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SCIENTIFIC AMERICAN

NOVEMBER
1938

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AMATEUR PHOTOGRAPHY
By Jacob Deschin

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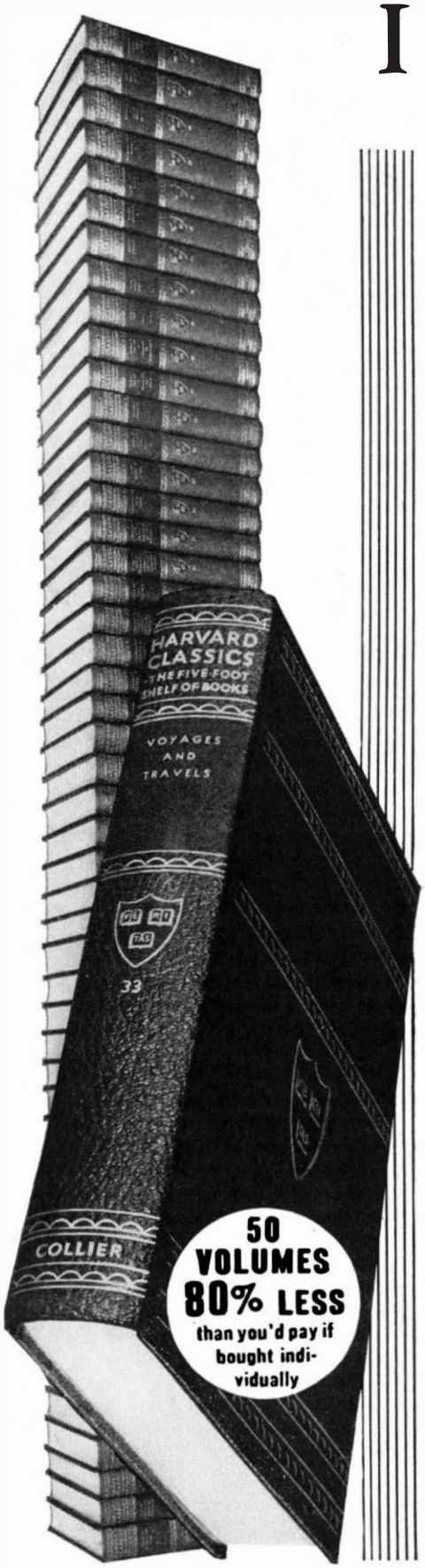
ALEXANDER HAMILTON INSTITUTE, 137 ASTOR PLACE, NEW YORK

How to get rid of an INFERIORITY COMPLEX



A true story of a man who found that self-confidence is not a matter of education or luck

HE WAS GOOD in his job. No one denied that. But he felt inferior to his associates. Most of them were college men. He envied them the mysterious thing called "background."

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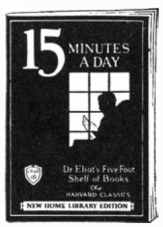

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-FOURTH YEAR • ORSON D. MUNN, Editor

CONTENTS • NOVEMBER • 1938

COTTON, picked laboriously by hand for several thousands of years, yields up its fruit to a machine. The particular mechanical cotton picker shown on our cover was developed by The International Harvester Company. It picks much more cotton in an hour than an expert human picker can pick in a full day. Numerous factors, as outlined in the article on page 242, will limit both the time and the extent of its use.

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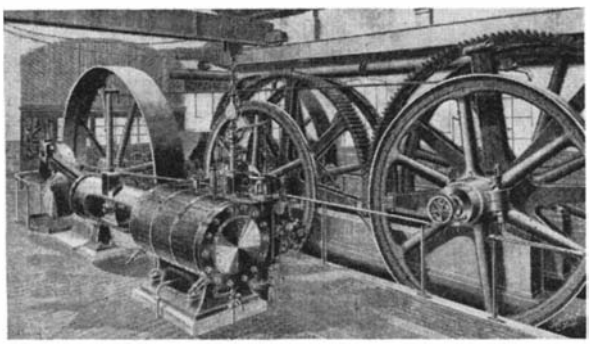
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of November, 1888)

LONG DISTANCE—"Words spoken in Philadelphia can now be heard in Portland, Maine, a distance of 450 miles. . . . The American Telephone and Telegraph Company, of New York, of which President Theo N. Vail and Vice-President and General Manager Ed. J. Hall, Jr., are the energetic and far-seeing executives, is to be congratulated on the successful opening up to telephone service of this vast and wealthy territory. What was at first looked upon as a doubtful venture is now rapidly becoming recognized as one of the successful and progressive moves in recent electrical history."

CABLE RAILWAY—"Cable railways are now being introduced in England. We present herewith an engraving of the engines used for driving the Birmingham cable. . . . The engines have jacketed cylinders 24 in. diameter by 48 in. stroke, and run fifty revolutions per minute; they are fitted with Jefferiss' automatic expansion gear. The piston rods, 4 in. diameter, are of steel; the steam pipes 6 in. diameter, and exhaust pipes 8 in. diameter. A main equilibrium stop valve is placed in a convenient position, so that the engineer can have full view of his engines. Under each fly wheel a powerful steam brake is fixed, so that the engines can be stopped immediately any accident happens to the rope. . . . The rope driving pulleys for the Birmingham service are 10 ft. diameter, in halves, and are also provided with jaw couplings cast on the boss at one side. . . . The carry pulleys along the line are placed 28 ft. apart; the yokes are placed 4 ft. apart; the radius of sharpest curve, namely that at Colmore row, is 45 ft., a very awkward corner; the steepest gradient on the route, 1 in 20, is on Snow Hill."



CONDUIT—"A Pittsburgh man has invented a glass conduit which looks as if it might answer the purpose, and which the inventor is sure solves the problem of underground electric wires."

WESTWARD—"The multiplication of bridges across the great rivers of the West is a movement in the direction of advanced civilization. Simple and cheap pontoon bridges, by their number, may be made to do better work in facilitating intercourse than would be effected by a smaller number of more pretentious structures. For some years their service may be all that will be desired, and, as they prove inadequate, one by one they can be replaced by more permanent works."

VOLAPUK—"The cranks of the age are for the present turning from the congenial labor of inventing perpetual motion machines to invent a new language, which they call 'Volapuk.' It is a conglomeration of all the modern and some of the dead languages, and an experienced linguist can see little sense in it."

DISEASE—"It is reported from Chicago that a by no means inconsiderable local outbreak of scarlatina has been brought about by a cat, which acted as the means of conveying the infection. . . . We are at present only just on the borderland of a wide subject—namely, that of the relationship of diseases of the lower animals to diseases in man; and we may possibly learn hereafter that, apart from the origin of infective diseases in the lower animals, the latter may serve as media for communicating infections to an extent as yet not understood."

MOSQUITO FLEET—"Those who have pinned their faith to big ships, big guns, and heavy armor have had cause, more particularly of late, to doubt the efficacy of the system they espouse. . . . One military journal declares that half a dozen torpedo boats would avail far more in offshore work than the big belted ship which costs as much as a dozen of them."

MYCENAE—"The excavations commenced by Dr. Schliemann at Mycenae are still being energetically carried on, and continue every day to bring to light fresh objects of great archaeological and anthropological interest. Among the numerous objects discovered . . . are articles of glass, crystal, and ivory, besides precious stones with engravings of animals charmingly executed, the whole treatment being Oriental in character."

DAM—"The director of the geological survey is of the opinion that the recently conceived plan of constructing an immense dam across the Rio Grande at or near El Paso is perfectly practicable, but he thinks the question of conflicting water rights must first be settled by the enactment of a general law by Congress. The purpose of the dam would be to irrigate the valley for fifty miles and furnish motive power, to prevent destructive floods, and to settle the Mexican boundary question by keeping the river in its proper channel. It is proposed to make the dam an international affair."

HARBOR DEFENSE—"According to a recent report . . . a large company, backed by millions of dollars, has proposed to the Secretary of the Navy a striking and possibly effective scheme for the defense of harbors from the attacks of an enemy's fleet by shooting ignited petroleum at the unfriendly ships from the bottom of the river and burning them up."

HAMMERS—"The five heaviest hammers in the world were built in the following order: Krupp, at Essen, 1867, 40 tons; Terni works, Italy, 1873, 50 tons; Creusot, France, 1877, 80 tons; Cockerill, Belgium, 1885, 100 tons; and Krupp, Essen, 1886, 150 tons. Thor can take a vacation now."

MAINE—"At the Navy Yard, Brooklyn, New York, work has been commenced on the construction of the twin-screw armored turret cruiser Maine, and immense amounts of material and plant have been delivered. This vessel, the largest ever built at the Brooklyn yard, will be of 6,650 tons, and . . . will be 310 ft. long between perpendiculars, 57 ft. beam, 21½ ft. draught, built of steel, with cast steel stem, stern, post and rudder frame."

AND NOW FOR THE FUTURE

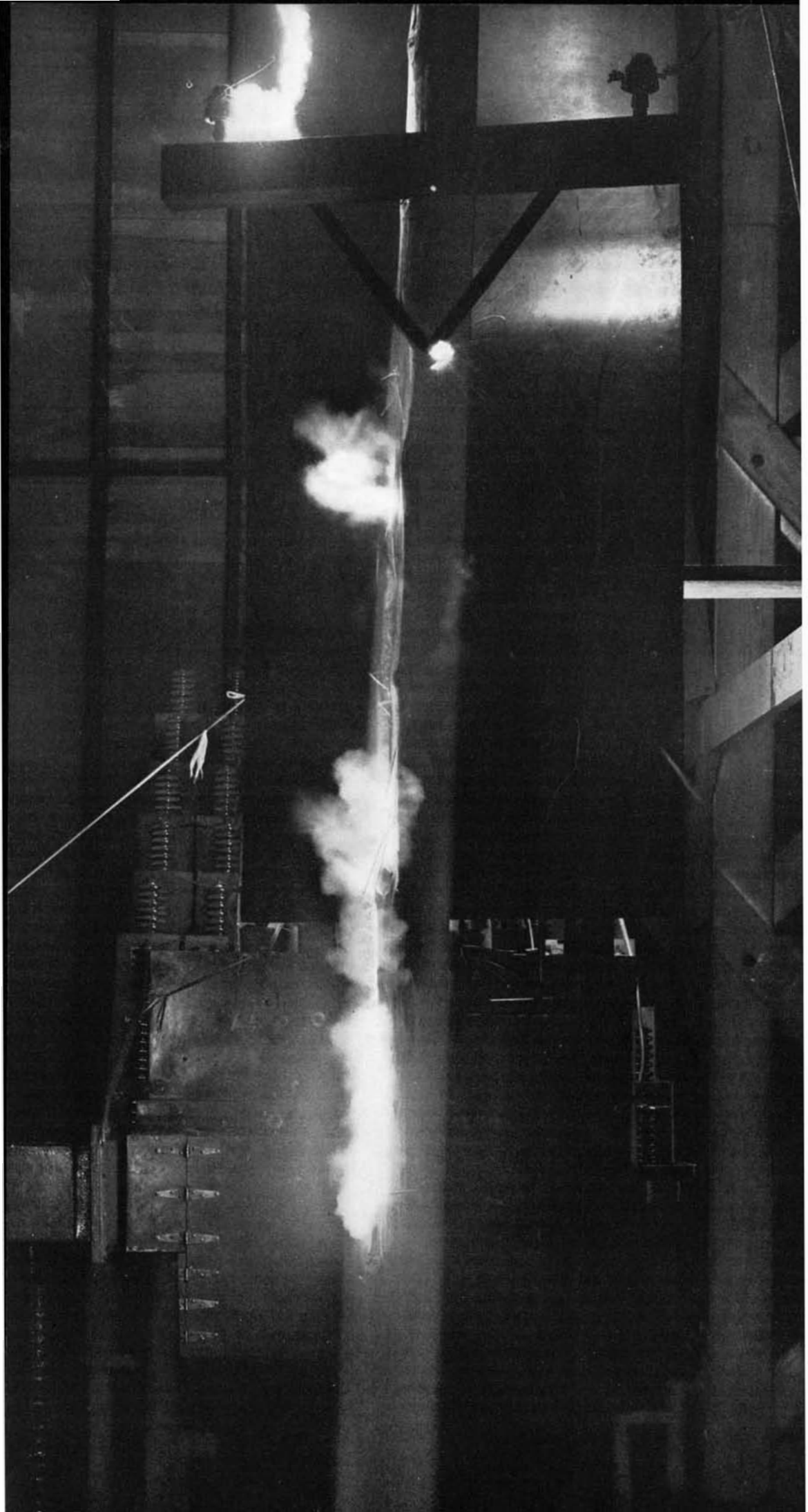
¶Must human beings grow old? By Barclay Moon Newman.

¶Grand Coulee Dam—far larger than originally planned. By R. G. Skerrett.

¶Recording the earth's pulse. By Rev. Joseph Lynch, S.J.

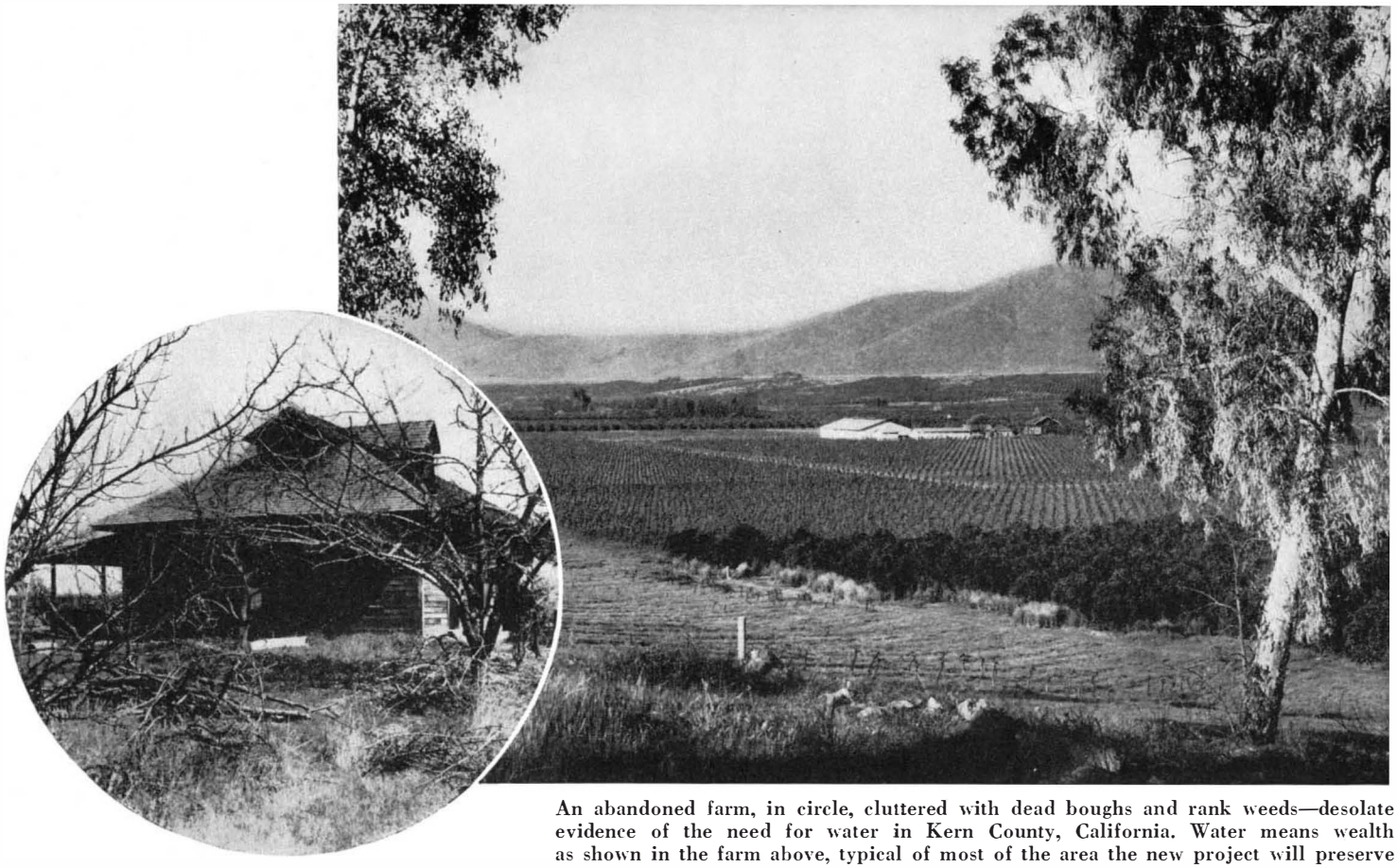
¶Indian petroglyphs were mere idle scribblings.

¶Transmutation cannot be accomplished economically. By E. U. Condon, Ph.D.



SPARKS, STEAM, SPLINTERS

ERRATIC and unpredictable in nature, lightning is gradually giving up its secrets in the laboratory. In the process, bolts of artificial lightning are made to flash over and through electrical equipment to determine the effect and to work out controls for limiting its destructiveness. The flash shown here splintering a telephone pole in the high voltage laboratory of Westinghouse Electric and Manufacturing Company, and sending jets of steam from the splintered cracks, is the quarter millionth such flash that has been made in that laboratory in five years. Dr. P. L. Bellaschi, research engineer, estimates that this number exceeds the frequency of natural lightning "hits" on all the high voltage power systems in the United States during the same period. Each artificial bolt has been made at over 300,000 volts and 65,000 amperes. Five years ago, when the first test was made with lightning in the laboratory, the odds were 99 to one that a direct lightning hit on a distribution transformer would blow it up and cause a serious interruption of service. Today, as a result of this research, the odds are practically inverted.



An abandoned farm, in circle, cluttered with dead boughs and rank weeds—desolate evidence of the need for water in Kern County, California. Water means wealth as shown in the farm above, typical of most of the area the new project will preserve

To Stop Desert Encroachment

Water Table Pumped Lower and Lower, the Desert is Creeping into Rich Central Valley . . . Two Great Dams, Long Canals, Will Supply Needed Water

By PHIL DICKINSON
Central Valley Project, Bureau of Reclamation

WHEN Spanish vaqueros first entered the interior valley of California they saw only a vast expanse of desert, broken infrequently by patches of green vegetation along the water courses. Little did they dream that in a span of two generations the region would become one of the world's garden spots, the home of thousands of prosperous families, and the source of millions of tons of food products known around the world. They did not envision the romance and adventure that marked the development of this great inland empire—now a two billion dollar agricultural wonderland built by irrigation and wholly dependent upon a single natural resource—water.

As the Sierra-Nevada range is called the backbone of California, so may the Great Central Valley be considered as the state's living heart. Nature has been kind to the valley by endowing it with soil rich in the elements of plant growth, temperatures conducive to sub-tropical fruit culture the year 'round, and 10 million acres of potential agricultural land surrounded by a mountain watershed of 40,000 square miles.

But Nature has been perverse, too—she neglected to provide proper distribution of her endowments. The water resources of the valley do not conform, either geographically or seasonally, to the irrigable lands. How these resources are to be adjusted by Man is the story of the Central Valley Project, one of the greatest reclamation dramas of modern times. Construction of the project has been started by the United States Bureau of Reclamation.

THE Great Central Valley in the heart of California really is two valleys—the Sacramento and the San Joaquin. The Sacramento River flows down from the north and the San Joaquin River comes from the south. The two, meeting in a common delta, mingle in a myriad of channels, and issue together through the San Francisco Bay system to the Pacific Ocean. The valley is almost 500 miles long from Mount Shasta on the north to the Tehachapi Divide on the south, about 50 miles wide between the Sierra Nevada and the Coast Range, and its floor varies in elevation from sea level to over 400 feet. Prior to the coming of white men it was part desert and part swamp. The first settlers, utilizing the unregulated spring flood flow of the rivers, made it a vast area of grain and cattle ranches. Now, under intensive irrigation, it has become a realm of diversified agriculture, including 83 cities and towns in 20 counties, populated by a million persons.

In the semi-arid climate—characterized by hot rainless summers in which midday temperatures sometimes exceed 100 degrees, mild winters in which frosty nights are the exception rather than the rule, and light seasonal precipitation varying geographically from 5 to 25 inches—choice products of both the temperate zone and sub-tropics are grown. The valley is famous the world over for its raisins, table grapes, and sweet wines. It is acquiring almost equal fame for its phenomenal yield of long-fiber cotton, averaging in excess of 500 pounds of lint per acre compared with a national average of about 155 pounds. Other major crops include fruits and vegetables too

numerous to mention in this discussion.

Adjacent San Francisco and Los Angeles metropolitan areas provide nearby markets for dairy, livestock, and poultry products. Extensive petroleum fields dot the southern valley. Canneries, creameries, wineries, processing plants, lumber mills, and oil refineries operate in many of the cities, on the output of the agricultural, mineral, and forest resources. Gold mining still is important in the romantic Mother Lode counties.

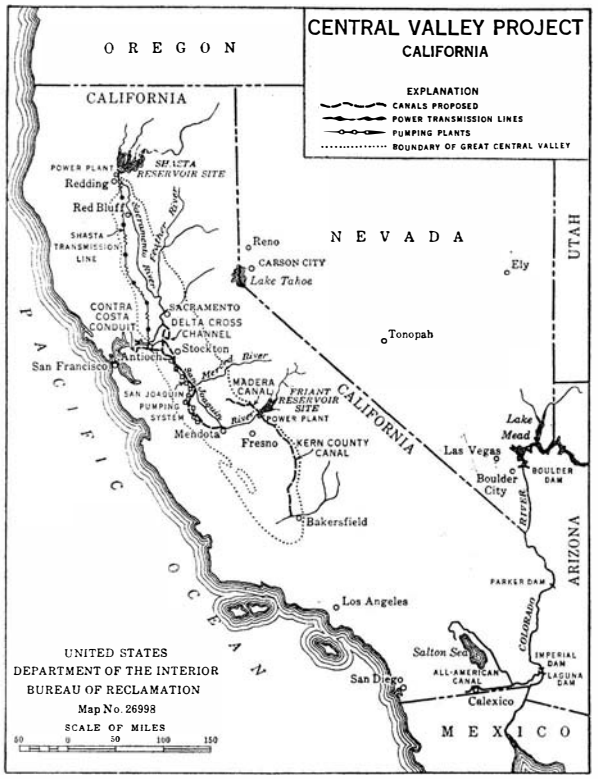
The Great Central Valley's water problem, which has been a subject of study by Federal and State agencies for more than half a century, is mainly a problem of conservation. The unregulated water supply is ample in quantity, averaging more than 30,000,000 acre-feet in the annual flow of the two principal rivers. The Sacramento itself is a mightier stream than the Colorado River. It has a recorded high flood flow of 610,000 second-feet, a peak discharge exceeded only by the Mississippi, Ohio, and Columbia Rivers in the United States.

TWO thirds of the water which Nature supplies in the form of rain and snow falls on the watersheds of the Sacramento Valley which has crop lands with one third of the relative irrigation need; while one third of the water falls to the San Joaquin Valley which has crop lands with two thirds of the irrigation need. That is the geographical problem.

Then there is seasonal waste. In spite of what has been done so far to conserve stream flows, two thirds of the water which Nature deposits annually on these watersheds flows unused to the sea within 90 days after it has fallen. Almost all the precipitation comes in a few months of winter and early spring, and virtually none in the long hot summer and dry autumn when water is needed for irrigation. This condition of climate makes impossible the reasonable use of the water resources without rigorous conservation and economic regulation.

Under existing conditions at least a million acres face an acute irrigation crisis. The extreme low summer flow of the rivers has put an end to upstream commercial navigation, and has permitted the encroachment of salt water from the ocean upon reclaimed crop lands in the fertile Sacramento-San Joaquin delta.

Perhaps the most interesting symptoms of this conservation problem are to be found in the San Joaquin Valley, particularly in the southern portion, where about 400,000 acres of settled and producing lands now are dangerously short of water. Spring floods this year in California served only to focus new attention on the problem, for by August the streams had faded to a trickle. Almost all the normal surface flow in this region years ago was fully appropriated for irrigation, and the farmers resorted to pumping water from underground in the summer and fall. As this type of irrigation increased, ground water levels fell; and the farmers discovered, years too late, that their draft upon the subterranean supply is greater than its annual natural replenishment by rainfall and stream flow.



In one area, the water table 20 years ago stood 10 to 20 feet below the surface. Now it is down as far as 240 feet, requiring a pumping lift, considering draw-down in the wells, of as much as 275 feet. The cost of such pumping of water in volume required for irrigation in many cases has made the continuance of crop farming economically impossible. In another area, the pumping depths vary from a minimum of 100 feet to a maximum of 275 feet; in the Ducor citrus groves, from 200 to 250 feet; around Exeter, 100 to 175 feet; and McFarland, 90 to 250 feet.

The extraction of ground water for the lands now developed greatly exceeds that which percolates into this underground reservoir. Studies show that under the 400,000 acres on which the water table generally is falling in Tulare, Kern, and Fresno Counties, there is an annual water supply sufficient for only half that acreage. Thus, the conclusion is unavoidable that 200,000 or more acres of highly developed lands will have to be abandoned unless relief is forthcoming. As a matter of tragic fact, the latest survey shows that between 40,000 and 50,000 acres already have gone—more than double the abandoned acreage of six years ago. Unfortunately, it is the best 200,000 acres that are succumbing first—those in the citrus belt in the frost-free foothill coves that produce crops worth $20,000,000 annually. The situation is similar, though less acute, in Madera County in the northern San Joaquin Valley.

Water table in this deep well formerly was 10 to 20 feet below the surface; now 240 feet down

In the face of these conditions, a pertinent question is: what is being done about it? The answer is to be found in a description of the Central Valley Project, a multiple-purpose reclamation undertaking of the Federal Government. To conserve and regulate the Valley's precious water resources, the Bureau of Reclamation is engaged in a $170,000,000 program which involves construction of large storage dams on the headwaters of the two principal rivers, and the building of a 350-mile system of main canals to serve areas of water deficiency.

The key to this approved solution of the valley's water problem is, of course, the mighty Sacramento River with its surplus water. A contract has been awarded to a syndicate of 12 large contracting firms for the construction of giant Shasta Dam on the upper Sacramento River north of Redding, in Shasta County. It will be the second largest con-

crete dam in the world, rising about 560 feet from the lowest foundation to the top, slightly higher than the Washington Monument. Shasta Dam will be a curved gravity-type structure, 3500 feet long on the crest, and 580 feet thick at the base, requiring 5,600,000 cubic yards of concrete in its construction.

Second only to Boulder Dam in height, and exceeded only by Grand Coulee Dam in mass, Shasta will be first in at least one respect: it will be the highest overflow type of dam in the world. Water falling over the 375-foot spillway in the center of Shasta Dam will have a drop of 480 feet, three times the height of Niagara Falls. River outlets will be provided through the dam at three elevations. A hydro-electric plant at the base of the dam on the west bank of the river will accommodate five main power units, each to consist of a 70,000-kilowatt generator driven by a 100,000-horsepower turbine.

The existing Southern Pacific Railroad winds up the Sacramento River Canyon past Shasta Dam site. Thirty seven miles of this line are to be replaced by 30 miles of new line over the mountains at an elevation above the high-water level of the future reservoir. During construction, trains will pass through a diversion tunnel.

With a tributary drainage area of 6665 square miles, Shasta Dam will back up the waters of three rivers—the Sacramento, Pit, and McCloud—a distance of about 35 miles each, to create a reservoir with a gross storage capacity of 4,500,000 acre-feet. This is water enough to cover the entire city of San Francisco to a depth of 167 feet.

THE reservoir will be operated to diminish the flow of the Sacramento River in flood times and increase it during the dry months—in substance, to stabilize the year-'round flow. It will, thereby, check seasonal waste of water to the sea, permit restoration of all-year navigation on the river as far north as Red Bluff, afford improved irrigation in much of the Sacramento Valley, repel seasonal intrusion of salt water in the channels of the Sacramento-San Joaquin delta, and incidentally generate about 1,500,000,000 kilowatt-hours of electricity annually for municipal, industrial, agricultural, and project use. Finally, when the conserved waters of the Sacramento River have performed all of these functions, and have passed every possible user on that river, they will afford a surplus for export by canal from the delta to parts of Contra Costa County and the San Joaquin Valley.

Through the network of 550 miles of channels and sloughs which comprise the delta, a Cross Channel will be constructed at the eastern edge to facilitate the fresh-water flushing of the sometimes-salty waterways, and to introduce surplus Sacramento River water to the intakes of the Contra Costa Canal and the San Joaquin Pumping System.

First part of the Central Valley Project to be constructed is this initial four-mile section of the great Contra Costa Canal, which will be 46 miles long

The Contra Costa Canal, scene of first project construction in October, 1937, will take 350 second-feet of water from Rock Slough of the San Joaquin River near Knightsen. Four pumping plants will lift it to an elevation of 124 feet whence it will flow by gravity. The canal, 46 miles long, will afford a dependable supply of fresh water for industrial use in manufacturing and processing plants along the south shore of Suisun Bay, for domestic use in several Contra Costa County municipalities, and for agricultural use in an upland area of orchards and field crops. It will terminate in a small reservoir near Martinez.

