by which it is produced.

As long as there is no competition in a certain market, a product that meets that market's demands will sell regardless. But let competition creep in—as it inevitably will—and things begin to happen. Assume, for example, that there is only one electric iron on the market. It does its job after a fashion, but about the only thing that it offers the purchaser is freedom from the necessity of heating a flat-iron on a stove. The iron will sell, of course, because of this one feature. But then comes competition. The newcomer's iron may be no better than the original but it, too, will sell because of the demand. Now the designer goes to work. Here is a proved product, a receptive market. How to improve the product, broaden the market?

The original iron is made of many parts, riveted and bolted together. Study shows that many of these parts can be cast or otherwise produced in a single unit. Redesign of the heating element decreases current consumption, increases heat. A new handle can be produced in two machining operations instead of the six needed in the first design, and fits more comfortably to the hand that guides it. Thus, step by step, there comes from the designer's drawing board a new iron that offers new features and is low in cost. The ad writers call it "streamlined": the designer calls it "functional."

Oversimplified as is the foregoing fable of the electric iron that beat a path to the consumer's door, while the designer turned that path into a six-lane super-highway, it serves to stress the point that there is more to this infant part of our industrial system than meets the eye of the casual observer.

PLANES FOR JOHN Q. PUBLIC

News of the day continues to center attention on the military aspects of aviation, overshadowing a trend of flying which, if present appearances do not deceive, is going to be the one thing that, more than anything else, will bolster up the aviation industry when military requirements start to fall off. This is the trend toward private flying. No attempt is going to be made in this column to predict skies darkened by millions of flivver planes; better minds than ours have done that periodically for many years, only to wish later that they had gone fishing instead of wandering in the green fields of prediction. When, however, such organizations as the Ford Motor Company and United Aircraft Corporation report that they are actively experimenting with low-priced, fool-proof planes, there appears to be ample basis for a sane mental excursion into the future.

The fact that only 6000 light-planes were produced during 1940 would seem to indicate that there is not much interest on the part of the public who buys motor cars by the millions. But the reasons for this small demand are the same as they have always been: present-day planes are still relatively difficult to fly; they are dangerous compared to automobiles; and there are a limited number of large landing fields.

Ford and United are both aiming to correct these shortcomings by experimenting with planes that can be operated out of small fields—backyards, if you want to stick your neck out that far in prediction. This means that the ultimate plane will be so designed as to be controllable at or very near zero speeds, a possibility with certain helicopter types, as has been amply demonstrated by Igor Sikorsky. Ford, also, is leaning toward plastic body construction and a high-powered, light-weight, inexpensive engine.

There can be no doubt that a market exists for safe planes which can be flown as easily as a motor car can be driven. The potential demand for greater speed in transportation and for freedom from the restrictions of travel on the ground means that a mass market awaits the practical, fool-proof plane. Whether that ultimate plane will be of the conventional type, a giro, a helicopter, or a combination of the best features of each is something that only the future can disclose. In the meantime, the work of Ford, United, and Sikorsky will bear watching.

— The Editors

Mud Huts to Skyscrapers

Archeology Shows that Many Modern Building Methods are Thousands of Years Old

NEILSON C. DEBEVOISE, Ph.D.

Research Associate, Oriental Institute,
University of Chicago

FROM a reed and mud hut to a steel skyscraper may seem a far cry, but many of the basic principles still utilized by the building trades were known and used 5000 years ago in valleys of the Nile, the Tigris, and the Euphrates.

In Egypt, especially, we can trace the development of building construction with considerable accuracy. The men of the Old Stone Age, the earliest inhabitants, enjoyed a more favorable climate than their European contemporaries. While the latter were driven into caves by the cold and glaciers, man in Egypt roamed the vast forests then covering the present-day Libyan desert and the Sahara. Toward the close of the Old Stone Age these forests began to disappear as the climate became drier, and man was crowded toward his dwindling water supplies. With his movements thus limited, he soon began to erect screens of wattle plastered with mud, then small huts of the same materials. In the New Stone Age, groups of such dwellings formed the beginnings of village life. From such huts soon developed reed, mud, and timber buildings, for by that time commerce was expanding and cedar was imported from Syria. Not long after 3000 B.C. these reed, mud, and timber structures were translated into stone, and many

structural details of the early temples reflect forms occasioned by these earlier materials. Flint drills, copper, and, later, bronze chisels, were used. After 1500 B.C. iron might be employed.

In Egypt and Mesopotamia men in antiquity did as they do there today—either built their homes themselves, or employed a local mason under a written and witnessed contract to work with them. Occasionally the builder agreed to furnish labor and materials, in return for which he might use the house rent-free for ten years. For everyone's convenience, building was usually done when farm work was at a minimum.

STRUCTURES under royal control were built by royal or temple slaves under experts in the king's employ. In Mesopotamia, where land-holders owed labor to the king, they might be called upon to help. The king, theoretically, took part in temple construction and, while he probably did no actual work, he ceremonially turned the first shovelful of dirt and carried it on his head in a basket (Figure 1). Current newspapers often contain photographs of some corporation head at the controls of a steam shovel turning the first ground for a new plant.

Another interesting modern parallel is the foundation deposit (Figure 2), now continued as the corner stone deposit. Originally a sacrifice of propitiation to the gods, by the first millennium the foundation deposit had lost its magical character and had much the same significance as it does today. Construction records were written on clay or metal tablets and buried under the corners of new structures.

Building materials were limited in those parts of the Near East where there was little timber or

stone. Sun-dried mud brick has always been the most common building material in the Near East. With clay available everywhere and cheap labor in abundance, mud brick was utilized for every structure, except where the utmost in permanence was desired or where moisture made stone or brick imperative. Sun-dried mud brick possessed sufficient strength so that barrel vaults and arches 25 to 35 feet in span could be constructed. Some such 2000-year-old brick showed an average compressive strength of 123 pounds per square inch.

By 2700 B.C. simple bonding was used and occasionally what is now known as English bond was employed. Simultaneously, woven reed matting began to be laid between every three to five courses of brick to tie the wall together. In Egypt, where excellent stone was available, only the great temples, heavily endowed by wealthy and pious Pharaohs, were built of

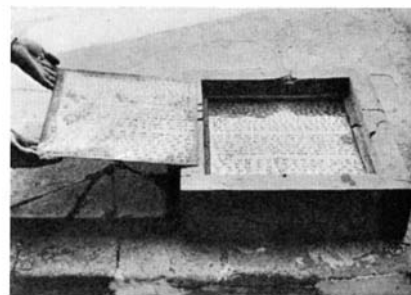


Figure 2: Gold-silver tablets of a foundation deposit, Persepolis

that material. Individuals, and even the Pharaoh, himself, had to be content with a mud brick dwelling which frequent replasterings scarcely kept habitable for more than three generations. In alluvial Mesopotamia even the temples were of mud brick. Burned brick, which in Persian times cost the equivalent of a bushel and a half of grain for 60, were generally employed only where water, as in drains and baths, made their use imperative. Not until the 7th Century B.C. were they used extensively even for palaces and temples. In Syria and Palestine stone often took the place of burned brick and it was employed in private houses as well as more important structures.

From very early times bitumen was used as water-proofing in drains and baths, originally over mud brick and later over the baked variety. Bitumen springs and oil seepages in northern Iraq fur-



Figure 1: A Chaldean king, in 2700 B.C., starts a temple job

nished waterproofing which was cheaply transported southward by river. By the 7th Century B.C., especially under Nebuchadnezzar of Bible fame, much brick work was laid in bitumen mortar, which gave exceedingly strong and durable walls.

Throughout the Near East, timber, especially in the larger sizes, was scarce. Syria, with its Lebanese cedar and Aleppo pine, and the mountains of northern India, were the main sources of supply. The Persian kings brought wood, probably teak, from India for their palaces. Transporting timber 12 inches square by 30 feet in length over a thousand miles of sea or mountains and desert would even today be a considerable task. Nevertheless inscriptions and architectural remains, as well as charred cedar, prove that the work was accomplished.

BOTH the peoples of Egypt and Mesopotamia prepared plans (Figure 3) for their more elaborate structures. Much of the detail was traditional and was not shown. Plans were often unnecessary since temples and palaces were frequently built upon foundations of earlier and similar structures. Egyptian plans, drawn in ink on papyrus or a smooth piece of limestone, sometimes showed both front and side views, although commonly only a ground plan was given. In both Babylonia and Egypt dimensions are sometimes given; frequently they are omitted entirely and we may suppose that the plan was laid out with peg and cord at the builder's instruction.

The tools employed by the ancients were of the simplest kind. With the aid of rollers, sledges, and levers the Egyptians handled stones weighing upwards of 1000 tons. In both Egypt and Mesopotamia a plumb-bob similar to modern ones was employed. In constructing Egyptian buildings the

interior was filled with dirt as the work progressed, and ramps were built against the exterior. Up these ramps the blocks for the walls were moved on rollers or sledges. When the building was complete, the stone face was dressed, the work progressing from top to bottom as the dirt was removed. Scaffolding was employed and was probably used in cutting the reliefs. The pulley remained unknown until about the 6th Century B.C. and the simple tools enumerated above, plus unlimited manpower, account for the great buildings of Egypt. The overseer of an expedition sent to secure building stone from quarries 87 miles away for a great temple in Thebes engaged 3000 men and 44 ships for the task. Building problems were

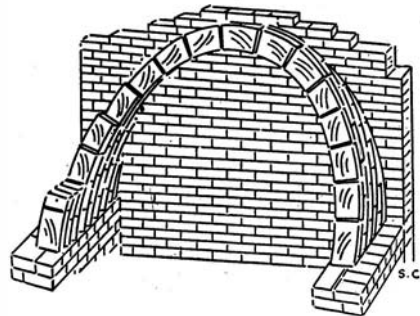


Figure 4: A brick arch erected without centering. Early Egypt

much simpler elsewhere in the Near East where stone of smaller sizes or mud brick were used.

A number of methods of roofing were available. The large monolithic block construction of Egyptian temples precluded the use of the arch in such structures and flat stone roofs were generally used. Indeed, the flat roof has been the commonest type in the Near East from the earliest times to the present day. Houses of mud brick use a flat roof of mud, the weight of which is carried on stout poles three inches in diameter. Over these is laid a layer of smaller poles and then brush or reed matting,



Figure 5: Mud brick arch of a private house, Iraq, 2700 B.C.

topped off with six inches of mud, well packed with a stone roller. The mud provides good insulation from the scorching sun but the brush harbors scorpions, snakes, and rats, which sometimes lose their footing, much to the discomfort of the inhabitants, as any excavator can testify.

The principle of the arch was utilized in Egypt from very early times. From 2700 B.C., and continuously thereafter, arches of mud brick were built in the Nile valley. These were commonly erected without centering, by leaning the entire arch against a thick rear wall (Figure 4). Occasionally centering, consisting of rings of specially made and shaped bricks, was constructed and the remainder of the arch built upon these. By the 12th Century B.C. barrel vaults in buildings were sometimes erected with the aid of forms, which in some cases were not removed but were left to create a ceiling for the room.

BUT earlier and more frequent in Egypt than the true arch was the false, or corbelled arch, found there as early as 3000 B.C. and commonly employed thereafter. All stone arches were of this type until the 18th Century B.C., when true arches were also made of that material.

About the same time that the true arch appears in Egypt, the barrel vault, the dome, and the arch appear in Mesopotamia. Apparently the dome and barrel vault were used above ground only at a relatively late date. Domed buildings appear on Assyrian reliefs of the 7th Century B.C., where towns of north Syria are pictured. Identical domed buildings are still used there today—the only place in the Near East where such roofs are

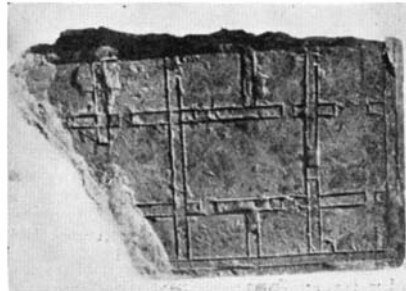
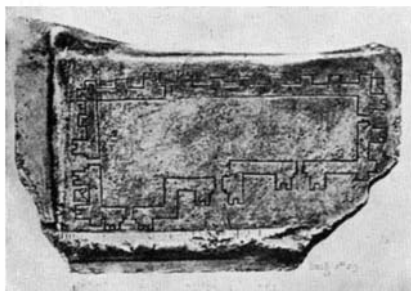


Figure 3: At left, the plan of a Chaldean building, carved in stone, 2350 B.C., and, at right, another plan inscribed in clay, 2500 B.C. From Iraq

now to be found. While certain gateways of Assyrian structures of the 8th Century B.C. are roofed with barrel vaults, that form was not used to cover rooms until the beginning of the Christian era. The arch, however, was used above ground in Mesopotamia for doors, drains, kilns, and gateways continuously from about 2700 B.C. onward (Figure 5).

Barrel vaults, both with and without centering, were employed in sub-surface tombs at Ur of the Chaldees as early as 2700 B.C. and appear to have been commonly used after 2000. In the early examples the walls and perhaps also

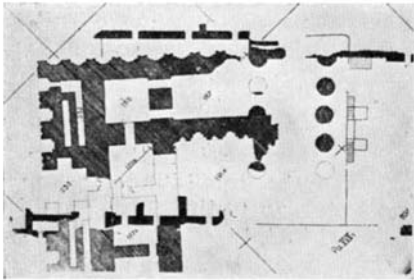


Figure 6: Free-standing columns in plan of colonnaded building

the vaults themselves were made by pouring a mixture of mud and stones over forms made of wooden planks. In some cases the stones were carefully laid, probably over good centering so as to form a true arch. The corbelled arch was also employed contemporaneously, the wishes of the builder or his skill seemingly determining the choice. Barrel vaults of burned brick were also built with the wedge-shaped bricks laid in an arch with radial joints.

Centering for such vaults was constructed on beams laid transversely and set into the stone walls at about the point where the arch began to spring. On these beams were laid planks, and upon the latter dirt and straw were piled to make a form. This method is employed in modern Palestine and probably elsewhere in the Near East today. Such forms were sometimes allowed to remain as ceilings to the chambers, as was done in Egypt.

That the column should appear at an early date is not surprising, for wooden poles were used from New Stone Age times onward as supports for house roofs. In southern Babylonia were discovered the remains of a temple with free standing columns eight feet in diameter (Figure 6). This building

may be dated to about 3400 B.C. No other examples of columns are known until about 2700 B.C., although our information is not yet complete enough to assume that they did not persist in this interim. Most of the examples from 2700 and earlier, whether of brick or wood covered with shell inlay, appear to have had the palm trunk as prototypes.

How many of these architectural forms and building practices passed from Babylonia through the Mycenaean world to Greece or spread northward into Asia Minor to be carried to Italy by the Etruscans is difficult to say. Perhaps some of the Greek mercenaries of Nebuchadnezzar, dazzled by the glories of the Ishtar Gate and the towering ziggurat (the tower of Babel) may have carried some of the tricks of the builder's trade to their homeland. Good ideas traveled rapidly 3000 years ago, even as they do today, and the Greeks, and the Romans after them, partook of the culture of all the Mediterranean lands, just as they gave much to it.



FOLSOM MAN

Relics of Earliest Man

Establish Time Scale

As a result of his continued work at the famous Lindenmeier site in northern Colorado, where nomad bison hunters camped in the closing days of the last ice age, Dr. Frank H. H. Roberts, Jr., Smithsonian Institution archeologist, has worked out a key to the culture sequence in the earliest known period of human occupancy of North America.

The bison hunters were makers of the characteristic "Folsom point," supposedly a spear head, which has been found in other places associated with the remains of the mammoth, the native camel, and the prehistoric horse. At the Colorado camp the most numerous bones are those of an extinct species.

There are certain variations of the point type, however, which have been gathered over a wide area. In some respects these have appeared to archeologists more primitive than "Folsoms" and it has been argued that the latter developed out of them. If this

were true, it would indicate that the makers of the variant styles preceded Folsom man himself.

Dr. Roberts hit upon a nicely stratified corner of the Lindenmeier site. At the uppermost level were variant types of projectile heads such as have been found hitherto scattered on the surface in Nebraska, western Oklahoma, and Texas. Below these, and separated from them by a deposit, the building up of which must have required several centuries, were scattered specimens of still another Folsom variant, also found in Nebraska, Kansas, the Texas Panhandle, and New Mexico. At a still lower level, separated from the second by deposits which must have required hundreds of years to accumulate, were typical Folsom points in association with quantities of bones of bison and other animals.

The picture, says Dr. Roberts, can be reconstructed roughly as follows:

First came Folsom man, himself, following the bison herds southward through the lush pastures which came into being along the edges of the retreating ice. For various reasons the Lindenmeier site was a good camp ground for these nomads. They returned summer after summer and apparently made it a headquarters. Then something happened and the hunting parties were ended. After a few centuries, during which winds and floods had covered up the Folsom campsite, came other hunters. They used the site not as a summer camp, but as a bivouac.

In the intervening centuries the characteristic projectile head had degenerated. It was made more hastily and simply. The new hunters may have belonged to a different group, but they had acquired some elements of the Folsom culture. Again something happened, perhaps a major climatic change, leading to a dispersal of the bison. Again the campsite lay vacant while wind-carried dust and flood-borne debris piled up over it. Then came new bison hunters, with a still different type of projectile point.

Henceforth, wherever these different types of points are found, they will indicate the relative age of the occupation. The rough time scale thus made possible may cover 1000 years or more of human occupancy in North America. The period was roughly from 10,000 to 15,000 years ago.

AMATEUR SCIENTISTS

WHILE there always have been amateur scientists, never in the whole history of science have there been so many of them as there are right now, and they are increasing. The professional scientist has long been aware of their existence and growing interest in science, but even he did not sense the extent of it until recently when the American Philosophical Society supervised a test census of laymen-scientist activities in and around one city community—Philadelphia—and published a directory of amateur scientist organizations there. The professionals expressed astonishment when as many as 287 groups of amateur scientists, representing 32,000 members, were discovered thriving in that one community.

The boundary that once rather sharply demarcated the professional from the amateur has been largely erased by the existence of borderline bodies such as the American Association of Variable Star Observers and the American Meteor Society, in which amateurs in their spare time perform professional work, and the British Astronomical Association in which professional astronomers participate as amateurs.

Similarly, in the Seismological Society of America, Eastern Section, there is a Committee on Amateur Seismology, the professional seeking through this committee to encourage amateurs to make seismographic instruments and get into the game in their spare time. In the Seismological Society one could build a bridge by steps all the way from the relative tyro to the full professional; from members who are merely intelligently interested to others, such as fire insurance men and municipal engineers, whose interest is more direct, and so on across the gap.