The San Joaquin Pumping System will comprise a series of works to lift water from the delta up the San Joaquin Valley about 100 miles as far as Mendota. The object is to furnish substitute water from the delta to lands in the northerly half of the San Joaquin Valley now irrigated by San Joaquin River water which is to be conserved and diverted at Friant Dam. The essence of the plan is a neat exchange.

Friant Dam, on the upper San Joaquin River near Fresno, will be a sizeable structure itself. Although only about half as high as Shasta—285 feet compared with Shasta's 560—it will be almost as long—3300 feet against Shasta's 3500. Friant Dam will be a straight gravity-section concrete dam with an overflow spillway in the river section, outlet conduits through the dam for river regulation, and similar outlets to the Friant-Kern and Madera Canals which will divert at the dam.

To the people in the rich agricultural counties of the southern San Joaquin Valley whose very existence depends upon an adequate supply of water for irrigation, the most important features of the Central Valley Project will be these two large gravity canals leading from Friant, one southerly an ultimate distance of 160 miles to the Kern River west of Bakersfield, and the other northerly 40 miles to the Chowchilla River above Madera.

The Friant-Kern Canal in popular conception will be a "young river"—68 feet wide at the water surface and 15 feet deep in its upper reaches. This concrete-lined channel, 30 feet wide at the bottom, will have a capacity of 3500 second-feet for the first 30 miles, decreasing in size thereafter in accordance with the amounts of water to be taken out at various delivery points. The Madera Canal, with a diversion capacity of 1000 second-feet, will be 32 feet wide at the water surface, 10 feet wide at the bottom, and will carry water nine feet deep. These two canals will deliver supplemental water to parts of Fresno, Madera, Tulare, Kings, and Kern counties where the failure of the existing supply, mostly from underground, is threatening the reversion to desert of large acreages of once-lush crop lands.

Construction of the Central Valley Project, involving besides the dams and canals many auxiliary features such as bridges, tunnels, inverted siphons, and similar structures, is of tremendous importance to California. The project is to be self-liquidating under the reclamation laws, with revenues to be derived from the sale of the project's two facilities, water and power. Present interest is concentrated upon the imminent construction era with its immediate benefits of large-scale employment and heavy expenditures in many states for materials and supplies. Of far greater significance, however, will be the more lasting benefits of water conservation for improved navigation, flood control, irrigation, salinity repulsion, and electric power generation, which will follow completion of this great Federal reclamation enterprise.

A Legacy for 6939 A. D.

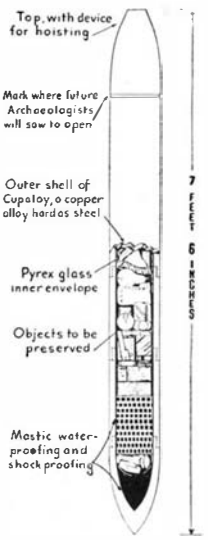
Buried Metal Capsule Contains Sample of Our Civilization . . . Some of Our Products . . . Millions of Words in Print . . . For Future Archeologists

By DAVID S. YOUNGHOLM
Vice-President, Westinghouse Electric and Manufacturing Company

AT the bottom of its 50-foot "Immortal Well," beneath the rising walls of the Westinghouse building at the New York World's Fair 1939, the world's first Time Capsule has begun its long journey into the future—a journey which, it is hoped, will extend through 5000 years of time and give future archeologists a considerable insight into our present civilization. Unlike H. G. Wells' imaginary apparatus, however, it cannot hasten forward through Time; it can only wait.

The Time Capsule represents months of careful planning and the combined efforts of hundreds of persons. Archeologists, historians, scientists, engineers, librarians, scholars, and many others were consulted at every step, so that the project might be as nearly successful as all our present-day arts and sciences could make it.

Leaving a message from our time to so distant a future presented three distinct problems: How to build a vessel capable of preserving the record; the selection and preservation of the objects to be included; and how to leave word of its whereabouts for future historians.



Drawing of The Time Capsule

The Capsule, as finally constructed, consists of an outer shell of Cupaloy (chosen because of its electrical qualities and resistance to corrosion), cast in sections, each section to be threaded and screwed into the next and sealed with asphalt.

The contents of the torpedo-shaped capsule were packed securely in an inner envelope of Pyrex glass, which was then sealed, evacuated, filled with nitrogen, and set into the shell in waterproof mastic. The inner crypt is about six and a half inches in diameter and seven feet long.

More than 40 articles of common use are included. Among them are a fountain pen and mechanical pencil, a watch, an electric lamp, a tobacco pouch with zipper, tobacco, pipe, cigarettes, cosmetics, a woman's hat, eyeglasses, toothbrush and powder, a miniature camera and film, a razor, a can opener, specimens of our money, and so on. There are samples of the major metals and alloys; textiles, including wool, cotton, silk, linen, rayon, glass fabrics, rubber fabrics, asbestos cloth; materials such as Portland cement, asbestos, synthetic and natural rubber, synthetic plastics; also samples of coal (which may be rare in 5000 years), seeds of staple food crops, and many other items.

Most important is a carefully prepared microfilm "essay" on our times, taken from books,* almanacs, pictures, arranged in logical order to cover all the major activities of human life. Multi-lingual texts, a dictionary, and an idiomatic lexicon will enable future historians readily to translate the texts of the microfilm. All film in the Capsule is cellulose acetate for permanence. The microfilm contains a total of more than 23,000 ordinary book pages, reproducing more than 10,000,000 words, and many hundreds of pictures. A microscope is enclosed to enable "futurians" to read the text. Complete directions in text and picture are given for the construction of a larger reading machine and a motion picture projection machine.

For use with the latter, a newsreel is enclosed, specially prepared for the people of A.D. 6939. This contains nearly a score of historic, typical, or significant scenes of our day, with sound.

Word will be left for future archeologists in the form of a Book of Record, printed with specially compounded permanent inks, on 100 percent rag permanent book paper. Copies will be sent to libraries, museums, and other repositories throughout the world with the expectation that some will survive, either in the original form or translated into new languages that arise.

In order that futurians may know when the year 6939 has come, the equivalent of this date is given in the book not only in our own calendar, but also in the Chinese, Jewish, Mohammedan, and Shinto. If none of these survives, futurians may still calculate the years elapsed by reckoning from astronomical data supplied by the United States Naval Observatory. These include the number and dates of eclipses of the Sun and Moon in 1939, the positions of the planets, and the angle of the Earth's pole relative to the star Polaris.

The United States Coast and Geodetic Survey has provided a description of the Survey's network of stations across the United States, astronomical and geodetic locations of nearby permanent stations, and the exact latitude and longitude of the Time Capsule, determined by a special survey. Given to the third decimal point in seconds, these geodetic coordinates are sufficiently accurate to locate the spot with an error of less than an inch. They are: Latitude 40° 44′ 34″.089 North of the Equator; Longitude 73° 50′ 43″.842 West of Greenwich.

IF other guides fail, the futurians can still find the Capsule. Minute directions have been prepared for constructing and using electro-magnetic instruments to locate it by the methods widely used today.

Finally, that our language may not be lost, the book contains a simple but ingenious Key to English which will permit readers to translate our tongue and to pronounce it, 1938 style, as well.

It is impossible, of course, to detail here all the studies and reasoning which led to the construction of the Time Capsule and selection of its contents. We have undertaken with humility the enormous task of leaving this message to the future, realizing well that no selection of ideas and materials, no matter how large, could really do justice to the astonishing variety and vigor of our age. Whether, in the end, the project can achieve its purpose still depends on ourselves and our posterity—that the Book of Record may be preserved and the Time Capsule left undisturbed. The engineering difficulties of removing it from its resting place in 50 feet of muck can probably be counted upon to protect the Capsule from vandalism. We feel that the good instincts of the human race may be relied upon to preserve word of its whereabouts for the generation to whom it is addressed.

*The complete September, 1938, Scientific American is reproduced in this microfilm.

OUR POINT OF VIEW

Arid Farming and Ecology

NOW that the semi-arid and arid states, the latter including the recently famous but already half-forgotten Dust Bowl, have produced good crops for two successive seasons, another kind of drought, a "drought" of human foresight, appears likely as in the past to set in about on schedule time and hold sway until we reach the next period of poor rainfall. Hardly, however, can we expect to settle a great problem by concentrating on it only when it is definitely upon us. Some of us, therefore, must study the problem on an all-time basis and, by much continued harping on the findings, gradually hope to raise public awareness of the answers to such a level that intelligent results will be attained at a later date.

The drought of 1936 has been closely studied by the United States Geological Survey, one of Washington's efficient bureaus of many years' standing, and the question of drought in relation to climate discussed in available documents. From such study certain "frozen facts" are quite evident, though the answer—the final remedy—is not of the kind one instinctively seeks; that is, it is not any simple, direct, short or especially tangible cure-all. Rather it is a recommendation for closer application to details—something not easy to bring about.

One of the most pernicious phases of the arid states' drought difficulty is man's cussedness to man—"man against himself." With the coming of drought, thousands of discouraged farmers pull up stakes and depart hence. A few years later, with the return of the rains, the first to bring in a "bumper crop" is the booster and the boomer—bumper crops of the victims of over-optimistic misrepresentation, people whose lack of scientific background makes it easy to convince them that droughts are not periodic but accidental and that the final one is past and gone forever. Against such misadventure the people must be educated—no simple task.

As its final answer to the drought problem the Survey offers the study of the science of *ecology* by more of the people than understand it now. "More people must come to understand human ecology, plant ecology, and animal ecology."

How many of the plain people today understand the science of ecology? How many can define it? How many have ever heard the word? And how many, on learning what ecology is, will get down to close grips with its underlying principles and sense what a pregnant science it is? For ecology is not a science that is self-evident at first glance. It grows on its student only as it is studied. Simply defined but most inadequately set forth by any mere attempt at definition, ecology is the scientific study of the relations between plants and animals (man included) and their environment. If this study is the prerequisite to the farmer's success with the arid regions, we have a long road to travel, for the study is relatively a new one even among scientists. And the sooner begun the sooner ended.—*A. G. I.*

Too Old at Forty?

FORTY years old and on the shelf! That is the plaint raised so often by persons who, seemingly, have just discovered that when a man reaches the age of 40, he finds it extremely difficult to get a job. That is quite correct, but discussions of the problem usually give the impression that a man at 40 is shelved entirely, that those who have jobs are automatically dropped from the payrolls soon after reaching that age. The facts show that the reverse is true. All these years of argument, however, did not bring out the figures and it remained for A. W. Robertson, chairman of the board of Westinghouse Electric, to do so.

Taking his own company as an example, Mr. Robertson shows that its payroll has a higher percentage of persons over 45 than has the general population. Thirty-one percent of those employed by the company are over 45, while persons of this age constitute only about 23 percent of the entire population. This comparison of percentages will hold throughout most manufacturing organizations. "After all," Mr. Robertson reminds us, "older men rule the world. It isn't reasonable to assume that they are leagued against people of their own age. One thing of which we may be certain is that industry is not hostile to the older man. He is usually more steady, more careful and reliable, and is generally an entirely desirable type of employee."

Now that these facts have been pointed out, memory calls to mind hundreds of inspection trips through many plants, large and small, and sight of a high percentage of relatively ancient workers of both sexes. And about them there was always an air of contentment, a sense of responsibility, a pride in good workmanship, a spirit of service. Why? Perhaps these older ones retain some of the idealism of youth. Perhaps they realize how necessary is their work, how much the product of their brains, their hands, their experience contributes to the well-being of the nation as a whole. It may even be because they are of a generation that still believes in the joy of working, that does not expect something for nothing.

That older men are employed in manufacturing does not, however, make less serious the problem of unemployment. Millions still are looking for work. When they get it, as they assuredly will, let us hope that they will go into their new jobs with some of the spirit of these mature workers on whom so much depends, and work with a singleness of purpose toward the day when they, too, can look backward with contentment and pride on years of gathering experience and rendering service.—*F. D. M.*

It Can Be Done

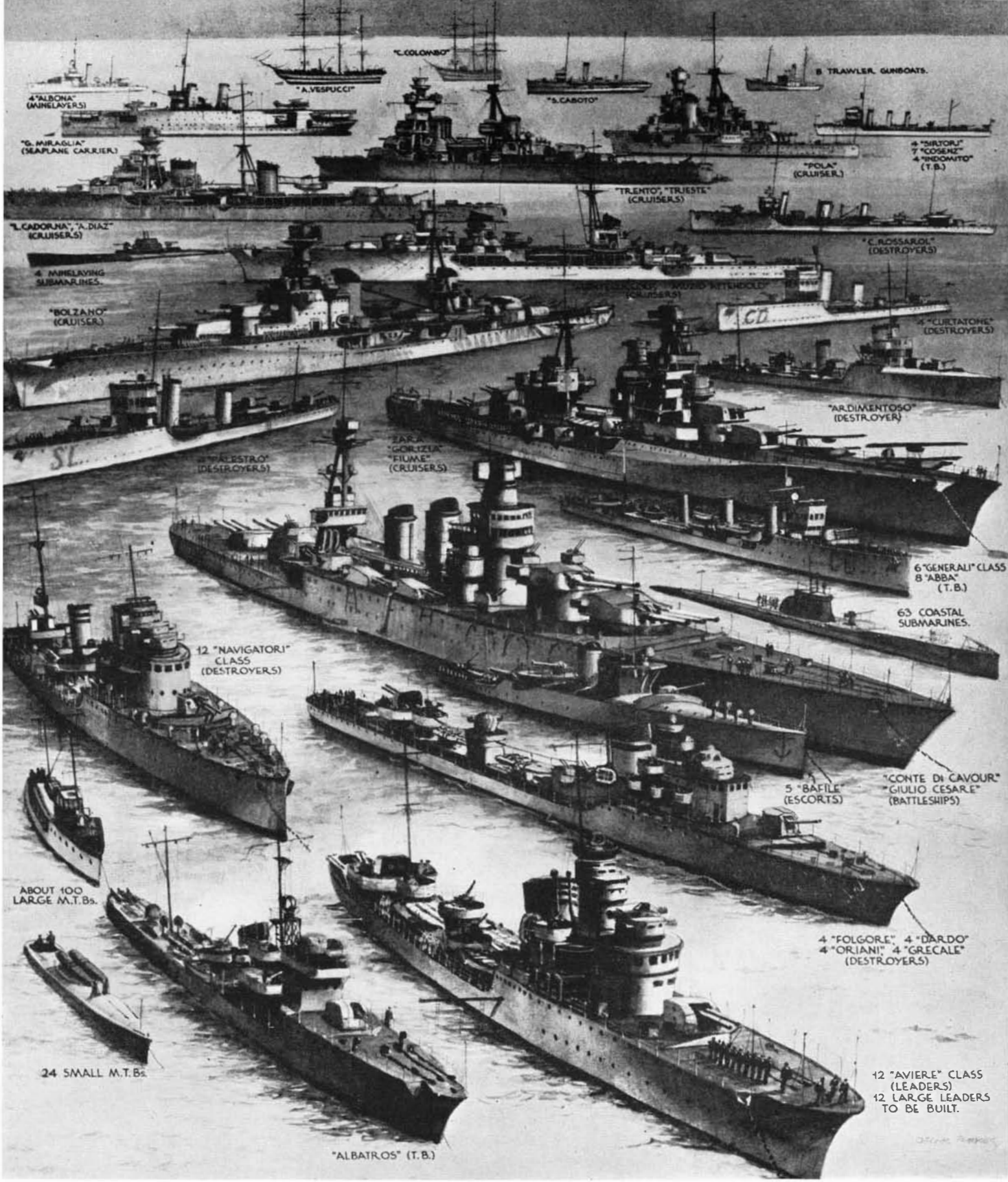
DURING the first seven months of 1938 there was a decrease of 22 percent in highway deaths throughout the United States, compared with the similar period in 1937, and this with an increase in traffic volume of 1 percent. So reports the National Safety Council. Here indeed is good news.

Part of the increase in highway safety undoubtedly can be attributed to safer highways, better law enforcement, improved road-sign systems, and so on. But it can hardly be questioned that by far the greatest portion of the record must be credited to "education" and its cumulative effect on motor-car drivers. Educational campaigns conducted by a wide variety of organizations through the media of the press, the radio, bill-boards, and almost every other conceivable channel that ultimately reaches the brain of the driver, have begun to show results. Just when the situation seemed darkest, when many were ready to throw up their hands and admit that a solution of the serious problem could not be found, statistics carefully compiled show a gleam of light. Drivers can be educated to safety; so educated, they will drive more carefully; so driving, they will have fewer fatal accidents.

A start has been made, a theory proved. If fatal accidents can be reduced by 22 percent, they can be reduced by 44 percent, by 66 percent, by even more. Such reductions can be made, however, only by keeping everlastingly at the process of driver education. Those who have contributed to the cause must not rest on their laurels. They must continue to strive toward the irreducible minimum of accidents that is the ultimate goal.—*A. P. P.*

The Italian Navy at a Glance

TO an American layman, several unusually interesting details are brought out in this drawing by Dr. Oscar Parkes, the second of a series which we shall publish this year through arrangement with *The Illustrated London News*. The most immediately apparent is possession by Italy of five monitors, a type which Americans associate with the earliest days of ironclads. The illustrated *Faa di Bruno* is said to have given a good account of herself, with her two 15-inch guns, during the World War. Note the incongruous peaked roof forward. A second noteworthy point is the splendid group of 12 destroyer



leaders apparently already built and the 12 large leaders that are to be built. Needing this type for many years, the United States did not start building leaders until the last two or three years. The Italians have evidently proved the success of small motor torpedo boats, for it will be noted that they have 100 large and 24 small ones. Our own Navy long denied that these small craft could be useful to us but lately there has been talk about experimenting with the type. A fourth important fact, emphasizing Italy's confidence in land airplane bases and her evident belief that any war she will fight will be in restricted waters, is that she possesses only one seaplane carrier and no flight-deck carriers. It will be noted also that Italy has a powerful underwater fleet with 106 large and small submarines and a large number of ocean-going ones to be built.

ELECTRICAL RHYTHMS

What Causes Our Brain Waves and What Do They Signify? . . . Hypotheses . . . Have They Something to Do With Vision? . . . A Beginning Has Been Made

(In Two Parts—Part Two)

THOUGH records of electrical brain waves from the same head vary, they are fairly distinctive. Often they may be picked out of a gallery of miscellaneous rhythms. So an individual may frequently be recognized by his brain waves. It is not true, however, that brain waves have the individuality of fingerprints—despite popular press reports. The wave-patterns of a given person merely tend toward similarity in the long run.

Wave-patterns do not hint of sex. Without previous familiarity with a given record, the scientist cannot decide: "This pattern is from a fair head," or "That pattern is from a thick-head, a man." Still, it is claimed that women are likely to show about 11 waves per second, and men, about ten.

Twins have fascinatingly similar Berger rhythms. This is but another evidence of the close bonds of twinhood. In addition, it is a clue for investigators who are trying to determine how fundamental a phenomenon the alpha waves are. Were rhythms of the average pair of twins not alike, brain probers would have doubts concerning the importance of brain waves.

Does the Berger rhythm in any way indicate level of intelligence? No—except perhaps in a very indefinite and roundabout way.

THUS far, the Berger rhythm of the adult brain alone has been considered. Very young infants are said not to manifest the waves. Observation is that no rhythm appears until after the age of three months. Somewhere between the age of three and six months the waves show up. At seven months, their frequency is about four and a half waves per second. At 13 months, the waves come at the rate of about six per second. Adult frequency is not reached until approximately the age of 12 years.

What is the explanation of this delayed appearance and gradual increase in frequency of brain waves? Briefly, everyone is mystified. Some theorists would have it that the onset of the rhythm is correlated with the development of the brain center controlling vision.

In support of this contention, it is said that, as a rule, the infant at about the age of three months starts to take note of objects and to follow them with its eyes. Theorizing, Lindsley continues:

"We believe that the onset of the alpha waves at about this time may indicate some relationship with this functional ability," and may further indicate "the onset of function in the particular brain area investigated"—the visual center, where vision is controlled.

The experimental evidence, however, consists almost solely of the Berger rhythm determinations at various ages. With respect to a delayed onset of function in the visual region, very little is really known. Stage of development of intellect may also conceivably be a factor here.

What of distorted mentalities and the Berger rhythm? Observer Lemere believes that individual differences in the rhythm are highly significant:

"The ability to produce 'good' [strong] alpha waves seems to be a neuro-physiological characteristic which is related in some way to the affective [emotional] capacity of the individual."

In Lemere's hypothesis, a person tending to have marked "up" and "down" states—that is, a person alternately highly elated and deeply depressed—should produce "good" waves. An individual with a schizoid personality—that is, an individual who may be said to project his dreams excessively into his daily activities—on the other hand should give "poor" waves.

Having developed this hypothesis out of his studies of fairly normal persons, Lemere turned to psychotic patients to verify it. According to his observations, schizophrenic patients do indeed always have "poor" rhythms, while manic-depressives give "good" rhythms — the schizophrenic being the extreme schizoid, and the manic-depressive the extreme in ups and downs.

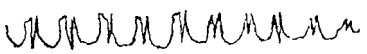
An impartial scientific opinion, however, warns concerning Lemere's speculations:

"We must still regard any such suggestions as tentative working hypotheses. There seem to be too many exceptions."

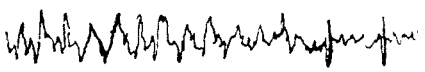
Yet it is widely accepted that rhythms of twisted personalities will eventually be found to differ significantly from rhythms of normal people. So far, no agreement has been attained as to what significant differences are likely to be clearly demonstrated. Certain labors are toward the invention of refinements of Lemere's methods and toward the determination of what shades of meaning are to be allotted to exceedingly minor variations in rhythm. At any rate, working hypotheses such as that of Lemere are, though tentative, still new leads to the awesome problem of insanity. In fact, it is already being suggested that, should a person begin to have symptoms of serious mental unrest, a study of his electro-encephalogram is in order. What definite outcome this study would have, and even how the study ought to be conducted, are moot points.

The present cash value of such leads cannot even be guessed. Too much is rumored about what startling treasures science is going to dig up—some fine day. But if there are any doubts regard-

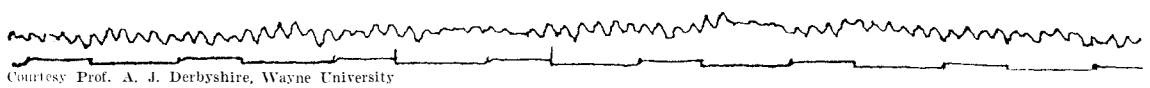
In schizophrenia, the alpha waves are said to be superimposed on larger waves of lower frequency, called "delta waves," as shown above. The analysis of the record is done graphically or else by means of an automatic electrical device



The unmistakable cusp-and-dart pattern of petit mal seizures in epilepsy. This pattern is visible sometimes in sleep when the other symptoms of the seizure are absent



Grand mal in epilepsy has a pattern basically similar to that of petit mal, but the violence of the seizure introduces other currents which may complicate the tracing

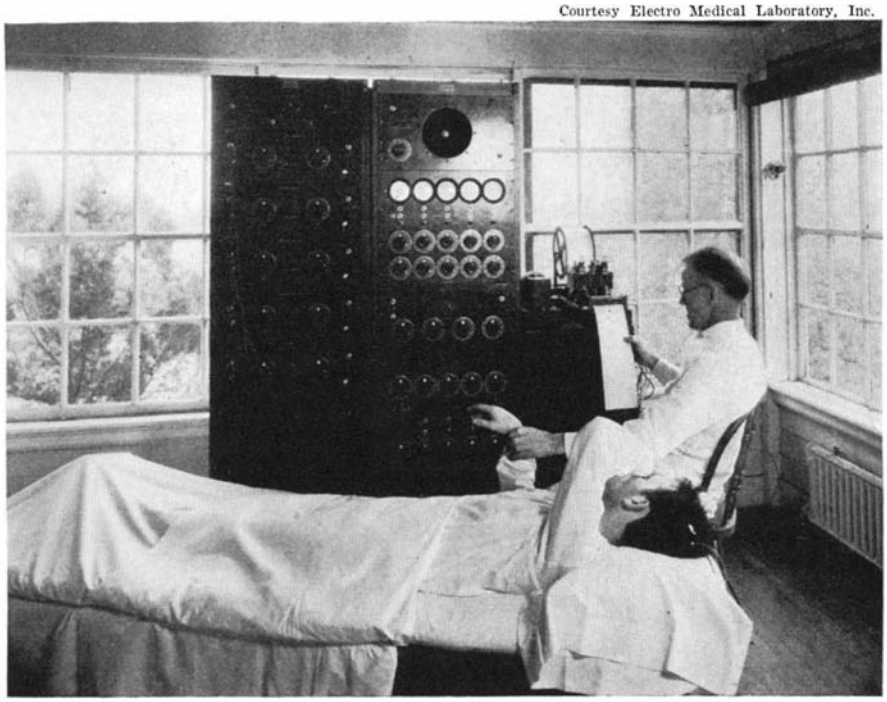


Courtesy Prof. A. J. Derbyshire, Wayne University

A record of a normal subject, showing alpha waves of a characteristic type

OF THE HUMAN BRAIN

By BARCLAY MOON NEWMAN



An electro-encephalograph of the five-channel type, similar to the three-channel apparatus shown in the first installment of the article but having greater possibilities. The physician is reading the ink-written oscillogram

Courtesy Electro Medical Laboratory, Inc.

ing Berger's deserving a Nobel award—always based on profit already on the balance sheet of science—they melt away in the light which is today brilliantly cast upon the timeless affliction, epilepsy. The electro-encephalograms of epileptic seizure have provided the first new experimental evidence in many years as to the nature and possible causes of this mighty medical bafflement, the mightier because the disease is incomprehensibly linked with heredity.

Now we know that in an epileptic seizure, the hitherto blithe little wavelets surge into menacing, high-voltage billows which ultimately seem to involve all the cells of the cortex. It is as though an electric storm accompanied the mysterious gales which lash the brain and force the body into writhing upset.

As the tape slides past the observer's eye, the oncreep of the storm can be clearly seen. The waves become slower, and gradually beat more and more powerfully, as more and more regions of gray matter are stirred up and made to volley electricity. Thus, large slow waves come to stand out on the tape.

The voltage triples, as estimated by the height of the waves. The beat falls to three waves, or perhaps only one, per second. And as the pen moves up to mark each crest, in unison with the brain discharge, it makes a curious down-twitch—small, but observably splitting the smooth contour of each wave. This down-twitch signifies an odd and sudden slight drop in voltage. The last spasm brings the calm of unconsciousness, as the simultaneous electric beat of many million nerve cells breaks up and is gone.

NOW medical scientists know that the climax thus built up represents a definite over-excitation of the highest centers of the brain—the centers located in the cortex. Moreover, severe epileptic attacks are distinctly seen to involve practically the whole brain-surface.

Petit mal epilepsy is characterized by milder symptoms, but the wave records of attacks are very much like those of grand mal, the severer form. Hence it is already to a certain extent possible to accomplish what has never before been possible: to predict the onset of a seizure. One need only remark the diminishing frequency and increasing height of the alpha waves.

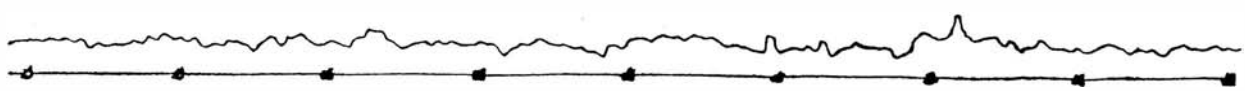
Gratifyingly enough, it has further been possible to detect a condition approaching that of true epilepsy. Certain individuals of disturbed mentality and recurrent emotional lapses have been shown to exhibit rhythms characteristic of epilepsy. The conclusion is that extremely mild and therefore unsuspected epileptic afflictions are to be found, probably much more often than has been thought. Consequently, the outlook for Berger's hypothetical new leads to enigmas of distorted mentalities, including the insanities, begins to promise more.

Since both mild and severe seizures can be scientifically investigated and electric aspects recorded, the influence of various factors, such as drugs, food, blood-oxygen, amount of sleep, can be measured to an instructive degree. The delight of the long-puzzled expert on epilepsy can scarcely be imagined.

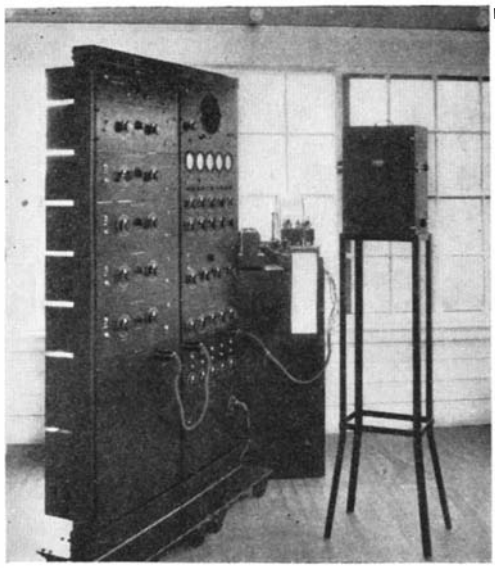
How do we know that the cortex—the surface layer of the brain—is really the source of alpha waves? There are sources of electrical rhythms outside the skull: muscle contraction, the pulse, and respiration always give rise to observable electrical changes, many of which are rhythmic. Wrinkling the forehead by contracting the scalp muscles produces recordable electric oscillations. A tense muscle quivers electrically, rhythmically. Graphs of the electrical rhythm of the heart have for years been used in the diagnosis of cardiac conditions, as well as in the study of the normal heart.

To demonstrate that the Berger rhythm originates in the cortex, these possible extra-brain sources must be eliminated first. So records were taken simultaneously of alpha rhythm, and of electrical variations caused by the pulse, by respiration, and by any chance muscular contraction. The individual and independent existence of each type of pulsation was by this means clearly recorded.

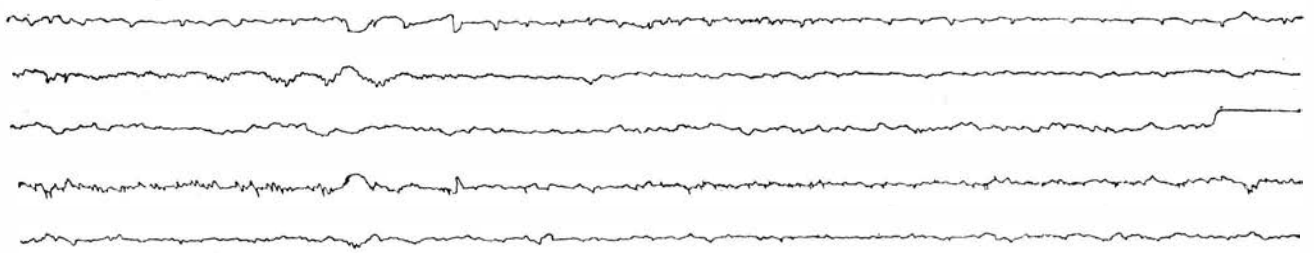
A patient with paralyzed scalp-muscles turned up, and Adrian and his co-worker, Yamagiwa, obtained alpha imprints as distinct as when scalp muscles are functioning. And these two experimenters went on to insert a metal disk into the cortex of a cadaver, plastered up the cracks in the skull, and bandaged elec-



Brain wave record of a mongolian idiot, taken with a clinical electro-encephalograph



At left: Electro-encephalograph of the five-channel type faced by its motor-driven continuous camera which records the oscillograms photographically, and, *lower right*, the back of the same apparatus. The five lines of records between the two photographs were made simultaneously on a five-channel electro-encephalograph. Note the differences in the waves. Each is led or taken off from a different region on the same subject's cranium



trodes against the scalp. Then they set up electric oscillations in the disk, using a frequency and a voltage approximately the same as those presented by alpha oscillations. Not only were these electric pulses detectable on the scalp, but even were led off to trace out inky trails very like those of the real Berger rhythm.

Needle electrodes stuck into the brain of a cat convey signs of the alpha rhythm until the points pierce a slight distance below the cortex. Pushed deeper, the needles send back no rhythm. Return their points to the surface of the brain, and the rhythm is retrieved again. The source of the alpha waves is not above or below the cortex. It must be in the cortex.

Yet the cortex is a broad expanse, with fascinatingly diverse regions. Where in particular in this brain jacket do the alpha waves arise? The marked effects of light point to the visual centers at the back of the brain. And contacts variously placed on the scalp usually yield the strongest waves when located over the visual region. Hence the optical centers are regarded as the prime source of the electric pulse named alpha.

BUT the focus of the alpha rhythm may swing outside the area of visual control and have play farther forward, on one side of the head or on both. Sometimes, however, the waves drawn off from one hemisphere differ in frequency and form from those drawn off from the other hemisphere—and no one understands why.

The evidence is, too, that the rhythm generally arises first in the visual region, and thence spreads over the rest of the brain surface. There is some elusive connection between the cortex at the back of the head and the rhythm—and so also between the visual centers and the rhythm. But why light should have prime influence over alpha waves is altogether unknown. It has been hazarded that, because in man (and the higher animals) the visual centers are so great in extent, probability favors the origin of any possible and detectable rhythmic phenomenon here—where the largest number of similar nerve cells with similar functions would be simultaneously ready to cooperate in building up a synchrony of discharges. For a center of alpha activity to be detected, it must have a diameter of at least an inch.

As Dr. R. W. Gerard, professor of physiology, University of Chicago, expresses it:

"When an audience starts applause each individual claps in his own way and a chaotic medley results. But note that after a few seconds, without any deliberate attempt on any one's part, most people are clapping together in perfect time so that a large, slow, regular wave of sound is rhythmically produced. Just so are brain waves built of the added beats of many synchronizing cells."

Nerve cells have for more than a century been known to be electrically active. Messages passing along nerves are always accompanied by electric disturbances—indeed the electric discharge may actually be the message in each case. And, very recently, nerve cells have been proved capable of automatic discharge of electricity. Consequently, nerve cells can act as batteries, and periodically volley forth an electric display. Then, cells of the cortex, under conditions utterly dark to scientists, can, like the clapping audience, synchronize a multitude of individual reactions and give rise to a rhythmic display.

How does each cell generate its electricity? Why should myriads of cells harmonize? The physiologist is not ready to answer.

Concerning beta waves and other deeply hidden rhythms, extremely little has been established. Their precise origins and the conditions under which they manifest themselves remain dark. Their importance, however, is recognized. They contribute to the modern

motion picture of the human brain.

Such are the meanings now being read between the lines of alpha tracings. Meanwhile, the passage from alpha to omega in the brain remains among the grander distances of the cosmos. Yet Berger has guided us past still-secret alpha to beta at least, and perhaps even to gamma. A new beginning has been made in our struggles toward knowledge of this stupendous thing, the brain about which sentience glows like phosphorescence.

The Big Concretions of Ohio

Odd Rock Curiosities that Intrigue Collectors . . . Formed in the Rock Where They are Found . . . A Peculiar Chemical Reaction is Their Origin

By ARTHUR DAVID

THOUSANDS continue to gaze with wonder upon Ohio concretions. Created some 300,000,000 years ago in the Devonian Period, these strange natural curiosities range from hickory-nut size to monstrous round or oval masses 18 feet or more in diameter. Maximum weight of some of the largest, now in partial or complete state of ruin, is estimated at about 300 tons.

Concretions are odd geological curiosities and always seem to fascinate their finders. Sometimes they are found loose, because they have long since been detached from their original positions in

Concretion in place in solid rock (seen above, in cliff) and, at bottom, a detached, fallen concretion

the rocks by natural forces, but when found where they first formed they look like the one shown high up in the cliff in the upper photograph, which is seen to be emerging from its ancient prison as the surrounding rocks gradually weather away. One might be forgiven for taking for granted that, originally, these objects were brought from afar and placed in the soft sediments as these were deposited, later to be encased as the sediments became rock. This appearance, however, is false, for they were formed in the rocks at the time these were first laid down as mud. This is proved by the fact that the regular bedding planes of the adjacent rocks continue through them, as is shown in the photographs. They are composed of some of the lesser components of the local rocks, those in shale often being of sulphide of iron (fool's gold). Usually they have at their centers a plant or animal fossil. Their formation is caused by material precipitated rhythmically from these nuclei, diffusing outward and reacting with other material diffusing inward from the rock. They take many bizarre shapes but are usually round or oblate spheroidal in form.

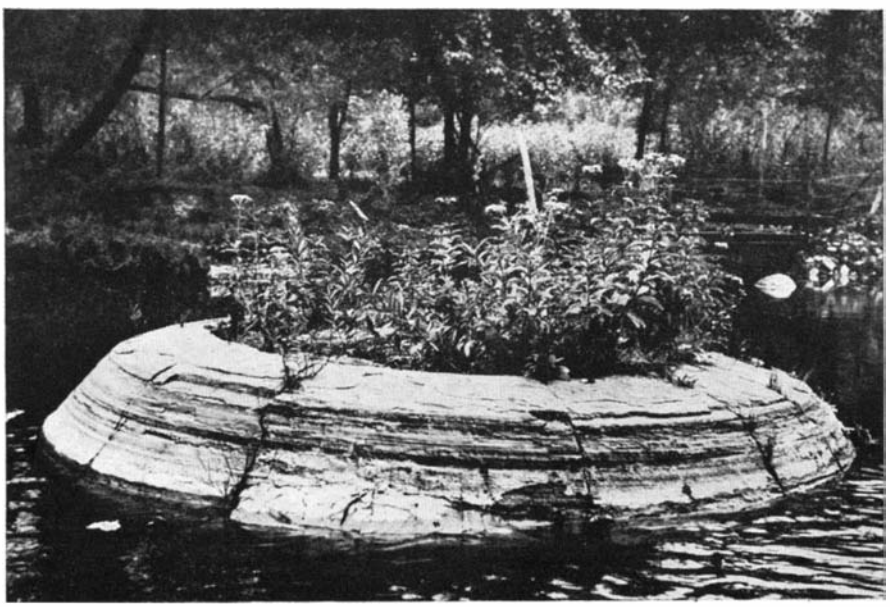
In Ohio, the largest concretions are found only in a belt of the Ohio Shale a few miles wide, from some distance south of Cincinnati, northward through central Ohio to the Lake Erie shore east of Sandusky. Concretions similar to those found in Ohio are observed in the same formation in the vicinity of Kettle Point, Ontario.

TO examine concretions in hope of finding fish, mollusk, or plant remains of Devonian age continues to be the quest of many geologists and natural history students. Often fossil hunters break up the dense formations with dynamite in order to examine the interior material. A request has been made to the Ohio Conservation Department to take steps to stop such needless damage to specimens.

In Ohio, after being enclosed in the shale through many geological ages, the concretions, through effects of weather and water, are gradually exposed by the elements in the shale river bottoms or by wave action on the shale beaches of Lake Erie.

A few years after a concretion becomes visible in a shale cliff from effects of weathering, it begins to lose its outer segments, often weighing hundreds of pounds. The irregular interior is then revealed. Some take on the appearance of weird faces that look out from their cliff windows often at elevations of 50 feet or more. This emergence from within the rocks to the outside world in time proves fatal, and now and then, when the shale support crumbles, the great masses tumble down into the streams or upon the banks. Disintegration by natural elements soon follows.

In the East Branch of the Huron River near Norwalk, Ohio, a singularly beautiful effect is produced yearly in the broken top of a concretion that protrudes about two feet above the water level of the small stream. This is shown in the lower illustration. Ice action has scooped out a bowl-shaped cavity ten feet long and six feet wide, and in this 300,000,000-year-old flower garden wild plants bloom —blue vervain, boneset and joepye-weed.



A large concretion at Norwalk, Ohio, in whose hollow center wild plants grow

ARTIFICIAL ECLIPSES

At Their Triennial Meeting the World's Astronomers Witnessed the Amazing New Technique of Observing Solar Prominences and Corona without an Eclipse

By HENRY NORRIS RUSSELL, Ph.D.
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THE Stockholm meeting of the International Astronomical Union is over, and its members are scattering to the ends of the earth. Some of them have a long way to go, for there were members from as far east as Japan, and as far west as California and British Columbia.

More than 400 people—including wives and families—were listed on the official program. Of these, the largest delegation came from the United States—92 of them. Next in number were the British—69. Then followed our generous hosts from Sweden, of whom 64 were listed, but many more contributed to our enjoyment and comfort. France and Holland sent delegations numbering more than 20, and Belgium, Czechoslovakia and Germany were not far behind.

It would be an interesting study—quite in line with the present-day love of statistics—to interpret these "indices." Several factors obviously enter—the number of astronomers, professional and amateur, in the country; the time and distance required for a visit to Stockholm; and, last but not least, considerations of finance. The remarkable size of the American representation was doubtless considerably influenced by the attractiveness of a summer in Europe, and, in particular, the charms of a visit to Scandinavia. A gratifying feature was the presence of a considerable number of the younger members of the staffs of various observatories.

All who came were well rewarded, and in many ways. The traditions of hospitality which have grown up around the meetings of the Union in many countries were admirably maintained by our Swedish friends.

By invitation of the Government, our meetings were held in the Houses of Parliament—the law-makers being not in session. The halls of the Upper and Lower Houses furnished admirable places for the larger sessions, while the numerous committees had at their disposal the rooms of the Parliamentary committees with every possible convenience. Receptions and dinners, at the Royal Palace, the old Castle of Uppsala, and the new and magnificent Town Hall of Stockholm, and elsewhere, made the social side of the meeting memorable.

The scientific work of the Union had, as usual, been almost completed months before, by correspondence between the chairmen of the numerous technical committees and their members in all countries; and the draft reports of these committees, which were printed and distributed to all the members attending the meeting, form a volume of nearly 300 pages. At the sessions of these committees in Stockholm, there was often little to do but to give formal approval to the report, already well discussed by letters. Room remained, however, for discussion. For example, the committee on Stellar Spectra had to consider the adoption of a notation for the spectra of the Wolf-Rayet stars—those remarkable bodies which show broad, bright lines of highly-excited atoms. A sub-committee, composed of four or five experts in this specialized field, had, after long correspondence, agreed unanimously upon a scheme of classification, and upon detailed criteria for the distinction of the various sub-types. Since there appear to be two parallel sequences of these stars—one showing strong lines of nitrogen and the other of carbon—it was agreed to distinguish them by the chemical symbols C and N, appended to the W which denoted the general spectral type; but how? Should one recommend W_n8 (with a subscript letter) or WN8 (with a small capital on the line), or WN8 (with a large capital)? (The figures 5, 6, 7, 8 . . ., which represent the degree of excitation of the atoms, were generally accepted.) This apparently small point led to 20 minutes of lively and very useful discussion of practical matters such as the difficulty of handling small capitals on a typewriter, and the practices of printing-offices and proof-readers in various countries, and when a decisive majority finally decided for the large capitals, there was a feeling that a great deal of annoyance to future authors, typists, and proof-readers had been avoided. Such matters may look small at first; but the adoption of a scheme of classification (in practice as well as in theory), is one of the main services which can be rendered by an efficient international organization.

So well was this work done in the various committee sessions, that the final "General Assembly" ratified their reports without modification.

There was much, however, of more general scientific interest. We visited the new Stockholm Observatory—beautifully situated on a wooded hill near the summer resort of Saltsjöbaden, a dozen miles from the city, with fine equipment, including a 40-inch reflector, and an able and enthusiastic staff—and admired the important work which is being done by Professor Lindblad and his colleagues, especially in the study of the spectra and absolute magnitudes of faint stars. At Uppsala, a group of spectroscopists, at Dr. Edlèn's laboratory, saw spectra running down to a wavelength of 12 Angstroms—1/500 part of that of yellow light—and learned, with great satisfaction, that he and Dr. Swings, of Belgium, have almost completed an analysis of the third spectrum of iron—the most important, to the astrophysicist, of all spectra which had not previously been observed.

By common consent, however, the most noteworthy scientific communication made at the meeting came from the French astrophysicist Lyot. The story has been told long ago in these columns how he attacked the supposedly hopeless problems of observing the solar prominences without a spectroscope, and the solar corona without an eclipse; and how he solved them by the application of optical principles which were long familiar, but which no one had had the inspiration to utilize. [See December, 1932, and January, 1934.—*Ed.*] By making a telescope with perfectly clean lenses, and cutting down scattered light in every way, and by observing on the Pic du Midi in the Pyrenees, at a high altitude and in very clear air, he succeeded, some years ago, in observing the prominences by direct telescopic vision, and the bright lines of the coronal spectrum on any clear day.

Now, with technique improved by experience, he showed results which are simply amazing. On his recent spectra, the bright coronal line in the green looks as strong on photographs taken in broad daylight as it does on many spectra taken during eclipses, while the opportunities

for exact measurement are better. His plates show 11 bright coronal lines, from the ultra-violet at 3388A to two newly discovered lines far in the infra-red, at 10747 and 10798. What is more, he has succeeded, by utilizing the finest days, in obtaining direct photographs of the inner part of the corona in full daylight. It will at last be possible to learn how the corona changes from day to day, or even from hour to hour—instead of waiting a year or more to find its form utterly different at the next eclipse.

Most remarkable of all were long series of moving pictures of the prominences—taken through a red screen, which transmits only the region of the spectrum near the red hydrogen line, but without the aid of a spectroscope or spectroheliograph.

During the summer of 1937, when a number of great eruptive prominences appeared, some of them were followed for hours, with exposures taken at intervals of a minute or so. The resulting films, when run through an ordinary projector, show what happened, speeded up 600 times, and present a bewildering picture of solar activity.

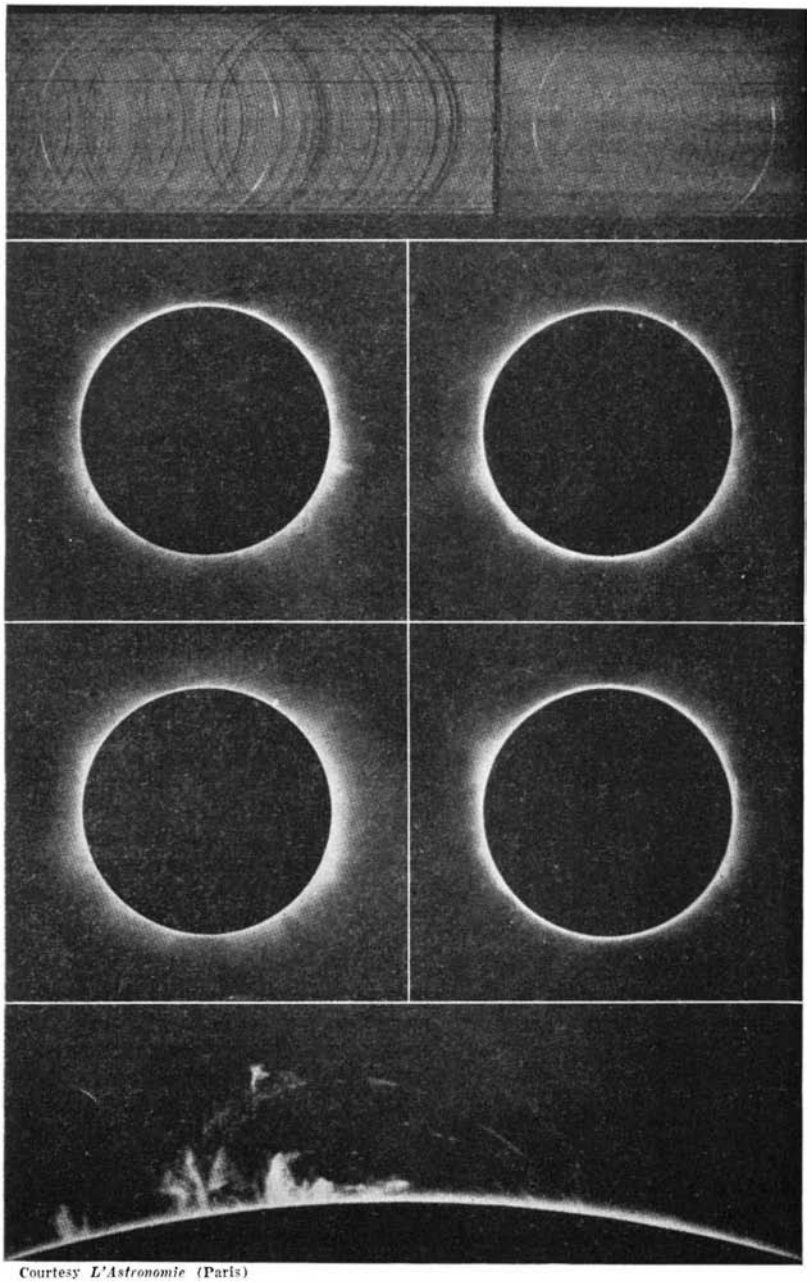
FROM the main mass of a prominence, perhaps 100,000 miles above the Sun's surface, great flakes and patches of luminous hydrogen break loose, and fall into the Sun. Others stream off sidewise, rising at first, and then falling along the curve of a great arch. Direct upward motions occur but rarely; those to the side are the most frequent.

In the films which were exhibited, the same set of pictures was shown three times over, in immediate succession—to the great advantage of the spectator, who, having seen the general course of the phenomena, could fix his attention the second time on some particular detail and study it. At times, bright clouds formed apparently in empty space. This confirms an observation made more than 50 years ago, visually, by the writer's old teacher, C. A. Young. To catch the moment of such an appearance upon plates taken with an ordinary spectroheliograph, at intervals of three or four minutes, is almost impracticable; but the motion picture cannot miss it.

Most remarkable of all was a film in which a huge luminous jet burst from the Sun, struck a prominence-cloud above, and apparently blew it to fragments—with a change so rapid that the eye could hardly follow it on the screen.

Moving pictures showing these extraordinary changes in prominences were obtained two or three years ago by the McMaths, at their private observatory in Michigan, with the most ingenious spectroheliokinematograph of their invention. The great activity of many prominences, and the motion along curved arches, are excellently shown in these photographs; but those which were taken a year or two ago lack the fine detail of Lyot's pictures. In one respect, direct photography has the advantage. If a moving mass of hydrogen has a considerable velocity toward or from us, the bright lines it emits will be shifted in wavelength; they will go off the second slit of the spectroheliograph, and the eruption will not show on these photographs, while, of course, it will appear on those taken without a spectroscope. The newer work, therefore, is more decisive than the older on the question whether bright patches of hydrogen appear in "empty" space near the sun.

In general, the two methods of observation are not rivals, but allies—each being able to contribute something which the other does not. It is to be hoped that both will be actively continued.



Courtesy *L'Astronomie* (Paris)

Top: **Rays at 5303 and 6374 A. U.** ***Center:*** **Four direct photographs of the solar corona.** ***Bottom:*** **A protuberence having an open and tremendously wide arch, seen rather sketchily in the half-tone reproduction, high above the center. This image was taken from a motion picture film**

The nature of the forces which cause these extraordinary motions is hardly understood at all. The luminous matter descending along an "arch" appears often to be sucked into a sunspot, or into some point near it. It will take years of study before the full advantages of all phases of this new method of observation are realized.

At the concluding session the Union elected Sir Arthur Eddington as President for the next three years—a choice everywhere approved—and decided to hold its next meeting, in 1941, in Switzerland—the place to be determined later. We are on our way home now, hoping to have (collectively and as a profession) results as good to present then as we have just seen.—*At Sea, SS. Stavangerfjord, August 23, 1938.*

Machines Pick Cotton, But—

Mechanical Cotton Pickers Coming . . . To Solve Planter's Biggest Problem . . . Complex Factors . . . Adoption Very Slow . . . No "Economic Revolution"

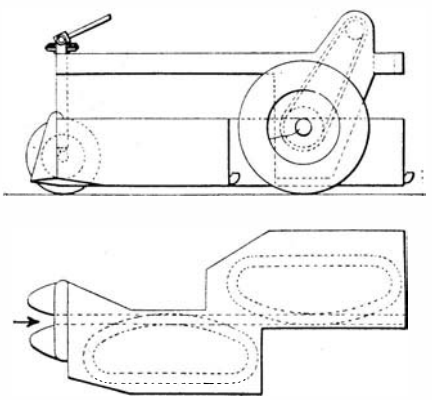
By F. D. McHUGH*

SCORES of articles, in newspapers and magazines habituated in recent years to the use of superlatives, have told the public that cotton-picking machines are destined to cause a "social upheaval" in the South, to threaten an "economic revolution" there. These machines, it is claimed, will revive the growing of this major crop in some sections. They will, it is predicted, throw into the ranks of the unemployed millions of hand pickers of cotton, remove their source of livelihood "in five years." One noted newspaper has repeatedly stated that they will make useless something like 5,000,000 horses and mules, supposedly now used during cotton-picking time. These machines, we are told, will salvage the tenant farmer (with the help of political reformers, the C. I. O., a "new relationship between southern whites and Negroes," and the "socially minded folk" of the nation), will give him, apparently, a new position of social, economic, and political power.

Brash statements, these! Predictions are always dangerous, but especially so when applied to new labor-saving inventions. One has but to scan the history of other such developments to note the boomerang effect of predictions. Far better is it to consider a subject temperately, to analyze the controlling conditions, and to base conclusions on background facts and consequent possibilities rather than on wishes, hopes, or fears.

Although there are several new cotton-picking machines practically ready for the market, most of the recent nation-wide comment on them has been inspired by the one developed, after something like 11 years of experimentation, by John D. and Mack Rust of Memphis, Tennessee. Of simple and clean design, this machine employs as its working principle the affinity of cotton fibers for wet surfaces; hence it has no hooks or teeth on its collecting spindles. In the words of the inventors, "it consists primarily of an endless belt carrying several hundred smooth wire spindles. As it passes over the row of cotton, the rotating wire spindles enter the plants. The speed of travel of the spindle carrier (and the consequent movement of the spindles in a backward direction during contact with the plants) is approximately equal to the speed of the forward travel of the machine. The spindles, therefore, while in the plants, rotate in a position approximately stationary with relation to the stalks. This avoids endangering the plants."

A Rust cotton picker in action. *Below:* Its essential features. The lower drawing (from the patent) shows, dotted, the two endless belts. Arrow points to throat



The spindles of the Rust machine are automatically moistened before they enter the plants. Cotton fibers adhere, are wrapped about the spindles as they rotate, and in another part of the machine are stripped off the spindles and delivered by a suction fan to a container. It is claimed that the spindles probe every part of the plant, that only mature cotton is gathered while immature and faulty cotton is left behind. However, much trash—leaves, small limbs, and dirt—is gathered in; and because at harvest time some leaves are still green and may be bruised by the machine, a green stain will be imparted to some of the lint.

Another mechanical cotton-picker is that developed after 30 years of intensive research and experimentation by the International Harvester Company under the leadership of Mr. E. A. Johnston, Vice President of the company in charge of engineering. This machine also employs a large number of probing fingers of steel. In this case, however, a comparatively short, tapered spindle with several rows of inclined barbs was adopted; in fact, it is quite stumpy.

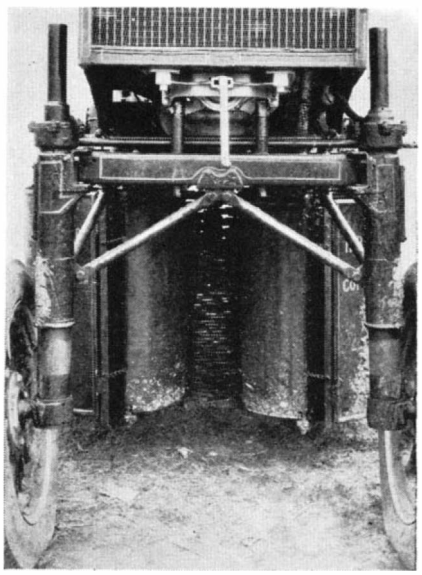
The International cotton-picking machine consists of two vertical, parallel, rotary drums which straddle the cotton row. Each drum carries 154 of the tapered, barbed, picking spindles, each of which also rotates on its own axis. The rotative speed of the drums is so synchronized with the speed of the machine that there is no raking of the plants. Since the cylinders are located, one in advance of the other, on opposite sides of the picker throat, the spindles protrude across the throat and penetrate the plants from opposite sides so that contact is made with all mature cotton on each plant. On the opposite side of each drum is a doffer which removes the cotton from each spindle and drops it onto a conveyor belt which carries the fiber to bags. The emptied spindles are then sprayed with a fine mist to remove any green stains caused by bruised foliage.