The membership of the Society for American Archeology is largely professional but not wholly so. A perusal of its quarterly publication, *American Antiquity*, reveals that it, too, is a common meeting ground on which "men of a feather," as one member puts it, may find one another even though they have never met. Members of this organization come from all walks of life—which reminds us that the article on "The Temple of the Effigy," an account of its author's participation in the excavation of an Ohio mound-builder temple, published in *Scientific American* last August, was by one of them. He is a postal deliverer, who for many years has made a serious study of American archeology and who can recite letter and book on the complex culture levels of pre-Columbian Indian civilizations. It is smug even to be surprised that this should be so; for the postal deliverer, but for some of the trivial accidents of circumstance which determine our lives, might easily have been a professional scientist, just as the professional scientist in slightly different circumstances might have been a postal deliverer. One of Britain's noted archeologists was a grocer, and another is a merchant tailor. Knighted archeologists come to visit him.

Charles Amsden, vice-president of the Society for American Archeology, has told how a man, who went to Nevada for his health, started hunting Indian things as a pastime and became scientifically interested. Finding no local sources of data, he called with much humility at the Southwest Museum in Los Angeles to find out who was the real authority on his local region. After hearing him out, and knowing that no archeologist had investigated that particular area, the professional told him "You are"—which put



him in a fine dither! Re-oriented, no longer feeling so inferior and humble, he went back to dig in the earth and into scientific literature, joined the Society and is up to his ears in a hobby that helps science.

None of the scientific groups named above is fully professional, but just what does this mean? Mainly it means simply that the professional is a man who works at it all the time, and the amateur is one who works at it part of the time.

That ancient boundary fence surrounding the professional is down in a lot of places, and isn't being put up again.—A. G. I.

SWEDEN COMMENDS

IN SOLACING contrast to the sharp brusqueness that today is keeping international diplomatic relations on tenter-hooks is the courtly graciousness with which His Majesty, King Gustavus, V, of Sweden, recently honored Sylvester J. Liddy, former contributing editor of *Scientific American*.

Mr. Liddy, a member of the patent law firm of Munn, Liddy, Glaccum & Kane, of New York City, was knighted with the Order of Vasa, First Class, in recognition of what, in his capacity as Director and Honorary Counsel, have amounted to "extra-curricular" activities for the welfare of the Swedish Chamber of Commerce in the United States.

It is not the bestowal of this honor by a European nation in sincere acknowledgment of constructive services favorably furthering Swedish-American interests, and its acceptance by an American citizen, that alone makes this incident worthy of comment. Rather, it is a significant trend, indicating that, despite the ominous totalitarian shadows now falling across Sweden from all directions, the Swedish government has not lost sight or control of the constructive niceties that lead to broader, sounder, and more amicable trade relations. It is significant, too, that The Order of Vasa, instituted by Sweden's King Gustavus, III, on the day of his coronation in 1772, is an award of merit for services rendered to the national industries and manufactures, a civic attribute long held in high esteem by democratic peoples.

That Mr. Liddy has found it possible to devote time and energy toward betterment of Swedish-American relations is exceedingly commendable; that the administration of His Majesty, King Gustavus, V, has taken cognizance of the efforts of a representative of our American democracy is a gratifying omen.—A. D. R., IV.

The Shape of the Earth

New Determination of Its Polar Flattening, with a Saner Proposal for Submarines

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

AN INGENUOUS student once wrote on his examination paper: "The Earth is a great ball, flattened at the ends." One was tempted to ask him: "Where *are* the ends of a ball?" — but his answer got a pretty good mark, since the Earth is really flattened at the ends — of its axis of rotation.

To find out just how much it is flattened is a harder job than might be supposed. We can not calculate it by theory, though we know that the flattening is caused by the centrifugal force arising from its rotation. If our planet was a homogeneous body, of uniform density in all its parts, the ellipticity of its figure would depend on the ratio of the measured force of gravity at the equator to the centrifugal force calculated from the length of the day and the Earth's radius. But to calculate the shape of the outside of the Earth, we must know the way in which the density increases toward the center, or, to be more precise, a certain averaged effect of this increase. It is obviously impossible to find this directly, so we must find the external ellipticity by observation — after which we will be the richer, not only by a datum necessary for any accurate mapping of the surface, but by knowledge of the deep interior.

There are several quite different ways in which the Earth's shape may be found. First, we may measure the length of a degree of latitude on the surface. The elliptical cross-section of the Earth by a meridian plane is most sharply curved at the equator, and least at the pole, and one has to go a smaller distance northward in the first case than in the second to shift the vertical by one degree. We can find the latitude of any place with great precision by a few nights' observations. To measure the distance between two stations is a surveyor's job, demanding a

high degree of care and technical skill, but fully practicable though expensive. Of course our stations do not have to be exactly a degree apart, or just at the equator or the pole; these things are simple to allow for. But they do have to be *on land*, and with a land connection between them or, at least, one broken by no arm of the sea too wide for the surveyor to sight across.

THIS method, then, no matter how much time and money is spent on it, enables us to find the shape of the surface of the continents, but not of the oceans. What we get is not the form of the irregular land-surface, but of the surface which would be found if a "sea-level" tunnel could be bored through the continent from coast to coast at such a depth that the sea would fill it partly full all the way. Ordinary precise leveling gives us the height of the surface above the water in such an imaginary tunnel. But would there be anything queer about the shape of the level surface thus defined? In some cases there certainly would. Consider an island such as Puerto Rico rising out of very deep water on each side. The rock of the island is denser than the water of the sea. Hence at a point on the north shore there is an excess of attraction southward (compared to what there would be if the mountain was removed and the sea filled in) and the plumb-line is deflected southward, toward the land.

The opposite is the case on the south coast. Hence the water-level in our imaginary tunnel would rise inward from both ends, owing to the attraction of the island mass, and be higher in the middle than if the mountain were not there. The slope at each coast is about one foot in 7500; the island is 33 miles wide; hence the excess height in

the middle (which is half as great as it would be if the two slopes were extended to meet in a point at the middle) is six feet. The slope must continue, gradually diminishing, in the open sea for miles off-shore, and sea-level on the coast of the island must be raised fully ten feet by its gravitational attraction.

In our hypothetical tunnel, the surface of the water is more curved than that of an undisturbed sea. If we should expand it by calculation into a sphere, we would get one 260 miles less in diameter than the actual Earth. This is an extreme case; no one would think of finding the size of our planet from so small a measured arc under such conditions of natural disturbance. But the attraction of the continents as a whole must pull the oceans toward them, and produce a similar, though not so spectacular, effect.

Determinations of the polar flattening, which depend on the difference of the curvature of the surface in different latitudes, will be affected by a larger percentage, and whether the result comes out too large or too small will depend on the topography of the regions surveyed.

When good maps are available, the direct attraction of the mountains, and so on, may be calculated and allowed for. But it is found that this over-corrects the observed effects — showing that, deep under the mountains, there is a deficiency of mass more or less completely balancing the excess above sea level, — with an opposite excess of mass in the layer below the sea-bottom.

This isostatic adjustment is, however, not complete, so that it is impossible to allow fully for the local attractions.

A second method of attack on the problem depends on measures of gravity. This is less at the equator than at the poles, both because centrifugal force counteracts a part of the Earth's attraction and because the attraction itself is less at the greater distance from the center. The theory of the change, though not simple, is well-known.

The acceleration of gravity at any given station may be measured with great accuracy by finding the time of oscillation of a pendulum. The apparatus is fairly portable and may be carried wherever a car can go — being brought back for checking at intervals to a standard station where gravity has been

precisely measured. Accurate time is necessary for comparison; but this can now be had by radio, all over the world.

Gravity stations may be set up anywhere on land — on isolated islands too — and no costly surveys are required to connect them. Still more important, gravity may now be measured at sea. The roll of an ordinary ship, even in smooth water, disturbs the motion of the pendulums hopelessly. But in a submarine submerged a hundred feet or so, the motion of the waves is hardly felt, except in bad weather.

THE distinguished Dutch geodesist, Dr. Veining Meinesz, has developed a most ingenious apparatus, such that the small residual motions of the submarine do not vitiate the accuracy of its results, and has personally made long transoceanic voyages in submarines of the Netherlands Navy. Work in the Caribbean has been done in American submarines, in the Pacific by Japanese, and so on.

It should be possible, then, in quieter times than these, to extend a gravity survey all over the globe. Such a survey would not only determine the general shape of our planet — the polar flattening — but also the large-scale departures from the simple spheroidal form, such as may be caused by the attraction of the continents, and of differences in the character of the deeper crust under continents and oceans, and reveal whether there are any deeper-seated irregularities in density, as yet unknown.

Dr. Jeffreys, the leading authority on this matter, has just published a discussion of the existing material. The desired goal is not yet reached, owing mainly to the lack of observations in the South Pacific, and in southern latitudes generally. He remarks: "A series of observations in a submarine traveling from Adelaide to Cape Horn, up the coast of South America, and back to New Guinea, would give an improvement of the estimates far beyond what could be done using the best methods on present data."

Should a "good time coming" succeed to the present distress, the world's geodesists will protest against the destruction of all submarines. They will ask, at least, to keep a squadron of the best and most seaworthy in commission, and send them, loaded with pendulums instead of explosives, all over the

Seven Seas. They will have plenty of work to keep them and their crews busy until they are retired for old age.

Measures of gravity are not immune to the effects of the attraction of mountains and their buried roots — indeed, they give some of the best information about the latter — but a world-wide set of them should afford a much more accurate determination of the shape of our planet than any surveys on land.

There are other ways of finding the Earth's ellipticity which escape altogether the difficulties due to local attraction, since they depend upon the gravitational attraction of the Earth, as a whole, for the Moon, or of the Sun and Moon upon it. The attraction of the latter upon the Earth's equatorial bulge influences its rotation, as a small disturbance influences a gyroscope, and causes the precession of the equinoxes. The annual rate of this slow shift of the Earth's axis is very accurately known, the disturbing forces can be calculated in terms of the ellipticity, and a very good determination of the figure of the Earth follows.

The attraction of the equatorial bulge upon the Moon — more accurately, the difference between the attraction of the actual, spheroidal planet and a sphere of equal mass — leads to certain changes in the Moon's motion. There is a change in the latitude, by 8".3 in either direction, with a period of about a month, and slow cumulative effects on the motions of the node and perigee.

The periodic perturbation can be found, clear of complication, from a century and more of observation, which is long enough to get its effects disentangled from other changes of nearly the same period. The motions of the perigee and node are added to and, at first sight, swamped by the very much larger effects produced by the Sun's attraction. But Brown has calculated this influence of the Sun with a precision of one part in three or four millions, so that the outstanding differences are known to about 0.5 percent of their values. If they acted alone the perigee would revolve forward in 200,000 years, and the node backward in 210,000. From each of these three influences on the Moon, separately, the ellipticity of the Earth can be found. The motions of the perigee and node depend also on the figure of the Moon. Fortunately, certain

other things do so too. Though the Moon rotates once a month, so that it keeps always the same face toward the Earth, its axis is inclined to the plane of its orbit, and shifts its position as the latter shifts. It can be shown that the amount of this inclination depends on the ellipticity of the cross-section of the Moon by a plane at right angles to the Earth; that is, of the edge of the visible disk (averaging out the mountains). The ellipticity of the equator can be found — less accurately, but well enough—from a minute physical libration, or "wobble" of the Moon's rotation. Both these quantities have been determined by observation.

COLLECTING the results from the motions of the Moon and those from gravity on the Earth, Jeffreys finds that they are all consistent and indicate that the ellipticity of the Earth is $1/297.05 \pm 0.38$; that is, that the polar diameter is shorter than the equatorial by this fraction of the latter.

From the constant of precession, de Sitter, some years ago, derived the ellipticity $1/296.75 \pm 0.10$.

The "probable errors" attributed to the denominators indicate that, owing to the small inevitable errors of observation, the main figure is as likely as not to be wrong by the stated amount. It is clear that the two quite independent determinations agree as well as could be expected. The difference is 1/1000 of the amount of the ellipticity — which corresponds to 1/1000 of the amount by which the polar diameter of the Earth is less than the equatorial. This is 26.7 miles, so that the difference of the two amounts to only 140 feet on the whole size of the Earth.

The Moon's equator comes out very nearly circular, with the diameter pointing toward the Earth a quarter of a mile longer than that at right angles to it. The polar diameter is shorter than the latter by a little more than a mile and a half.

These are the differences which would result if the mountains were smoothed into the depressions and the effects of internal differences of density evened out. The resulting surface would nowhere be as much as half a mile from a sphere of the same volume. The irregularities due to the lunar mountains are far greater.—*Princeton University Observatory, April 3, 1941.*

Mad Dog—Mad Man

Most Modern Treatment for Hydrophobia is the Easily Obtained Semple Treatment

CHARLES BARTON, M.D.

Assistant City Health Officer,
Los Angeles

IT WAS Pasteur who first worked out a successful treatment for rabies, but within the past few years a more modern treatment, which differs somewhat from that of Pasteur and in several respects is even better, has come into use among physicians. This is the Semple treatment and if you are bitten by a mad dog or cat, or other mammal, your doctor probably will employ it.

Theoretically, therefore, all you need to know and do is what he tells you. Yet there is a great deal that the layman can learn about rabies and rabid dogs which may be to his advantage—especially if it results in his learning to detect and avoid the rabid dog and therefore not even have to consult the physician.

While the virus of rabies is carried in the saliva of the infected animal and is introduced under the skin of the bitten animal or person by the teeth, rabies is essentially a disease of the nervous system and brain. And the victim does not acquire the disease until the virus reaches the central nervous system. The time required for this depends upon the location of the bite. Naturally, it takes the virus much longer to travel up the nerves from, say, the ankle to the brain than it does from the face or ear. In a dog the first symptoms may appear, from ten days to two months or more after the infection. In man this may be from 12 days to three months or longer. It is during this incubation period that the Pasteur treatment, or the newer Semple treatment, is administered. Should there be too great a delay in beginning the treatment, however, and should the symptoms of rabies actually appear, then the human patient is certain to die within three to five days, seldom longer. The dog, on the other hand, will live for about four to eight days

after rabies set in. And it is during this time, and not immediately after he has been bitten by another dog, that his saliva contains the deadly virus.

In a dog, rabies may appear in one of two forms, either as furious madness or as dumb madness.

In furious madness the disease goes through three stages. During the first period the dog becomes depressed. If he obeys his master at all he will do so sullenly. And there soon will be a loss of appetite. This melancholy stage may last for only a few hours, or it may endure for two days.

There follows next a period of irritation, this second stage usually lasting from three to four days. If



Photos by Bob Plunkett

Rabies (dumb type) just before the hind legs become paralyzed

the dog is caged, he will tear and chew at the bars, sometimes even breaking his teeth and fracturing his jaws. His eyes become unnaturally bright, there may be some evidence of saliva, and he may emit a peculiar, terrifying howl. If the dog is not confined, he may range many miles from home, biting and snapping at anything which appears before him—trees, posts, cattle, horses, human beings, corners of buildings, or automobile tires. The furiously mad dog either trots or has a slow, loping gait with head and tail drooping. He may run in a straight line, but usually weaves from side to side.

Only when the disease develops into the third and last period, the paralytic stage, does the dog desist from his desire to roam. He becomes subdued and more sullen, and staggers if he attempts to walk. His lower jaw is paralyzed and hangs down, and his mouth may drip saliva. Death from paralysis or exhaustion soon follows.

In the alternate form, or dumb madness, on the other hand, the second stage, in which the dog wanders over the countryside, may be lacking entirely, for the animal, with eyes that appear dull and glazed, becomes paralyzed in both hind legs.

But the most prominent feature, and the one that gives this form its name, is the dropped lower jaw, which becomes paralyzed to the extent that the dog cannot bite. Owing to a paralysis of the muscles in his throat and head, he continually scratches his throat, and this, combined with a hoarse, choking cough, may lead some good Samaritan to suspect the lodgment of a bone and innocently risk his life to set it free. The jaws are fixed, with the teeth separated, and the dog drools large amounts of thick,ropy saliva. It is this which accounts for the popular belief that mad dogs always foam at the mouth. Despite the fact that dogs with dumb rabies—the second form—cannot bite, they have a far greater flow of saliva than the furious ones that do the biting. And the saliva from this or from either type is liquid death if it gets through the skin.

THE symptoms of human rabies are very similar to those of animal rabies, and are equally terrifying. When the symptoms appear, a series of convulsions sets in. Between these convulsions the patient is entirely conscious and in terror of the next attack. The sufferer from rabies intensely *desires* water; he has no water "phobia," that is, fear. But he cannot swallow water—he cannot even go through the motions of swallowing. In fact, any attempt at swallowing may cause spasms of the throat and general convulsions. These may even follow the thought of swallowing, and this may account for the old notion that rabies sufferers fear water. There is also a secretion in the throat and mouth of a thick, viscid mucus, with a thickened saliva, and the effort to get rid of this, with the muscles refusing to act, causes the bark-like cough and

hawk. The temperature rises. The patient becomes maniacal. He dies.

It was not until 1885 that the first successful treatment for rabies, that by Louis Pasteur, was discovered. Pasteur experimented with rabbits, and he found that, upon being inoculated with an emulsion made from spinal cords taken from rabid animals, these rabbits became rabid, and died. If the spinal cords of these rabbits were inoculated, in turn, into a man, that man likewise would take rabies and suffer death. On the other hand, he discovered that if the rabbit cords were dried in the air, they would become less poisonous, and the longer they dried the weaker they became. Moreover, if a human being were inoculated from such a cord that had been dried sufficiently long, it would not give him rabies, for the agents, called antibodies, would develop and overcome the rabies virus. After this, if a cord that had been dried less than the first were introduced into the human being, more antibodies would develop,



Furious madness. The teeth are broken off on the wire screen

and these, plus the first ones, would destroy the virus of the second inoculation. Thus, with the daily inoculations from rabbit cords that had been dried less and less, and with the antibodies accumulating, the point would be reached where they would be sufficient to withstand the virus at its full strength.

While, briefly, that is the essence of the Pasteur treatment, of late a modification of it has been developed—the Semple treatment. In this the preparation from the cords of rabid rabbits is heated until the

virus is killed and is therefore no longer capable of causing rabies, yet the killed virus retains the properties which enable it to produce the antibodies that destroy the virus from the bite of a rabid animal. Advantages of the Semple over the Pasteur treatment are:

FIRST: In the Pasteur treatment the rabbit cords were hung over potassium hydroxide for from one to six days. Little chunks were cut from these cords, and the material was held in glycerine. When an order was received for the Pasteur treatment, which consisted of 21 daily doses, one section of cord was ground for each day's dose and mixed with additional glycerine and saline solution. In the Semple treatment, by contrast, the doses are all of the same make-up and size. In practice, the first seven are picked up at the drug store, and the remainder ordered and shipped in plenty of time. This, therefore, does away with the problem which the Pasteur treatment contained, in which each dose had to be shipped separately on consecutive days in thermos containers. Due to breakage of containers and the possibility of slip-up in the mail, every complete treatment consisted of a series of headaches for the laboratory and continuous anxiety for the patient and the physician.

Second: In the Semple treatment, relatively large doses are administered from the beginning, and this causes the patient to become immune more quickly than when the Pasteur treatment is used.

Third: Because the Semple treatment involves the use of killed virus, it can be discontinued at any stage if it is found that the biting animal was not rabid.

Fourth: In the Semple treatment there is no danger of the physician accidentally infecting himself.