A THIRD machine which seems about ready to go on the market is the Hanauer-Berry-Gamble cotton picker, the result of some 25 years of experimentation. Mr. A. M. Hanauer writes that

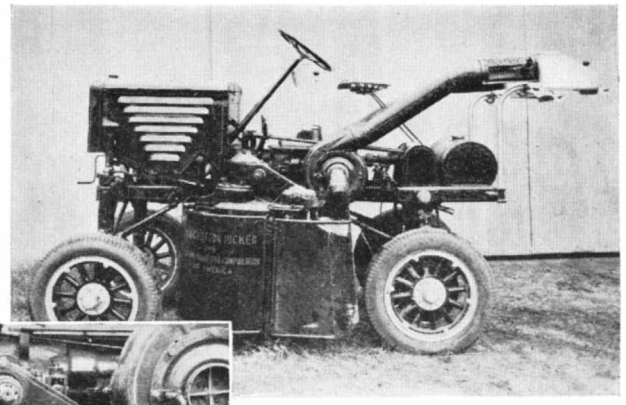
*The author of this article, a member of our editorial staff, is himself a southerner with a broad, first-hand knowledge of the problems incident to the growing and harvesting of cotton and its manufacture into textiles.—*The Editor.*

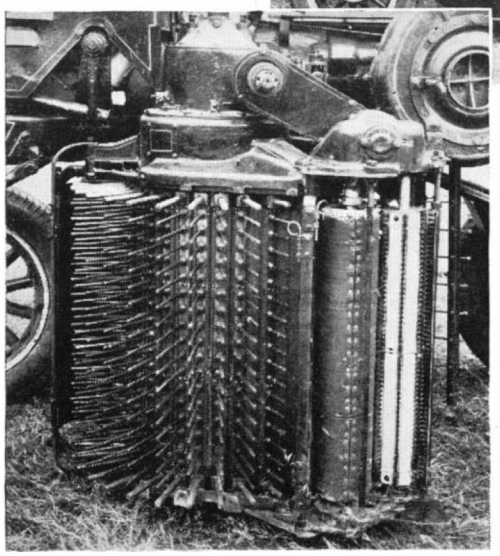
". . . we feel that we have the problem [of mechanical cotton picking] licked." This machine also has two vertical cylinders which straddle a cotton row. These cylinders are directly opposed, and each has over a thousand rotating spindles barbed in such a manner as to do the least possible damage to the plant. As the machine moves along the row under its own power, these spindles penetrate each cotton plant from both sides simultaneously. Seed cotton (mature lint and seeds combined), wound on the spindles, is doffed when the spindles reach the back position. Suction then carries the cotton to a container.

In Texas, a fourth cotton-picking machine has undergone numerous tests and, according to reports, has proved a strong competitor to the others in results achieved. A. R. Nisbet and his son, J. L. Nisbet, and H. G. Wendland are the developers. Its name, Wind-Roll, is descriptive of both its design and its operation. The picking element consists of a pair of mesh rollers which roll the cotton out of the bolls as the cotton plant is blown by a blast of air, first to one side against one roller and then to the other side against the second roller 20 inches behind the first. The mesh of the rollers holds the loose fiber until a half revolution has been made, when the same blast of air blows it off the cylinder. The released fiber is caught by a revolving screen and carried to a suction pipe which empties it into bags.



Other machines are in the offing but these four are the ones most widely discussed among agricultural experts and engineers. They are all important; make no mistake on that score. That they have all reached the practical stage almost simultaneously is pure coincidence. Their developers did not accidentally bump into a new problem and solve it forthwith; cotton picking is and always has been the costliest operation of cotton growing and much thought has been given to the job of lowering that cost. Attempts to ease this burden of the cotton planter were doubtless made by the ancient Egyptians but have been made intensively in this country since the first mechanical cotton picker was patented in 1850. Since then, numerous pickers have been invented, and no less than about 850 patents have been granted by the United States Patent Office on devices to aid or supplant the human picker. This large number of inventions serves to emphasize the complexity of a problem which can be understood only by a consideration of the many factors involved, peculiar to cotton growing.





One model of Hanauer-Berry-Gamble picker and, *below center*, with cover removed, the spindles of one of its vertical cylinders. At left below is the front of its throat, with its spindles meshing

The first of these is, naturally, the age-old practice of hand picking, celebrated in song and story as a time of joy among the pickers who are preponderantly Negroes. There is, however, little romance in the job; it means hard work under hot suns, low pay for the pickers, and a disproportionately high labor cost for the planter. In most sections of the South, the pickers go into the fields equipped with no more than a large bag which trails on the ground. The picker's deft hands harvest mature cotton from scattered open bolls, leaving the dried burr on the stalk. Periodically, each picker carries his bag load to a central point where it is weighed and then dumped on a common pile or into a wagon or truck. It will be noted that horses and mules take no part in this actual picking operation.

An expert picker can pick several hundred pounds of seed cotton a day, but the average is about 150 pounds, which makes about 50 pounds of ginned cotton, the seeds accounting for the remainder. While the picker gets from 35 cents to $1.25 for picking a hundred pounds of seed cotton, this wage takes from the planter up to half the price he will get on the market for his ginned cotton.

Besides the elements of time and expense involved in hand picking, there are other factors which complicate the picture. Cotton does not mature all at one time in any one field; hence it is usually necessary to pick over a field several times. Rain may come at the wrong time and beat some of the loosely hanging fiber to the ground, spatter grit on some. Continuous rains sometimes wet the cotton so that it cannot be picked for weeks simply because gins cannot take care of wet cotton. Furthermore, dampness often causes the seed to sprout in the boll or on the ground so that the clinging fibers are damaged. Labor in any given locality may not be sufficient to harvest the cotton as fast as it ripens, and some fiber may weather, take on a gray, stained appearance which lowers its grade—and its price—on the market.

IN some parts of Texas, a method known as "sledding" or "stripping" cotton was begun some 11 or 12 years ago, and other sections are studying the practice. The stripper, originally home-made as a sort of large box on a sled but now built on wheels by several manufacturers, rakes cotton off the plants with a large comb-like row of fingers. The comb, however, gathers an enormous amount of trash—burrs, twigs, leaves, and dirt—as it is drawn over the cotton row. Consequently, the cotton must go through a separate cleaning process which cannot thoroughly clean; hence the grade of cotton harvested in this manner is below that of cotton picked by hand. Nevertheless, the cheapness of the practice and the fact that it prevents a total loss of the crop when hand labor is unavailable make it attractive to many planters.

The mechanical cotton-picker that can supplant these methods and overcome

the several important handicaps mentioned must, obviously, be most ingenious. Without attempting comparisons between the four machines discussed, it may be stated that all have shown excellent results—under test conditions. Roughly, we might average the amount picked by any one of them as seven or eight times as much seed cotton in an hour as a hand picker turns in after a day's labor. The net saving to the machine-using farmer may range from $4.00 up to $15.00 a bale. To pick this much, however, the testers of the machines naturally chose clear days with large quantities of mature, dry cotton available in wide, flat fields. Thus the comparison is partially fictitious, for on thousands of farms such a combination of conditions is rare, often unapproachable.

A CONSIDERABLE amount of the cotton grown in this country comes from thousands of farms in rolling, hilly sections. Here the cotton fields are relatively small, rows are short and curved to follow contours, and terraces and jagged gullies abound. No mechanical picker in existence could operate economically on such farms.

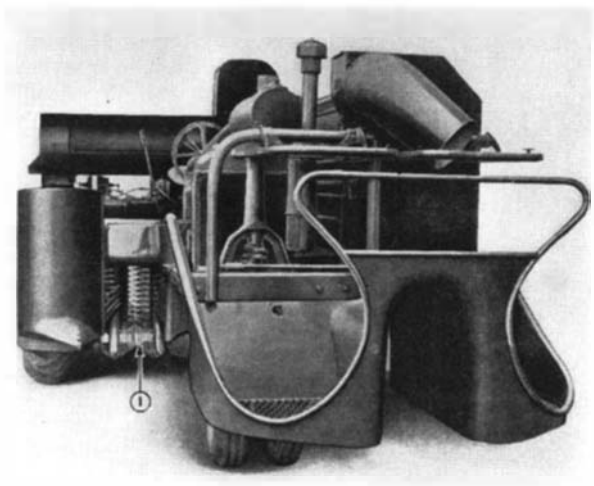
There are many varieties of cotton, identified by fiber length and plant size and shape. Fibers range all the way from ⅝ of an inch to 1¼ inches long, while stalks vary from a few inches in height to five or six feet. The yield, depending on variety, weather, soil, fertilization, and other factors, may be anywhere from a quarter of a bale to two bales per acre. These are vital statistics having an important bearing on the possibilities of mechanical pickers. If to these is added the problem set up by the continuous rains mentioned previously, an increased handicap for the machine becomes apparent. Such rains bring out rank new growth of limbs and foliage and often a second growth of blooms and bolls. While the mechanical picker awaits the coming of frost to kill this green growth, the mature fiber on the same plants would be weathering and deteriorating. Hand pickers do not have to wait. Furthermore, while the hand picker gets all mature cotton the first trip, the machine must usually make a second run, besides knocking some cotton to the ground.

It is said that the mechanical picker is not perfectly discriminatory, that it does pick some of the green cotton; and green cotton is wet. Gins cannot handle this satisfactorily and if some wet cotton does get into the bale there is a lowering of the grade of the whole bale, if not also spontaneous combustion.

Under the present system of grading cotton, its color in the bale, the length of its staple, and its trash content all combine to determine its marketing price. Mechanical pickers almost invariably add a further element: the green stain from bruised leaves and bolls. As has already been hinted, all mechanical pickers will increase by several hundred percent the amount of trash gathered with cotton. Beaters in the opening rooms of all cotton mills remove this trash at extra expense but the matter of the green stain is a definite problem that still has to be solved.

Should the cotton-picking machine ever supplant the hand picker, labor will not have entirely "lost its livelihood" but only 40 to 60 days' work per year. The cotton-picking season lasts just that long. Yet much of that same labor is needed—not in such numbers at any one time, it is true—for other work on the farm, for planting, plowing, "chopping" cotton, and "laying by." True, a certain amount of labor will be forced to leave those plantations that are already so highly mechanized that the planters are supporting labor throughout the year in return for six weeks of essential work. On the smaller farms there is seldom an importation of cotton pickers from elsewhere; the regular farm hands and the farmer's whole family manage to get in the cotton without undue difficulty. Where it is necessary to import cotton pickers, only too often it has been impossible to find enough hand laborers when most urgently needed. There are times when considerable cotton must be left in the fields to rot for want of sufficient pickers.

On the other hand, sometimes labor happens to be so plentiful that cotton will be picked faster than gins can handle it. H. P. Smith, of the Division of Agricultural Engineering of the Texas Agricultural Experiment Station, reported such a case in a recent comprehensive paper presented before the American Society of Agricultural Engineers. He stated that in 1937 in the High Plains region of northwest Texas, three counties produced 425,000 bales. "Labor was available to harvest the crop so rapidly," he said, "that although the gins operated on a 24-hour schedule, they were overrun with cotton. Farmers, until stopped by risk insurance inspectors, unloaded hundreds of bales in the gin yards. They then harvested and piled cotton in the fields to wait until the gins could handle it." From what has already been said, it is easy to imagine the deterioration that must result from such a practice, espe-

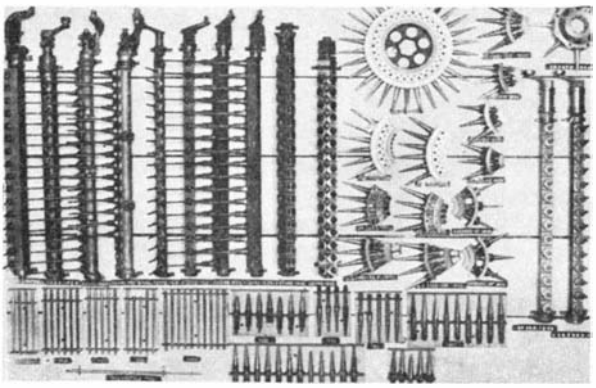


An International Harvester Company cotton picker in a fine field of mature cotton. This head-on view shows the bags of picked cotton. At left is presented a view clearly showing the picking throat at 1, and the dummy throat which merely straddles, but does not pick, another cotton row

cially if rains come to beat dirt into the piles of staple or if the seeds sprout. It is just as easy to understand how the mechanical picker could make this a common occurrence instead of a relatively rare one.

With hand labor, there has never been any difficulty experienced in picking the many different varieties of cotton—whether the staple is long, medium, or short; the stalk stunted or tall; the foliage rank or sparse, green or dead; the fruit plentiful or meager, bunched or scattered. Mr. Smith, whose station is said to be one of the first to gather data on mechanical pickers, stated in his paper that it was recognized that "the efficiency of any mechanical harvesting device would be greatly influenced by plant characteristics." Mr. Johnston, of International Harvester, says that "the problem is to breed a variety of cotton plant that is not so rank in growth, but which will be satisfactory in its yield and quality of staple." At present, a similar form of cotton plant will not be found in two successive years or in two different areas in one season. Mr. Smith's paper (which is to be published in the magazine *Agricultural Engineering*) discusses this breeding problem at great length, stating that already several years have been devoted to cotton breeding and study of the characteristics of various types as related to the machine. The indications are that a number of years will elapse before the problem will be entirely solved.

Another view, from the left rear, of a slightly different form of cotton picker made by International Harvester Company



Some of the many kinds of smooth and barbed, long and short spindles tested in the development of the machine above

Once a variety of cotton satisfactory for machine harvesting has been produced, there will come the job—and any southerner will affirm that it will be a slow and extremely difficult one—of overcoming the tradition-bound, cotton-growing habits of southern farmers. For many years they could have been growing less cotton but of a much better grade, thus releasing acreage for other crops; but no, they have always grown one variety in one way and in about the same quantity and are satisfied to continue the old régime. This conservatism will militate as much against the introduction of a new staple as against the new-fangled machine.

The initial cost of cotton picking machines would not be prohibitive to the larger plantation owners for, already, the Rust Brothers have promised a stock model to sell for around $1000. Other manufacturers will probably set their prices accordingly. Then, later, competition may be expected to lower prices considerably. Even so, numerous small but independent growers will find it impossible to tie up so much capital in a machine which is idle for over 10 months per year. Only too often these farmers make but a bare living plus enough to buy the next year's seed and fertilizer. Co-operative ownership in a given community will help to solve this problem but probably will never completely erase it.

COTTON, as may be seen by the foregoing discussion, is not a mysterious and romantic source of untold wealth needing but the magic touch of a simple invention, as it is pictured by outsiders and by some writers who should know better, but rather an agricultural product the harvesting of which is beset with more complexities than is the harvesting of any other important crop. Too much remains to be done in solving the picking problem for anyone to say that present mechanical pickers will cause a social upheaval or an economic revolution in the South. They will cause neither. Mr. Smith, Mr. Johnston, and other noted agricultural engineers agree with the writer on that point. In fact, it is not wholly a question of cotton-picking machines displacing human pickers; rather a lack of sufficient hand labor caused adoption of the sledding and stripping method in Texas and has given great impetus to the perfection of mechanical pickers. Further, this lack of labor seems most prevalent in flat country where the machine can be used most efficiently. In time, picking machines may revive cotton growing for some sections where labor costs had previously stopped it, but they will destroy the crop for some other sections that can neither use the machines nor compete with their cheaper cotton. Granting the widespread adoption of picking machines in the distant future, many of the displaced hand pickers may remain on the same farms for other work. Furthermore, their loss of cotton-picking wages may conceivably be more than offset by a larger wage for this other work, if the farmer makes a larger margin of profit due to the savings effected by the machine. On the smaller farms, the machine will have the good effect of releasing the farmer's children from a difficult job, but this will not be "displaced labor" in the true sense.

When the "tumult and the shouting dies," the cotton-picking machine will be accepted for what it is, for what it will do, and when. It is now considered by agricultural engineers no more as a thing to fear than as a sure cure for all the social and economic ills of the South. When it has been further perfected and when related problems have been worked out, it will be adopted by many cotton planters and will slowly have its influence on the South. There will be a gradual adjustment, the effect of which will be scarcely noticeable at any given time. Doubtless, after a period of many years, cotton-picking machines will be quite generally used throughout the South. A reasonable estimate of that "period of years" would be somewhere between 25 and 50.

Cosmic Radiation

Science Still Remains Uncertain What the Cosmic Rays Are, Where They Come from, How They Were Formed and When . . . Mainly They are a Puzzle

By P. M. S. BLACKETT, M.A., F.R.S.
Professor of Physics at Manchester University; formerly
Professor of Physics, Birkbeck College, University of London

THE study of cosmic radiation is rather a curious one. It is related ultimately to astronomy as well as to geophysics and to physics. The subject started about 1900 with the discovery by C. T. R. Wilson, and by Elster and Geitel, that the air in a closed vessel had a slight residual conductivity. The apparatus used for these early experiments consisted of an ionization chamber. A simple form of this apparatus consists of a metal box in which is suspended an insulated wire carrying a gold leaf; when charged electrically, the movement of this leaf records the electrical conductivity of the gas in the box. With such a simple apparatus as this it was found that there was a residual conductivity of the air, which could not be explained by the effects of the known radioactivity of the earth's crust, and which was probably due to the presence of some very penetrating radiation. In fact, C. T. R. Wilson himself, in 1901, speculated as to whether this residual ionization might not be due to some radiation coming from sources outside the atmosphere, either electromagnetic radiation, like X rays, or corpuscular rays like cathode rays, but of enormously greater penetrating power. Since that time at least 1000 researches have been made on the subject of cosmic rays and a great many facts have been found out. We know now that this residual ionization is, in fact, due to atomic particles of enormous penetrating power coming into the earth's atmosphere from some sources outside the solar system, but exactly what these particles are, or where they come from, or how they were formed, or when, we still do not know.

Soon after the earliest experiments, ionization chambers were taken to different places on the earth to find out whether this residual ionization varied from place to place. Then a great series of experiments began in which ionization chambers were taken up mountains, in balloons, lowered down to the depths of the sea and carried in airplanes. The crucial experiments, which showed the cosmic nature of the rays, were those of Hess in 1911 and 1912, who took ionization chambers to a height of 5000 meters in balloons. Hess found that the ionization due to the rays was larger at a great height than at sea level. This showed conclusively that the rays causing the ionization must have come downward from the top of the atmosphere, and not upward from the earth; for if they had come upward from the earth, they would decrease in intensity by absorption as one went up. Hess also found that the rays were equally intense both during the day and at night, and also during an eclipse of the sun. This showed that the rays could not come from the sun, because if they had, their intensity would be much less at night, or during an eclipse. Thus it was these experiments which led to the rays acquiring the name of "cosmic."

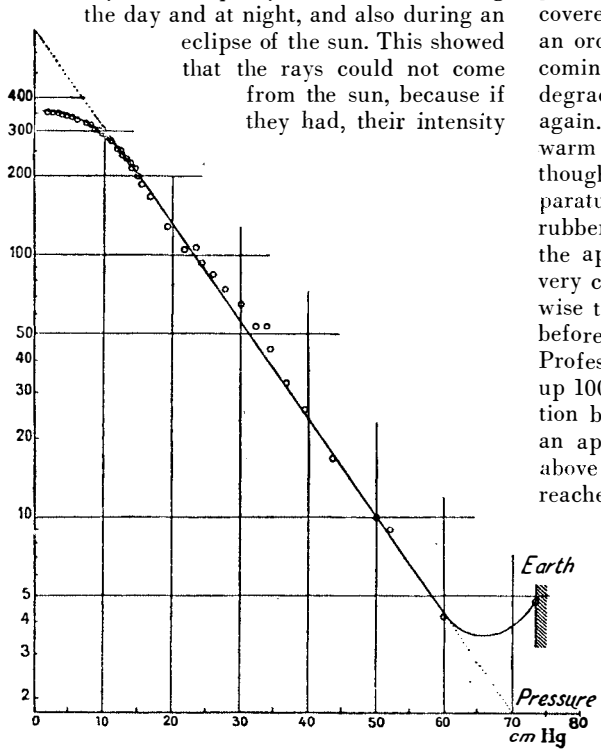


Figure 1: **Typical curve of variation of ionization with atmospheric pressure. Numbers at left refer to ions per square centimeter per second in standard air**

Since that time a very great number of experiments have been made to find out how the cosmic radiation varies in intensity in the atmosphere. Perhaps the most beautiful of these, and the most successful, have been the balloon flights of Regener and lately those of Millikan, who send very light recording apparatus up to great heights by means of small, hydrogen-filled rubber balloons. A small ionization chamber, which is made to record automatically the intensity of the rays on a photographic plate, together with the barometric height and the temperature, is made to weigh only a few pounds. This is enclosed in a light frame covered with Cellophane, which acts like an ordinary greenhouse; the sun's rays coming in through the Cellophane are degraded into heat and cannot get out again. In this way the apparatus is kept warm at about room temperature, even though the temperature outside the apparatus is −50 degrees, Centigrade. The rubber balloons which are used to take the apparatus up have to be examined very carefully for small pinholes, otherwise they are apt to burst prematurely, before the desired height is reached. Professor Regener sometimes has to stop up 100 or so tiny holes with rubber solution before using a balloon. With such an apparatus heights of 30 kilometers above the surface of the earth have been reached, where the pressure of the atmosphere is only about 1 percent of that at sea level. It is found that the intensity of cosmic radiation is about 200 times as great as on the ground, confirming, of course, the view of Hess that wherever it is the rays come from it is at least outside the earth's atmosphere. Figure 1 shows a typical curve of the variation of the ionization with the pressure of the atmosphere.

With similar, but much larger apparatus, the ionization due to cosmic radiation has been studied under water, down to great depths. Regener, again, has measured the ionization down to depths of 280 meters below the surface of Lake Constance, and finds that their intensity is only about 1 percent of that at sea level. So from the bottom of Lake Constance to the top of the stratosphere the intensity of cosmic rays increases by a factor of over 10,000 to 1. The enormous penetration of the rays, a penetra-

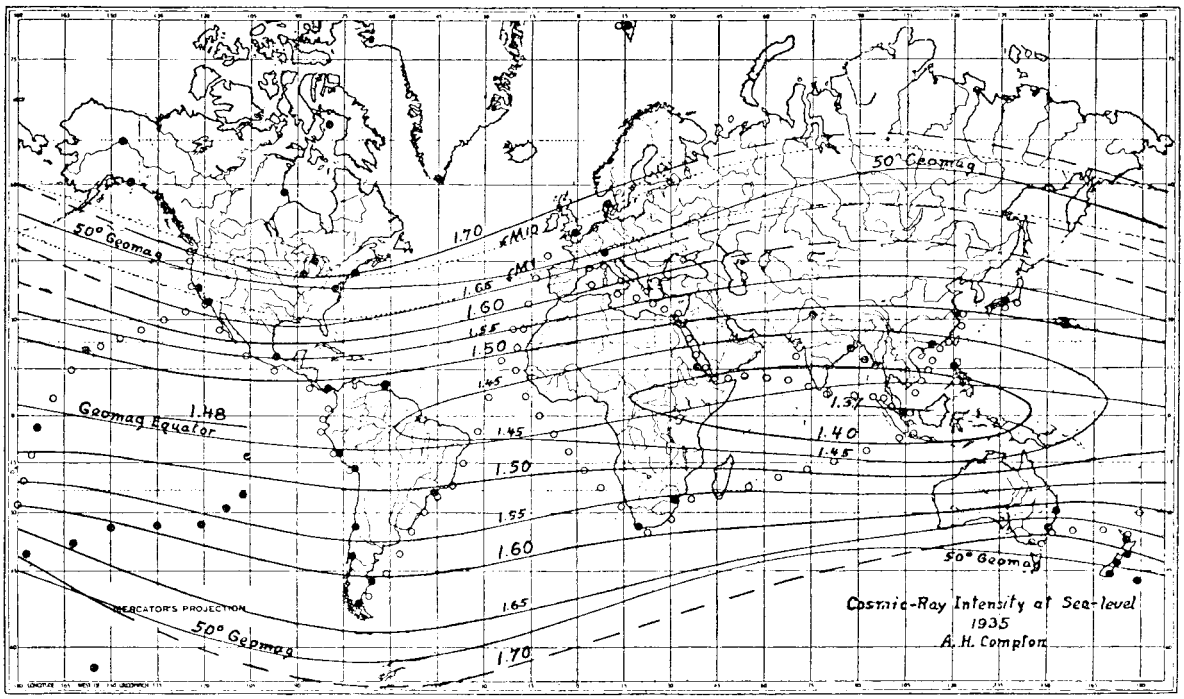


Figure 2: World map showing curves of equal cosmic-ray intensity (isocosms). This map makes evident the approximate parallelism of isocosms with geomagnetic latitude and auroral frequency (curves M_1 and M_{10})

tion quite unexpected in the region of atomic physics, leads naturally to the conclusion that the rays must be of immense energy. The most penetrating atomic rays previously known, the gamma rays from radium, can penetrate only a few meters of water. Thus, the cosmic radiation is many hundred times more penetrating, and is therefore likely to be very much more energetic. In fact, it can be easily estimated that, to explain the very great penetrating power of some of the rays, it is necessary to assume energies up to 10^{11} electron volts.

The next great series of experiments consisted in carrying ionization chambers all over the world. Expeditions to the equator, to near the north magnetic pole, expeditions on mountains and in ships, all these have been used to find out how the intensity of cosmic radiation varies with the latitude and longitude and the height of the place of observation. This aspect of the study of cosmic rays can be called the geophysical aspect and is, in fact, closely related to the study of the variation of the earth's magnetic field over the surface of the earth. In Figure 2 are shown the lines of equal cosmic-ray intensity—or isocosmic lines, as they are called—and these lines run very nearly parallel to the lines of equal geomagnetic latitude. They also run nearly parallel to the lines of equal auroral frequency. The explanation of this relation can be given shortly by saying that the cosmic rays as they reach the upper levels of the earth's atmosphere are mainly electrically charged particles of very great energy. These particles are deflected by the magnetic field of the earth so as to reach regions of higher latitude more easily than regions near the equator. This behavior is very similar to that of the charged electrical particles which are held to be the origin of the Northern Lights. In fact, the theory of the *aurora polaris*, proposed many years ago by Birkeland and Störmer, applies almost unchanged to cosmic radiation. The intensity of cosmic radiation is found to be nearly constant from latitude 50 degrees north up to the poles, but decreases toward the magnetic equator, the decrease amounting to about 15 percent. Figure 3 shows the results obtained during a voyage from Southampton to Cape Town. At greater heights, the increase from the equator to the poles is much greater.

THIS study of the intensity of cosmic radiation at great heights and in different latitudes is of the highest importance, but our knowledge is at present extremely fragmentary and quite inadequate for many purposes. In order to test theories as to the nature and behavior of the rays, we really want to know the intensity of the cosmic radiation from sea level right to the top of the atmosphere at all latitudes, but so far it has not been possible to do many experiments of this type.

Apart from the free balloon ascents by the technique already described, valuable results have been obtained by the use of manned balloons. This technique was first developed by Professor Piccard. It is well known that it is not possible to live at a height above, say, 20,000 feet, without the use of oxygen—at least, if one cannot spend a long time acclimatizing oneself to the reduced pressure. One can go to a height of 40,000 feet or so if one breathes oxygen instead of air, but one cannot go very much higher, even breathing pure oxygen, unless one keeps up the pressure of the body artificially. There are two ways of doing this: one can place oneself, as did Professor Piccard, in a metal gondola, generally of spherical shape, which is sealed up and retains the pressure on the body above that of the air outside. The other method is to use a pressure suit; that is, a suit rather like a diver's suit, but in which the pressure is kept above that of the atmosphere. This method was used in setting up the altitude record for airplanes. With the former method Piccard and his collaborators and also some other investigators in America have reached heights up to 18 kilometers, carrying elaborate and heavy apparatus with them. In one such flight from Belgium, which ended somewhere in Central Europe, Dr. Cosyns measured the variation of the intensity of cosmic rays as he floated across Europe at a height of some 12 kilometers. He found, much to his surprise, that the cosmic radiation remained constant from about 51 degrees north to about 49 degrees north, and then dropped suddenly as he went farther away from the poles. This critical latitude of 49 degrees north, above which the cosmic radiation remains constant, is of great importance in all cosmic-ray theory. We have to try to explain exactly why the cosmic rays remain constant north of this latitude both at sea level and at great heights. At present there is no satisfactory explanation of these facts.

The next part of the study of cosmic radiation to be described is how the intensity varies with the time. Experiments have been made over periods of years to see if the cosmic radiation is quite con-

stant or if, and how, it varies. Some results are shown in Figure 4. The soft components of radiation—that is, the part of the radiation which has not a very great penetrating power—do show an appreciable variation with the time of day. There is a slight maximum about midday of the order of a few percent of the whole intensity. But when the soft radiation is filtered out by means of thick lead screens, the remaining penetrating component is found to be almost constant. The figure shows that this penetrating component does not vary more than a fraction of 1 percent throughout the day—that is, when the results are averaged over a very large number of days. This again shows, as did the early experiments of Hess, that the radiation cannot come from the sun—at least, if it travels in straight lines—for if it came from the sun it would be very much more intense by day than by night. One can, in fact, conclude from the constancy of the radiation with time that the rays, as they reach the earth, must be isotropic—that is, they must be coming from all directions equally; for if they were coming from any one direction predominantly, then since the earth is rotating, any part of the earth's surface would receive more radiation when it was facing the direction from which more rays were coming.

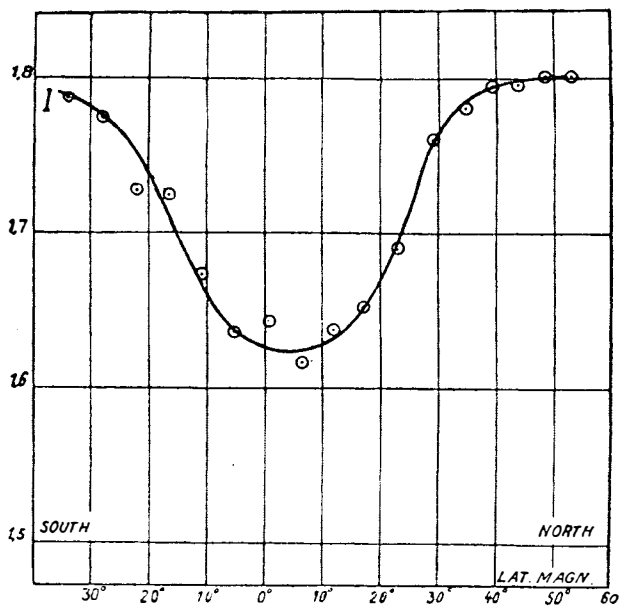


Figure 3: Variation of cosmic radiation with geomagnetic latitude. At left, ions per square cm per second

Thus, the constancy in time of the rays implies their isotropy in space. Now this is one of the most difficult things to explain about the cosmic rays, for it is very difficult to find plausible sources for the rays which are uniformly distributed with regard to the earth. As has been mentioned already, the sun is obviously excluded as a possible origin, but so also are the stars of our galactic system, for these are far from being uniformly distributed around the earth. If one looks at the night sky one sees a great concentration of stars which we call the Milky Way. There are many times more stars in this direction than in a direction at right angles, so if the rays came from the stars of the Milky Way there would be a greater intensity of the rays when the Milky Way is overhead. This means that the rays would show a variation with sidereal time, but careful investigations have shown that there is very little variation indeed. There is a small effect which is of great importance and which has only recently been detected, but the variation with sidereal time is very much less than would be expected if the stars of the Milky Way were the origin of the rays.

Now all the stars that one sees with the naked eye, or can see even with a large telescope, are members of a huge group of stars called the galactic system. This system contains some 30,000,000,000 stars. These stars form a kind of huge disk, of which the size can be roughly estimated as being 60,000 light-years in diameter and 5000 light-years thick. It may be noted that a light-year, which is the unit of distance often used by astronomers, is the distance traveled by a ray of light in a year, and is about 10^{13} kilometers. About 90 percent of the matter in the galactic system lies in this central disk, about half consisting of stars and about half of diffuse matter and of gas. The earth is situated somewhere near the central plane of the disk, but about 20,000 light-years from its center.

This whole galactic system constitutes a huge nebula analogous to, but probably rather larger than, the great spiral nebula in Andromeda. There is a great central condensation of stars near its center which lies toward the constellation of Sagittarius, this constellation lying in about the thickest part of the Milky Way. In recent years it has been discovered that the whole galactic system is in rotation, making one complete revolution in about 250,000,000 years. Since the earth lies so far from the center, it is traveling through space with a very large velocity, amounting to approximately 300 kilometers per second. It can be shown that the effect of this large velocity is to make the intensity of cosmic radiation slightly greater on the side of the earth which faces the direction of motion, as compared with the opposite side. Just in the same way as more raindrops are found on the windscreen of a moving car than on the back window, so the motion of the earth is revealed by the greater intensity of cosmic rays on one side. This fact was predicted by Compton, and has been recently found experimentally. The variation is quite small, being less than 1 percent in magnitude, but it seems fairly clear from the measurements of Hess and Steinmaurer, of Schonland and of Kohlhörster, that the predicted variation does really exist. This is a very important result, for it confirms the view, that I have mentioned above, that the cosmic radiation cannot have its origin in our own galaxy. Figure 5 shows the results of the variation with sidereal time which confirm Compton's predictions.

It is of interest to note that if the earth had been completely covered with cloud so that no stars could ever have been seen, it would still have been possible to show that the earth was moving very rapidly toward a certain direction in the heavens, or, more accurately, moving relative to something, the only property of the something being the power of producing cosmic rays. We will take it, therefore, that it is experimentally demonstrated that the cosmic rays are of extra-galactic origin.

WE must, therefore, seek for some extra-galactic origin for the rays which is uniformly distributed all 'round the earth. Now there are such bodies—in fact, the whole universe is filled with nebulæ—and these nebulæ are, in fact, nearly uniformly distributed around us. Each nebula may be considered to be another galaxy similar in principle to our own, but in general of rather smaller size. But if we imagine that these nebulæ are the origin of the cosmic rays, we meet with a great difficulty, for it has been shown that the rays do not come from our own galaxy, so why should they come from any other galaxy? These nebulæ are of widely different types, but it seems probable that these different forms represent mainly different stages in very similar life histories. The youngest nebulæ seem to consist of a great mass of diffuse gas which gradually condenses into stars, and develops finally, in many cases, into a spiral form such as is shown by the great nebula of Andromeda. Our galaxy is probably a nebula of this last type. Thus, it is, of course, possible that the cosmic rays are produced by nebulæ in the early stages of their existence, but not in the later stages such as our galaxy is in now.

There is another reason why the cosmic rays are unlikely to be produced by the stars in ordinary nebulæ. This is the fact that the outside layers of nearly all stars are rather similar. These outside layers consist of a gaseous envelope at a temperature of, say, between 5000 and 20,000 degrees, Centigrade. Now, since we know that the sun does not produce cosmic rays, it is difficult to see why other stars, which have rather similar surface

conditions, should do so. There are exceptions to this general similarity of the outside of the stars. The white dwarfs are very small but very dense stars, and have surface conditions which are very different from that of our sun, and so might conceivably be considered possible origins for the rays. It must be remembered that cosmic rays, although very penetrating from our terrestrial standpoint in that they can penetrate some thousand meters of water, cannot be considered penetrating from the point of view of a stellar atmosphere. Any cosmic ray which was produced inside a star would never get out. It is thus clear that it is only from the outer layers of a star that the rays could come, and these outer layers are nearly all alike.

Many other possible explanations of the origin of the rays have been given, but none put forward hitherto seems very plausible. It is possible, of course, that the rays have their origin in electric fields in extra-galactic space, but there is no real reason to believe that such fields exist, and it is difficult, perhaps, to explain on this basis the isotropy of the rays. Then, Swann has suggested that they have their origin in sun-spots—not sun-spots in the Sun, of course, but postulated spots in giant stars.

Milne has predicted the existence of rays of very great energy from his cosmological theory. This theory requires also the existence of uncharged particles as well as electrically-charged particles.

Zwicky and Baade have sought the origin of the rays in the super-novæ, that once every few hundred years appear in every nebula and grow to huge intensity for a period of a few weeks. Another class of suggested origins are the archeological hypotheses. The arguments in favor of these views are roughly as follows: It is very hard to find an origin here and now in the universe for the cosmic rays, so perhaps they were formed at the very beginning of time when the world was quite young and, supposedly, very different. It is, of course, obvious that if they have come from a very great distance that they must have their origin in the distant past. Lemaitre is an exponent of one of these theories. He supposes that the rays have their origin in some kind of super-radioactive process from a single primeval nucleus, from which has developed the universe as we know it now; but, as there does not seem to be any possibility as yet of testing or distinguishing between these numerous rival hypotheses, it is probably not worth while spending very much time on such speculation. One more ingenious origin may, however, be mentioned. It has been suggested by Alfvén that the rays arise from a kind of stellar cyclotron formed by the rotation of a double star. It is supposed that the combination of an electric field of one component of the double star, together with its magnetic field, may lead to the possibility of stable orbits for high-speed electrons very similar in principle to the orbits in the cyclotron of Lawrence; but here again no definite test of this hypothesis is possible.

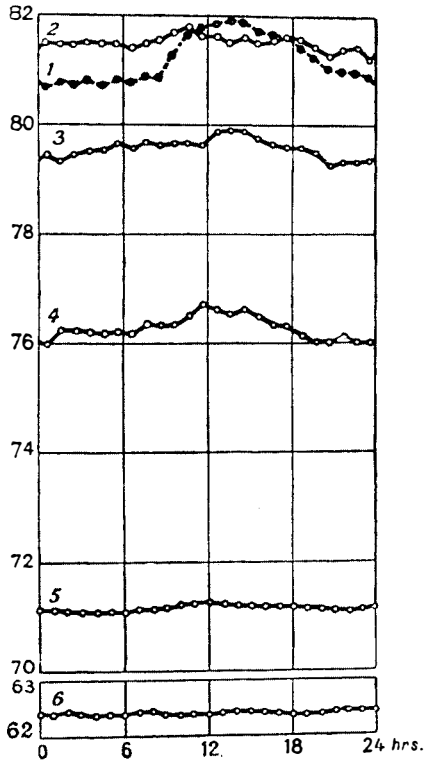


Figure 4: How the intensity (numbers at left) of cosmic radiation varies with time. Numbered curves refer to different thicknesses, respectively 0, .5, 1.5, 3, 10, and 20 centimeters of ray-absorbing lead

This is the first of three Cantor Lectures delivered before and published by The Royal Society of Arts. The remaining two lectures are not presented here because they are much more technical and mathematical. They may be obtained from the secretary of the Society, at John St., Adelphi, London, W.C. 2.

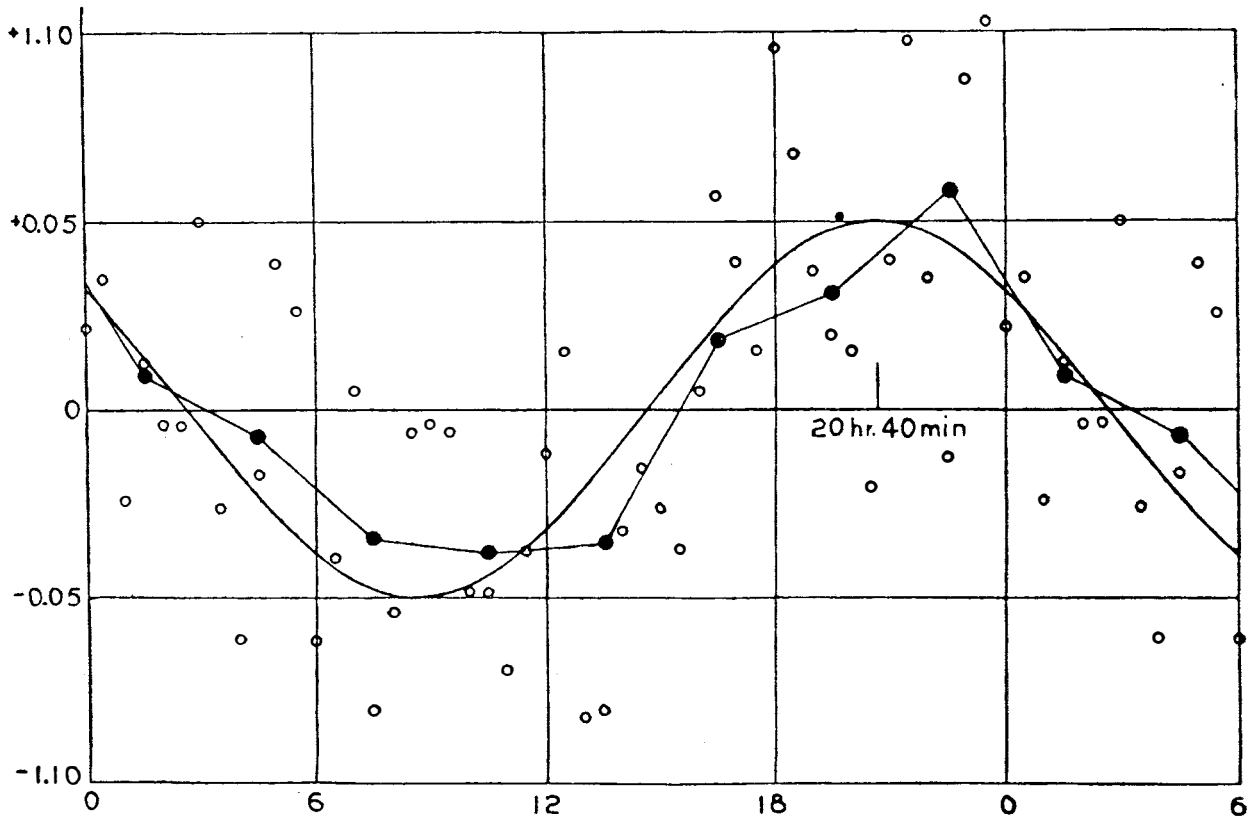
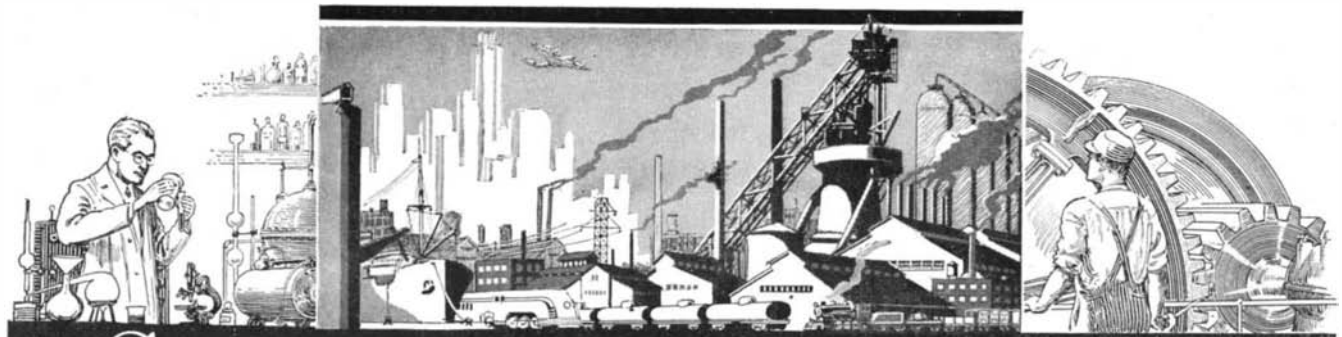


Figure 5: Percentage variation in intensity of the cosmic rays (left) with sidereal time. The smooth curve represents the predicted effect due to galactic rotation; open circles, half-hour means; solid circles, three-hour means



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
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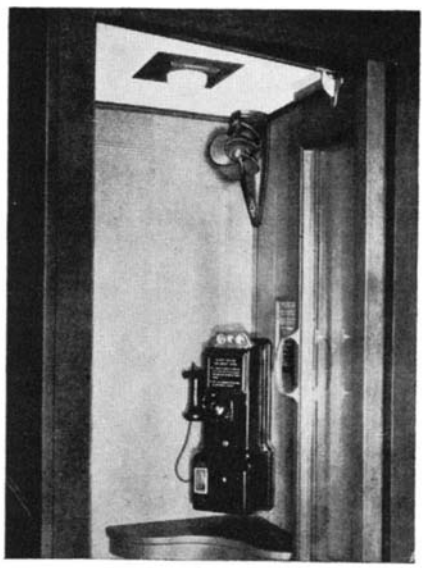
D. H. KILLEFFER
Chemical Engineer

Booth Air

PROBABLY everyone who has ever used a pay telephone booth has wondered why some provision for ventilation or circulation of air is not made. To fill this need, Samson-United Corporation has adapted its rubber bladed fan for use over the telephone



Comfort for 'phone users

in such booths. An accompanying illustration shows the mounting of this fan, which is so safe that wall scribblers may push probing pencils or fingers into it without danger.

Minds Rejuvenated by Sex Hormone

OLD men can be made young again, mentally as well as sexually, by means of hormone injection, Dr. Neal E. Miller, of the Institute of Human Relations, Yale University, told a recent meeting of the American Chemical Society.

Elation takes the place of depression in most of the patients, Dr. Miller observed in the course of an experiment in which the effect of injection of the hormone testosterone proprionate was compared with results of a similar injection not containing the hormone. The group included, in addition to the cases of old men being rejuvenated, a number who were suffering from various types of glandular deficiency. Improvement was greatest when the deficiency had been greatest. Rational aggressiveness took the place of irrational irritability, for some patients. Nervousness and emotional instability were decreased. Muscle tone, energy, and stamina returned. Emotionally and sexually the patients were in better condition.

The psychological improvement did not take place after the dose not containing the hormone.—*Science Service.*

Glass in Plastics

WOVEN glass fabric is being used to replace paper and cloth in laminating resinous insulation. The advantages claimed for the new material are lower moisture absorption, greater resistance to corrosive liquids, and better electrical characteristics. The resin used is of the phenolic type.—*D. H. K.*

Torpedo Turns Around and Goes Back to Target

A TORPEDO that does the seemingly impossible in turning around and going back after the target it has just missed has been patented by Ellison S. Purington, of Gloucester, Mass. A trailing wire contains the secret of the performance of this newly-designed underwater weapon.

If the torpedo misses the target and crosses ahead of the ship at which it is aimed, a wire trailing behind the torpedo is touched by the ship's bow, closing a contact and causing the torpedo to turn around and go back for a second try with its deadly cargo. The direction in which the torpedo will turn is determined by the direction of the ship target, a manual setting of the torpedo being made just before it is fired. Little difficulty is anticipated on this last score because of the fact that a torpedo is fired from relatively short range.

The invention is assigned to John Hays Hammond, Jr., also of Gloucester. Mr. Hammond is noted as a torpedo inventor and designer of widely-used radio equipment.—*Science Service.*

Lamps Combine Bulb and Reflector

A RADICALLY new type of Mazda lamp which includes an efficient reflector inside the bulb is announced by the Westinghouse Lamp Division of the Westinghouse Electric & Manufacturing Company.

These new lamps are made with a flared bulb, coated on the inside of the flare with metal, which takes and retains a high polish and directs the light of the filament in a powerful beam. The efficiency of the directed light is high because the reflector has the accurate shape of a modified paraboloid and the filament is precisely positioned with relation to the focal point of its reflector.

The lamps are for use primarily in show windows but will find many other uses wherever a self-contained unit of this character is required. They are equipped with a medium screw base fitting the ordinary socket and can be installed and removed with ease, an important factor when displays are changed frequently. The lamps are rated 150 watts and are available for 110, 115, and 120 volt circuits. The rated life is 1000 hours,

Bulb and reflector combined

the same as the standard 60-watt Mazda lamp for household use. They may be used with color screens when colored light is desired. The lumen maintenance is particularly good. For many applications it is expected that these lamps will often be used with flexible adapters now on the market.

Abundance of Rare Elements

GEOPHYSICISTS have calculated that the average cubic mile of the earth's crust within 10 miles of the surface contains:

71,869,400 tons of titanium
2,966,038 tons of zirconium
456,313 tons of lithium
114,078 tons of beryllium

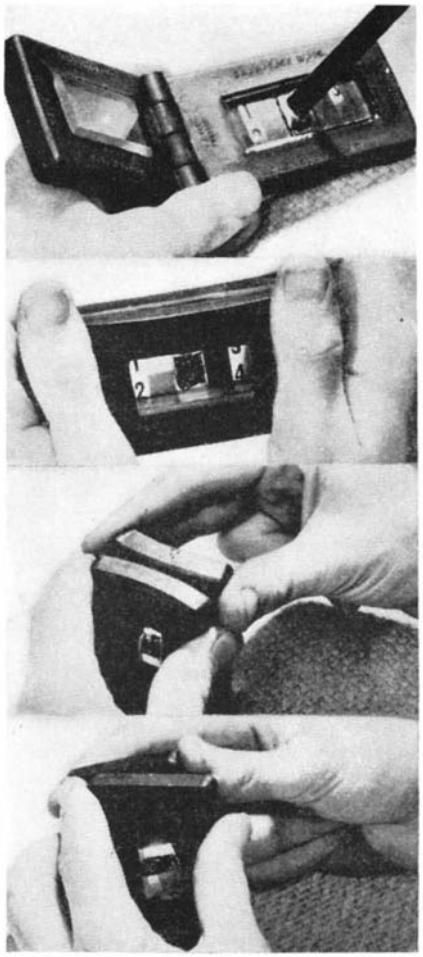
All that is necessary is an economical method of extracting these metals. All of them are valuable industrially but their prices are high because of the rarity of the ores from which they can be economically recovered.—*D. H. K.*

Simple Oil Tester

SINCE every motor car is operated under different conditions, the matter of oil contamination and oil change is of vital interest to the motorist. To enable the average service man to determine readily the condition of the oil in any car, a simple device has been developed by the Inspection Machinery Company. Called the Lubrimeter, this notebook-size device can be carried in the coat pocket.

The Lubrimeter is made of two small slabs of synthetic rubber (hinged together), each of which has a rectangular central window of glass. One of these windows is plain, while the other is provided with a photographic film divided into four densities for comparison with the shade of the oil in the central panel.

In testing oil, the crankcase gage stick is held over the central groove of the Lubrimeter so that a few drops of oil fall on the test glass. The device is then folded together, thus spreading the sample of oil into a thin film between the glasses. The shade of this sample is then compared with the shades of the four photographic squares. Reference to a Lubrimeter chart, considering how far the oil has been driven, will show immediately whether the oil needs changing. Viscosity may be determined by pressing a film between the two glasses and then pulling apart with a steady pressure.



Motor-car engine oil may be quickly tested for color, viscosity, and gritty contamination with this simple inexpensive device. It is easy to use

An abrasion test may be made by placing oil between the glasses and then rubbing them back and forth, gritty contamination offering resistance to this movement. After these tests, the glasses are wiped clean with a cloth and are ready to be used again.

Largest All-Welded Vessel on Great Lakes

A NEW vessel, unusual in several respects, recently completed her maiden voyage on the Great Lakes. The vessel is the *Dolomite IV*, built for Great Lakes-Barge Canal and Atlantic Coastwise Service. She is the largest all-welded vessel on the Great Lakes, according to the builders; her five storage tanks are lined with nickel; the craft was never actually launched.

This new vessel is 300 feet long, 43 feet 4 inches beam, 20 feet depth. She displaces 5500 tons light. Powered by two 750 horsepower Diesel engines, her speed is 15 miles an hour.

The hull was fabricated entirely by arc welding from rolled steel channels 18 inches wide, ½-inch web. The channels were butted against each other, flange to flange, and arc welded together both inside and out. Over 40 miles of arc welded seams were required in construction. Automatic arc welding by the "Electronic Tornado" process, using tractor type welders, was employed in fusing the main seams of the hull.

The use of nickel lining for the tanks permits rapid cleaning to accommodate different cargoes. On her maiden voyage, *Dolomite IV* unloaded her cargo of 1,200,000 gallons of kerosene one day, reloaded with wheat the next. Cleaning was accomplished by means of steam.

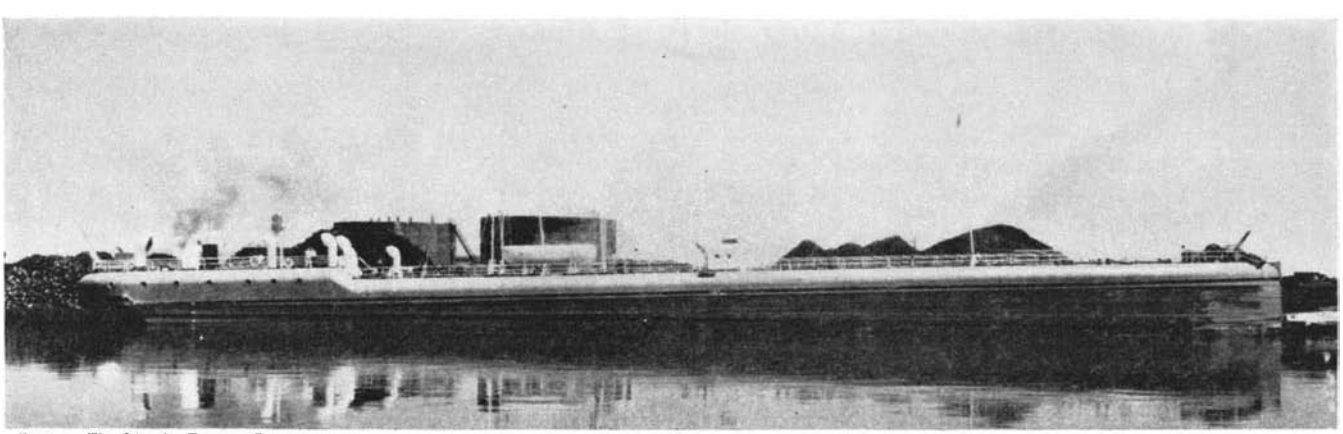
The launching should more properly be called a floating! The ceremony consisted simply of cracking a glass plate over the siphon in the lock in which the boat was built, thus admitting water which set the vessel afloat.

STAR

ZETA AURIGAE, the largest star in the eclipsing system, and which is equivalent to about 10 million of our suns, is as dense as the vacuum in an electric bulb.

What Fools These Mowers Be!

GRASS lawns are beautiful when perfectly kept and periodically mowed. Yet there is a tendency toward covering the lawn space with plants other than grass, and several likely ones have been developed to the point where they make superior greenswards. The *Industrial Bulletin of Arthur D. Little, Inc.* discusses this matter from the time when grass lawns on a large scale were first made possible by the development of the lawn mower and the gardening hose. That *Bulletin* then quotes an item from the magazine *Horticulture* regarding a new "turfing daisy" which seems to have many advantages over ordinary grass. This plant, *Matricaria tchihatchewi*, makes a close mat of foliage never over two inches



Courtesy The Lincoln Electric Company

Electric welding made possible this huge tanker for service on the Great Lakes

high, of a deep rich green color, and it grows well almost anywhere except in deep shade and in very sandy soil. The sowing should best be done in the fall or early spring. Even if the first plants come up a foot apart, the gaps will soon be closed by the creeping roots. Once a year, and once only, the daisy lawn needs cutting, in late May or early June, when the flower heads appear. No watering is needed. If this is not the dream lawn of many a long-suffering home owner, it is at least of the type and deserves consideration.

A Stratosphere Laboratory

ENGINEERS of United Air Lines now have at their disposal a stratosphere laboratory in which it will be possible to simulate atmospheric conditions existing at altitudes up to 65,000 feet. The stratosphere chamber, shown in one of our photographs,

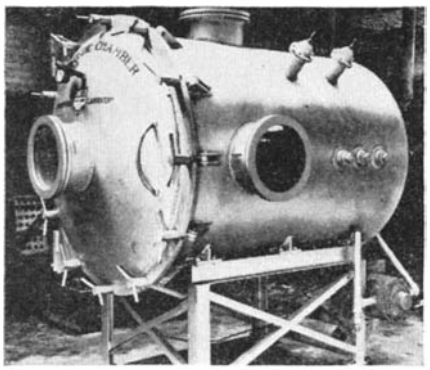
is a steel cylinder with an inside diameter of four feet and a length of five feet. Like the "bathosphere" used in under-water exploration, the heavy steel cylinder is provided with circular pressure-proof glass port-holes, located at the sides, ends, and top. These port-holes will be employed for observation of the apparatus being tested inside the cylinder. The stratosphere chamber weighs one and a half tons. The external air pressure on one of the port-holes will attain nearly 12 tons when high-altitude conditions are simulated.

Another photograph shows engineers "taking an altitude flight" and testing oxygen-inhaling apparatus. Other equipment which will be investigated will include radio apparatus, instruments of various kinds, valves for supercharged passenger cabins, and other mechanical equipment, the proper functioning of which is essential to safety in the air. —*A. K.*

Three Dimensional Weather Indicator

THE transport pilot must know the condition of the weather not only at sea-level but at varying altitudes. Now a device invented by Denis and J. Kenneth Bartlett of London, distinguished meteorologists, provides the flier with a three-dimensional weather indicator.

The instrument enables the pilot to "see" the weather not only at sea level, but at various altitudes. It is constructed of light sheets of cellulose acetate, which are transparent and non-inflammable. A six-inch cubic box is built up. On the base of the box is drawn a map of the area to be covered by the airplane. The first shelf, which is set only a few inches from the base, shows the weather conditions at ordinary sea-level; that is, barometric pressures, wind directions and magnitudes, temperatures, air mass fronts, and so on. The second shelf gives conditions at 3500 feet, and the third at 7000 feet. The top of the box represents a height of 10,000 feet. All the data can be readily sketched in and just as readily rubbed or washed off. The number of altitude shelves can be increased if required. The box is collapsible,



Above: The stratosphere laboratory test chamber for aeronautical research. *Left:* **Oxygen-inhaling apparatus being put through its paces under simulated altitude conditions**

and when not in use can be slipped into the pilot's pocket. When assembled, the device locks automatically and stands rigid. Apart from its value to pilots in actual flying, the instrument should be of great practical use in schools of meteorology and navigation. —*A. K.*

Operating Characteristics of Large Flying Boats

WE are inclined to think of a seaplane as a flying machine and its water properties as merely relating to take-off and landing. As a matter of fact, the water handling characteristics are almost equally important. In the water the flying boat must be controllable, adequately and accurately, from the moment that the securing lines are cast off until the moorings are again picked up. The pilot must at times be able to thread his way through a narrow channel with all sorts of obstructions to avoid. The hull must be directionally stable in the water, yet easy to turn without requiring bursts of power. The bigger the seaplane, the more essential are precautions when approaching moorings. The casual observer may become exasperated by the slow and deliberate approach to a mooring, but he may be equally amazed by the strain put on the snubbing posts, and temporary mooring lines, and the force with which a boat hull strikes a float or a dock if the approach has been made at a slightly optimistic speed. In addition to cutting engines at just the right speed, the pilot may have to use fully deflected flaps, water rudder, and other devices. Sailing must sometimes be resorted to, utilizing the draft of wind and water currents, alternately with short bursts of engine power.