Fifth: With killed virus, "treatment paralysis," which occasionally followed the use of Pasteur and other methods, has become almost non-existent.

Sixth: While with the Pasteur treatment the death rate was as low as 3 or 4 out of 1,000, it is even smaller with the Semple treatment.

IF YOU are bitten by an animal suspected of being rabid, immediately get in touch with your physician or local health officer.

Don't kill the animal, but confine it within a safe enclosure, for it is



The beginning of another hideous convulsion. Patient is conscious, knows what's coming

much easier to determine whether or not it has rabies if it is alive.

Should the creature be rabid, it will exhibit the symptoms and die within a few days; if not, then the symptoms will be lacking and the animal will live. In the first case the doctor would continue his Semple treatment of the human patient who was bitten by the animal; in the latter instance he would be satisfied with merely cauterizing the wound.



PREGNANCY TEST

Skin Reaction is Rapid,

Reliable

A SKIN test which tells within less than an hour whether or not a woman is going to become a mother has been announced by Dr. Frederick H. Falls, Dr. V. C. Freda, and Dr. H. H. Cohen, of the University of Illinois College of Medicine.

The test is similar to those made for allergy to hayfever. It is said to be 98-percent reliable. Previously developed tests for early pregnancy take, according to reports of them, from 18 hours to two days. The widely used Asheim-Zondek tests takes two days for a verdict.

In the test developed at the University of Illinois, colostrum is used. This is a watery liquid secreted in the breasts during pregnancy until milk formation starts after the baby is born. A tiny amount of this is injected by hypodermic needle into skin of the forearm. If the woman being tested is pregnant, there is no reaction. If she is not pregnant, a reddish area of one or two inches diameter ap-

pears within an hour around the injection point, disappearing within about five hours.

Besides the speed and economy of the new test, it is said to be valuable because it helps to differentiate between pregnancy and abdominal tumor and also helps to determine quickly the dangerous condition in which the baby starts developing outside the uterus of the mother.

Another rapid skin test for early pregnancy has previously been announced by Dr. G. C. Gilfillen and Dr. W. K. Gregg of Dayton, Ohio, reports *Science Service*. In this test a hormone is injected under the skin.

VITAMIN K

Medical Experiment Shows Value of Doisy Vitamin

EXCESSIVE bleeding of a newborn baby, due to injury, can be prevented by feeding the expectant mother synthetic vitamin K.

Experiments confirming this fact have been reported by Dr. James W. Mull, A. H. Bill, and Helen Skowronsko, of the research laboratory of the Maternity Hospital, in Cleveland.

Dr. Mull reported on experiments with one hundred mothers who were given synthetic vitamin K while they were in labor. Tests of the clotting capacity of the blood of the newborn child revealed a striking increase in the rapidity of clotting. Only one baby out of the hundred was found to have blood which did not respond to the treatment, Dr. Mull reported.

SLIT-LAMP

For Diagnosing Diseases of the Eye

IN a manner similar to the way in which light, deflected and diffracted by dust particles in the path of a light beam, makes such particles appear self-luminous and larger than they actually are, so does a new slit-lamp illuminate the cell structures and minute opacities in the eye, affording the eye specialist greater facility in diagnosing pathological conditions.

Light from a strong nitrogen bulb source is condensed at a slit and this narrow beam is then projected into the eye. The cell struc-

tures and minute opacities can thus be observed and magnified by means of a wide-field binocular microscope. The three dimension view which is obtained in this manner makes it possible accurately to locate and measure the position of foreign objects in the eye, or the areas of disease. The slit-lamp,



Dr. Max Poser with the instrument, combining a new slit-lamp and a wide-field binocular microscope, used in diagnosing a wide variety of eye diseases

demonstrated recently by Dr. Max Poser of the staff of Bausch and Lomb Optical Company, may dictate the removal or the retention of an eye in cases of sympathetic ophthalmitis, in which the inflammation in a diseased eye affects the sight of the good eye. It will also provide information on the age of lesions and the nature of injuries or congenital processes.

THIAMINE

Way Found to Test Whether Body Lacks Vitamin

IT is possible to determine whether a person's body is securing a sufficient amount of vitamin B₁ (thiamine) by determining the amount of the vitamin secreted in the person's urine.

This new clinical test for vitamin B₁ deficiency has been explained by Dr. Daniel Melnick and Dr. Henry Field, Jr., of the Department of Internal Medicine, University of Michigan. Dr. Melnick reported on experiments made with a group of adults known to be normal and another group known to be deficient in the vitamin.

The normal patients showed an

average excretion of 12 percent of the original vitamin dose during a four-hour test period. The deficient patients showed an average excretion of 3 percent during the same period, the remainder of the vitamin having been absorbed by their bodies.

ACNE

Common Pimples of Adolescence Correlated with Sex Hormones

NEW evidence that acne, a skin eruption of the face and arms usually occurring during adolescence, is related to the sex hormones, was recently presented in a research report by Dr. James B. Hamilton, of the Department of Anatomy, Yale University School of Medicine. Although medical science has long known that such a correlation exists, no direct experimental evidence for it had been established.

Dr. Hamilton conducted his experiments with a group of men and women, all of whom were lacking in sex hormones. The group included male eunuchs (men who had either been castrated or who had not matured sexually), young boys who had not reached adolescence, and women who had lost their ovaries because of some disease or accident. None in the group had acne at the time the experiments began.

The patients were then given injections of male sex hormones (androgen). They immediately acquired the skin eruptions characteristic of acne. When the hormone injections were stopped, the skin eruptions rapidly disappeared.

"A close relationship of acne to male hormone substance is attested by the rapidity with which the acne fades upon cessation of the injections, and by the fact that a developing papule which has undergone retrogression may again become inflamed if treatment is resumed," Dr. Hamilton declared. He added that susceptibility to acne did not appear to be related to either the color of a person's hair or skin.

"The fact that sex hormones may induce acne in susceptible individuals is not proof that the sole cause of acne is the action of the hormone," he said. "Other factors and a predisposition to acne undoubtedly are of great importance."

Trucks for Defense

The Trucking Industry is Mobilizing its 4,500,000 Trucks for Emergency Transport

P. R. RIEBER

WHEN the German army began its major offensive at Verdun early in 1916, it had 14 railways at its disposal. The French had one. Otherwise, the defending forces were cut off from the rest of their country: One big push, lasting a few weeks, perhaps, the German strategists reasoned, and it would be all over. But they underestimated the resourcefulness of the French and they failed to take into consideration a new instrument of war—the motor truck.

Trucks received their baptism of fire on the 37-mile road from Bar le Duc to Verdun—the famous “Sacred Way”—and contributed much to the enforcement of the French battle cry, “They shall not pass!” Despite constant artillery fire, motor service on this shell-pocked lifeline was stepped up to the point where 1700 trucks passed each way daily, moving troops and artillery, evacuating the wounded, and furnishing food and supplies for 250,000 French soldiers. In his book on Verdun, Marshal Petain, the French general in charge of defense, states that during the two

● **THE trucking industry of the United States is a service industry which transports goods by highway. It is composed of 4,500,000 trucks, operated by about 3,500,000 employees, and 1,000,000 farmers. Approximately 600,000 of these trucks are in the “for-hire” class; that is, their services are sold to shippers of goods. 1,000,000 are on farms. The remaining 2,900,000 are in the “private” class, owned and employed by individual businesses to distribute their own products. For the past two and one-half years members of this industry, through their national organization, American Trucking Associations, Inc., have been drafting defense plans for the use of their equipment in the event the United States enters the war, or should an even more critical emergency develop.—The Editors.** ●

weeks from February 26 to March 16, 1917, the trucks moved 190,000 men, 25,000 tons of munitions, and 2500 tons of materiel.

The world knows the nation which best learned the lesson at Verdun. The “Blitzkrieg,” product of the formidable Nazi Panzer divisions, is now an old story. The miracle of the German achievement in so speedily subjugating half of Europe lies in the service of supply. Without a constant stream of trucks loaded with gasoline, oil, rations, and other materials, the lightning conquests of the Panzer divisions would have been virtually impossible.

United States Army officials have marked well the success of the Nazi mechanized divisions. Here in this country they already have had a practical demonstration of the part that commercial motor vehicles can play in time of war. Early in 1940, for the first time, the job of furnishing supplies to a sizeable army was entrusted to commercial trucks at maneuvers in east Texas and western Louisiana. For more than a month and a half 30 trucks of the Red Ball Motor Freight Lines, of Dallas, were used exclusively to haul food, gasoline, and other supplies for two corps, known as the Third Army—a total of 70,000 men! The troops were concentrated near Sabine, Texas, for “war” between the Blue and Red Armies. Red Ball furnished trucks to the Red Army.

Their initial job was to equip the base depot with immediate supplies. This called for the movement of more than 30 carloads of non-perishable goods within a week, and supplies going to the depot, in turn, were transferred to various distribution points by truck caravan. Food alone accounted for a major proportion of the 500,000

pounds of supplies per day which left the base depot. Here are some of the supplies which were delivered daily: 12,000 loaves of bread; 100,000 pounds of ice; 15,000 pounds of fresh meat; 39,000 eggs; 3300 pounds of onions; 1800 pounds of bacon; 1300 pounds of lard substitute; 1200 cans of evaporated milk; 4800 pounds of sugar; 750 pounds of salt; 16,600 pounds of flour; and thousands of pounds of other foodstuffs.

Besides the rations, during the three-week period of maneuvers, 900 tons of hay were required; 1,500,000 pounds of oats; 61,000 pounds of bran; 200 cords of wood; 500,000 gallons of gasoline; and large quantities of oil, grease, gas masks, smokepots, ammunition, hospital equipment, radios, telephones, clothing, candy, veterinary



United States Army gave early recognition to truck transport possibilities

supplies, motor parts. About 156,000 pounds of wire for the communication system also were hauled.

The trucks observed all Federal and State regulations, although they were under army rules, which in times of emergency presumably would supersede other regulations.

Inasmuch as most commercial vehicles operated by for-hire trucking companies are much larger than Army units, the Red Ball trucks had a distinct advantage. To supply a division of 8000 men, for example, three Red Ball semi-trailers, closed-van type, were needed; the same job would have required 24 average-size Army trucks. The result was definite economies, fewer drivers, less servicing, and savings in time. Officials of Red Ball and drivers were under direct control of the Army heads, drivers were selected according to their safety records, length of service, and citizenship, and every man cautioned against

talking about what he saw in the field. The commercial vehicles engaged in this operation were under constant surveillance and study by Army officials, including more than 70 generals from all parts of the country who witnessed the maneuvers.

General Joseph E. Barzynski, Chief of the Motor Transport Division of the Quartermaster Corps, recently stated that the army contemplates a total of 286,000 vehicles, necessary for a force of 1,400,000 men. Even cavalry mounts will be moved by truck. About 75,000 of the vehicles already have been obtained; by the latter part of April, approximately 140,000 will be in service; by June 30th, the figure will be around 190,000; and by late summer or early fall the Army expects to reach its goal of 286,000 vehicles. Insofar as possible, the War Department is seeking to standardize its vehicles by favoring ½-ton, 1½-ton, 2½-ton, 4-ton, and 6-ton chassis. Progress also has been made toward greater standardization, and interchangeability of parts.

TRUCKING companies and truck manufacturers, meanwhile, have been drafting their own defense plans for the past two and one-half years. Although truck manufacturers have assured defense chiefs that 1,000,000 trucks per year can be produced without straining capacity, truck operators have laid out blueprints for the use of their equipment in the event the United States enters the war, or should an even more critical emergency develop.

The United States is the most motorized nation on earth. Investments in the highway transportation industry, according to the National Resources Planning Board, total more than \$19,000,000,000, as against \$24,000,000,000 in the railroads and about \$5,500,000,000 for waterways, pipelines, and airways. In 1939, the rails operated 246,922 miles of track; there were 3,065,000 miles of highways, 1,122,000 miles of which are now hard-surfaced.

How does the trucking industry propose to mesh these vast facilities of men and machines into the national defense program?

Two plans providing for the employment of existing trucking facilities, but insuring against any serious disruption of the normal services of highway carriers, have been placed in the hands of defense

officials. The first merely covers co-operation of the trucking industry in the movement of defense goods; the second is designed to meet the heavier demands for transportation service which would develop if the United States actually entered the war.

Plan One contemplates the establishment of a pool of trucking equipment, expanded and contracted from day to day to take care of fluctuating requirements. To avoid any congestion and delay, this program also proposes establishment of a central dispatching service to guarantee most efficient use of trucks and loading and unloading facilities. All operations other than dispatching would remain under the control of the owners and operators of the vehicles.

Requests for trucking facilities from the defense commission would go directly to the American Trucking Associations, Inc., with headquarters in Washington. This national organization, in turn, would telephone or telegraph the requirements to member trucking associations in the area affected. The state organizations, of which there is at least one in every state, would then relay the orders to the actual truck lines. Requests for equipment from the various corps areas would be made to the state liaison men, and relayed to the proper territory. Some idea of how the plan would operate comes from the Rhode Island trucking association, which states that within two hours it could muster 200 trucks for any service required. Truckmen in many states have had actual mobilization experience in disaster relief work, particularly in New England and the South, when they were struck by hurricanes and floods. This experience

has proved invaluable in planning for defense.

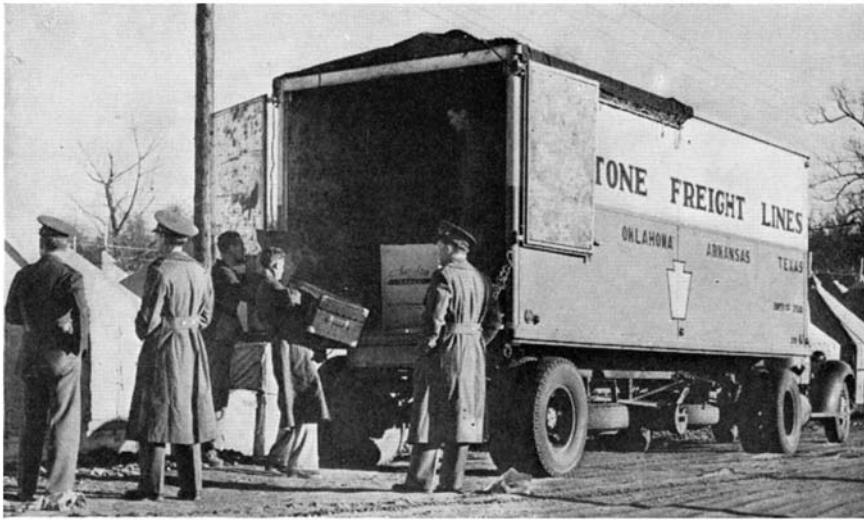
Plan Two, for use in wartime, contemplates the use of the same basic set-up, plus the establishment of an "American Trucking Emergency Corporation" to handle the fluctuating pool of equipment. Thus, while in Plan One the national trucking association would direct operations of the pool in accordance with defense orders, under Plan Two an entirely separate organization would be set up. Equipment in the pool would be obtained not only from for-hire truck lines, but from owner-operators as well as farmer-operators. Many owner-operators are always available for over-flow work, and in the agricultural off-seasons farm trucks could be pressed into service. Vehicles of for-hire carriers whose customers are engaged in non-essential industries would be available, as well as the surplus equipment of other truck lines.

IN DRAFTING its plans, the organized trucking industry has borne in mind the fact that, in war time, operations on the home-front are as essential as front-line service. In other words, it has sought to formulate plans which will permit the normal services of the trucking industry to be carried on with a minimum of delay and interruptions. Suddenly to choke off peacetime highway transportation, the truckmen realize, would be as disastrous as failing to plan for the movement of men and materials.

If, after all surplus equipment has been thrown into the pool, there is still a shortage, then regular truck lines would make up the difference in the requirements on a pro rata basis. No line would have to endure any serious equipment shortage. Necessary data on



Trucks of "over-the-road haulers" blend easily into military tactics



Capacity of freight-hauling trucks makes army transport economical

equipment in the pool will be on hand in the offices of the various state trucking organizations. This would include information on the make or model of equipment; body type; capacity in pounds, cubic feet or, in the case of tank trucks, gallons.

Neatly dovetailing into these mobilization plans is a step which the United States Public Roads Administration is about to take. In co-operation with the states, the PRA will take an inventory of trucking equipment. The forms are now being printed and will be distributed during the month of June. Once the inventory has been completed, defense officials will know how many and what kind of trucks can be counted on if an overnight emergency should develop. Thus, if the Army needed a specified number of five-ton trucks for a certain period, it could determine where such vehicles might be withdrawn with a minimum interference with regular traffic.

ANOTHER important phase of truck mobilization deals with servicing of equipment. Arrangements have been made with the automobile manufacturers to keep the Emergency Corporation informed as to the availability of servicing facilities and replacement parts in the various corps areas. In this manner vehicles will be transferred only to those areas where there are adequate servicing facilities. The Emergency Corporation would be dissolved nine months after the emergency is over, thereby allowing ample time for terminating its affairs.

With the growth of the trucking industry after World War I, mile-

age of hard-surfaced roads in the United States increased from 360,000 in 1920 to 1,122,000 today. The War Department has laid out a network of 75,000 miles of strategic roads to be brought up to defense standards. For example, about 1800 bridges in the rural network of highways need strengthening so that they will be able safely to carry military and commercial

loads dictated by emergency requirements. Even more urgent than this program, according to Federal road officials, is the need for construction of access roads and streets for new plants and Army cantonments. Access-road improvements which are required total 2900 miles alone, according to preliminary estimates.

There is only one dark spot in this whole picture of men and trucks for defense—the interstate trade barriers. Recently, there has been much evidence of the fact that the Army, as well as numerous other governmental departments, is fully aware of the problem. They have lined up in the fight against state trade walls which are obstructing the flow of defense goods. An uncompleted survey by the Federal Government already has uncovered 300 such statutes.

With the President calling on the whole nation to convert itself into an “arsenal for democracy,” the load on all the transportation facilities of the nation is mounting steadily—and rapidly. The trucking industry’s plans are laid and the wheels are rolling.

BADGES

Identification Photos

Taken Rapidly

Now that national defense production has made necessary rapid and constant checking of the identification of factory employees, badges on which appear photographic likenesses of the wearers are being turned out by the thousands. One photographic set-up for this work, used by Westinghouse, is shown in one of our illustrations. The photographers work with assembly-line speed, averaging six pictures a minute. The camera used is a fixed-focus device through which feeds standard 35mm motion picture film from 100-foot rolls. It is claimed that one roll of film is sufficient for a full working day’s production.

In many organizations where national defense materials are being produced, this identification system is being applied to all employees, from top executives to office boys. The pictures on the badges, sufficiently large to make possible immediate identification of the wearer, and available only



Photography plays its part in national defense: a moving picture camera being used to produce pictures that, printed on badges, will serve to identify workers in industrial plants

to bona fide employees, will enable guards and watchmen to bar from the premises those individuals who have no legal right to be there. Simple precautions such as this can do much to prevent interference with the even tempo of defense preparations.

Bird Dogs of the Oil Field

Gamma Rays Often Point to the Presence of Oil in Old Worked-Out Wells

RANDALL WRIGHT, M.Sc.