In other words, the pilot of a flying boat is a seaman as well as a flier.

In addition to wind-tunnel models and towing-basin models, the Glenn L. Martin Company has actually built a real flying model, carrying two men, to predict the characteristics of its large designs. Such a flying model is tremendously expensive, but not as expensive as would be a mistake made in a 100,000-pound seaplane. The outcome of tests with this flying model will be awaited with intense interest.—*A. K.*

Instrument Flights

IT is interesting to learn from Paul E. Richter, Vice-President of T. W. A., that their pilots, no matter how well qualified or experienced, have to submit every 90 days to "instrument flight" tests. Placed in a covered cockpit, and flying by instruments alone, fliers must execute, perfectly, such maneuvers as instrument take-offs; spirals; 45-degree banks; 90-, 180-, and 270-degree turns; fly the radio beam and put the plane into landing position; find the airport after being deliberately "lost" by the chief pilot in charge of the tests. The cost of these tests is approximately $20,000 a year. They are well worth it since they keep flight personnel always up to standard.—*A. K.*

Propellers Rotating in Opposite Directions

TANDEM propellers rotating in opposite directions, and placed one immediately behind the other, are by no means new. According to Lieutenant H. M. McCoy of Wright Field, there is evidence of such an installation dating back to 1917. The world speed record achieved in 1934 by the Italian Macchi-Costaldi twin float Schneider Cup racer was in no slight measure due to the use of oppositely rotating propellers. The power of a 3000-horsepower engine was

One engine drives the two propellers rotating in opposite directions

readily absorbed by the use of such a system and the speed attained was over 440 miles per hour.

It is not because the system in itself offers increased propulsive efficiency that it is coming back into favor, but because there are valuable indirect advantages. With the ordinary propeller the enormous torque of a powerful engine is difficult to counteract with ailerons and rudder, particularly on a small single-seater. And even when the torque is counteracted (as it must be for flight to be possible) there is serious loss in aerodynamic efficiency—it is obvious that

flight with ailerons and rudder displaced cannot be as efficient as normal flight with all controls in neutral. Moreover, if rudder and ailerons are counteracting the torque, the available control power is much reduced.

When a 3000-horsepower engine is to be used in a single-seater having a span of say only 30 feet, opposite rotation of airscrews driven by the same engine becomes absolutely imperative.

Our photograph shows an experimental installation on a single-seater fighter, with which the Army's Materiel Division at Dayton has carried out completely successful tests. The actual mechanism is still a matter of official secrecy. But of course everyone will guess that one propeller shaft will be hollow, that another propeller shaft will pass through the outer tube and drive the forward blades, and that gearing will be interposed between the engine and the outer tube or shaft to secure a reverse direction of rotation.—*A. K.*

Courtesy *Flight*

Hawker Hurricane single-seater fighter monoplane with Rolls-Royce Merlin engine

The Absolute Altimeter

THE altimeter is generally considered to be an instrument for indicating heights, and so it is as long as the atmosphere behaves in exact accordance with a hypothetical "standard atmosphere." But when the curve of pressure or temperature against height departs from the standard atmosphere convention, the best aircraft altimeter is no longer a reliable indicator of actual height above the ground. Many attempts have been made at absolute height indication. Sonic altimeters have been developed in which the reflection of sound waves from the earth's surface, and the time elapsed for such reflection, give indications of actual height. But the sonic altimeter has been found to be too much of a laboratory device, too little of a practical flying instrument; experiments along these lines apparently have been discontinued. Richard C. Gazeley, of the Civil Aeronautics Authority, indicates a totally different approach to the absolute altimeter.

In a paper presented before the American Society of Civil Engineers, Mr. Gazeley made the following remarks:

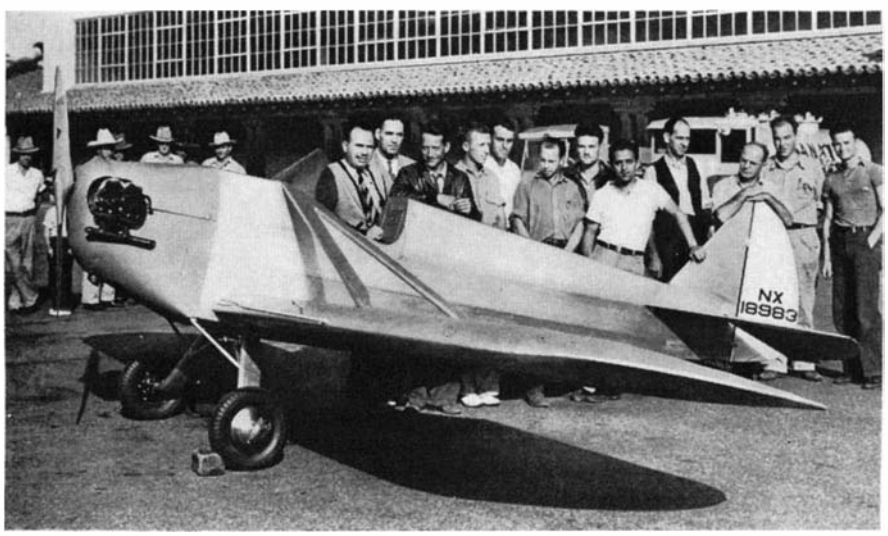
"I can foresee the development of ultra-high-frequency radio to the point where it may be utilized in an airplane to detect objects such as other aircraft in flight, mountain peaks or the varying ground elevations beneath, and indicate the distance and direction of the object from the instrument. When that day comes, we will have the collision preventer and absolute altimeter, which is one of the most wished-for developments on the part of the pilots who are accustomed to flying through clouds."

Apparently the Civil Aeronautics Authority is tackling this project of a height and object detector in earnest. Considerable secrecy surrounds the work, and we can only conjecture that the underlying principle will be akin to that of the sonic altimeter. The high-frequency radio waves will be sent out from the airplane. Encountering an obstacle —ground, mountain, or other aircraft—they will be reflected back to the airplane, where suitable delicate and intricate electrical apparatus—radio receiver and oscillograph, perhaps—will indicate the reflected waves. From such indications, suitable calibration will give a measurement of the distance between airplane and the solid object, the position of which is being determined. While we do not envy the research workers the difficulties of their task, we certainly wish them the speediest success.—*A. K.*

Busman's Holiday

NO one has ever heard of the employees of a shoe factory banding together to build shoes on their own time, but the construction of new types of aircraft is so fascinating an activity that men whose vocation lies in the construction or development of aircraft, will take a long busman's holiday and devote the major portion of their leisure hours to the construction of a novel design of airplane. Thus our readers will perhaps remember that the young engineers of the N.A.C.A. laboratory at Langley Field, under the leadership of Fred Weick, built a light plane with a nose-wheel or "tricycle" type landing gear, and this type of gear has now been quite widely adopted.

Now we hear that the employees of Consolidated Aircraft Corporation have formed an Aircraft Mechanics Association, and instead of plotting strikes or joining the C.I.O., the Association has designed and built a very trim and workmanlike light plane, which is shown in our photograph. While the new ship is designed on the conventional lines of a low-wing single-seater, it shows excellent streamlining, good structure, and a simplicity which will help if the ship is ever put on the market. Equipped with a 40 horsepower Continental engine, carrying fuel for 400 miles, and 20 pounds of baggage, the machine attained a top speed of 94 miles per hour—a highly satisfactory figure for such a craft.—*A. K.*

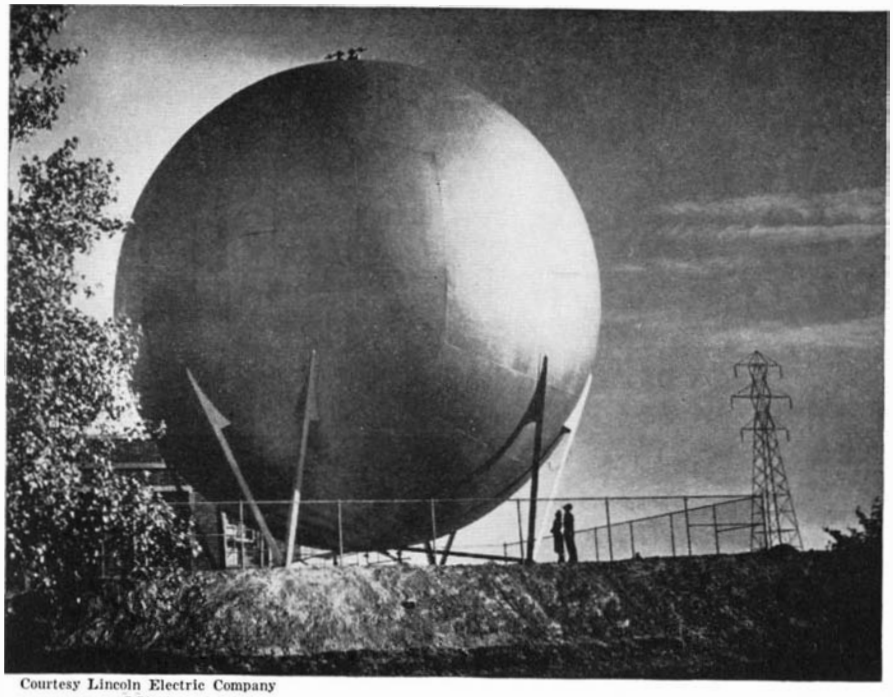


Fine results of a busman's holiday

Are Fighters too Fast?

THE Hawker Hurricane single-seater fighter is in rapid production for the British Royal Air Force and is one of the best known airplanes in the world. A Hurricane machine recently accomplished a spectacular night flight of 327 miles in 48 minutes, at the average speed of 408.75 miles per hour. It is probable that a favorable tail wind helped in this achievement. Nevertheless, the Hurricane is undoubtedly one of the two or three fastest airplanes in service anywhere. The maximum speed is given as 335 miles an hour, but there is a shrewd suspicion that, in the latest versions of this fast machine, speeds in excess of 350 miles have been attained. Landing speed is 60 miles an hour, so that the speed range has the remarkable value of approximately 6 to 1. The time to climb to 15,000 feet is only six minutes.

Endurance is only two to four hours, and this is low according to American practice. But the Hawker Hurricane is an intercepter fighter and there are only short distances between England's coast and the city of London. As a compensation, there is a plenitude of guns, with eight Browning machine guns, four in each wing, fired by remote control, and without the interrupter gear which is used when firing through the propeller.



Courtesy Lincoln Electric Company

Minimum size pressure gas holder, with maximum capacity

But, strangely enough, there are some indications that military designers the world over have perhaps gone too far in seeking speed and in adopting the extremely clean, long span, and large over-all dimensions of the monoplane in place of the more concentrated, though slower, biplane. In gaining enormous speed, the fighting ships have lost maneuverability, and with loss of maneuverability there is loss of the ability to take care of oneself in an aerial dog fight.

Reports from Spain have it that obsolete English biplanes in the hands of the Loyalists, with unsupercharged engines, have played havoc with the enormously speedy German Heinkels and Italian Fiats, supercharged for high-altitude work, available to the Insurgents. It was one of the biggest surprises of the war that Loyalists, apparently outclassed, refusing unchivalrously to fight at great altitudes, shot down their opponents again and again by virtue of greater maneuverability.

A highly qualified American engineer, now building airplanes in China, who has observed many aerial combats between the Chinese and the Japanese, gives us a similar account of the actual tactical superiority of the slower biplane. The high-speed monoplane swoops, fires, and runs. The biplane can dive, flatten out, roll, loop, and perform other military acrobatics with complete disregard of load factors, and as a result actually wins the fight!

It is to be hoped that our own Army Air Corps is making observations and deductions from these reports of the Spanish and Sino-Japanese aerial warfare.—*A. K.*

Combustible Sewage Gas Stored in New Type Holder

A PRESSURE gas holder, a comparatively new type for storing gases generated by decomposition of sewage, has been completed at the Cuyahoga Heights southerly plant of the $14,000,000 sewage disposal project of Cleveland, Ohio.

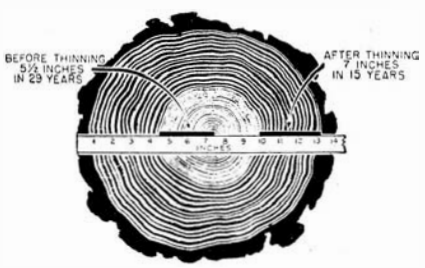
The holder is a 57½-foot diameter, arc-welded sphere having a capacity of 200,000 cubic feet of free gas at 29 pounds operating pressure. The design and method of construction made it possible to obtain the required capacity in a structure which is considerably smaller than would be the case with other types of holders. The smaller size provides savings, not only in initial cost, but also in operating costs, since there are no moving parts. Maintenance costs are expected to be negligible.

The purpose of the holder is to store gas produced in excess of normal consumption and to pay out deficiencies as required. The sphere floats on the line in much the same manner as an elevated tank in a water system. The surplus gas in the sphere will be compressed and paid out into the service lines as needed for laboratory, boilers, and two 400-horsepower gas engines. Generation of gas from sewage is by natural decomposition, accelerated by controlled digestive elements.

The designers of the disposal project, George B. Gascoigne and associates, Cleveland, liken the sphere's form to a bubble, nature's example of a structure having uniform stress in every part.

Thinning Speeds Tree Growth

TREES in overcrowded stands grow slowly. Thinning them out pays, as does thinning of cotton or corn. The accompanying illustration shows a cross section of a crowded pine that grew to only 5½ inches in diameter in 29 years. After the stand was thinned, growth stepped up to increase the diameter seven inches in only 15 years. After thinning of the forest in which it grew, the tree grew about three times as fast as before.



How thinning speeds tree growth

New pulp and paper mills in the south are creating new markets for wood. Pulp mills require a steady and constant supply of pulpwood. A constant market makes it more practical to cut for steady profit, says Wilbur R. Mattoon, Extension Forester of the United States Department of Agriculture. Trees are the capital in the farmer's woodland bank, he says. If the timber is cut only to the extent that the growth has increased since the previous cutting, the woods' capital remains unimpaired and continues as a paying investment.

SCIENCE TALKS

THE number of scientific papers (reports) published in a year throughout the world has been estimated to amount to three quarters of a million.—*Nature* (London).

Acetylene Paint-Burner

IN removing paint with an ordinary blowtorch, considerable soot is deposited on the woodwork and the flame itself is none too efficient. The Linde Air Products Company has developed an air-acetylene paint-burner to supplant the older process. It is said to be one of the fastest known methods for removing paint and far superior to the use of chemical removers. The flame, flattened out in a brush-like shape, is of an even, high temperature throughout. It is not easily blown out by wind and is under such close control that the danger of burning spots on wood or canvas is eliminated. With it, many coats of paint can be removed in one operation.

Paint burning with gas flame

Why Athletes Rest Before a Competition

IN a paper contributed to the recent British Medical Association meeting, Prof. E. P. Cathcart of Glasgow discussed the various factors that go to form the basis of physical fitness. It will not be achieved merely by

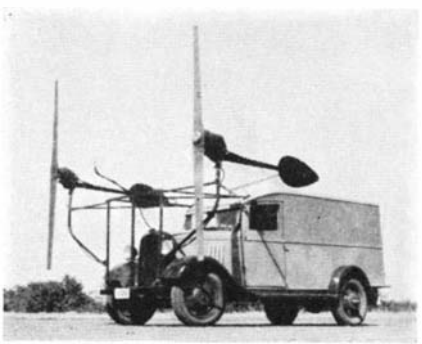
satisfaction of the needs of the body, for malnutrition of the spirit is quite as common as malnutrition of the body, and the one reacts upon the other. There is evidence that meat is not essential, and perfect fitness may be acquired on a diet of brown bread, milk, butter, cheese, fresh fruit and salad, provided it is adequate. For heavy work, fat appears to be an important source of energy. Sugar and carbohydrates are known to be important sources of energy; but apparently are not immediately available, but have first to be converted into glycogen, so that Krogh and others suggest that in sporting events the athlete should have two days' rest before the contest to secure a complete filling up of the glycogen stores of the body.—*Nature* (London).

Wind-Charger Test Truck

W. G. DUNN, pioneer wind-electric engineer and inventor, has added a truck testing unit to the experimental equipment of the Parris-Dunn Corporation. This 1½ ton truck is designed and outfitted exclusively for wind-electric experimental work.

The unique arrangement permits the experimental department to obtain accurate comparative readings on any two wind electric units while operating under identical wind conditions created by the movement of the truck.

Our photograph shows how the mounting standards open out from the truck for comparative experimental test runs. The goose-



Wind-chargers on test

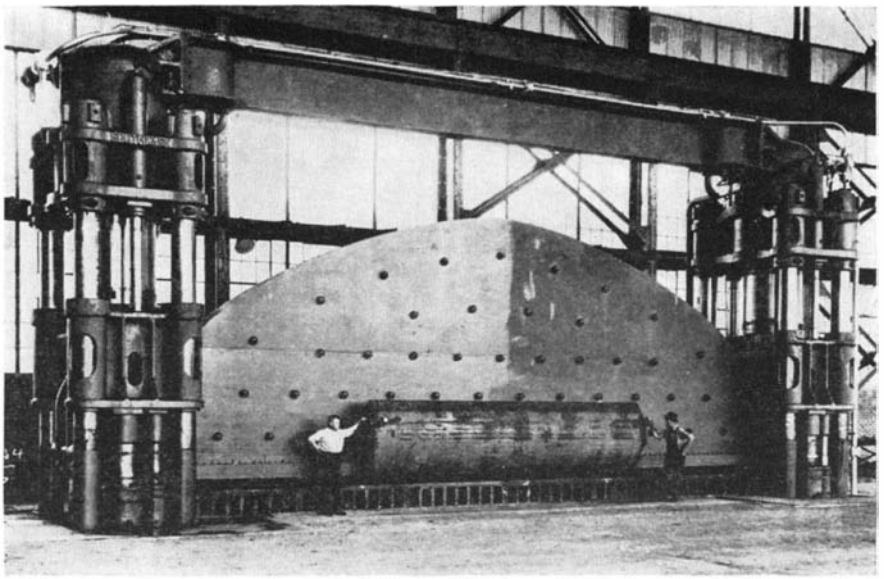
neck standard that appears in the center is a supersensitive velometer for determining the exact wind velocity under which the wind-electric equipment is operating. The mounting standards fold back beside the truck to comply with all highway laws while in transit between factory and proving grounds.

On the inside of the panel body are two complete instrument panels consisting of master ammeters, voltage gages, relay cut-outs, and the like, as well as the velometer dial for accurate wind-speed readings.

Huge Bending Press

WHAT is believed to be the largest bending press in the world, both as to size and capacity, has recently been built by the Baldwin-Southwark Corporation. Of 6000 tons capacity, it will handle plates up to 40 feet in length and 8 inches thick, and bend them into semi-circular shapes for high-pressure steel drums.

The bending press consists of two specially designed vertical presses of 3000 tons



Steel plates eight inches thick can be bent in this press

capacity each. These presses are connected by bending beams 52 feet long which are made of plate steel construction, 15 feet deep and 20 inches thick.

While only the top beam is visible in the photograph, a similarly constructed bottom bending beam is below the foundation line. This bottom beam rests on the cast-steel bottom platen of each press.

Weight of the material entering into the construction of these two beams is approximately 1,000,000 pounds, while the weight of the two presses, together with accessories, is also approximately 1,000,000 pounds, thus making the total weight of the machine about 2,000,000 pounds.

Unique features in the design of this press are the equalizing arrangement of the pressure on both main cylinders to take eccentric loading and, also, the special swiveling and thrust block arrangement on the moving beam. This latter arrangement permits the eccentric loading without throwing any side strains on either press.

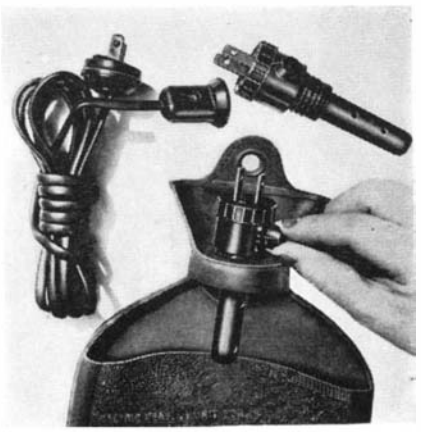
HOLES

ELECTRIC eyes now keep holes out of tin cans. Installed in a steel mill, a bank of photoelectric cells keeps watch on the thin sheet of steel as it races 700 feet a minute on its way to become tin cans. An article in *The Electric Journal* reports that these "eyes" not only see tiny pin point holes as small as one sixty-fourth of an inch across but they also operate a device to mark each hole.

Heating Hot-Water Bags Electrically

IT is claimed that electric heating pads are inferior to hot-water bottles in certain respects and that hospitals generally favor the use of the latter. Hot-water bottles, however, ordinarily require a great deal of attention in the constant refilling that is necessary. The Thermo Electric Products Company has eliminated this inconvenience by developing an electric heating unit which may be screwed into the neck of the bag in place of the ordinary screw stopper.

In the upper part of this unit there is a thermostat made of laminated steel with silver points, which maintains the heat at a pre-determined point. The heating element which protrudes inside the bag is enclosed in a moisture-resisting Bakelite shell which is provided with holes for the penetration of water. Water in the bag makes the final electrical contact so that, even though the current is turned on, the unit does not heat unless there is water present to close



Constant heat for hot-water bottle

the circuit. The whole unit is so enclosed that there is no possibility of the patient receiving a shock at any time. Since the heat is at all times lower than boiling, no steam can be formed. The unit is made to operate only on alternating current.

The manufacturers claim that this unit is sufficiently rugged to last for years, and claim further that in continuous use for weeks at a time its action has been safe and efficient.

Advertising Costs

TO contradict the prevalent fallacy that advertising is a wasteful process and that the consumer pays the disproportionate bill, the National Better Business Bureau, Inc. has published some interesting statistics in a new bulletin.

For example, the Bureau says, the advertising expense on a nationally adver-

tised bed sheet that retails for $1.75 is exactly one cent. The advertising expenditure on a loaf of bread is less than the cost of the wrapper that keeps it clean. The manufacturer of a well-known soap costing seven cents a cake uses just 1/5 of 1 cent per cake to advertise it. The cost of advertising a 12-cent can of soup is 36/1000 of 1 cent.

Oil Under the Mississippi

OIL deposits directly underneath the bed of the Mississippi River were successfully opened recently when Continental Oil Company brought in a flow estimated at 204 barrels a day in St. James Parish near

Site of the oil well that has tapped deposits under the Mississippi

Vacherie, Louisiana, through the first well ever drilled inside the river levee.

The discovery well, known as Realty Operators No. 1, is located on the eastern side of the river about 55 miles northwest of New Orleans at a point where the bottom ground or "batture" between river and levee is about 1600 feet wide. Protection from possible flooding of the well site required the building of a separate circular levee 14 feet high, inside the main levee.

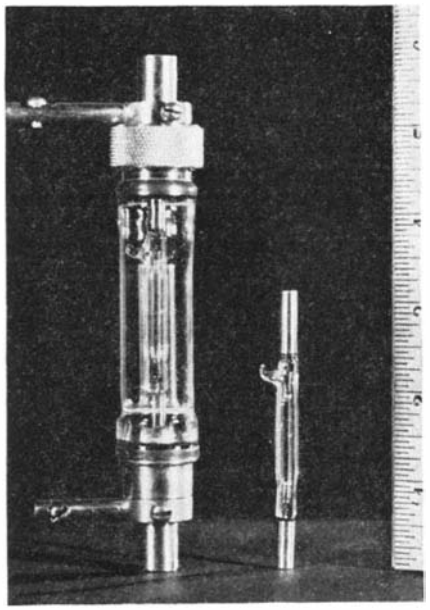
Continental officials revealed that 40 foot pilings had to be sunk in the swampy soil to support the drilling rig and that equipment was brought over on a specially constructed plank road.

The well was reported producing a 43.2 gravity crude through tubing perforated from 6358 to 6364 feet, with a tubing pressure of 2350 pounds. The well was drilled to a total depth of 7499 feet, but plugged back to 6364 feet to a sand laid down in the Miocene Age. The well is also producing 4,131,000 cubic feet of gas daily. The new field is known as the Hester Dome area, where Continental and Shell have about 10,000 acres under lease.

"Midget Sun" Electric Light

A MIDGET sun in the form of a 1000-watt mercury lamp, no larger than a cigarette yet designed to attain a brilliancy equivalent to about one fifth that of the sun's surface, was announced recently by the Incandescent Lamp Department of General Electric Company.

Since the light source, an arc, is highly concentrated and is approximately 12 times



Mounted and unmounted "midget sun" lamps, compared with a ruler

as brilliant as the incandescent filament of a 1000-watt standard projection lamp, G.E. engineers believe the water-cooled midget sun will revolutionize lighting practice in numerous fields of light projection. Results of numerous laboratory tests indicate that the new lamp can be used to great advantage in photo-engraving work, in blueprinting, photo-enlarging, in searchlights, and for therapeutic application.

The new lamp consists of a small quartz tube. Confined within a tiny bore inside the tube is a globule of mercury and a trace of argon gas. Each end of the quartz tube is furnished with a brass ferrule which provides electrical contact.

In producing so brilliant a light, the midget sun develops such high pressure and heat as to destroy itself unless the lamp is properly water-cooled. By developing an ingenious water-cooling jacket, which permits three quarts of water per minute to flow past the gleaming mercury lamp, engineers found a practical way to carry off the excess heat without affecting the light output. The cylindrical glass portion of the water jacket is about the size of a shotgun shell. A small screw adjustment at one end of the jacket permits easy insertion and removal of the quartz lamp. Metal connections for water intake and outlet are located at each end of this water-cooling accessory.

HEAT

SINCE the earth's air weighs 11,850 million millions of pounds, all the heat produced in factories, homes, vehicles, and so forth, increases the temperature of our atmosphere only 1/54 of one degree.

The brilliant light produced by the quartz capillary lamp emanates from a narrow arc stream not much wider or longer than a common pin. Compared with the bluish light emitted by conventional mercury lamps, radiation from the new 1000-watt source is much whiter.

When the water jacket is made of quartz instead of hard glass, the unit emits a wealth of ultra-violet radiation. Special glass that screens out dangerous ultra-violet rays not found in natural sunlight at earth levels may be used instead of quartz, G.E. engineers said. Although the water in the jacket absorbs approximately 90 percent of the heat generated, it allows practically all the ultra-violet and visible radiation to reach the outer envelope.

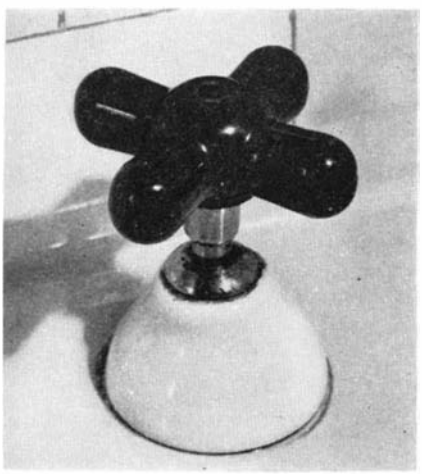
Combating Banana Disease

A DISEASE threatening the banana plantations of Central America is being checked by the copious use of Bordeaux mixture as a spray. This mixture consists of five pounds of copper sulfate and five pounds of lime in 50 gallons of water. To preserve the plants, applications of 250 to 300 gallons per acre are required at 15-day intervals. As many as 18 applications per season are necessary. The residue left on the fruit must be washed off first with dilute hydrochloric acid and then with water before shipment. The disease, known as sigatoka, which attacks the leaves of the plants, is effectively stopped by this treatment.

—*D. H. K.*

Safe Faucet Handles

LAST year after one of the editors of this magazine suffered a serious cut on his thumb—which severed nerves and a small artery—we asked in this department why molded resin faucet handles could not be made available. Too many similar accidents caused by the breaking of porcelain handles under pressure have happened throughout the country. To eliminate this danger the Boonton Molding Company has molded in black Bakelite a faucet handle which is both attractive and permanently safe. It will not break under severest use.