Petroleum Geologist

AND now the petroleum geologist has appropriated the physicist's gamma-ray detector—essentially the same apparatus as is used by the astrophysicist for detecting cosmic rays—and applied it in the search for new oil-bearing rock strata. The usefulness of gamma rays to the petroleum engineer derives from their great penetrating power, which enables them to traverse steel or rock with ease.

The device used to detect these gamma-ray emanations from rocks consists of a cylindrical electrode surrounding and insulated from a single wire. These two electrodes are enclosed in a sealed glass container filled with air or some other easily ionizable gas, and a high potential is connected across the chamber from the wire to the cylinder. As long as nothing disturbs the gas in the chamber, no current flows. If, now, a gamma ray enters the chamber, the gas is ionized and carries the current from one electrode to the other. This current may be amplified and recorded. This is the physicist's gamma-ray counter—the Geiger-Müller counter.

The utility of this device for the oil engineer lies in the fact that various kinds of rock contain different amounts of radioactive matter, and therefore some rock strata emit more gamma rays than others. Rocks formed by the solidification of once-molten material—the igneous rocks—contain a great deal of radium and thorium, also their radioactive cousins. These igneous rocks, like the granites, were the chief source of the more widely distributed sedimentary rocks and it is in these sedimentary rocks that we find oil in paying quantities. They consist chiefly of shales which were originally muds, and sandstones which were originally sands. They were made millions of years ago by the processes of

erosion and deposition. Stream-cutting and frost action and similar natural agencies acted upon the ancient granite hills, and the rivers carried the resulting mud and sand to the oceans and there spread them over great areas of sea-bottom, where they hardened to become the shales and sandstones we know today. Often intercalated with these sand and shale beds are layers of limestone formed of lime precipitated from the sea.

It is easy to see why the most radioactive of these sedimentary rocks are the shales, since they were formed as muds which contain much of the original parent-material of the ancient granites, brought almost unchanged from the lands to the sea-bottoms, for these granites included radium minerals. Sandstones, on the other hand, consist chiefly of quartz grains, which are not radioactive; waves and ocean currents removed most of the other minerals, including the radium-bearing compounds, before they were solidified. Since the radioactive minerals are present in sandstones only in minor amount, these strata are only slightly radioactive, and thus they affect the ionization chamber but slightly. The limestones, which contain no radioactive material, will, of course, have no effect upon

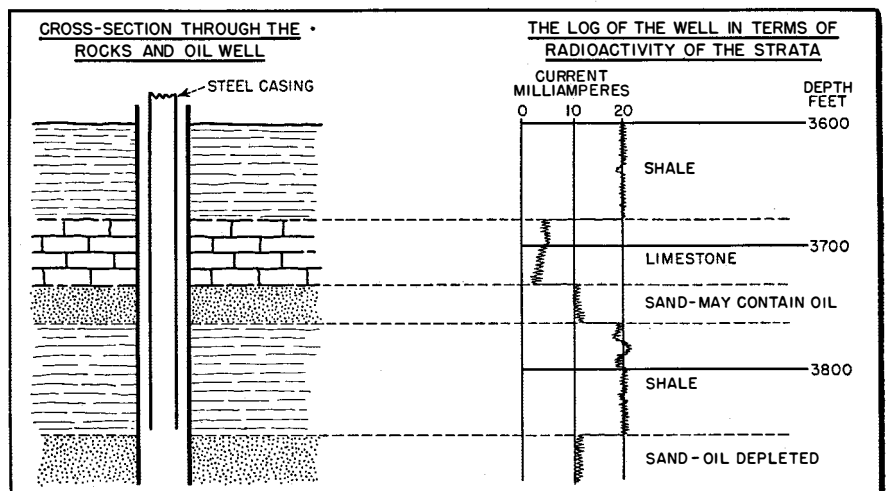
the gamma ray recorder or counter.

These differentials of radioactivity exhibited by shales, sandstones, and limestones afford a readily applicable method of differentiating between them, and these differences are demonstrated when the ionization chamber previously described is lowered into an oil well. The flow of current, set off by the gamma rays, shows which is sand, which is shale, and which is limestone.

In practice, the device is placed in a metal case and lowered on a cable which also carries the necessary electrical connections. The record is made on a scale, reduced to convenient size, on photo-sensitive paper placed on a rotating drum synchronized with the reel carrying the steel cable.

The flow of current that is registered reflects the quantity of radioactive matter in each stratum passed by the device, and thus gives an index of its nature. Oil occurs most often in sands, sometimes in limestones and only under unusual conditions in shales, and this is the key to the method.

IN many cases in the early days of the oil boom, time was the valuable element, and the man who got his well drilled down first took all the oil under his own land and maybe a little from under his neighbors'; if he did not hurry, the neighbors got some of his oil. That system was picturesque, but lots of oil was missed—nobody knows exactly how much, but it was a great deal. The unscientific haste of such procedure means that many oil sands were drilled right through unnoticed. The well records, or logs, of those days were poorly kept or entirely neglected. In



How the ionization counter reads off the nature of the strata

these older, long-used wells, where the deeper sands have been depleted of their oil, there has until recently been no way of ascertaining the depth of the shallower oil sands, because the drill holes are lined with steel casings.

The ionization chamber, however, can "see" through this casing about as easily as though it were not there. The automatically recorded gamma-ray log made by this instrument shows the depth and thickness of each stratum. Such logs are being made today as part of routine operations in old, depleted fields. A truck backs up to the oil derrick and the ionization

chamber is lowered into the well. The recording apparatus is in a light-proof compartment on the truck. The operation of lowering, recording, and raising again takes perhaps an hour. Then the petroleum engineer or geologist examines the record. If it shows a "sand" at a certain depth and the engineer believes it may contain oil, the casing is opened at this point by means of a knife-ripper, or a gun-perforator, or simply by a charge of nitro-glycerine. The oil flows into the well and an investment previously scheduled for abandonment is given a new lease on life.

lost on a pinhead), yet could be detected at several hundred feet. Subsequent experimentation has incorporated a recording counter, making possible exact quantitative measurements.

POLARIZER

And Now It's Down to Actual Molecules

A NEW kind of light polarizer which for the first time uses individual molecules instead of crystals as "combs" to line up the light vibrations is said to be the most efficient synthetic polarizer thus far produced. Made from coke, lime, air, water, and iodine, it is synthesized from materials which cannot be cut off in wartime. The new polarizer is the invention of Edwin H. Land, scientist-president of Polaroid Corporation.

Previous polarizers invented by Land and used in such applications as sun glasses and desk lamps have employed crystals embedded in a plastic sheet. The new H-type polarizer makes use of the molecules themselves to line up the light vibrations. It transmits one third more light than previous Land polarizers and it polarizes over 99.99 percent of all the light vibrations lying in the middle of the spectrum where the eye is most sensitive. Two sheets of it, with their "optical slots" turned at right angles, cut off the light and make invisible the rays from any ordinary light source.

One of the processes described in the patent for making the H-type polarizer calls for heating and stretching a sheet of solid polyvinyl alcohol until it is three to eight times its original length. This operation pulls the molecules of the plastic sheet into line. The sheet is then allowed to imbibe an iodine solution.

The high freedom from color of the H-type polarizer, together with its efficiency and polarizing power, are expected to make it suitable for scientific and military instruments, camera filters which will preserve the color values of color pictures, the projection of three dimensional pictures without color distortion, control of light intensity, devices for stress analysis in engineering and machine design, correct-color glareless illumination for desks, art galleries, and merchandise displays, and many other devices.

To Find \$1000 . . .

A Pinhead-Sized Bit of Radium Can't Long

Hide from a Physicist in a Ten-Acre Lot

R. BURTON ROSE, M.A.

Mining Geologist

ONE morning recently the "aristocrats" who spend much of their lives in the aromatic purlius of the city dump, mulling over the empty cans and bottles in expectation of finding riches, major or minor, were strangely perplexed. They apparently had competition. Three new scavengers were there, strangers and well dressed. They had a pick and a shovel and were using them in an awkward way; they also had some kind of box with a handle, that looked like a portable radio set. One of them wore a headset and wandered around in an odd manner. These certainly didn't belong to the social set of the "aristocrats," but just what was their odd game?

They were scientists, and they were looking for \$1000.

That much worth of radium in seven tiny needles had been lost from a medical office a year previous. Thrown out by mistake with the trash, the needles went through an incinerator and were carried to the city garbage dump where a tractor stacked the refuse.

An electroscope search, in cooperation with the nearest college physics department, had proved unavailing and the metal-cased

needles, far more valuable than their weight in gold, were given up as a total loss and insurance claims paid.

A geologist and his radio technician associates heard of the incident months later, and this led to research and development of the radium finder mentioned above. The unit is built around a counter tube sufficiently sensitive to detect gamma rays. Indications of the nearness of the radioactive materials come as increasingly frequent clicks in the earphones or the miniature loudspeaker.

Essentially, the instrument consists of an all-battery-powered, vacuum tube circuit giving an output of over 800 volts, which is impressed on the cylindrical anode of an ionization tube containing neon and oxygen gases. Each single gamma ray passing through the ionization tube causes a momentary discharge. The output from the cathode of this detector tube is highly amplified through an audio amplifier.

Armed with the detector, three searchers located and recovered all seven needles in less than a day's time.

The extreme sensitivity obtained is suggested by the fact that the total radium content of the needles found was only 35/1000 of a gram (small enough when pure to be

Tektites, Puzzle of Science

The Origin of these Odd Objects Remains

α Mystery Despite Years of Dispute

JOHN DAVIS BUDDHUE

MANY years ago the peasants of Bohemia noticed that their plows occasionally turned up curious pieces of rough green glass. The Vltava River flows through that region and so these specimens became known as Vltavines. Another name is moldavites.

The scientists of those days knew that Bohemia had long been famous for its glass, so they assumed that the pebbles were clinkers of ancient glass works. This satisfied some of them, but others were troubled because the pebbles were always green, and nearly always the same shade of green. Worse still, there were no other traces of glass works where they were found.

Geologists said that the deposits containing them were laid down long before man had learned how to make glass, consequently they were assumed to be obsidian.

In 1844, Charles Darwin published a description and drawing of a blackish-green pebble from Australia, and called it a volcanic bomb. Like the moldavites, it was regarded as obsidian, although no one thought of connecting the two then.

Still later, van Dijk found some oddly marked pebbles in the tin mines of the Billiton Islands, near Java. These were named billitonites, and were likened to moldavites. Meanwhile more of Darwin's bombs had been found, studied, and named australites.

An engineer named Bares attacked the still controversial problem of the moldavites, and proved conclusively that, whatever their origin, they were not artificial products, and had no connection with man-made glass, Bohemian or otherwise.

Later, surprised scientists read a paper by the famous geologist Suess, who claimed that these curiously marked glass pebbles were meteorites. Suess pointed out that moldavites are covered with a

multitude of wrinkles, grooves, and pits, which he assumed could not have been formed by water, but which did have some resemblance to the markings of known meteorites. He also invented a new name for them, regardless of where they might come from. He called them "tektites," which means simply "melted."

Ever since that time a dispute has been going on among interested people. Some accept Suess' theory, and some say it is pure humbug; the remainder prefer to keep an open mind. If the problem



Photos by the author

**A moldavite from Bohemia.
Note its oddly grooved markings**

could be settled by a vote, the meteorite, or "cosmic," theory probably would win, but in science truth cannot be attained by plebiscite; the minority may later prove to have been right.

Meanwhile, more kinds of tektites were discovered in the Malay Peninsula, in Tasmania, and in British Borneo. Subsequent to Suess' cosmic theory, other variations were suggested, one being that tektites were volcanic bombs from the Moon.

De Boer discovered in 1829 that the then known tektite localities lay on or near a great circle around the Earth. This discovery led to the theory that the Earth once had a second and smaller satellite and that this had been broken up by tidal action. The tektites were thus supposed to be the fallen fragments.

More tektites were later dis-

covered in the Philippine Islands, French Indo-china and southern China, the Ivory Coast of Africa, Java, the Libyan Desert, Sweden, and in Texas. Some of these discoveries did not fit the De Boer great circle but it has recently been shown that, by including the great meteorite craters of the Earth with the tektites, they all fall close to two great circles.

Under ordinary circumstances, when one finds a piece of glassy rock, such as obsidian, that is, volcanic glass, it is not difficult to account for its presence. Even when the obsidian is marked in a tektite-like manner, there are volcanoes not too far away. With tektites, however, it is another story. For illustration, by far the greater part of the tektite area of Australia is free of volcanic activity, and the same thing is true of most if not all of the other tektite areas. That is one of the best arguments in favor of the meteoritic theory.

Among tektites, the australites are a unique species: nothing like them is known anywhere else in the world. Dr. C. N. Fenner, an authority on australites, believes that they began as spheres of glass of various sizes which fell as meteorites. As they fell, the front side became highly heated and soon melted. The air rushing past swept the molten glass away to the edge, where it formed a rim. Thus the variety known as "blackfellow's buttons," or just plain "buttons," were formed. The forms are so perfect that it has been maintained at times that they must have been cast in molds. The "rim" of the "saucer" is fragile and easily broken away. There then remains a thin, lenticular mass of glass, a biconvex disk.

SOME of the larger balls, under the Fenner theory, lost less of their mass in proportion and these landed in a form something like a scoop of ice-cream: a strong curve on one side and a gentler one on the other. These are known as "cores," or "bungs," if especially large. Some australites are oval but otherwise are like buttons or lenses, and these are known as "boats" or "canoes." Others are called "dumbbells," for obvious reasons. It is thought that these resulted from a mass of plastic glass rotating so fast that it began to fly apart, but cooled before the process was completed. In some cases, the glass actually did separate into two

parts, and gave rise to the "tear-drop" variety.

The surfaces of australites are generally rather smooth, but speckled with numerous tiny, shallow, round pits. Some have larger pits, and some of the bungs, at least, have clusters of grooves on their less curved sides.

Few moldavites have regular shapes, but there is a tendency toward spherical and ellipsoidal forms, and drop-shaped specimens are sometimes seen. Many are broken, and some of the fragments resemble the pieces of a large blister or bubble.

Although Suess seems to have been led to his cosmic, or meteoritic, theory by a fancied resemblance between the surface markings of moldavites and meteorites, later authorities have pointed out more than once that he was mistaken. Small meteorites rarely if ever have such markings, and, while large ones sometimes do, they are on a scale hundreds of times larger than moldavites. The markings of moldavites consist of rather deep grooves, often parallel or radiating. With these are fairly large and deep pits, and overlying both is a thick peppering of tiny round pits. Some authorities think the large pits are bubble cavities, and that



Typical moldavite, about 1 2/3 natural size. Habrd, Bohemia

the grooves are bubbles that were drawn out into tiny tunnels or tubes and then broken open. Others think that all the markings are due to corrosion of the glass. Between these extremes are those who believe that there is something to be said for both theories. The corrosionists have produced tektite-like markings on ordinary obsidian by attacking it with hydrofluoric acid and such experiments suggest that, over a period of hundreds of years, rather mild reagents might

produce the same result as drastic ones accomplish in a few days. A piece of violet glass was found at Trebic, Bohemia, which bore the same kind of markings as the Trebic moldavites. This suggests that there is a substance in the soil of that locality which can corrode glass over a period of years. Further proof is given by outcrops of obsidian at Seleska, Slovakia, and at Hrafninnuhryggur, Iceland, which bear markings strikingly like tektites, yet which have been acted upon by nothing more drastic than the weather in one case, and hot water, probably alkaline, in the other.

OF COURSE, the experiments mentioned above have been made on artificial glass and ordinary obsidian, and it might be argued that the results cannot be applied to tektites which differ slightly in composition from most obsidians. However, moldavites on one hand, and indochinites, for example, on the other, differ far more in composition than either one does from obsidian, yet their markings are regarded as comparable.

Besides, proof that corrosion does have something to do with the moldavite markings can be found on the broken moldavites themselves. Some of the fractures are as bright and smooth as though made yesterday. Most of them are more or less dulled, and the duller they are the more they resemble the unbroken surfaces, until in the very oldest it is not always certain that a given surface has been broken. Moreover, this progressive change from fresh breaks to perfectly etched surfaces can be followed in indochinites, javites, australites, certain etched obsidians, and probably on other tektites as well.

Nevertheless, the bubble theory is not left without a leg to stand on. I have some indochinites that are as full of elongated bubbles as some kinds of stick candy. As one might expect, their external markings consist almost exclusively of parallel grooves. I have found something similar in a few moldavites; in these as well as Philippine tektites (rizalites or philippinites), I have found bubbles that are only partly broken open.

However, even if the question of the markings of tektites is ever finally settled as due to corrosion, or to bubbles, or both, the question of the origin of tektites will still be

open and the debate will not stop.

There are extremists who insist that tektites are nothing more than an unusual variety of meteorites, and others who insist that they have nothing whatever to do with meteorites. There are also in-betweeners who have their own theories. Other theories are that they are volcanic bombs from the Moon, or that they are accumulations of the stuff from which comet tails are made. There are theories that they are the result of lightning flashes in dust storms, which



Australites. These are: boat, tear-drop, dumb-bell, lens, button.

fused some of the dust into glass. Another postulates a peculiar kind of meteorite composed of certain "light metals" which caught fire as it fell, and produced a glassy ash. This theory seems fairly good, except that such a meteorite would resemble known meteorites even less, if possible, than do tektites.

ANOTHER of the better theories is that of Dr. L. J. Spencer, noted British mineralogist, who suggests that they may be a by-product of the landing of very large, but otherwise quite ordinary meteorites. When a very large meteorite lands on the Earth, it may, and often does, strike so violently that the soil beneath it and parts of its own substance are fused, and even vaporized. Huge holes in the Earth associated with fused or altered rock or both, and often with meteoritic material, are known in Campo del Cielo, Argentina; Wabar, Arabia; Siberia; Canyon Diablo, Arizona; Odessa, Texas; and Henbury, Australia. The fused rock is usually of a frothy, or pumaceous nature, and in some cases contains millions of minute beads of nickel-iron.

The theory of Dr. Carl Rufus, of the University of Michigan, is based upon a much older theory, originally having nothing to do with tektites, that the Moon once broke away from the Earth, leaving the Pacific basin to show where it had been. If this event took place, some fragments ought to have been left behind. Some of these might have had a period of rotation around the Earth coinciding with

the Earth's period of rotation, so that they would remain suspended over the Pacific basin. In time, gravitational attraction might cause some of them to fall. This would account for the uniform composition and great abundance of tektites in southeastern Asia, and the islands to the east, including Australia.

H. H. Nininger, of the Colorado Museum of Natural History, advances the theory that when meteorites bombard the Moon they send up violent splashes of lunar rock, some of it at such great velocity that it passes beyond the Moon's gravitational control and reaches the Earth.