For safety in the home

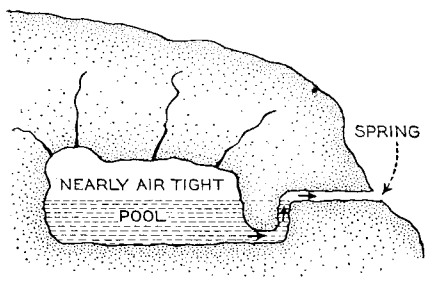
Mysterious Springs—Dry Weather Type

NOW and then a reader of this magazine describes and inquires for the explanation of a type of intermittent spring called dry weather springs. From an article on intermittent springs, in the *Monthly Weather Review* (United States Weather Bureau, Washington, D. C.), written by the meteoro-

logical physicist, Prof. W. J. Humphreys, we quote the following lucid explanation of this puzzling type of spring:

"Especially in limestone regions, an occasional spring that has become nearly, or even quite, dry starts flowing again or flowing more strongly on the approach of a general rain, hours before a drop of water has fallen within many miles of its place. Sometimes, though relatively rarely, very little rain, or even no rain, falls in the region of the spring for days, or perhaps weeks, after the flow begins; in which case the spring promptly dries up again. Marked fluctuations of this kind are distinctly drought phenomena; they do not occur when rains are frequent enough to maintain a goodly supply of ground-water.

"Their explanation is simple: The channel to such a spring leads to a cavity (see the accompanying drawing) which, during



A dry-weather spring

a prolonged dry spell when the seepage into it is becoming less and less, gradually empties, slowly filling the while with infiltered air, until the water pressure at the reservoir outlet, below the surface, is no longer sufficient to force an outflow.

"If, now, the pressure of the open air should be lowered while that of the rather closely entrapped air in the half-emptied underground reservoir is unchanged, water would be forced out from the place of the greater to that of the lesser pressure, that is, from the half-filled cavity to the open spring. Now a marked decrease of atmospheric pressure is just what happens at the approach of a general rain, often beginning hours ahead of the precipitation; and, as early, causing certain springs to run again in the midst of a drought, or to run more freely if not yet dry—a mysterious flow, prophetic of rain."

The Food, Drug, and Cosmetic Act

THE Food, Drug, and Cosmetic Act of 1938 has been signed. This is a law of far-reaching importance to every person in the United States. It is a revision of the Food and Drug Acts of 1906, and greatly strengthens the protection given the health and the purses of consumers. It will stand as a legislative monument to the memory of the late Senator Royal S. Copeland of New York who worked unremittingly for a really effective measure.

The differences between the new law and the old are many. A few of the more important are as follows:

The new law brings *all cosmetics* except toilet soaps under control, and outlaws those which may be injurious to health.

It brings under control drugs used in the diagnosis of disease, and drugs intended to

affect the structure or any function of the body. Reducing drugs, so-called "slenderizers," are included in this provision.

The new law prohibits traffic in *new* drugs, unless such drugs have been adequately tested to show they are safe for use, and requires that certain habit-forming drugs bear warning labels.

It includes therapeutic devices and will afford protection against the sale of such fake contraptions as so-called "electric" belts.

It provides for definitions and standards of identity and quality for food under which the integrity of our food supplies can be maintained.

It sets up more effective safeguards against poisonous foods.

It provides increased criminal penalties for violations.

While the *general* provisions of the law become effective a year from the date of signature, certain provisions affecting the public health became effective when the President signed the bill.

Those provisions include the prohibition against drugs which are dangerous to the consumer when used as prescribed on the label, and against cosmetics which may be injurious to the user.

However, let me say that under the new law, as under the old law, the consumer who wishes to avail himself of the maximum protection afforded by the operation of enforcement will have to make some study of the meaning of statements that appear on the labels of foods, drugs, and cosmetics. The old Act forbade certain types of statements on labels. It contained few positive requirements for labeling. The new Act requires much information of value to consumers to appear on the packages in which we buy foods, drugs, and cosmetics. It is still up to the consumer to find out what this significant information means to him and his family, and to apply that knowledge in his buying.—*From a radio talk by Henry A. Wallace, Secretary of Agriculture.*

FINGERPRINTS

IT has been estimated that fingerprints may be duplicated once in 1,606,937,974,174,171,729,761,809,-705,564,167,968,221,676,069,604,401,-795,301,376 times! Or, we might say, a particular fingerprint will be repeated in about 2800 years!

CALCIUM METAPHOSPHATE FERTILIZERS

HIGH concentration phosphatic fertilizers have been among the prime objectives of the Tennessee Valley Authority development at Muscle Shoals, Alabama. Among the fertilizers made is calcium metaphosphate, containing 60 to 70 percent phosphoric acid (P_2O_5), of which 99 percent is available to plants. This material compares with ordinary phosphate containing 16 to 20 percent available phosphoric acid and the more concentrated triple superphosphates having 48 to 50 percent available phosphoric acid.

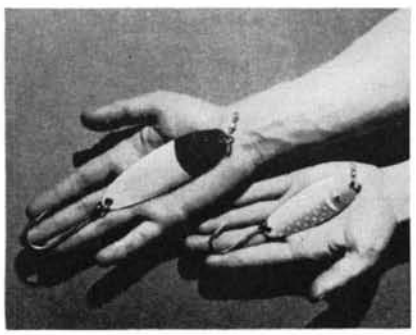
Calcium metaphosphate as manufactured is a transparent glass colored by the impurities present. It is slowly soluble in water and in

the soil solution when ground for use. The method of its manufacture utilizes phosphorus pentoxide produced by burning phosphorus. The hot fumes from the burning of phosphorus are conducted through a bed of phosphate rock in a kiln resembling a lime kiln. By proper regulation of temperature, the metaphosphate melts and runs out of the bottom of the furnace. The potential value of this method of converting phosphate rock into fertilizer lies in the fact that the element phosphorus, itself, can now be shipped in tank cars to the place where exist the rock deposits for the treatment. The high concentration of metaphosphate fertilizer makes it more economical to ship than other forms of phosphate fertilizer.—*D. H. K.*

Porcelain Lures

VERSATILE porcelain enamel is invading the realm of sport. The Porcelure Fishing Equipment Company has announced a new kind of trolling spoon made of Armco enameling iron with a fused coating of gleaming porcelain enamel.

Known to the sporting goods trade as Porcelure, the spoons come in four sizes and



Fish foolers

are colored to represent sardines, gold fish, and white red-heads. Because of the durability and luster of the porcelain enamel, the manufacturers guarantee the spoons against scratching, fading, or tarnishing. The spoons are said to have a stunned fish action calculated to whet the appetites of game fish. The eyes always gleam and the scales glitter, whether the spoons are used in fresh water or salt.

Improved Reading Technique

AN increase of nearly 44 percent in reading speed and 10 percent in reading comprehension through use of a new corrective reading technique has been reported by E. A. Taylor of the American Optical Company's bureau of visual science.

Subjects undergoing the training ranged in age from 14 to 65 years, and age did not hinder improvement of reading habits, he stated.

As reported, reading speed jumped from an average of 256.20 words per minute to 368.80, a gain of 43.90 percent, after 13.16 20-minute periods of reading training. In every case there was an increase in reading speed.

Average comprehension of what was read jumped from 77 percent to 84.50 percent, an increase of 9.74 percent. Regressive movements during reading decreased 37.11 percent, fixations decreased 20.14 percent.

and eye discomfort, present in most cases, was relieved.

Scientific equipment used consisted of the Metron-O-Scope, an instrument designed to control reading patterns, and the Ophthalm-O-Graph, an instrument which photographs eye movements in the act of reading.

Scorpions More Dangerous than Rattlers

SCORPIONS are not to be regarded lightly, declares H. L. Stahnke of Mesa Union High School, in *Science*. "More lives have been lost in Arizona from the sting of the scorpion than from the bite or sting of any other venomous arthropod or reptile, at least during the nine-year period since 1929," he writes. "For a period of six and one half years, beginning with 1929, there were recorded 25 deaths resulting from the sting of the scorpion and only 10 deaths caused by the rattlesnake, gila monster, and other poisonous animals.

"Most of the deaths due to scorpion sting have occurred in the southern part of the state, particularly in the Salt River Valley, and the victims have been children usually six years of age and under. The writer knows of one case in which an eight-year-old child succumbed to a scorpion sting."

The Mexican government's Institute of Health donated two ampullae of anti-scorpion serum, Mr. Stahnke states, adding: "In all cases it has proved entirely effective, and no deaths have resulted from scorpion sting, even though the serum was used in quite advanced stages of poisoning."—*Science Service.*

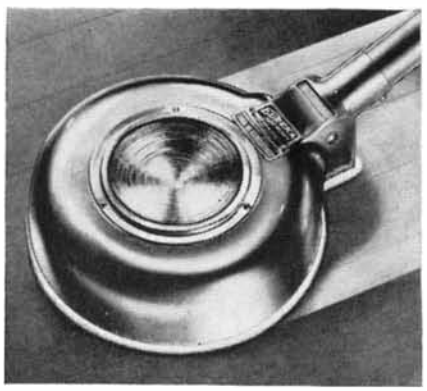
Rayon from Reeds

CELLULOSE now being made in Manchuria from reeds is reported to have a higher content of alpha cellulose than that made from wood pulp. The Japanese are using this pulp in the manufacture of rayon.—*D. H. K.*

Floor Polisher Uses Air Pressure

OPERATED by the air pressure developed by the Eureka Vacuum Cleaner, the new inexpensive Eureka Power Polisher makes child's play of floor polishing.

Housed in a die-cast aluminum case, the floor brush is rotated by the die-cast alumi-



Vacuum cleaner powered polisher

Under side of floor polisher, showing the rotating polishing brushes

num turbine mounted on its back. The turbine is connected to the bag-fitting of the vacuum cleaner by a flexible hose and hollow aluminum alloy handle.

The housewife disconnects the bag from the vacuum cleaner, attaches the polisher hose, starts the cleaner motor, and lets air pressure do the work. The light weight of the aluminum polisher makes its operation easy for the woman of the house, and enables her to move the machine anywhere in the house without back-breaking effort.

Synthetic Drying Oils

NEW types of drying oils have lately been developed which are derived from animal fats by synthetic processes. The new oils are said to be cheap and to possess remarkably good properties for use in paint and varnish films. The films formed from them possess remarkable flexibility and toughness.—*D. H. K.*

"Zippers" Electroplated and Colored

MANUFACTURERS of textile, leather, and other products which use "zippers" in their construction will be interested to know that metallic "zippers" are now obtainable in plated, lacquered, and colored finishes to harmonize with the design of the merchandise with which they are used. This development is a product of the Hanson-Van Winkle-Munning Company, manufacturers of electroplating equipment and supplies, who have developed a machine which automatically and continuously plates the "zippers."

This machine is essentially a conveyor mechanism which handles the "zippers" in the tapes on which they are shipped. The principle of the machine is simple. It draws the tape through the various tanks, cleaners, plating solutions, rinsers, in regular order.

Each Family Has 400 Mechanical Slaves

"MORE power to you" is no idle toast but a prediction to Dean A. A. Potter of Purdue University who foresees more and more power being used in future years to promote general well-being. More comfortable living due to air-conditioning, electrical gadgets in home and business, and other improved mechanical devices will require more power in the near future, he says.

Each of America's 30,000,000 families has

the mechanical equivalent of more than 400 human slaves available day and night, Dean Potter reminded the scientists. This means 10 horsepower for each person or more than 1⅓ billion horsepower in all.

The bulk of America's power will continue to come from coal as it does now, Dean Potter states. Stationary coal-burning steam-electric power plants now produce electricity at a cost of four to six tenths of a cent per kilowatt-hour.

Research to solve the power problems of the future was urged by Dean Potter. For instance, now it is cheaper to haul coal 900 miles than to transmit electrical power 200 miles. The steam locomotive is to remain the main source of power for railways, although electric and Diesel locomotives will find larger use. Now electric locomotives are only 2 percent of those in use and internal combustion engines less than one half of one percent.

Trucks, buses, and tractors will use more engines of the Diesel type, Dean Potter predicted, while passenger autos are destined to be safer, more economical, and more powerful.—*Science Service.*

THOUSANDS OF WOMEN ARE DUPED

THE feminine side of the birth control business is appalling. Women spend 200,000,000 dollars yearly for millions of devices, instruments, jellies, powders, and liquids, totaling at least 636 different brands, sold largely under the deceptive advertising term "Feminine Hygiene." Not one of them has been proved to be entirely effective when used alone, and some of them are potentially dangerous. Physicians have asserted that not one of the products thus advertised cures or prevents venereal disease and that the normal female organs have no need for such hygiene. In fact, too frequent attempts at cleansing may even cause inflammation. Some of the numerous feminine products may not be harmful in themselves. Nevertheless they may cause incalculable harm when advertised under a slogan that the public understands to mean contraception. "Feminine hygiene" products may even be advertised as "sure, safe, and dependable," but where the advertiser means "sure, safe and dependable for feminine hygiene" the purchaser interprets it to mean sure, safe and dependable for contraception. Perhaps only physicians know that no "feminine hygiene" products are "sure, safe and dependable" contraceptives. The result of such advertising is that thousands of women are duped. There is not one product on the market that is 100 percent efficient as a contraceptive measure. —*Journal of the American Medical Association.*

ELECTRICAL BABY BLANKET

THOSE who remember General Electric's development of an electrically heated bed sheet, which had the virtue of supplying sufficient heat under absolute control without the burdensome weight of heavy bed covering, will be interested in a new baby crib blanket constructed along the same lines. This blanket is fully automatic, in that it adapts itself to changing weather

conditions during the night and maintains a pre-set temperature level. Despite the wiring contained in its double thickness, it can be laundered easily and it is shockproof when wet. It is connected to the ordinary household circuit of 115 volts but a transformer reduces this voltage to 18, a voltage which is not even strong enough to provide a tingling sensation when passed through any part of the body.

STEAM

A PASSENGER locomotive uses from 70 to 120 gallons of water per mile; a freight locomotive uses from 150 to 350 gallons for the same distance.

Wool-Like Fiber From Skim Milk

A SYNTHETIC fiber having the appearance of wool can be manufactured from casein, a milk by-product, by a process devised by Stephen P. Gould and Earl O. Whittier of the Bureau of Dairy Industry, United States Department of Agriculture. The process is similar to that used in making viscose rayon from cellulose, and public service patents, applied for by the Bureau, are pending.

In Italy, where a somewhat different process for making casein fiber was announced three years ago, production is already on a commercial scale. Most of the fabrics, however, are half synthetic and half wool.

To make the fiber, casein is softened in water and dissolved in a solution of caustic alkali. It becomes a thick, sticky mass and is carefully worked into the proper consistency by aging, addition of modifying agents, and dilution. The mass is then forced through multiple spinnerets of the kind used in making rayon. The fibers are separated and hardened in an acid bath containing formaldehyde and modifiers.

Synthetic fiber produced in this manner has a chemical composition almost identical with wool except for a lower sulfur content. The fiber is faintly yellow in color and closely resembles best grade, thoroughly washed and carded, Merino wool, the finest size marketed. The casein fiber has the characteristic fine kink of natural wool and may be blended with it to make a product that has the resilience of pure wool. Synthetic fibers with this kinky structure have been made from plant materials recently, but they do not take wool dyes.

Because the fibers are smooth, rather than scaly like natural wool fibers, they cannot be felted. For the same reason, however, the synthetic fiber does not shrink as much as wool. By varying the acid bath in manufacture, the fiber may be made either soft or harsh to the touch. The softer grades, while not as strong, make up into knitted garments which may be worn next to a sensitive skin which cannot tolerate knitted wool.

Because casein fiber has been produced in this country only on an experimental basis, commercial costs have not been definitely determined. Gould and Whittier believe, however, that it can be manufactured to be sold at a price on par with that of rayon, which is about 50 cents a pound.

Conducted by JACOB DESCHIN

Seeing Double

UPON the simple fact that one eye sees a different aspect of the same subject than the other, is based the fascinating art of stereo photography, now slowly returning to favor after a long neglect. Various experiments may be employed to illustrate this, as by holding an object at arm's length and observing the subject first with one eye and then with the other. The subject will appear slightly different in each case. By using both eyes at the same time a single image of natural solidity is seen.

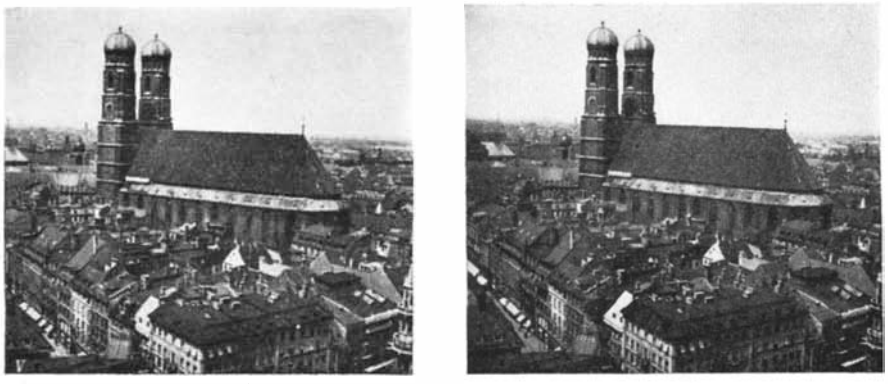
The stereo camera in essence is simply two cameras in one box, divided by a partition in the center. Each "camera" has its own lens, diaphragm, and shutter and the pictures are taken side by side on a single film or plate. The lenses are identical and, imitating the separation of the eyes, are placed about 2½ inches apart. As with human vision, the image recorded by one of the camera lenses is slightly different from the other.

For projecting stereo photographs

How a projected stereo photograph looks when viewed without glasses

The resulting negatives must be printed differently from the method employed in normal, single-lens photography; that is, two prints are made, one for each of the recorded images. These are mounted side by side and viewed by means of a stereo viewer. However, since the images are inverted during the exposure, it is necessary to separate the double print by cutting across the center and interchanging or transposing the prints so that the picture taken with the left lens is viewed with the left eye and the picture taken with the right lens is viewed with the right eye. Where transparencies are made, correct printing is assured through the use of a transparency frame designed for the purpose.

Among the better type of stereo cameras are the Heidoscop and the Rolleidoscop;



A typical pair of stereo photographs

among the cheaper is the English Stereo Puck, a box camera type using 2¼ by 3¼ inch roll film and providing eight pairs of stereo pictures. Both the Heidoscop and the Rolleidoscop are available in models giving 6 by 13 cm or 4.5 by 10.7 cm stereo pictures, the one taking plates, the other roll film. Both are of the reflex type.

Single lens cameras have been successfully adapted to stereo work by shifting the position of the camera from 2½ to 2¾ inches, after the first exposure, to make the second. This adaptation of the single lens camera to stereo photography is limited, of course, to still subjects. Special stereo heads providing for the exact shifting of the camera for the two stereo positions are available as accessories for such cameras as the Plaubel Makina, the Rolleiflex, and the Leica. For the latter camera there is also available the

Stereo attachment for Leica

Stereoly Attachment, which contains two prisms positioned 2½ inches apart and slips over the regular 50-mm lens of the camera to reproduce two images on the single Leica negative.

For viewing stereo pictures a variety of optical stereoscopes are available providing a magnified image. These range from the simplest device, such as the Eho Stereo Viewer, to the most elaborate viewing cabinets, which take stereoscopic prints or transparencies and automatically change from one pair of stereo pictures to the next. For projecting stereo pictures, the makers of the Leica camera have recently adapted their Stereoly Attachment for use on the Leitz VIII-S projector, with a pair of Polaroid filters mounted over the attachment. Since the screen shows two overlapping images, as shown in one of the illustrations, it is necessary for the spectator to wear a pair of glasses, the lenses of which are polarizing filters.

Those Vacation Shots

NOW comes the reckoning. You took pictures galore, of course, but how many were worth the taking? How many are worth the printing? Far from the bewitching influence of the subjects, you may now take stock and decide. Study the negatives carefully, project them under your enlarger, give them every chance. If the whole negative looks disappointing, maybe a part of it is worth while. If the negative won't stand up at all and is a complete flop, why waste precious time in printing it, even if "just for the record?" The time wasted in printing bad negatives may well be devoted to greater thoroughness in processing the really good negatives. And if the total of prints that may result from this weeding process is far less than the total of negatives you brought back with you from vacation, you may be sure your album will take on a finer dignity by the inclusion only of good pictures and the complete absence of the bad and indifferent ones.

At the Game

"AND a Goodly Crowd was There" is a type of picture that may be shot at almost any outdoor game. The audience is sometimes worth more attention than the

"And a Goodly Crowd Was There"

game itself. Sections or small groups or individuals offer many striking opportunities. In the illustration, the view was arranged to show the crowd in the extreme foreground so that the interesting cloud formation would also be included.

Candid Shooting

THE candid subject still remains one of the most attractive fields for the user of the miniature camera. It was our good fortune recently to spot one such opportunity while strolling through a park one sunny afternoon. The "Crossword Puzzle Addict" was the result. Happily we had with us the twin lens reflex camera, which proved ideal under the circumstances. The subject was sitting at one end of the bench and we waited our chance until the park bench sitter at the other end decided to walk on, thus providing us with an ideal camera location. We turned the lens of the camera toward the

"Crossword Puzzle Addict"

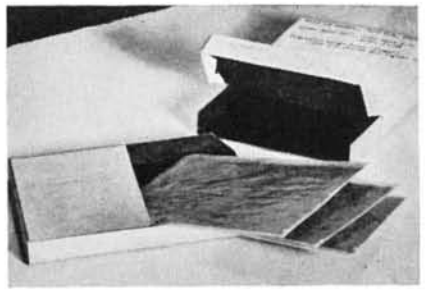
subject but observed the image at right angles. After focusing quickly and setting the camera in position, we poised the finger on the release and watched the subject directly, snapping the picture at *f*/5.6 and 1/50 of a second.

VIEWERS

A NUMBER of negative and transparency viewers have recently been placed on the market along with several types of transparency frames. While principally intended to furnish a pleasant method of viewing 35-mm color transparencies, these viewers offer a convenient means for examining 35-mm negatives under ideal conditions; that is, by transmitted light evenly distributed over the area of the negative, and with the aid of a magnifying lens fixed in the device. In this way negative strips are easily examined for sharpness, for contrast, and generally as to their suitability for enlargement either in whole or in part. A device of this sort would seem to be almost an essential in the equipment of every user of 35-mm negatives.

HOME-MADE NEGATIVE FILE

HERE'S an idea for those who have access to discarded Agfa cut-film containers. The enclosure, a drawer-type box



Film file

which contains the film, is used for filing the resulting negatives. The box itself is open at one end, a hinged end serving as cover, as shown in the illustration. The negatives are filed in individual glassine envelopes as a protection in handling. The top of the box is covered with a white sheet of paper on which is indicated a list of the enclosed

negatives, together with pertinent exposure and other data. The front end of the box is lettered with some general classification covering the entire contents. The whole arrangement affords a convenient system of filing large negatives as well as protection against dust.

Chromium-Plated Aluminum Cameras

EXCITING considerable comment is the process of chromium-plating aluminum discussed in an article in the July, 1938, issue of Scientific American. One of the first to take advantage of the new development is the Eastman Kodak Company, which is using this process on the new Super-Kodak Six-20 and the recently announced Bantam *f*/4.5 cameras.

Film Ratings

RECOMMENDED ratings for the new Eastman films recently announced in the "What's New" columns—Super XX, Plus X, and Panatomic X—are listed for Weston and General Electric meters as follows:

	Daylight		*Tungsten*	
For Weston Meters:				
Super XX	80	128	50	80
Plus X	40	64	24	40
Panatomic X	24	40	16	24
For General Electric Meters:				
Super XX		128		80
Plus X		64		40
Panatomic X		40		24

The second columns in the Weston figures provide for somewhat less dense negatives, while the ratings for the General Electric meters may be increased proportionately.

Writes Paul Favour, Manager of Eastman's Service Department:

"The values in the left-hand columns do *not* represent the least exposure which will give the best possible prints. They include a safety factor to take care of variations in the use of the exposure meters and in the handling of the photographic materials. On the average, the exposure called for by these numbers is more than twice that actually required for the best possible prints, but decreasing the exposure by that amount is not recommended unless the operator is thoroughly familiar with the characteristics of his exposure meter and of ordinary darkroom practice. The Weston numbers in the right-hand column represent a safe decrease in exposure under these conditions."

Versatile Darkroom Pail

FOR waste prints and other waste that piles up in the course of an evening's work in the darkroom, some amateurs use an ordinary galvanized tin or iron pail. However, experience has shown that a pail of this type soon corrodes and becomes objectionable in other ways, chiefly odoriferous. One might use a paper carton or a similar container, and throw it away, contents and all, but it would become somewhat of a chore after a time to make sure of providing such a container every time one is ready for the darkroom.

What's wrong with using a white enamel

pail? Not only is such a pail a good looking darkroom accessory, but it is easily washed and cleaned after a night's work, and it does not rust. Furthermore, a pail of the proper size may also be used for mixing up a good quantity of hypo fixing solution. Every darkroom addict knows what a nuisance it is to mix up a quantity of fixer with the regular darkroom graduates. The white enamel pail should offer a welcome solution to a vexing problem for many, as it has for this department.

WHAT'S NEW

In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please accompany your request by a stamped envelope.

SUPER SPORT DOLLY, with built-in visual type exposure meter ($65.00 to $82.50, depending on lens and shutter equipment): Has built-in range finder of split-field type. Available with Schneider Xenar and Zeiss Tessar *f*/2.8 lenses in regular Compur delayed-action shutters with speeds of 1 second to 1/250, and Compur Rapid with speeds up to 1/400. Uses 120 or B-2 film, taking 16 pictures 1⅝ by 2¼ or 12 pictures 2¼ by 2¼ inches.

FILMO 141, available in two models, 141-A providing speeds of 8, 16, 24 and 32 frames per second, and 141-B operating at speeds of 16, 32, 48 and 64 frames per second: Declared to incorporate improvements never before available to amateur movie makers. Among other things, the Filmo 141 features a new "projected area" view-finder, the four camera speeds, and a single-frame exposure device. The lens is the color-corrected 1-inch *f*/2.7 Cook and since the camera has the same lens mount as the Filmo 70, all lenses used on the latter cameras are interchangeable with the new model. The selection of focal lengths includes 15-mm to 6 inches with "projected area" view-finders for each. The view-finder is set in a soft rubber cup, thus preventing side glare.

Filmo 141 is small, and weighs only 39½ ounces. The camera is jet black and chromium, with inset panels of a new and durable hard-rubber composition finished in pin-seal grain. Built into one of the side panels is a complete exposure calculator. Available with the camera is a leather carrying case arranged to hold the camera, two film magazines, three lenses, and a complete set of view-finder units.

AMICO MOTORIAL TRIPOD ($48): Designed for use with both still and movie cameras, all movements being controlled by friction, the latter being adjusted to the weight of the camera being used. Panorama and tilting movements are made on cylindrical bearings, the tripod head carries a rectangular platform 1¾ by 2⅜ inches, and tilting may be had to any degree up to a complete right angle on either side. For pan-

oraming, a circular scale of 360 degrees is provided, subdivided at every tenth degree. The tripod is made of duralumin in two sections and measures 36 inches when closed, 58 inches extended; weight 8½ pounds.

LAACK ENLARGING LENSES: TEXON ($20.50 to $67.00); DEFINON ($9.00 to $25.00). Texon ("tessar" four-element type, two elements cemented) focal lengths from 5.5-cm to 21-cm, with iris diaphragm, in barrel mounts, speeds *f*/3.5 and *f*/4.5. Texon 5.5-cm, *f*/4.5, and 10.5-cm, *f*/4.5, in spiral mount. Definon (three-element, uncemented) focal lengths 5.5-cm to 13.5-cm, with and without iris diaphragm, speeds *f*/4.5 and *f*/6.3, enlarging mount, except 13.5-cm, *f*/4.5, which has iris diaphragm and is in barrel mount.

UTILO ROLLFILM camera is available in two models, both equipped with the Meyer Trioplan *f*/4.5 lens of 4-inch focal length, designed to expose eight 2¼ by 3¼ inch negatives on 120 or B-2 film. The two Utilos differ only in the type of shutter provided, one with the Vario shutter ($15), the other with the Prontor II shutter ($18), the latter being provided with a delayed action release. Accessories available include a leather carrying case ($3); Orthoplan slip-on type filters in yellow 1, 2, 3, red, green, blue and ultra violet ($2 each); slip-on type supplementary lens ($4.50).

KEYSTONE SLIDE PROJECTOR ($34.50): For black and white or color films. Features a patented heat-absorbing unit designed to furnish protection against burning or buckling of the film. A built-in cooling chamber acts as an additional safeguard against excessive heating of the slides and makes possible longer showing of individual transparencies. Other features include: 200-watt illumination; *f*/4.5 five-inch Wollensak projection lens; three-piece condenser unit; automatic centering of slide carrier on each picture; 2 by 2 inch standard slide holder; die-cast lamp-house and cast base with leveling screws; size, 10½ by 7¾ by 9½ inches; weight, eight pounds.