The composition of the tektites is one of the strongest arguments against a meteoritic origin. Of known meteorites, some are composed of iron or a 50-50 mixture of iron and stone. These, of course, bear no resemblance to tektites, but the remaining meteorites are composed largely of stone. If fused and quickly cooled they would yield a dark-colored glass. This



A grooved moldavite from Habří, Bohemia. About natural size

glass might bear some physical resemblance to tektites but it would be very different chemically. Roughly speaking, tektites contain 70 percent of silica; meteorites contain up to 55 percent of the same element. Darwin glass and the glass from the Libyan Desert contain about 90 percent.

To show how big a difference this really is, we refer to the petrographers, who have classified all rocks according to their chemical composition. Rocks rich in silica are near one extreme of the series, and those poor in silica near the other. Meteorites are classified among the ultrabasic rocks at the extreme low-silica end. Tektites, on the other hand, are among the most acid rocks, near the other end of the classification. Thus tektites and meteorites are about as different as silicate rocks can be.

Even if one overlooks this difference, no glass meteorites are

known. Some contain a little glass, but one with even 10 percent of glass would be exceptional. Moreover, there is no way in which an originally crystalline meteorite could be fused to glass while falling. The surface melts, it is true, but, as fast as the material melts, it is swept away by the air as this rushes by. The fused layer on the surface of meteorites is rarely as much as a twenty-fifth of an inch thick.

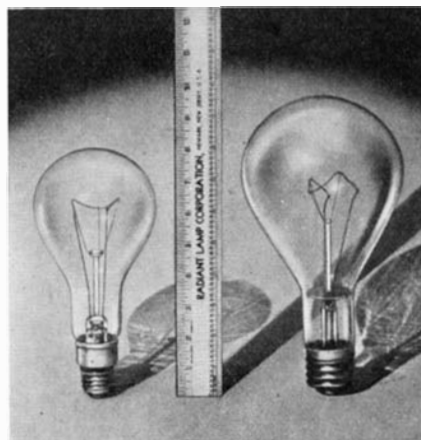
Thus the mystery which began a century and a half ago is still without a definite answer. The origin of tektites is just as much a mystery as it ever was. As far as our knowledge goes now, the only way to prove a cosmic origin would be for someone to see a tektite fall, and recover it afterward.



LAMP

Hard Glass Bulb Makes Possible Small Sizes

ATTEMPTS to reduce the size of high-wattage lamps have usually failed because the intense heat generated would melt the glass bulb or result in the collapse of the filament support. In a new type of high-wattage lamp, a hard glass bulb has been devised which overcomes former difficulties. This bulb, made by the Radiant Lamp Corporation, makes it possible to increase factory illumination 250 percent or more without changing fixtures. Because of the glass employed it is possible to reduce the size of a 500-watt lamp to that of an ordinary 200-watt lamp. The glass will also withstand thermal shocks of rain or sleet without



New and old—500 watts

cracking, thus making it available for outdoor use without additional protection.

In place of the large "mogul" base of the ordinary 500-watt lamp, necessary to support the weight, this new high-wattage lamp makes use of the same size screw base as that used in an ordinary household fixture.

MAGNIFIER

Molded Plastic Makes

inexpensive Reading Glass

A SMALL magnifying glass, of the powerful jeweler's type, is now available in inexpensive form. Molded of Lustron, a water-white polystyrene plastic, the precisely curved lens is an integral part of



Of molded plastic

the flared base which keeps it always at the right distance. It is claimed that lenses made of this transparent plastic are practically flaw-free, assuring good magnification with a minimum of distortion. The ready moldability of the plastic makes possible high-speed, low-cost production.

BOOKS

Technical and Science Books

Reach New Peak

BREAKING all quantity production records for the United States in scientific and technological books, publishers turned out 3,432,642 volumes in 1939, the Bureau of the Census has just reported.

This peak record represents an increase of more than a million books on science and technology over the previous manufacturers' census, of 1937. Added to these might be over 1,868,000 books on medicine, 1,018,000 books on agriculture, and many other books which overlap into the science and technology class.

SPEED SHIP

**Plywood Hull is Light,
Strong, Fast**

MODERN plastics and radical airplane-type design are combined to produce a speedy carrier that is reported to cost less than three cents a mile to run and sells for as little as a thousand dollars. Designed and built by Arthur E. Doane, of Stamford, Connecticut, the contours of the ship are based on Boeing Clipper hull designs. The hull is made of plastic-bonded plywood with lightweight Plexiglas windows.

Because weight is the greatest single factor governing ship speeds, Designer Doane has pared every necessary pound from his cruiser. For example, weight savings were made by replacing 20 square feet of plate glass with a transparent plastic which is only half as heavy as glass. The plastic is tough, practically unbreakable, and unaffected by sun, wind, and sea water.

The resin-bonded plywood, also used in airplane construction, is stronger per pound than steel and cuts hull weight by a third. It is used in large sheets on the "stressed - skin" principle, thus making a single unit of the planking, ribs, keel, and deckhouse, and requiring only one fifth as many seams as conventional construction. Built-in spray deflectors, such as used on the new motor torpedo boats, and a "flying stern" that rides out of the water at high speed to permit level planing, are other features of the new craft.

TREEOSCOPE

**New Method to Estimate
Health of Trees**

TREE surgeons now have available an instrument that will do for them what the stethoscope does for the doctors who safeguard the health of humans—make a quick estimate of what's going on inside.

The new method is a result of the discovery, by Thaddeus Parr, of the United States Department of Agriculture, that there is a slight difference in electrical potential between top and root of a tree. During the time of fastest growth in spring, this gradient is from top to root; later, it reverses its direc-



Plywood speed ship on trial run, Long Island Sound

tion. But in a tree seriously injured by insects or otherwise in bad health, the reaction is abnormal, being either weaker than a sound tree or reversed in direction.

A comparatively simple but very sensitive voltmeter has been developed that can be carried into the woods so that field diagnoses will be readily possible by foresters, entomologists, and others who have been trained in its use.

— *Science Service.*

SWALLOWED SHOT

**Duck Deaths Prevented
by Simple Device**

WILD ducks are saved from death by lead poisoning with a device, invented by Warren H. Nord, of the Minnesota Agricultural Experiment Station, which works somewhat on the principle of the stomach pump used in human medicine, reports *Science Service*.

Wild ducks frequently shovel up shot pellets that have fallen into the water, in the course of their grubbing for food on the bottom. The pellets are retained in their gizzards like small stones, and in time may cause lead poisoning. Serious wildfowl losses have been traced to this cause in recent years.

Mr. Nord's lifesaver for sick ducks consists of two tubes of Pyrex glass, one within the other. For operation, the sick duck is laid on its back, with its wings and feet held to prevent it from struggling. The tube is carefully pushed down its esophagus and into the gizzard. A trickle of water is flowed

through, in the annular space between the two tubes. This loosens the contents of the gizzard, which are then drawn out through the inner tube, by means of a slight vacuum produced by an aspirator attached to a laboratory faucet.

There is no difficulty in catching lead-poisoned ducks. They are just too sick to fly. The operation, of course, is not particularly relished by the ducks which naturally do not understand what is going on. But it does bring out the poisonous leaden pellets. And Mr. Nord figures it is better for the ducks to be uncomfortable for a few minutes than to be permanently dead.

RESERVOIRS

**Life Shortened by
Uncontrolled Erosion**

OF the 12,000 or more water-supply reservoirs in the United States, over 20 percent have a useful life of less than 50 years, due to erosion of the surrounding countryside and consequent sedimentation. Another 25 percent of the total will be lost in 50 to 100 years, and only 54 percent will meet present requirements 100 years hence.

According to the Soil Conservation Service of the United States Department of Agriculture, erosion control practices have already proved effective in reducing reservoir sedimentation. A survey of the High Point, North Carolina, reservoir, for example, showed that erosion control had reduced the rate of siltation by 25 percent in less than 10 years.

NEVER SEEN BEFORE

Electron Microscope Reveals Viruses for First Time

DISCOVERIES in the realm of biochemistry which point the way to new frontiers in the field of medicine have been revealed by Dr. Thomas F. Anderson, RCA Fellow of the National Research Council. The methods used would be applicable in the study of such human ailments as smallpox, infantile paralysis, influenza, and the common cold.

Dr. Anderson pointed out that scientists are now able to see the larger molecules under the powerful magnification of the electron microscope. In fact, it is even possible to see reactions between individual molecules of different types. Such reactions are responsible for immunity to disease and even for the discomforts of ordinary allergies such as hay fever. Persons suffering from a disease develop antibodies in their blood streams, and these attack the disease agent, overcome the disease, and, in many cases, give the persons an immunity to the disease.

As a basis for their studies, Dr. Anderson and Dr. W. M. Stanley, of the Rockefeller Institute at Princeton, produced in rabbits an artificial

immunity to tobacco mosaic virus. They actually succeeded in photographing the virus which had been attacked by antibodies from the rabbits' blood serum. The photographs were so clear that the actual manner and extent of attack could be determined. The techniques developed in these experiments are being used in the RCA Research Laboratories at Camden, New Jersey, as the basis for continuing studies of causal agents of human disease.

QUICKSAND

You're Safe In It If You Keep Quiet

IF you ever have the misfortune to fall into quicksand, don't get panicky and thrash around. If you keep quiet, allow yourself to go down feet first and keep your arms outstretched, you will soon find yourself resting at a depth just below your armpits.

This is the advice given by Lawrence Perez, director of the Soil Mechanics Laboratory at Cooper Union, in New York, according to *Science Service*. You stop sinking when your weight equals that of the quicksand you displace. As a matter of fact, quicksand will support you twice as easily as water.

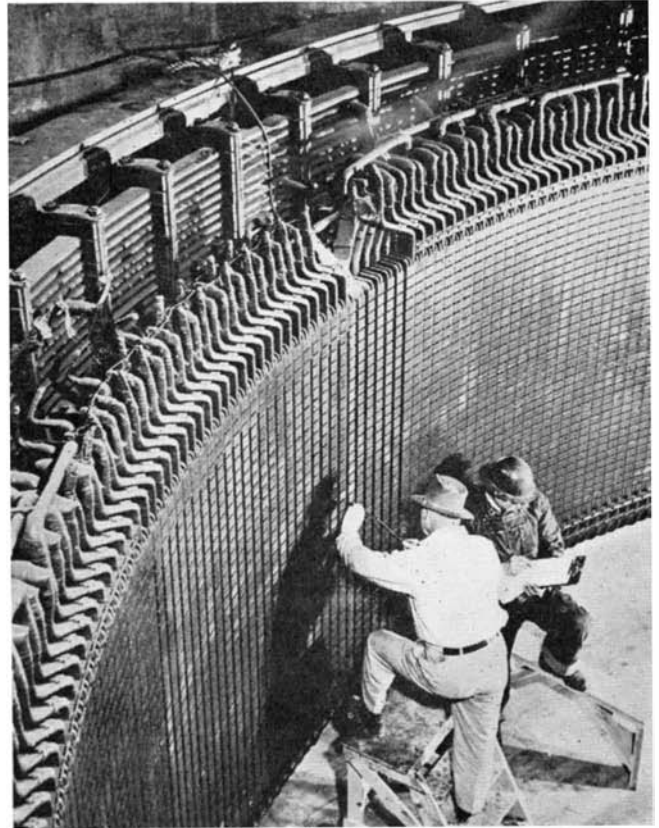
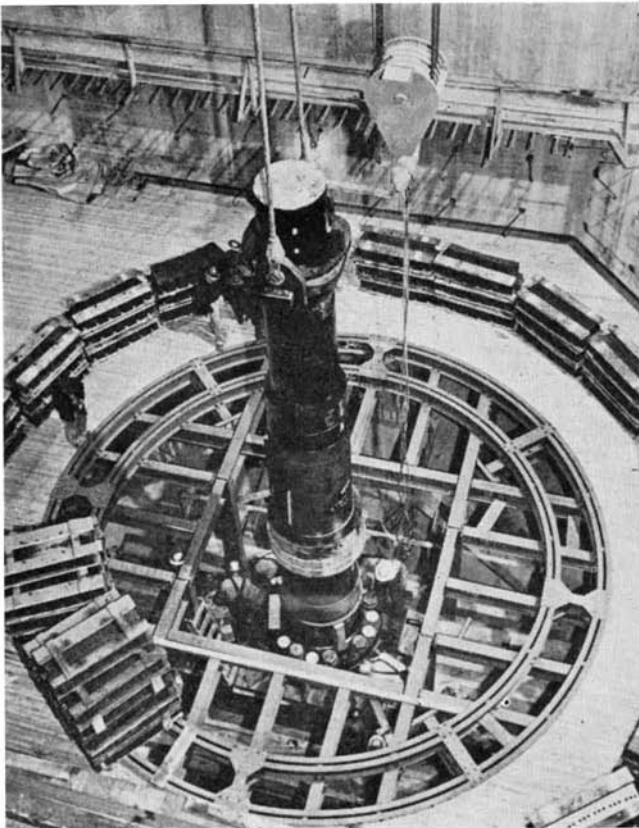
Quicksand is no particular type of material. Instead, it is a condition possible in granular soils where flowing water exists. The weight of the solid particles is balanced by the water pressure.

GENERATORS

Power Production Started at Grand Coulee

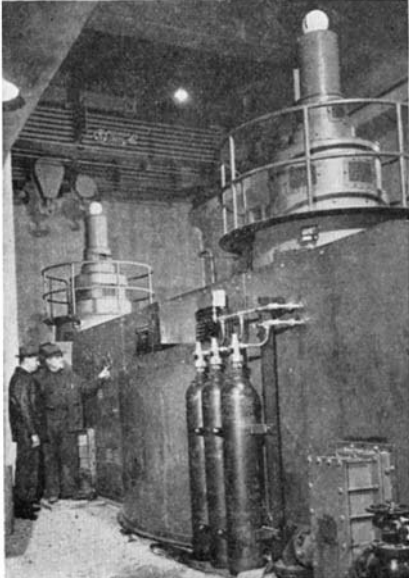
THE first two water-power turbine generators have begun their work at Grand Coulee Dam of turning the energy of falling water into electric power. These first two generators each produce 10,000 kilowatts of energy and are known as "station service" generators. For the present, and until the first main generating unit of Grand Coulee is placed in service, these two generators will supply power to a line connecting Grand Coulee Dam to Bonneville Dam, thus augmenting the power supplied by Bonneville for some of the vital defense industries of the northwest. Later, these two 10,000 kilowatt generators will be used for supplying power to the Grand Coulee powerhouse itself — for lighting and heating and for operating electric motors, air compressors, and numerous other station auxiliaries.

The main generators at Grand



Shaft of one of the 108,000-kilowatt generators for Grand Coulee, and checking generator stator joints

Coulee will completely dwarf the "station service" units. Each of them will have a power output of 108,000 kilowatts, the rotors being 30 feet in diameter at the largest section. Completely assembled, these generators will be 24 feet high and 44 feet in diameter and will contain more than 4,500,000 pounds of steel and almost 300



Station service generators

miles of copper wire. The rotors will rotate at a speed of 120 revolutions per minute.

When the Grand Coulee power plant is complete it will consist of 21 power generators. Three of them will be of 10,000 kilowatt size, while the remaining 18 will be rated 108,000 kilowatts. It is expected that three of the large machines will be in operation by next summer. One of them is now being assembled at the dam.

Energy from many of these units will help to lift water to the vast semi-arid Big Bend area and thus restore productivity to over 1,200,000 acres of land. In addition, these generators will make available a vast reservoir of power for national defense and peacetime industrial needs.

STABILIZING A DUNE

Planting of Pines to Protect a Harbor

WITH sand threatening to choke up their harbor, the people of Grand Haven, Michigan, are doing something about it. For years a huge dune has been showering tons of sand into the Grand River, necessitating frequent dredging by engineers. This year the citizens

U. S. N. AEROMARINE COMPASSES

Suitable for car, boat or plane made for Navy
All at fraction of original cost (\$60 to \$140)

MAKE
Kollsman
1° grad. \$25.00
5° grad. 20.00
Pioneer
1° grad. 25.00
5° grad. 20.00
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1° grad. 22.00
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5° grad. 12.50

If electric illumination desired, add \$2.50



U. S. ARMY ALIDADES
Hardwood, metric scale, 0-15 cm. and reverse, and log. scale, hairline sight spirit level. 45° angle adj. type, made in France **\$1.95**

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U. S. Army Engineers, Geologists, Surveying, Mapping, etc. Magnifying Eyepiece. **\$3.50**

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Bronze jewel bearing. Leather case. 2 3/8" diameter, 1 1/4" high **\$2.50**

"PLAN" COMPASS
New U. S. Army Engineers
Floating day and night dial on jeweled pivot. Used for map reading; setting and keeping a course, etc. Heavy metal case with automatic stop; sighting window with reflecting mirror. Jeweled floating dial, radium marked, 0 to 360 degrees, 1/2 inverted markings. Radium arrow on lens.
Price **\$5.50**

U. S. Army Parabolic Searchlight Mirrors
Precision Quality
FOCAL GLASS

DIA.	LENGTH	THICKNESS	PRICE
11 in.	4 in.	1/2 in.	\$12.
18 in.	7 7/8 in.	5/16 in.	25.
24 in.	10 in.	5/16 in.	50.
30 in.	12 1/2 in.	7/16 in.	55.
36 in.	18 1/4 in.	7/16 in.	75.

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

1000 ALUMINUM PROPELLERS
Controllable pitch. Blade 1 1/2", sweep 23". All aluminum 9/16" shaft. Weight 5 1/2 lb. **\$5.00**



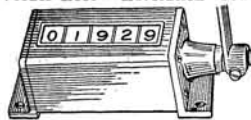
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Pocketbook style, case 9" x 4" velvet lined. No. 2570 **\$7.95**

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Cast iron housing, \$7.50
Available in 6, 12, 32, 110 volt d.c., 110 v. a.c., 110 v. universal. Specify type and voltage desired.



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\$18 value

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All brass on wood base. 20, 50, or 200 oms. **\$2.95**

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

Model	Amps	Hrs.	Ea.	Price
A-4	150	150	Ea.	\$5.50
A-5	187	110	"	5.50
A-6	225	110	"	5.50
A-7	262	110	"	7.00
A-8	300	110	"	7.00
A-10	375	110	"	8.00
A-12	450	110	"	12.50
B-4	75	110	"	4.00
B-2(J-3)	37	110	"	3.50
M-8	11	110	"	1.50
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All cells 1.2 volts each. Above prices are per unit cell. For 6 volt system use 5 cells, 12 vt.—10 cells, 110 vt.—88 cells. Note: On all cells 75 amps. or less an additional charge of 10% is to be added for trays.

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Western Electric lever type. Combination locking and non-locking (anti-capacity). Equivalent to 2 double pole double throw switches. Platinum contacts. Price **\$1.00**

Fire Alarm Equipment

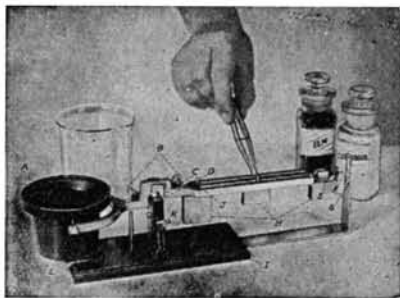
Gamewell Street Boxes **\$18.00**
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SINGLE STROKE ELECTRIC GONGS
Edwards 12" bronze DC 5 Ohm Mech. Wound **\$13.50**
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Schwarze 5" 18 volt **5.00**
Gamewell 12" Bronze "turtleback" 6 volt Mech. Wound **18.00**
Also limited amount Faraday bells.

United States Govt. Fire Extinguishers (Refillable)

Heavy Copper & Bronze
Carbon tetrachloride (pyrene liquid), pressure type, ideal for labs, trucks, boats, garages, office, etc. (10 times more pressure than hand extinguishers.) Just turn handle. No pumping necessary. Ideal for remote control with wire. (Original cost \$40.00.)
1 qt. (100 lbs. pressure) **\$8.95**
2 qts. (200 lbs. pressure) **\$14.95**
Lots of 3, 10% discount.
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For Sale by

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

of Grand Haven are determined to "tie down" Dewey Hill once and for all. The city acquired 83,000 pine trees, and one day the whole community marched on the hill, armed with shovels and buckets, to plant them. The volunteers, with the help of CCC workers, covered about 40 acres with the trees. It is expected that the pines, together with the beach grass planted by a CCC crew, will hold the sand in place and help protect the harbor. The planting is a part of the work of the West Ottawa soil conservation district, started in the Grand Haven area two years ago.

LIGHT METER

Extinction Type is Simple to Operate

IMPROPER lighting wherever artificial illumination is used—whether it be in home, office, or factory—is definitely known to cause irritableness and fatigue. Often insufficient lighting is a serious contributing factor to impaired eyesight, yet surveys show that many of us work and play under conditions of illumination that are seriously in need of correction.

Frequently the only correction necessary is the repositioning of a lamp or substitution of a bulb of



Using the light meter

higher wattage. The only way to be sure, however, that there is sufficient illumination for the work in hand, is to measure it.

This measurement of lighting can now be done rapidly and inexpensively with a new extinction-type light meter called the Lightmaster, developed by John A. English and Company. As our illustrations show, this meter is

easily read and checked against a chart which is an integral part of the meter itself. This chart covers the most common applications of lighting, while a more comprehen-



Chart is built in

sive listing which accompanies the meter goes into greater detail.

This extinction type light meter is completely free of complications so that even a school child can use and interpret it successfully. The case is made of durable plastic and metal with no moving parts.

HOUSE NUMBERS

Visible at Night Under Ordinary Street Light

ADDRESS numbers which "shine in the dark" by reflection from ordinary street lighting in the usual village or suburban arrangement, are made of Lucite, a crystal-clear plastic which controls and reflects light without glare.

The numerals are made with a series of tiny parabolas or saucer shapes in relief pattern on the back of the plastic, backed with thin metal and outlined by a plain, transparent rim of Lucite. Each little saucer acts as a minute controller and reflector, not only shooting light back toward its source, but causing the whole numeral area to glow as though illuminated from behind.

Because Lucite has the property of internal reflection, light penetrates the flat part of each saucer shape but cannot penetrate the curved sides and so is concentrated within each tiny circular area. By thus preventing the light from spreading too much, glare elimination is accomplished. The saucers offer just enough



The Quiet Air-Conditioned Rooms

(individually regulated—you control the temperature yourself by a local thermostat) are so completely insulated you would never guess the noisy activity of a great city goes on outside. And the price averages little more than rates at an ordinary first-class hotel.

*Air-Conditioned Public Rooms,
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WALT DISNEY who created a new form of musical entertainment in "Fantasia", the masterpiece of animation, says "Time is of the essence in motion picture production." Because scenes are measured in seconds, and dialog, sound effects, and music are tailored to fit by precise time measurements, motion picture producers have made extensive use of Longines Watches from the earliest days.

Mr. Disney's personal watch is a Longines "Hall of Fame"



To the aviator, sports official or motion picture producer, a watch is an instrument for the precise measurement of time. For them, as for others, Longines makes technical watches of the highest character. And these men generally select Longines watches for their personal use. They recognize that Longines' 75 years experience in fine watch-making assures greater accuracy—in every Longines Watch.

Longines jewelers show exclusively styled Longines Watches from \$40; also Wittnauer Watches from \$24.75, products of Longines-Wittnauer Watch Co., Inc., New York and Montreal.



They "shine in the dark"

spreading, however, to provide the desirable wide angle of vision. The principle is the same as that used in lighthouses to attain the best balance between light control and a wide angle of vision.

Legibility of the numerals is further aided by the contrasting plain surfaced plastic rim outline. Day-time legibility is also excellent. There is no variance in legibility as each numeral, being molded, is a precision piece—an advantage of plastic materials. This method of mass production also makes possible extremely attractive cost.

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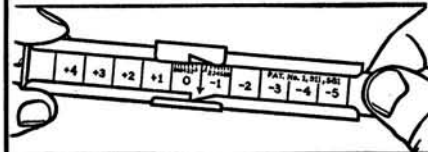
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"Winged Warfare"

A Message to the Nation from Airmen
Who Know What Military Aviation Needs

ALEXANDER KLEMIN

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

OUR military airmen are not ordinarily loquacious; the task of interpreting the aviation needs of the Army is more apt to be undertaken by newspapermen and Congressmen than by Air Corps Chiefs. Therefore, when Major General H. H. Arnold, Chief of the Air Corps and Colonel Ira C. Eaker, of G.H.Q., Air Force, collaborate in writing a book entitled "Winged Warfare," the nation will do well to read — particularly today.

Profusely and well illustrated, written in sober, clear style, "Winged Warfare" postulates certain questions and answers them. How many airplanes do we need? What kind of planes shall we build? Can we catch up with Germany in the air armament race? Should we have a separate air force? Are our planes better than England's and Germany's? What is the plane-building capacity of our aeronautic industry? Can Mr. Ford build fighting planes? Why not train 50,000 pilots? On the correct answers to these questions depends the future of civilization. General Arnold and Colonel Eaker will readily admit that some of these questions can only be answered by time, that some of their answers have already been contradicted by events. But their splendid book divides the whole subject into ten logical divisions, and lays the foundation on which knowledge rests and hence decision may be based. The best plan for anyone who is interested in this topic (and who is not?) is to buy, borrow, or steal the book and read it; this review can only quote a few striking thoughts or facts.

Actual warfare is the best instructor and that is why British experience is worth millions, even billions, to us. Only after the campaign in Poland was it found necessary to have a "command plane," capable of landing in small fields or limited areas, and to permit the

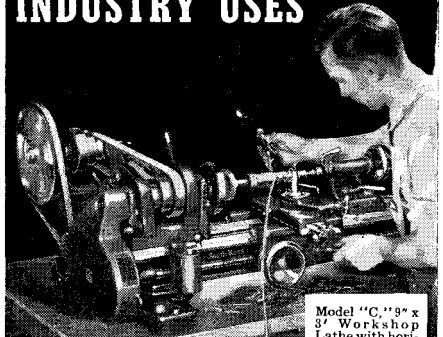
commander to look down on a battle scene. The authors are right; the command plane is invaluable. But why would not an autogiro or a helicopter be even better than a command plane?

Another lesson of warfare, drawn from the German campaigns in Norway and the Netherlands: we should have an airplane freight carrier for special supply purposes and for troop carrying. Here is a novel idea that General Arnold and Colonel Eaker approve; the glider train, and in particular a giant glider with sufficient size and carrying capacity to carry light tanks. "One particularly forward-looking inventor used the tank as the motive power to give the glider speed enough on the ground to take the air and thus to assist the towing airplane on the take-off."

A training plane in the early days was a very simple affair. Now a variety of training plane types are needed, and the twin-engine trainer has come to the front. Such a plane will be a measure of economy and efficiency in training personnel for multi-engine bomber operation. It will be a reasonably light, low-wing monoplane, with two engines of 300 to 400 horsepower each and an instrument panel closely resembling that of a medium-size bomber.

In an early chapter of the book we find the designation "Winged Warriors." How romantic, and how appropriate! Does West Point really teach its graduates how to write? "The boy in the Spitfire heads for the formation, singles out the left rear bomber, moves in behind, opens up at 100 yards with all his guns . . . He knows the grim answer. As he flies over the enemy bomber, a bullet cuts a gas line . . . The Spitfire is too fast to set down in a rough sea safely so he pulls back on the stick, rolls the plane on its back and tumbles head over heels through space. A pull on his parachute rip cord and he sits beneath a hugh, white canopy. He sees his stout little plane hit the water with a great splash and is glad that he is not aboard . . . As

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he tastes salt water and desperately fights his way from under the wet folds of his 'chute, he may reflect that life and death move swiftly in this air business."

We all of us know, or think we know, characteristics and qualifications of the military pilot. What of the bombardier whose problem is the laying of high explosives with accuracy on vital enemy objectives? "War has demonstrated time and time again that bombers who cannot hit their targets are of little more than a nuisance value in war. Bombing units must be able not only to find a target, but they must be able to hit it . . . Physically and psychologically the bombardier must be of the same stern stuff as the combat crew members. It is probable that it is wise and well for him to be the most phlegmatic of the flying brotherhood. He generally has his back to the fight. It requires a stiff spine, knowing that a fighter is on the bomber's tail pouring bullets into it, to sit with eyes glued to the instruments, with back to the fray and observe the steady progress, the ticking of the second hand and the approach of the target. . . ." Courage still counts and billions will not supply its want. The authors also give unstinted and deserved praise to the Army Air Corps mechanics without whom there would be no air corps.

In the matter of air tactics, history has little to teach. That is why the Germans, who had no old Generals left over from the last war, did so well. They improved their air tactics and really used the airplane. Nevertheless there are some principles of air tactics which are already well standardized. "The offensive fighting spirit must be instilled in all crews. Shooting is more important than flying. Volume of fire at close range is what counts; long-range, hit-or-miss shooting is out, it wastes precious ammunition . . . The picture of the attack must be brought back; it shows crews their deficiencies . . . The bomber must not turn and fight. His only objective is the destruction of assigned targets . . ." Surely all our military officers could read these remarks with benefit.

Air strategy and defense against air attack are treated with equal mastery. The chapter on Aircraft Production, if followed by the Air Corps in particular and the Federal Administration in general, would

end all our troubles as regards procurement! The chapter "Air Force for Us" is equally wise.

Congratulations to "Happy" Arnold and his gifted associate. Every one interested in supporting the government of our country in its great task of today can learn from the fascinating pages of this book.

WIND TUNNEL

Fans Driven by 40,000 Horsepower Motor

THE new wind tunnel at Wright Field, Dayton, Ohio, will be a closed, circular jet, varying in diameter from 45 feet to a minimum of 20 feet at the working or testing section. The air, as it passes round and round in the steel and concrete jet or channel, will reach its highest velocity at the narrowest section, where a hurricane of 400 miles an hour will be created and airplane models of 15-foot span will be tested for efficiency, stabil-



Working on the strator of the motor described in this column

ity, and control. The structure housing the tunnel will be 68 feet high, 108 feet long, and 62 feet wide. The models will be suspended in the test chamber by three struts connected to a balance, and the readings of the balance will be automatically recorded.

Two 16-bladed giant fans, each measuring 40 feet in height, will pull the air through the tunnel. To drive these huge fans there will be needed 40,000 horsepower, supplied by a Westinghouse wound-rotor induction motor, the largest ever built. It is very important that the speed of the fans, and hence of the motor, be kept constant during an experiment. By a

system of two motor-generator sets, Westinghouse engineers have combined close speed control with little waste of energy. The 40,000 horsepower motor is gigantic and needs 85,000 cubic feet of air every minute just to cool it. Our photograph shows a Westinghouse craftsman fitting some of the windings in the stator of the record-holding motor. — A. K.

LIGHT-PLANE FLYING

Its Future Depends on

Small Engines

WHAT is a light airplane engine? It is an engine of under 100 horsepower, generally of the four cylinder horizontally opposed type, though sometimes having six cylinders. There are some engines under 100 horsepower which are of the in-line or radial variety, but the opposed-cylinder types take in 90 percent of the field. Three companies build these engines — Aircooled Motors Corporation, Aviation Manufacturing Corporation, and Continental Motors. Hence the name "Little Three Engines," which has been coined by Ralph S. White, the powerplane authority of the Civil Aeronautics Administration.

In a paper presented before the Society of Automotive Engineers—"Some Present-Day Problems in Light Airplane Engines" — Mr. White has made an exhaustive study of these engines, on whose functioning the future of popular flying depends in so large a degree. What is needed in the light-plane engine field? Practically the same characteristics as for the more powerful Wasps, Cyclones, and Rangers — more power for a given weight, dependability, low cost, efficiency, and so forth.

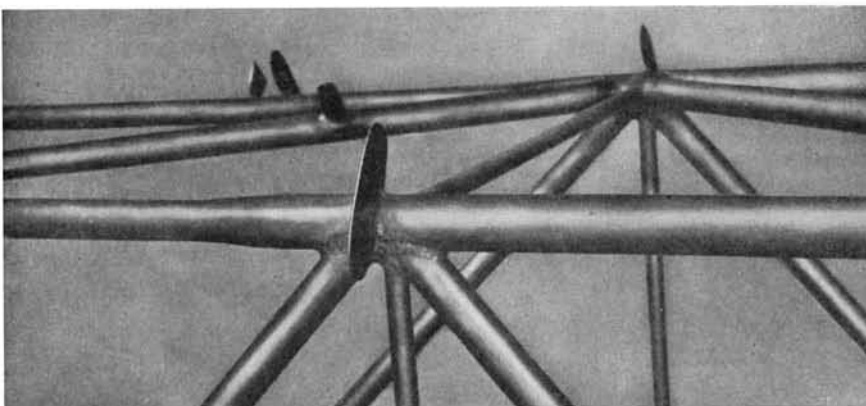
To date the light engine designers have not been quite as

ambitious as the constructors of the more powerful motors. But now Mr. White predicts that even in the low-power field there will be a demand for reduction in noise; propeller gear-box reduction; metal propellers; controllable pitch wood and metal propellers; vibration damping equipment; oil filters; air cleaners; and automatic heat and mixture control for carburetors.—A. K.

FEWER WELDS

TEN years ago the welded steel fuselage reigned supreme. Now its position has been challenged by the monocoque or semi-monocoque fuselage of aluminum alloy, but, in the low-cost field, welded tubing still holds its own fully. Certain production requirements may again bring the welded steel tube into favor. A recent development of the Summerill Tubing Company may help; this development is the production of seamless tubing tapered in diameter and strength, and so more readily adapted to the tasks of airplane construction where the same length of tubing may meet widely varying load requirements along its length.

The tube begins as a pierced billet which is hot rolled into a tube. Then one end of the tube is heated to 1400 degrees, Fahrenheit, and is formed into one long cone closed at the end. The tube is annealed, pickled, and lubricated and is then elongated by a special process on the draw bench. With repeated drawing operations, the tapered tube is available for use. Space will not permit us to give more detailed description of the process but the application of the tapered tubing is clearly shown in one of our photographs. In the landing gear, the opportunities for using the new process are even more appealing than in the fuselage. — A. K.



Tapered tubing means fewer welds in aircraft construction

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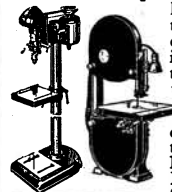


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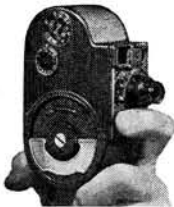
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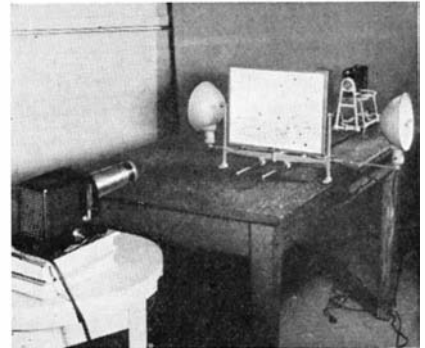


Figure 2

available rubber titling letters. In order to show the letters up properly, the projected background scene should not be too dark. A scene characterized by medium tone values is the best for the purpose. The projector light should be strong enough to permit a bright image on the screen, since we are re-photographing the scene, and the same conditions occur again that we would have in normal movie photography. Mr. Lang employed a 500-watt bulb, and this was found to be satisfactory. The camera lens must be stopped down in order to get lettering and scene into sharp focus, particularly critical at the short working distance employed in title-making.

Moving pictures appear to show scenes in actual motion only by reason of the phenomenon of persistence of vision; we know that a movie film is really composed of a string of still pictures. The projector moves the film so quickly—normally at 16 frames per second—that we do not detect any interruption. This is because, when we look at a picture, the image of that picture remains with us for an instant after the picture is removed from our line of

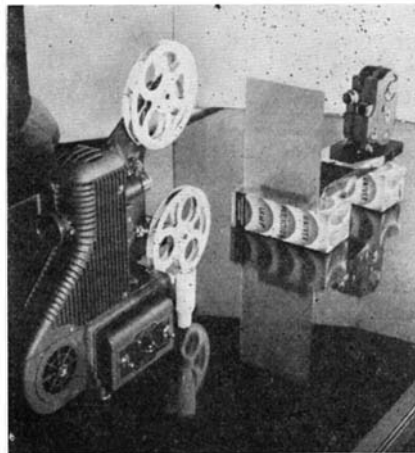


Figure 1

the meaning and effect of a scene here and there.

A fascinating phase of title-making is that in which an actual movie scene is used as a background, with the lettered title in silhouette. Recent experiments conducted by E. B. Lang, A. R. P. S., New York City, show that this can be done provided certain essentials are taken into account. Mr. Lang employed a Univex projector and titler plus the new Univex Cinemaster Double-8 movie camera. His set-up is illustrated in Figure 1, which shows a sheet of ground glass in place of an easel. This was held in position with strips of adhesive. A shim was placed back of the lens mount in order to bring the lens slightly forward and thus properly focus the camera for the short glass-to-lens distance.

An appropriate scene is selected from his files and projected from the rear, as shown, onto the ground glass, the ground side facing the projector lens. The smooth glass side facing the camera lens is used for lettering, either by writing or by mounting

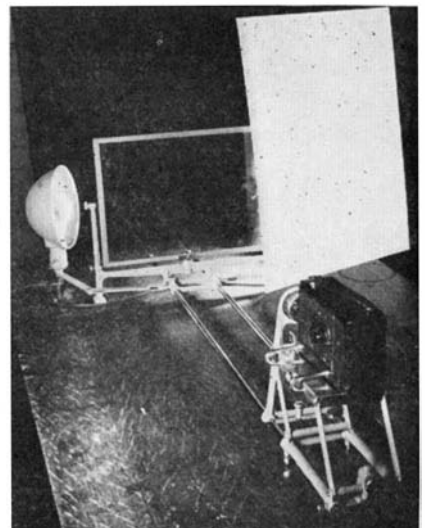


Figure 3

vision, but that instant, in observing a movie, is long enough to merge one image with the succeeding one, so that we imagine the picture is actually in motion.

To all intents it is in motion, but definitely there is a gap between each still. When re-photographing the scene with a movie camera, therefore, it is necessary to make an allowance for this. This may be done simply by shooting at more than the normal 16 frames per second. In Mr. Lang's experiments he used approximately 20 f. p. s. and found this speed completely adequate. The use of a small stop plus a faster taking speed makes a considerable demand on the film used, but this will be taken care of by using the combination of a strong projector light, a medium-toned background image, and a high-speed film.

A simpler method, though of course not quite so effective, is the use of a background projected by a still pro-

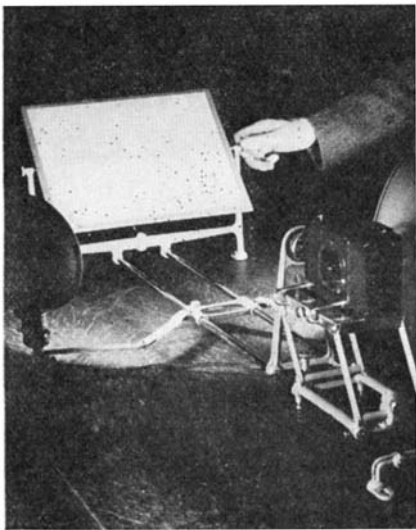


Figure 4

jector of the type used when showing Kodachrome slides. Here the problem is greatly minimized since you are merely photographing a still picture. Better than ground glass for this purpose is flashed opal glass because this avoids the hot spot and more evenly distributes the image on the glass. Figure 2 shows the use of the Brown Precision Titler for this purpose. The still projector is the Eastman Model 2 and the camera is the Filmo Magazine.

Figure 3 shows the use of the Brown Titler in making back-lighted titles. To avoid having the light strike the lens, a card is placed as shown. The angle of the light is illustrated by the idle unit at the left. Figure 4 shows how this titler is used when making so-called flip-flop titles. A title is set up on each side of the sheet-cork easel, one of the titles being arranged upside down with relation to the other. While the camera is operating, the title frame is turned evenly by a knob, as shown, from the first title to the second, being brought

to a vertical position by a stop. A turn-around title is made by attaching a pedestal bearing to the bottom center, the pivot bearings being removed. A title is set up on each side, both right side up, and the title frame is rotated from the first to the second title while the camera is in operation.

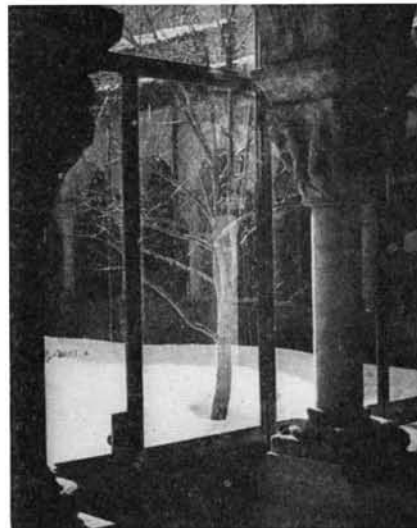
With the aid of devices such as these, title-making for movies becomes almost as exciting as shooting the the movie itself.

Rubber-Cementing Large Prints

WHEN mounting large prints with rubber cement, it may be found difficult to get the print down evenly on the mount. As a result, small bumps appear in various places due to scattered air spaces between print and mount where the print failed to make contact with the mount, or some sections get down sooner than others due to failure in laying the print down in an even progression from start to finish. A practical method of avoiding this and making sure of good adhesion over the entire surface is to rubber-cement the back of the print and the surface of the mount as usual, and then tack down only one edge of the print. Before pasting down the rest of the print, insert a piece of wax paper between print and mount and press the print down so that part of the wax paper is adhering both to print and mount. Then slowly and carefully, pull the wax paper away. This will pull the print down to the mount, with some guidance, and insure close adhesion without air spaces. The method is particularly useful with single-weight papers.

Charm in Contrast

OFFERING a severe test for photographic materials as well as an interesting subject, the accompanying winter scene, taken from the warm vantage point of a museum interior, depends for whatever charm it may possess on the rather extreme brightness contrast between the shadows of



High-lights and shadow

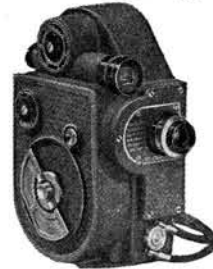
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**SCIENTIFIC AMERICAN
AMATEUR PHOTOGRAPHY
CONTEST**

POPULARITY of the divisional method of judging photographs in the Scientific American Annual Contests, as determined by the enthusiastic response in past years, has been so great that the method is once more being used for the Sixth Annual Contest. In each of the divisions listed below there will be awarded seven major prizes and five honorable mention awards, a total of 36 prizes in all.

Please read the rules carefully and abide by them. Note particularly Rule 6, under which any contestant may enter a total of six prints, but no more than two in any single division.

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, sea scapes, and so on.

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

THE PRIZES

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

2nd. Three \$90 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.

3rd. Three International Marketing Corporation PHOTRIX "22" Enlargers, complete, less lens. (List price \$54.)

4th. Three Burleigh Brooks FOTH-DERBY Cameras, with built-in coupled range finders. (List price \$34.75.)

5th. Three WESTON No. 715 Exposure Meters. (List price \$24.)

6th. Three ABBEY Vimo Flash Guns. (List price \$13.75.)

7th. Three Raygram LEE Timers. (List price \$12.50.)

Five Honorable Mention Awards, each to be a new or renewal subscription to Scientific American for one year.

Address all Entries to

Photograph Contest Editor, Scientific American

24 West 40th Street

New York, N. Y.

**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 or monotone. 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 1, 1941. Results will be announced in our issue dated February, 1942.

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.

**Names of the Committee of Judges
Will Be Published in a Near
Future Issue.**

the interior and the strong highlights of the snow. The result was achieved with a negative of good contrast enlarged on a medium hard paper. More detail could have been saved in the shadows had a softer paper been used. In that case, however, the effect of strong outdoor light would have been diminished.

Scared?

We wonder how great a percentage of the camera-toting public shies away from new methods in photography just because they are simply too scared to try them. Talking with workers, we have frequently had the feeling that they would go into toning or color photography or movies or lantern-slide making, if only they had the nerve. Licked before they even start, these defeatist fans can never know the possibilities of the newer fields unless and until they try. One good way to get rid of this negative attitude is to watch demonstrations of the new processes. Another, the most desirable way, is to buy the necessary materials and then go ahead and try your hand at the thing just to get the hang of it. It's surprising how quickly fear vanishes when results make their appearance—even poor results, which must be expected at the start.

Cropping Improves

THE two accompanying illustrations show, better than anything we might write, how greatly a picture may be improved by the simple process of eliminating from the original image all distracting details and concentrating on the main subject. None will doubt that Figure 2 is much better than Figure 1, yet this easy expedient of hoisting your enlarger higher than usual or making a smaller print to include only the wanted portion, is not practiced as generally among amateurs as it should be.

In our illustrations, you may notice that the angle of the baby's head and body is different in the finished result than in the first. This is another means of giving the print an added force. All you do is turn the easel until the picture looks right. The

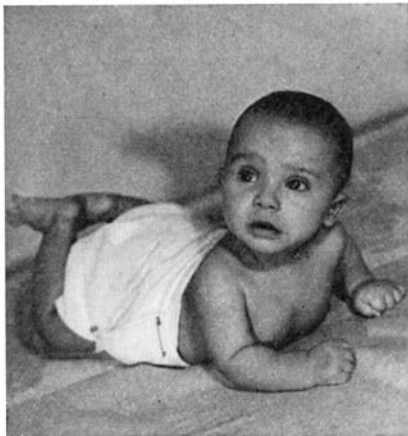
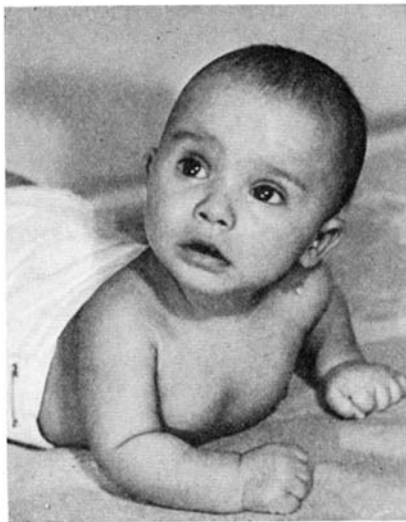


Figure 1: The full negative . . .



. . . and, Figure 2, as cropped

angle of the head in Figure 2 gives the baby's face a somewhat more lively and alert expression than in the original.

You can do your cropping right on the easel, but it is simpler and more convenient to make a straight print from the negative and do your experimental cropping right on the print. Having determined the arrangement, you are all set to make the print.

Temporary Marks on Glass

MUCH as we would like to do so, it is not often convenient to provide a label for a bottle immediately after having mixed a particular solution, or when the solution is made up to be used right away, but there is always danger of mistaking it for another bottle made up at the same time, also for immediate use. Sticking on a label is a nuisance. There is now on the market a marking pencil called Phano, which can be used to write on glass and other glazed surfaces. It comes in several colors. One of these, of a contrasting color that can be seen against the background of the dark or light glass, as the case may be, serves very well for such temporary marking needs.

Scum Marks

FILMS, upon drying, are sometimes coated with scum marks, which interfere with printing. You can remove these when the film is dry by rubbing the surface with cotton soaked in methylated spirit or wood alcohol, or by immersing in the following: Boil a pint of water, then let it cool. Add one half ounce of hydrochloric acid, mix. Immerse the negatives, wet or dry, for one minute. Then hang up to dry.

Animating "Dot" Books

MAYBE you wouldn't know about it, unless you have recently been shopping for children's books, but there's a type of book known as the "dot" book because the illustrations

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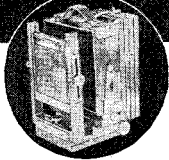
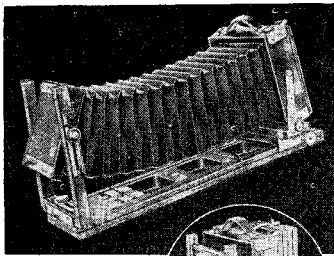
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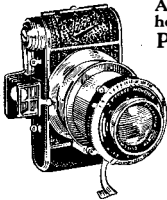


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consist of a series of numbered dots. You draw a pencil line from No. 1 to No. 2, then to No. 3, and so on, thus gradually giving form to the picture.

Henry J. Brock, St. Marys, Pennsylvania, writing to Bell & Howell's *Filmo Topics*, makes the following suggestion:

"Could there be a more perfect set-up for using the single frame release? We had a lot of fun animating one of these books, and the youngsters, especially, enjoyed both the filming and the resulting picture.

"Set your camera and the dot picture firmly in place so that neither will be moved at all during the animation. Expose several frames of the picture as it first appears, and stop the camera. Draw a heavy black line from dot No. 1 to dot No. 2, and then expose a single frame. Extend the line to dot No. 3, and expose another frame, and so on. On the screen, the line magically extends itself to complete the picture."

To which the editor of *Filmo Topics* adds: "We are going to try Mr. Brock's suggestion soon. Perhaps we will also try another idea that just occurred to us. We'll use Kodachrome, and after the animation is complete, we'll start coloring the picture with water color—one brush stroke, one frame exposed, another brush stroke, another frame exposed, and so on."

Kodachrome Processing

KODACHROME film in the 35mm and Bantam sizes can now be processed at laboratories in Rochester, Chicago, and Hollywood, and should be sent to the nearest station. The addresses are: Eastman Kodak Company, 1017 N. Las Palmas Ave., Hollywood, California; Eastman Kodak Company, 1712 Prairie Avenue, Chicago, Illinois; Eastman Kodak Company, Rochester, New York.

Sound Films on Silent Projectors

ENTERTAINMENT and educational films in sound versions may now be projected on the new 16mm Filmo silent projectors, according to an announcement by Bell & Howell. The sound, of course, will not be reproduced, but there is now open to owners of silent projectors interesting and instructive films available only in sound versions.

Gunning for Ghosts

OUR Abbey synchronizer got a new experience recently when we used it in an attempt to get a picture record of one of the Scientific American sponsored spiritistic seances. We did not get any ghosts on the film but we did make some interesting records of human reactions at a typical seance.

Because the seance was to be conducted in total darkness and we were supposed to make the shots dur-

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ing the session, we rehearsed three different positions before things got going. Each position was a distance of 15 feet from the table at which the medium was to be seated, two of the positions facing the medium, one facing the audience. Using Super-flash Press 40 bulbs, we preset the exposure at 1/200 of a second, stop f/8. Mr. Dunninger, who directed the shooting of the pictures from his position next to the medium, gave instructions as to which position to take for different shots. This called for maneuvering about in the dark and occasionally kicking somebody's heels, but we got around okay except when we were asked to take a fourth position, unexpected before the seance, in still another part of the room. There was no opportunity for changing the focus, of course, so we did the best we could, getting a badly overexposed and out-of-focus "foreground" of two heads, though the point of interest farther away (about 15 ft.) was sharply recorded.

As "official photographer" of the seances, we shall have an opportunity later on to pass on some more of our experiences.



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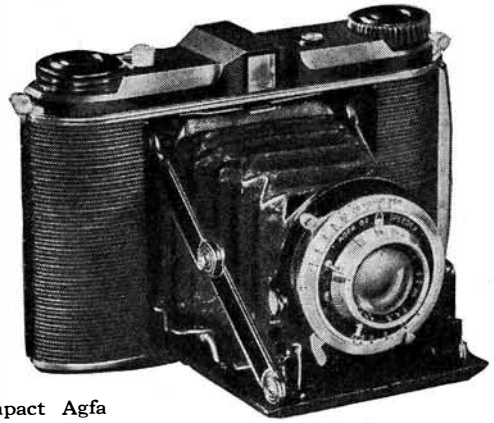


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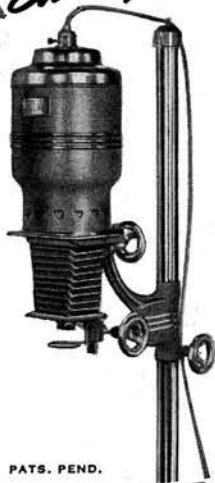


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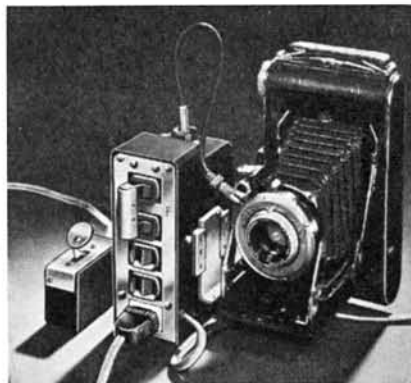
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no aluminum leaf, free wire, or shredded foil within its bulb. Instead, contains small amount of chemical paste applied to ends of lead-in wires, in an atmosphere of oxygen; this produces flash. Makes possible easy synchronization with nearly all types of manual-set shutters, even box cameras. Lamp does not have to be given head start before shutter is tripped as lamp and shutter start simultaneously, thus eliminating many variables. Technical data: voltage—dry cells only (two or more); bulb—B-11; bulb diameter—1 3/8"; maximum over-all length—2 5/8"; base—bayonet (single contact); total light output (lumen-seconds)—2500-3000; peak lumens—500,000; time, closing of circuit to peak lumens—5 milli-seconds; approximate mean color temperature—3350 degrees Kelvin.

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CRAIG FILM DRYER (\$19.95): Dries negatives by forced warm air. Balanced temperature and airflow insures rapid, dust-free drying, desirable for high negative quality. Large drying surface accommodates approximately three rolls No. 120 film, or 16½ feet 35mm film; other sizes in proportionate amounts. Simple clip arrangement permits separate attachment of as many individual lengths of film as desired.

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TECHNICAL ASSOCIATES' DRY MOUNTING PRESS (\$27.50): Mounts prints up to 11 by 14 inches on standard 16 by 20-inch mounts in any position on mount in one operation; larger prints in two operations. Heavy duty heating element, scientifically designed, assures even distribution of heat to all parts of pressure plate. Automatic time switch controls amount of heat applied to pressure plate. Press comes complete with tacking iron and detailed instructions.

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Regarding Nylon Leaders

DID you know that Spanish gut, one of the most widely used materials in the manufacture of leaders for fishing is taken from silkworms grown in Spain . . . that after these silkworms have reached their growth, they are killed by placing them in vinegar, then washed and torn apart to expose the sacs that secrete the silk? Did you know that the sacs are then pulled or stretched to form the gut, and that one result of this haphazard process is lack of uniformity in quality and gage of leaders?

Although this may sound like rank heresy to fishermen who have for years sworn allegiance to Spanish gut, it is a fact that few strands are

various and sundry trade names.

If you would like to know more about the properties of Nylon, which is not to be confused with the so-called synthetic gut, drop us a line and we'll send you a 30-page booklet entitled "What You Ought to Know About Nylon Leader Material." It is published by the Plastics Department of E. I. du Pont de Nemours & Company, and will tell you how Nylon compares in strength with the best silk worm gut, about its durability, visibility, diameters, water absorption, flexibility, and much more of interest. A number of excellent knots are described and pictured, and the book is free.

The British Can Use 'Em!

THE American Committee for the Defense of British Homes, C. Suddam Cutting, Chairman, has offices at 10 Warren St., New York City. It is a committee of American citizens seeking gifts of arms, ammunition, binoculars, steel helmets, and stop-watches from American civilians to be sent to the Civilian Committee for the Defense of British Homes.

As of April 10th, the Committee had received 3562 guns, 4340 revolvers, 1975 binoculars, 359,603 rounds of ammunition, 9815 steel helmets, and 292 stop-watches. There is need for all types of pistols, revolvers, rifles, and shotguns using ammunition now procurable. Rifle ammunition (not soft nose) and ball or buckshot shells for shotguns are most acceptable.

There are now local committees in 288 communities throughout the United States, all co-operating with the main office in New York City, but if there is not a committee in your locality, and if you desire to help this worthy enterprise, send us a postal card for complete information, or write to the Committee's New York office.

Don't Do It!

FROM time to time we've warned against use of modern shotgun loads in guns with Damascus or other twist barrels. Although this warning has been concurrently issued for years by firearms editors and manufacturers of sporting arms, some gunners still think twist barrels will handle modern loads safely so long as the extra heavy "long range" loads are avoided. This is *not* true.



Flexibility of Nylon eliminates snarls, improves night fishing

even approximately round, and the thickness from end to end may vary by several thousandths of an inch. To try to secure uniform gage and to eliminate weak spots, it has been the practice to "draw" the natural strands through dies. This not only has increased the expense, but also has resulted in confusion on the part of manufacturer and buyer as to actual scales of sizes and gages.

When the du Pont Company introduced Nylon to the angling fraternity, it offered a means whereby this uncertainty may be eliminated. That there are many other features favoring the use of the modern Nylon leader is attested to by the fact that 16 of our leading manufacturers are now selling Nylon leaders under

The Technical Committee of the Sporting Arms and Ammunition Manufacturers' Institute has studied this matter in scientific detail, and because of a persistent tendency on the part of owners of twist-barrel guns to ignore past warnings, the Committee says: "Never use smokeless powder loads—even light smokeless powder loads—in guns having Damascus or other twist barrels! Many of these barrels are the handiwork of highly skilled craftsmen. But regardless of the quality of workmanship employed, the method of combining low-carbon steel with iron, and the weakening heating process to which they have been subjected during manufacture, render them unsafe for the high pressures developed by modern loads, for which they emphatically were not designed.

"American manufacturers have not made twist-barrel shotguns since the advent of modern progressive-burning, or 'smokeless' powder. If you own a Damascus or other twist-barrel gun, don't take chances. Retire it now, while both the gun and your fingers are still intact."

POT-SHOTS

At Things New

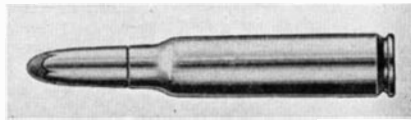
DELTA ELECTRIC COMPANY offers new 52-page booklet, "High Lights of Fishin'," by Mark W. Burlingame, noted angler, writer. This is companion volume to "Night Fishing," announced in these columns in January, 1941 issue. Delta Company's newest publication is packed with sound and tested ideas, fishing kinks, and methods for bass, bullheads, trout, crappies, muskies. Profusely illustrated with line drawings, encased in envelope conveniently ruled to six and one-half inches for use in measuring fish, and they're free. Want one?



Delta's "Powerlite" Lantern

J. STEVENS ARMS COMPANY, through engineering and research efforts of National Gas Furnace Company, is using new brazing process to unite shotgun barrels. Revolutionary from the standpoint of science as well as application of mass production principles to an old bottle-neck of the sporting arms industry, the new method assures gunners of more solidly brazed barrels, less possibility of their splitting apart from each other, or from the rib, due to sharp temperature changes or other factors. For full details, see page 332.

PETERS CARTRIDGE DIVISION OF REMINGTON ARMS COMPANY, INC., announces a new member in their family of "Inner Belted" Expanding Soft Point cartridges. This one is the .300 caliber Savage with a 150-grain bul-



Peters .300 caliber cartridge

let, and 'tis said it will prove ideal for small and medium game of the fleet-footed type. It is particularly recommended for the Model 81 Remington, or other game rifles chambered for this caliber, and has the following ballistics:

Velocity, in foot-seconds—

Muzzle	100 yds.	200 yds.	300 yds.
2660	2430	2210	2000

Energy, in foot pounds—

Muzzle	100 yds.	200 yds.	300 yds.
2360	1970	1625	1325

Trajectory, in inches—

100 yards	200 yards	300 yards
0.7	3.0	7.5

KRAFT & COMPANY, makers of fishing specialties, offers stainless steel wire leaders in 6- and 8-inch lengths, which, because they employ the principle of snubbing, rather than use of a knot to fasten line to leader, materially add to line strength. As all good anglers know, the knot in terminal tackle is important, has instigated many fire-side debates, been the cause of many a good fish lost. It is the weakest point in any fishing line, for the knot tightens as line tension increases, and when



tension becomes strong enough, or has been repeated often enough, the knot may "pinch" the line apart.

By winding the line around the leader four or five times, as shown, strain from line tension is almost entirely taken up by the leader, with little strain applied to the simple knots, shown tied between and after two metal beads, which are integral parts of the leader.

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A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

WRITING on January 12, from Susak, Yugoslavia, Mirko Baretic, sent the photograph shown in Figure 1, and said, "Your good book, 'Amateur Telescope Making,' has reached this part of the world, and by following its instructions I made this very reliable instrument which has given me much satisfaction and many happy hours. It has a 7" mirror of 58" focal length. As we have no access here to discarded automobile parts, I made the mounting of heavy boards and it proved very satisfactory. The prism was taken from a discarded binocular. Entire cost did not exceed \$10."

Baretic's letter reached these offices March 5 and not long afterward Yugoslavia was in the war. The Italian army was able to occupy his town of Susak, which lies just east of Fiume; there was no opposition, according to the daily press. One wonders where the telescope is now.

A telescope of this kind has no tube—simply a "spinal column" for support. Readers not familiar with telescopics often ask whether this is all right. A tubular support for the optical elements of a reflector is mechanically convenient, also conventional, but is not necessary from an optical point of view.

PHOTOGRAPH of a grinding machine and amateur telescope maker, reproduced in Figure 2, reached us just before the first act of World War II, from Robert Wehn, Berlinerstrasse 37, Wermelskirchen, which our atlas shows to be close to Köln, or Cologne, Germany. We hinted to Herr Wehn that perhaps a Prussian telescope-maker's work would receive a better

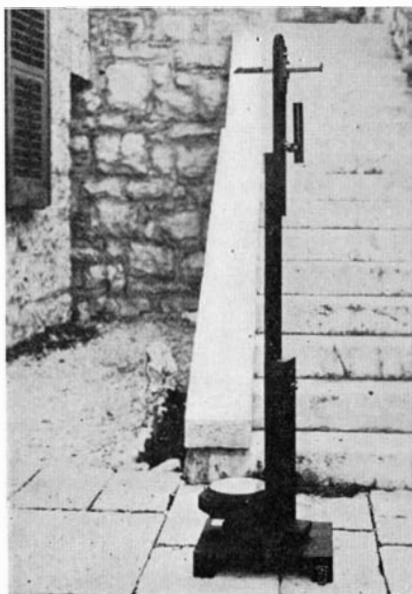


Figure 1: The Baretiscope

hand at some more fortunate time in world history and filed away the material. Now that things are worse, rather than better, we dig it out and publish it. Why? Just contrariness—we were born under the sign of the goat and goats are contrary; we had one.

Wehn says the machine was made by himself, according to the model of R. W. Porter. The power is a 1/5 horsepower motor and the spindle, crank-shaft, and main arm turn on ball bearings.

As Köln has been bombed many times, one also wonders where this apparatus is now!

IN his letter, Wehn recommends what he calls a "goatsfoot" for scooping out the channels in pitch laps. A goatsfoot is just a little rectangular piece of sheet metal, bent V-shaped and inserted in a wooden handle. The unchanneled lap is tipped up at an angle of about 45°, the goatsfoot is heated and started at the lower edge, cleanly cutting out and half melting out a strip of pitch as it is moved upward. This idea, in different variations, has previously been used by a number of American amateurs.

J. F. Bauer, Altoona, Pa., does it with a hot cold-chisel (if you'll pardon the term), ground to an edge having the shape of the desired channel section, held vertically and drawn along the lap as a plow. This, however, doesn't get rid of the two ridges pushed up on either side of the plow.

Wm. W. Peters, of the Department of Physics at Santa Barbara College, Santa Barbara, Calif., marks off the lines for the channels and then softens the pitch adjacent to them with a piece of electrically warmed resistance wire stretched across a hacksaw frame. He then uses the scraper shown in Figure 3 to remove the pitch.

Our vote still goes to Bill Mason's Hot Plow principle, described here in December, 1935, and now repeated. Figure 4 tells the story, except that Mason said: "Do not try to make the groove full depth at the first stroke, also pull the plow through the pitch rather than push it, and do it slowly."

Figure 5 is a modification of this design, devised by Prof. Henry L. Yeagley, of the Pennsylvania State University. Here the plow is attached diagonally to the end of the soldering iron and the lap is held vertically so that the plowed out pitch automatically falls aside.

Russell Porter tells us that the workers in the optical shop at the

California Institute of Technology do it thus: The lap is poured and fixed in a horizontal position. A large knife is slowly passed through a flame, which heats it, and is then drawn through the lap. This melts and draws off some of the pitch. The pitch is scraped off by a V-shaped "scraper-offer" and, after several repetitions of this, the channel is finished.

The "Pittsport Door Mat," so-called,

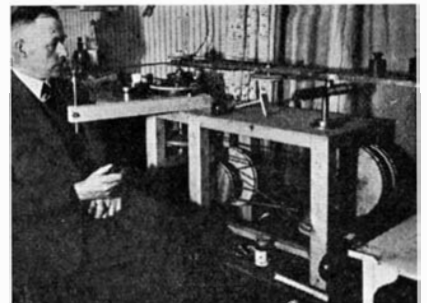


Figure 2: RAF target

or rubber grid, for making laps semi-automatically, as devised in 1935 by amateur telescope makers Everest, Munn, Morse, and Carlson, is still to be had, we learn, from the original makers, The H. O. Canfield Co., rubber works, Bridgeport, Conn., post-paid anywhere for a greenback. Its use is explained in "A.T.M.A."

STELLAFANE convention, Saturday, August 2.

EVEREST, in "A.T.M.A.," suggests that abrasives used in grinding be washed, or settled, even when taken directly from the can as purchased. Your scribe recently tried this and never a scratch was scratched. Dump the grains into a glass, stir vigorously till all are in suspension, let them

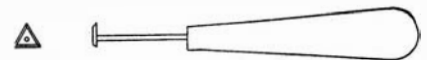


Figure 3: Peters' channeller

settle, pour off the water, and spoon off the upper two thirds for use. If reckless, chuck the rest or, if Scottish, repeat the process with it and in turn with its remainder, and so on and on, till you faint.

Kerosene for later grinding stages, instead of water, behaves normally, and no muss need be anticipated if the oil is dispensed from some kind of container having a small, controllable flow, also if something is provided to catch all the drippings from the tool. For grinding three stages, also slushing off between wets, a single pint of kerosene is enough. Fine abrasives that remain wet, or even damp, with

TELESCOPTICS

water, will spread badly on the tool with kerosene, hence they should either be dried up bone dry first, or washed in kerosene in the first place and put on wet with it.

COMPARISSET: "T.N.'s may have difficulty in judging whether the pits from any grade of abrasive have been completely removed by the next finer grade, even when using a magnifier," Cyril G. Wates, 7718 Jasper Ave.,

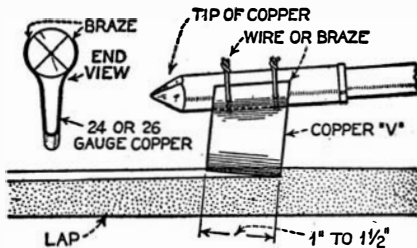


Figure 4: Bill Mason's plow

Edmonton, Alta., Canada, observes and continues:

"I have found the following stunt helpful: Suppose we are using eight grades of abrasive. Cut nine pieces of plate glass (old windshield), each about 2" square. Take one piece as the tool, and mark the back of it. With this grind both sides of the other eight pieces, each with a different grade of abrasive. Wash the tool carefully between grades, of course. Mark each sample on one side only with the grade used. Now go back to the glass on which the coarsest grade was used, and grind the unmarked side for a minute or two with the next finest grade. The object is not to remove the pits but to show a surface partly ground with grade No. 2 and containing pits from grade No. 1. Do the same thing with every other piece, and you will have a set of samples by means of which you can judge the appearance of a mirror at every stage of coarse and fine grinding."

Now and then a new—or old—reader of "A.T.M." writes this department to say that Ellison was not justified in his claim to the discovery of the auto-collimation test for objective lenses, described on page 121 of "A.T.M." Recently, while reading page 166 of *English Mechanics* for April 4, 1924, we there stumbled

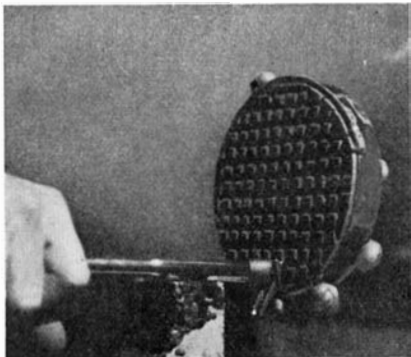


Figure 5: The Yeagley plow



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across a letter by Ellison in which he stated clearly that he only discovered it "independently." Four years later, when he prepared the material on the objective lens, for insertion in the second edition of "A.T.M.", he did not make any change in the claim for original discovery. The reader may make of this what he can.

BEFORE he made the 20" reflector described with numerous photographs in the October, 1939, number, William Buchele, 2832 Sagamore Road, Toledo, Ohio, made the Gregorian shown in Figure 6. "The drive," he points out, "is essentially the same as the Sellers alarm clock drive described in 'A.T.M.A.', page 275, except that I used a sector of a drum and a thin cable instead of a triangle plate and lever, since a lever action cannot give a uniform pull. Figure 7 shows the arrangement, also the device for

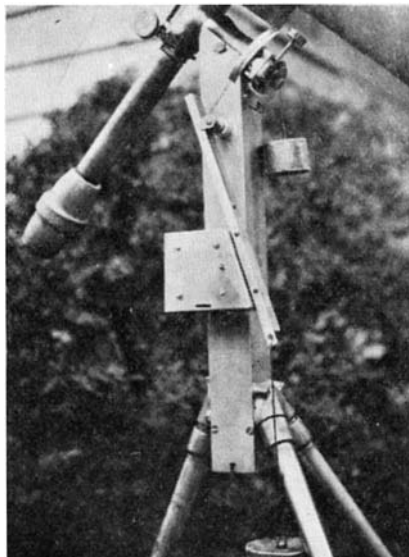


Figure 6: Buchele's drive

plumbing up the telescope, which is a portable and is mounted on a tripod.

"The axes of the telescope mounting are bicycle hubs and they moved so easily that I had to add a counterweight to keep the cable tight. Both axes contain small clutches and worm gear slow motions.

"The f.l. of the primary is 27½" and the e.f.l. of the two mirrors is 165—much too great for a 6"."

Recently, Buchele added to his collection the 12" Cassegrainian shown in Figure 8. He writes:

"The focal length of the primary is 29", which means a deep curve, and I had to bear down on the mirror 14 hours merely to parabolize it. [On two mirrors of even shorter focal ratio, Lower, also Ferson, parabolized mainly in grinding.—Ed.]. The secondary was even more difficult. The effective focal length of the telescope is 100".

"The finder is a 3½" of 22" focal length, with objective taken from a projector. Not quite achromatic but not bad. However, I do not need the

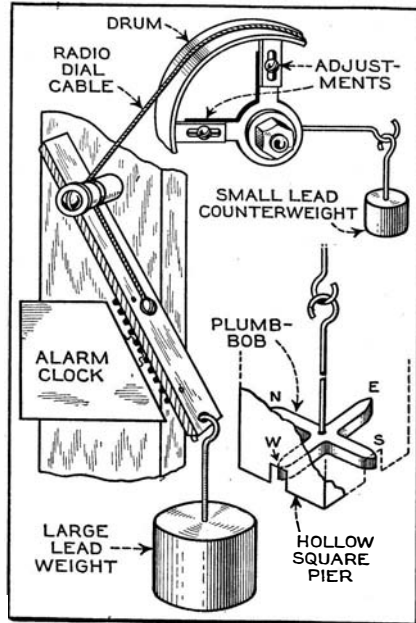


Figure 7: Buchele, detail

finder, since the field of the Cassegrainian itself is wide.

"I have also built the clock described by Souther in 'A.T.M.A.', and it works fine. The hour index is stationary and the face of the clock has numerals, 1 to 24, with a complete star map of principal stars down to -30°. This rotates in a counter-clockwise direction. I have it mounted on the north wall of my observatory and the illusion is very realistic, with the star map rotating just as do the stars above, at sidereal rate. The minute hand rotates in a clockwise direction, with the minutes lettered on the glass, which, of course, is stationary."

Asked how the job of building the clock went, Buchele states that "it was interesting. I did not have any real trouble. I believe the cost was lower than Souther estimates in 'A.T.M.A.'"

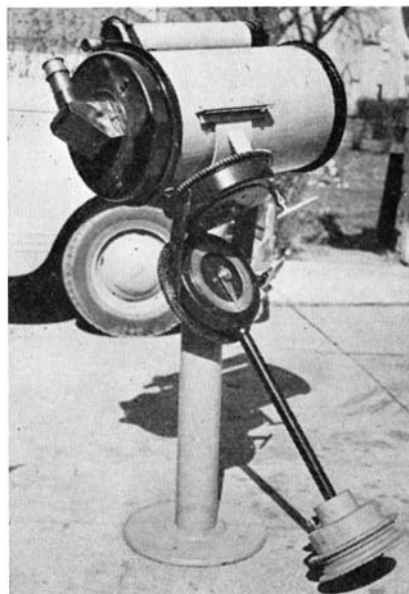


Figure 8: A 12" Cassegrainian

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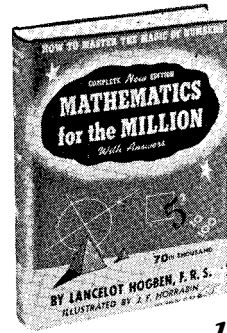
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BLUEBERRY CULTURE is a circular in which are fully described the soil and cultural requirements for the successful propagation of this particular bush. *New York State Agricultural Experiment Station, Geneva, New York.*—*Gratis.*

TEXROPE DRIVES is a 16-page booklet presenting facts and data essential in estimating costs, types, and sizes of V-belt drive equipment by engineers and buyers in industry. Complete information is also included on various types of sheaves. *Allis Chalmers Mfg. Company, Milwaukee, Wisconsin.*—*Gratis.*

REPORT ON BENTONITE, by Ben F. Powell, Construction Engineer, United States Forest Service, demonstrates the use of this versatile mineral to impede seepage in small dams. *The Wyodak Chemical Company, 4600 East 71 Street, Cleveland, Ohio.*—*Gratis.*

PLASKON RESIN GLUE is a colorful, illustrated pamphlet that puts forth the features and advantages of this particular type of adhesive. Illustrated are many specific applications which in themselves will suggest even wider uses. *Plaskon Company, Inc., 2112 Sylvan Avenue, Toledo, Ohio.*—*Gratis.*

FIRE-PROOFED WOOD is a report of the Committee on Fire Proofing of the American Wood Preservers Association, with particular reference to the ignition of roofs by incendiary bombs. Progress in this direction, both here and abroad, is reported, some of the tests employed being aimed at a fire insurance rating for fire-proofed wood. *H. L. Dawson, 1427 Eye Street, N.W., Washington, D. C.*—*Gratis.*

BUTTERFLY VALVES is a 12-page bulletin illustrating and describing new models of standard and wafer type butterfly or blast gate valves for the control of air, gas, steam, and liquids. Data are presented on both manual and automatic controls. *R-S Products Corporation, Wayne Junction, Philadelphia, Pennsylvania.*—*Gratis.*

LUMBER DISTRIBUTION AND CONSUMPTION FOR 1938 is the biennial report on this subject which has just been issued by the Forest Service of the United States Department of Agriculture. It gives the latest figures on exports and imports, amount of lumber cut in the United States, per capita utilization, and so on. *Miscellaneous Publication No. 413. Superintendent of Documents, Washington, D. C.*—*15 cents.*

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TOTAL VALUE \$2.30		POST PAID



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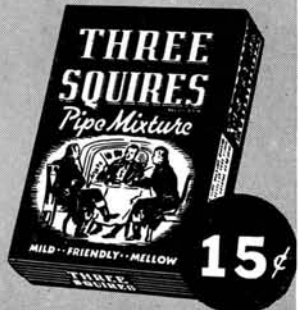
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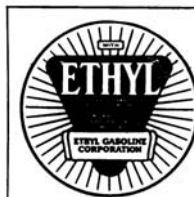
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