CURTIS DUFAYCOLOR PRINTER ($69.50): Designed by Dr. Thomas Curtis for color separation of Dufaycolor transparencies 4 by 5 inches or smaller. Special voltmeter controls light source. Voltage control dial permits cutting voltages of 108 to 125 down to 105 to obtain correct printing voltage for color balance. Peep hole aperture shows which filter is in position. Filter slide locks into position built-in red, green, and blue filters, as well as white filter for black and white printing. Light source supplied by special lamp having constant color-temperature life of 1500 hours. Graduated diffusion plates spread light rays for uniform lighting. Built of Aircraft Duralumin and wood fiber, formed under hydraulic pressure. Measurements: 12½" high, 11" long, 10½" wide. Weight: 7½ pounds. Supplied with printer: Insulated plug-in cord 12 feet in length; special cellulose acetate matte for use beneath

transparency to eliminate Newton rings in negative; transparency covering of cellulose acetate, 1/2000ths" thick, to prevent false light-scatter by dust between transparency and negative; complete instructions. Advantages listed by manufacturer: three correctly balanced Dufaycolor separation negatives in half an hour; correctly balanced negatives by giving equal exposure to all three negatives; good definition making possible 8 by 10-inch enlargements from pictures as small as 1⅝ by 2½ inches; your own paper prints with any standard method of color printing.

SEVEN-SECTION BROOKS POCKET TRIPOD ($7.00): Each leg telescopes independently (each has its own release catch). Master release catch on top section. Weight 10 ounces. Closed measures 10¼ inches long; extended, 46 inches. Made of aluminum and steel alloy. Top section finished in black enamel.

P. U. TRIGGER TRIPOD ($1.50, with cable release): Polished wooden "pistol grip" for steadying small camera. A 10-inch cable release fits camera shutter and terminates in "trigger guard." Permits operating camera with one hand; recommended for slow shutter speeds. Takes all small, hand-held cameras fitted with tripod socket and cable-release socket.

KODAK DARKROOM OUTFIT NO. 3 ($4.25): Includes one darkroom lamp; three 4 by 6 trays; one 8-ounce graduate; one 3¼ by 5½ printing frame with glass; one 8-inch glass stirring rod; a one-pound package of acid fixing powder; one tray thermometer; two film clips; six blotters, 9½ by 12 inches; one set of three rubber finger tips; one package of 5 by 7 mask charts; one copy of "How to Make Good Pictures;" two dozen sheets of Velox paper, 3¼ by 5½ inches; one instruction booklet; and five tubes of Universal developer.

DE JUR AMSCO PHOTOELECTRIC EXPOSURE METER ($10.50): Calibrated up to speeds of 200 Weston, this is the latest of the small electric meters to appear on the market. It is shown in the illustration compared in size with a golf ball. Featuring a single ring for adjusting the four variables—light intensity, film speed, shutter speed, and diaphragm opening—the new meter is employed at waist level and is said to incorporate the most recent developments in this field. The moving hand is mounted on jeweled bearings "so that the slightest light impulse will give an accurate reading."

ROBOT OMEGA ENLARGER ($63 to $78, depending on lens furnished): Designed specifically for enlarging from Robot one-inch square negatives. Similar in every respect to the Omega Miniature Enlarger with the exception that it carries a built-in mask for the Robot square format.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.*—The Editor.

Q. I would appreciate some accurate information as to the best method for obtaining platinum prints from regular camera negatives. Also information regarding the process used years ago for "carbon" prints.—R. G. M.

A. Platinum paper, largely because of its high cost and other difficulties, is not now so generally employed as it used to be and is, in fact, obtainable only from a single firm under the name of Platinotype. The firm is an English one and is the same one that was established in 1880 by the inventor of the process, W. Willis. The following developing formula is recommended:

Potassium oxalate	3 ounces
Potassium biphosphate	24 grains
Oxalic acid	6 grains
Water to	20 ounces

Two or three successive treatments with dilute hydrochloric acid follow development. This acid solution is made up of 1 part of concentrated acid and 60 parts water. A fresh bath is used for the last treatment, the latter being followed by thorough washing in several changes of water.

A rather full discussion of platinum printing will be found in Clerc's "Photography, Theory and Practice" and Neblette's "Photography, Principles and Practice." The same sources also give detailed information on the carbon process. The principal attraction of the latter process probably lies in the fact that the carbon tissue employed is available in many colors. The tissue (paper coated with a solution of gelatin and pigment) is sensitized in bichromate, exposed under the negative and transferred before development to another support. The pigmented gelatin adheres to the new support as the tissue backing is stripped off. Washing away the soluble gelatin in water constitutes the "development" procedure.

Q. Will you please discuss the advantages and disadvantages (if any) of the film-pack type of camera as compared to the roll-film type camera intended for general use?—C. W.

A. Generally, it is a matter of personal choice dictated largely by the type of work one intends to do. One outstanding advantage of the film-pack type is that of ground-glass focusing, which is often desirable. Film, both film pack and cut film, can be developed individually and a greater variety of emulsions is available than is at present obtainable in roll film. Also, since the negatives are usually larger than those made with roll-film cameras, many will find in this the advantage that contact prints of good size may be made from the negatives. The roll-film camera, on the other hand, particularly of the miniature type, is usually more easily manipulated than the film-pack camera, and a greater film capacity is possible, as in such cameras as the 35-mm and vest-pocket type. Development is simplified because negatives may be developed in strips rather than handled singly. However, there are some cameras that take both film pack (as well as cut film) and roll film by interchanging backs so that no dilemma on this score arises at all.

Q. The other day I was going through the attic and I came across some old photographic plates. In storage they had accumulated dust and I wonder if there is any way in which they can be cleaned so that more prints can be made from them.—L. S.

A. A thorough rewashing of the plates should rid them of dust completely. Several changes of water rather than continuous washing in a single tray will probably be the best plan. After washing, swab both sides gently before setting up to dry.

Q. I wonder if you have any list of accredited schools in photography that you could send me. If you do not have any such list perhaps you can tell me of schools of photography around Rochester, New York.—J. B.

A. We do not happen to know of any such list of schools in your vicinity but you should have no trouble in obtaining such a list from the Service Department of the Eastman Kodak Company there and obtaining similar assistance from the Chamber of Commerce of that city. Both of these organizations will recommend only the good schools.

Q. I use a 3¼ by 5½ plate camera. My finder, of the conventional brilliant (waist level) type, is out of alignment and unsatisfactory in other ways as well. My solution is an eye level, direct-view finder of the type on the Eastman Bullet camera. Can you give me the sizes

of openings in the above type of finder and the distance between the two?—C. H. M.

A. Probably all your brilliant finder needs is a little adjustment to bring it back into alignment again. It sometimes happens with your type of finder that in closing the camera the finder bracket is accidentally bent, in which case the agreement between the field of the finder and that of the lens will naturally be broken. As to the measurements for the direct-view finder you mention, these are simply scaled down from the negative size. The front opening of the finder may be scaled ¼ to the inch and the back or eye-piece, ⅛ to the inch, with the distance between the two about 1 inch. By these scales, the front opening will measure 1⅜ inch by 13/16, and the smaller opening back of it, 11/16 by 13/32 inch.

***Q.* Can you tell me the duration of the time lag on single lens reflex cameras between the time of the release and the actual exposure?—D. M.**

A. Between the moment that the mirror flies up out of the way and the actual start of the uncovering of the film by the focal-plane shutter curtain, the lapse has been variously estimated as between 1/10th and 1/40th of a second. However, this is merely a guess and it is probably safe to place the lapse at about 1/30th of a second.

***Q.* Can you recommend an effective hand stain remover?—S. E. L.**

A. The following Eastman formula S-5 has been found to give good results:

Solution No. 1	
Potassium Permanganate	¼ ounce
Water	32 ounces
Solution No. 2	
Sodium Bisulphite	16 ounces
Water	32 ounces

Rub the hands with a small quantity of the No. 1 solution, and rinse with the No. 2 solution.

***Q.* For some reason my camera leaves too great a space between the frames so that I am able to get only ten full negatives and a part of the eleventh; the space between them is about ⅞ of an inch and is uniform for the whole roll. The importers have refused to correct the error. I believe I can make the adjustments myself. What is your suggestion?—W. A. S.**

A. The trouble lies, obviously, in the winding mechanism of your camera and is a fault that should be corrected by the makers or their representatives. Since you say they have refused to do this, your other alternative is to take your camera to an expert camera repair man. This fault has rather complicated reasons and it would not be advisable for a layman to attempt to correct it.

***Q.* I am the owner of two cameras with Compur shutters and should like to know how they operate. Recently I have heard the theory expressed that the Compur shutters are the least accurate of any type of shutter used in cameras. Is this true?—J. B. T.**

A. On the contrary, Compur shutters are regarded by many as the leaders in their field and remain fully accurate with proper usage and care; that is, periodical testing of the several speeds. But this is true of all shutters. One sure indication of their high efficiency is the fact that the Compur and Compur Rapid shutters are being employed on some of the most expensive cameras in use today. The Compur shutter operates on a system of gear wheels for the faster speeds, with an escapement for the automatic exposures that range from one full second to 1/10th of a second.

***Q.* Were I telling a person that the lens on my camera has a speed of *f*/3.5, please state in words (not numerals) just how this should be repeated. I was corrected recently on the way I say this and wish to know *who* is correct.—Miss M. A. B.**

A. This is usually stated: "F, three, five."

***Q.* Can you please tell me what caused the round spots on the enclosed negative? It was developed in Agfa formula No. 17, and I thought I followed the directions to the letter. Also, please tell me what the Weston and American Scheiner ratings are for the new film, Agfa Superpan Supreme—A. F.**

A. There's nothing wrong with your negatives, which, by the way, should make fine enlargements, but the next time you develop a roll of film make sure your tank is clean. The transparent spots on your negatives were caused by particles of dirt or dust in your tank. Before loading the reel, you can avoid similar results first by cleaning the tank thoroughly; second, by soaking the film in water for a brief period before pouring in the developer.

The Weston ratings for Agfa Superpan Supreme are 64 in daylight, 40 in artificial light; the American Scheiner ratings, 26 and 24, respectively.

***Q.* Will you please advise me how to dry prints in a so-called "lintless" blotter book so that they will not stick to the blotter? I used a double weight enlarging paper and washed it thoroughly for about 10 hours in running water before placing the prints face down against the blotter with their backs to the wax paper fly leaves, and still they stuck. Why?—K. L. R.**

A. In the first place, 10 hours of washing is much too long, for prolonged washing tends to degrade the brilliance of the print. One to two hours in running water is ample for getting rid of hypo in prints; beyond that the print is simply soaking. Your difficulty with the blotter book is apparently due to the fact that you are following only half the routine involved in drying prints by this method. After the print or enlargement is removed from the wash water, the water should be allowed to drain off for a few moments and the print then placed face down on one of the blotter leaves in order to remove excess moisture. Then turn the print around to *face the wax paper.* An alternative, and perhaps more effective method, would be to have some extra photographic blotters handy for removing the excess moisture and then place the prints in the blotter book with face to wax paper and back to blotter leaf. By this method, the print would first be placed between two blotters and some pressure applied with a roller. This would leave less work for the blotter book and so expedite drying.

Books

SELECTED BY THE EDITORS

MORE LIVES THAN ONE

By Claude Bragdon

HERE is a rich and unusual autobiography whose appeal is as many-sided as Mr. Bragdon's own career. Once a leading Rochester architect and a friend and disciple of Louis Sullivan, Mr. Bragdon designed several notable buildings. At the height of his career as an architect, he turned his talents to the theater, making a second reputation as stage designer for Walter Hampden. Those of our readers who followed our spiritualistic investigations some years ago would be interested in the occult studies of Mr. Bragdon, in which he has achieved his greatest distinction. The mysticism of the East is known to him as to few Occidentals. He collaborated on the translation of Ouspensky's *Tertium Organum* and was largely responsible for his introduction to American readers. Claude Bragdon has cast a vivid backward glance, and has caught much of the fullness of his four-dimensional life—as writer, architect, stage designer and mystic—in his life story. Few men have lived so fully or written of their lives so vividly.—$3.95 postpaid.—*A. M. T.*

HOW TO MAKE GOOD MOVIES

THE pleasure to be gained from the movie-making hobby is the sole thesis of the book and to this end it "picks up the story where the instruction manuals leave off." Splendidly illustrated, partly in color, the book discusses, in word and picture, such subjects as close-ups, color film, continuity, duplicates, editing, fades, film, indoor movies, lenses, panoraming, plays, projection, reverse action, slow motion, trick shots, and many other subjects, in all comprising a complete handbook for the amateur movie maker. A pocket inside the back cover contains two Kodachrome Exposure Guides, one for Type "A" film (artificial light), the other for use in daylight. (230 pages, more than 600 illustrations.)—$2.15 postpaid.—*J. D.*

DEMONSTRATION EXPERIMENTS IN PHYSICS

Edited by Richard Manliffe Sutton, Assoc. Prof. Physics, Haverford College

TO this book over 200 physics teachers contributed a total of 1200 direct, practical, but compact recipes for physics teachers and others of equal background, outlining experiments having good "showmanship" content. (545 pages, 6 by 9 inches, 408 illustrations.)—$4.75 postpaid.—*A. G. I.*

THE AMATEUR GUNCRAFTSMAN

By James Virgil Howe

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THE MIND OF THE JUROR

By Albert S. Osborn

WHILE this book is repetitious and long-winded, and is padded with many statements of commonplaces it also contains the impressions of a man who for many years has had an almost unequalled opportunity to observe the workings—or perhaps the creakings—of courtroom procedures in nearly every state of the union; readers will recall him as the handwriting expert at the famous Hauptmann trial. In minute detail he points out the inefficient, time-consuming performances of many of our courts of law. The author shows also that the same situation once obtained in England but, the lawyers there not moving to remedy it, the people did it themselves. It can also happen here. (239 pages, 6¼ by 9¼ inches.)—$4.70 postpaid.—*A. G. I.*

STARCRAFT

By William H. Barton, Jr., Hayden Planetarium, and Joseph Maron Joseph, Science Dept., Smedley Junior H.S.

FINDING and learning the stars of the constellations, making your own star charts, never lost with the stars (finding one's position), getting way out into space, making sundials, making a reflecting telescope—these are some of the subjects, largely practical, dealt with in this excellent book. It is full of practical things to do in learning astronomy. A keen lad of 12 to 16 would find it a treasure-house of astronomical lore—so would an adult. Intended primarily for youths, it is not "juvenile." That is, instead of being written in some special approach which adult authors too often imagine a youth requires, but which a youth at once spots as "phony," it consists of those parts of grown-up astronomy which can be explained to a youth, explained in grown-up language and approach. (228 pages, 6 by 9 inches, many illustrations and charts.)—$2.65 postpaid.—*A. G. I.*

SHIPS OF THE NORTH ATLANTIC

By A. G. Horton White

YACHTS, YACHTING & SAILING

By PayMr. Lieut.-Commander E. C. Talbot-Booth, R.N.R.

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THESE three separate volumes in a steadily growing list of similar books, while having a British slant, are complete in every respect. Each covers its subject matter in long discussions, hundreds of drawings and photographs, numerous plans and tables, maps and color charts. Each provides an invaluable reference and makes fascinating reading for those interested in these subjects. (Each book is 4¼ by 5½ inches; total pages are 523, 612, and 608 respectively.)—Sold separately, $3.20 each postpaid.—*F. D. M.*

We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

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Books Recently Received

BUSINESS CORRESPONDENCE AND OFFICE MANAGEMENT—*By Edward A. Duddy, L. E. Frailey, and Raymond V. Cradit.*—Methods, machines and systems for the business office to make it more efficient.—$1.95 postpaid. . . . MARVELS OF THE INSECT WORLD—*By Jean-Henri Fabre.*—A new edition, annotated and translated by Percy F. Bicknell, of a famous volume by a famous insect man.—$2.65 postpaid. . . . THE STORY OF WATER—*By Augustus Pigman* and edited by Alice V. Keliher.—A light study of the problem of water supply for civilized communities throughout the ages.—$1.60 postpaid. . . . THE STRUCTURE OF STEEL SIMPLY EXPLAINED—*By Eric N. Simons and Dr. Edwin Gregory.*—For everybody who has to do with steel: steel user, student, layman, or worker.—$2.15 postpaid. . . . PAINTING AND DECORATING—*By J. Ralph Dalzell and Alvah Horton Sabin.*—Mixing formulas, directions for all kinds of painting, and how to obtain unique surface effects. For painters, decorators, and contractors.—$1.65 postpaid. . . . CHANGING THE SKYLINE—*By Paul Starrett.*—The autobiography of an architect which is as fascinating as the skyscrapers in which he was largely interested. Many of the giant intellects of recent years helped to make the story which he tells.—$3.20 postpaid. . . . FLYING VISTAS—*By Isaac H. Jones, M. D.*—An informative book discussing the human being as seen through the eyes of a flight surgeon who believes that aviation can make us understand our physical selves, for the man who is "fit to fly" is an exceptionally keen human being.—$2.15 postpaid.

FOR OTHER BOOKS YOU WANT, SEE PAGE 262

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

AS is pointed out in "ATM" (p. 160) the telescope maker may use a machine for his glass grinding, or he may use his hands. Either method is satisfactory. Many, however, actually enjoy the fun of cooking up a machine, also of watching it work while they lean back and smoke. From the depths of the drawer in which things someday to be published are kept, we draw forth a group of accumulated letters, with photographs, describing grinding machines made by our readers.

Figure 1 shows a machine, made by Loyd A. Magruder, 800 Ashman St., Sault Ste. Marie, Mich. It has direct gear drives and is of all-iron construction, made, as Magruder points out, largely of junk and with very few tools. The stand consists of two old auto flywheels bolted to legs sawed from old auto frames. The oscillating cross member is driven from two crank arms, one of which shows in profile. The rest is a matter of gearing. Possibly, as someone has pointed out, the bevel gears and pinions could be backed up more closely with bearings, to get away from flexure and chatter, yet the actual forces involved in working a small mirror are rather low and the proof of the pudding is that this machine has been a success.

Magruder's design embodies some brass castings, in making which he found that the brass could be melted at the hot point of a home furnace stoker, using a crucible improvised from waste electrodes obtained for a few cents from a carbide company. He plans next to tackle a ruling engine. [Commenting on this, R. E. Clark, author of the chapter on small lenses, "ATMA," says: "Several years ago I tried to make one. Making the master screw is a heart breaker, and trying to make the thing perform is still worse." Practical instructions for making the screw are contained in Vol. IV of Glazebrooks' big "Dictionary of Applied Physics."]

Concerning the large machine shown in Figure 2, we have no data, beyond the fact that one of its builders was Geo. I. Moe, 4118 N. 16 St., Tacoma, Wash., and that it was built for use in grinding a 24″ mirror of Pyrex which for several years has been theoretically under active construction by the Tacoma Amateur Astronomers.

The machine shown in Figure 3 is the one used at the Warner and Swasey Co. shops, in Cleveland, Ohio, for grinding and polishing the 80″ mirror for the McDonald Observatory in Texas.

A long time ago we asked whether anyone had made a first mirror on a machine, with no previous hand experience to learn the "feel" of the work, and John MacDonald, 828 N. Hibbard Ave., Jackson, Mich., sent us the photograph shown in Figure 4, with the comment that "the answer is emphatically, 'yes.' I have a 10″ reflecting telescope in the course of construction which is primarily designed for photographic work. The focal ratio of the Pyrex mirror is 6.5. It was 'machined' on a similar disk of Pyrex through the various grades of grinding. When grinding was complete, the tool was covered with the conventional pitch lap, and on this the polishing and figuring were completed. The 'shift' of the knife-edge in the Foucault test, determining the difference of focal length between the central and outer zones of the paraboloid, can be lengthened or shortened at will, without any alterations in the shape of the facets.

"The machine was designed and built by myself, and is of the transverse bar type. It is adjustable to any stroke desired. The difference in the speed of rotation between mirror and tool can also be regulated. The mirror and tool both rotate in the same direction, but at different speeds. The rotating action of mirror and tool is produced by over-running clutches, which prevent any ratchet action and consequently do not permit any synchronism of the intermittent turning action of mirror or tool. The transverse bar slides on hardened steel rollers, and can be raised or lowered to accommodate any thickness of glass, and the grinding pressure is adjustable from nothing to 60 pounds."

The little machine in Figure 5 was also made by MacDonald and is for grinding small lenses. It may be run vertically for grinding and polishing, and horizontally for

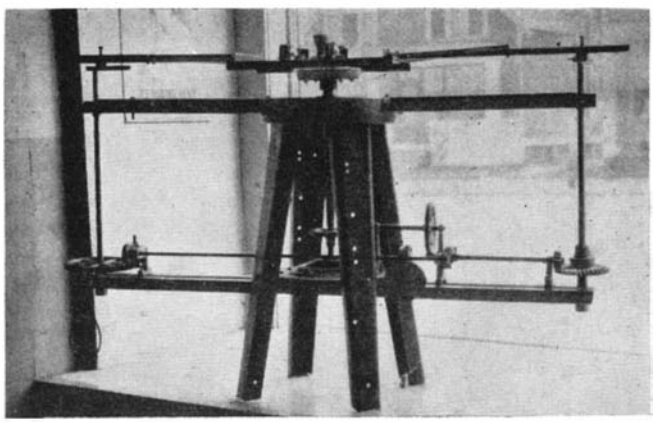

Figure 1: Magruder's grinding machine

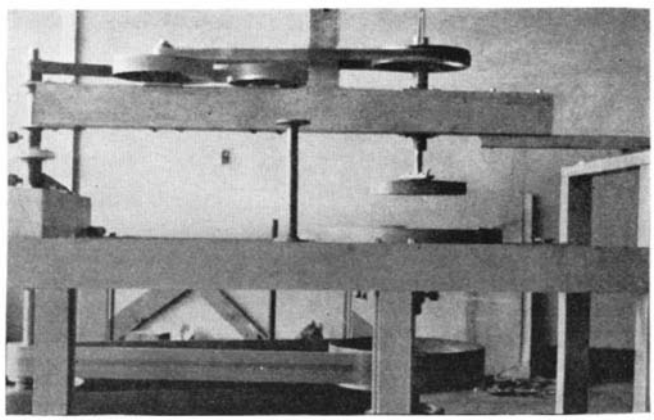

Figure 2: The Tacoma amateurs' machine

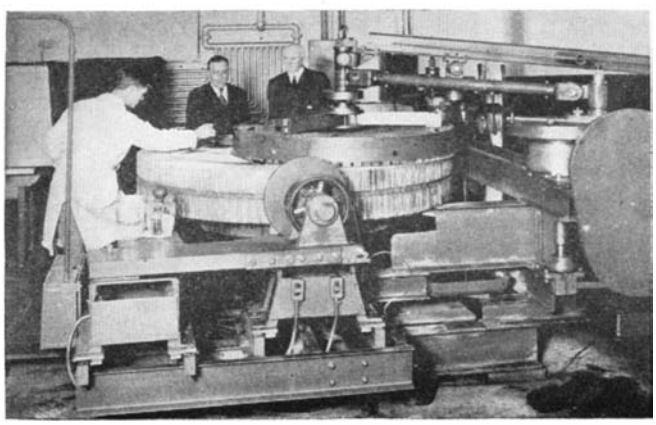

Figure 3: Large machine, Warner and Swasey

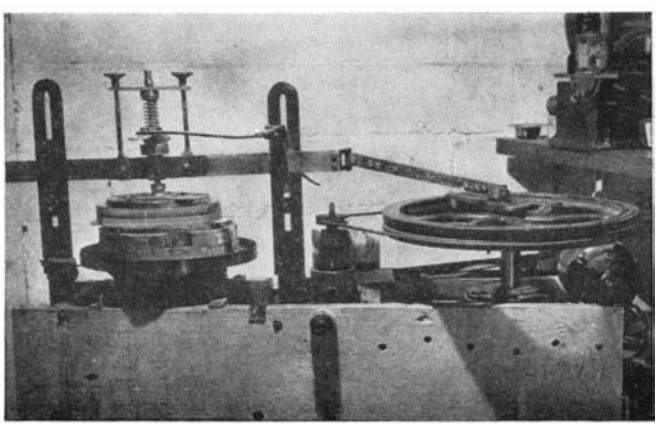

Figure 4: MacDonald's mirror machine

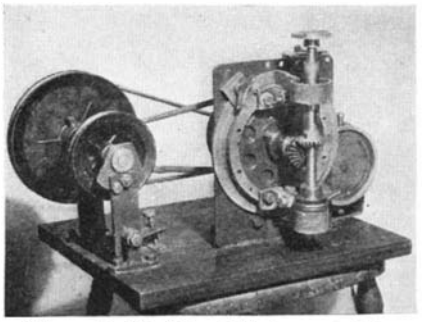

Figure 5: MacDonald's lens machine

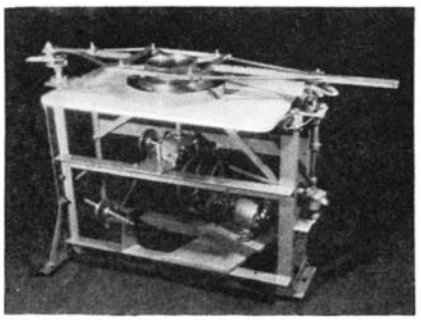

Figure 6: Kelley's Hindle machine

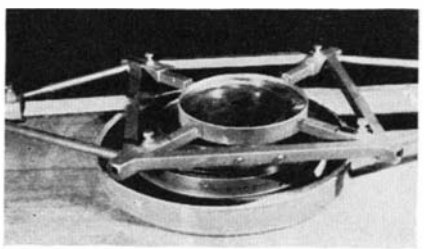

Figure 7: The Hindle "alligator"

centering, edging, and testing such work.

Hindle's alligator machine (so-called because the part on top which moves the mirror back and forth resembles an alligator in shape, when seen in plan) is becoming justly popular. We learn of two on Long Island, and Figures 6 and 7 show another, probably as finished in design and appearance as a machine could be made. The maker is the same Emir Kelley we mentioned in the October number—the Kelley who built a grandfather clock which automatically raises a flag and blows a whistle on his wedding anniversary, as a warning not to forget. Of this machine, Kelley (of Kelley and Stewart, South Brownsville, Pa.) writes in reply to our request: "It has a three-point base for leveling. The turn-table may be thrown out of gear, permitting easy rotation by hand for centering the tool. The tool is clamped in place by three eccentric, knurled disks, with a scrap of aluminum between disks and tool, making a very rigid chuck. The turntable and cranks are mounted on ball bearings, reducing friction and lost motion to a minimum. Figure 7 shows the central part of the alligator, with mirror floating between adjustable rubber-tipped push arms. The frame is adjustable for height, to provide a straight-line drive to the mirror."

Another Hindle alligator machine is shown in Figure 8, a photograph sent us by Franklin B. Wright ("ATM," chapter on accuracy in parabolizing, and "ATMA" chapter on theory and design of Schmidts), who says the machine was built by Carl E. Wells, 419 Oak St., Roseville, Calif., also that "the most beautifully figured mirror I have ever gotten a knife-edge in front of

THE BEGINNER'S CORNER

THIS is the beginning of "The Beginner's Corner," set aside from the more advanced discussions of the amateur telescope making hobby to be found in the surrounding department, and it will endeavor to live its life on the level of the average beginner, avoiding the more rarefied atmosphere in which the advanced amateur telescope maker customarily dwells. Its purpose is quite frankly to interest the new readers of Scientific American in the telescope making hobby, which has been dealt with by this magazine in nearly every number since 1926.

Actually to tell here how to make a telescope would not be practicable, since that would require too many words. This is told in detail in the book "Amateur Telescope Making." However, four very simple telescopes of the kind sometimes chosen by the beginner from those described in that book are shown above. These telescopes have no tube, but a tube is not a necessity on a telescope. The long column of wood, pipe or other material, serves to support the large concave glass mirror at its bottom, and at its top a crosswise member carries a diagonal mirror and an eyepiece.

Such a telescope, simple as it is, will magnify 50 diameters. Take, for example, the second one shown above. Its builder, Ralph B. Rice, 17 Maple St., Saugus, Mass., says: "With this telescope the Moon is a wonderful study, Venus shows a beautiful, clean-cut crescent, Jupiter lights up the eyepiece like a sun, and Mars shows large and red."

The cost of construction varies with the amount of materials which can be picked up locally. A few have made such telescopes for $8 or even less but it is better to count on about twice that sum (which is, however, a conservative, outside estimate).

In the surrounding department there are shown, this month, photographs of a number of machines for grinding mirrors. This may mislead the reader into the belief that such aids are necessary. Far from this, machines are much the exception, and most amateurs, tyro or advanced, grind their mirrors by hand. At least 10,000 Scientific American readers have made their own telescopes.

TELESCOPTICS

(*Continued from page 275*)

was made by him." Wells, not Wright, is included in the photograph.

In the May, 1937, number two amateurs designated as "Castor and Pollux, the Gemini Twins"—namely, Edward P. Woolcock and W. E. Lester, 319 Hermosa Ave., Long Beach, Calif.—told how they were working on a 20" disk by means of a simple vertical spindle. Later they built and substituted for this the machine shown in Figure 9. Woolcock describes this as follows:

"The grinding machine is of the Hindle type and uses the familiar alligator principle, as explained in 'ATM.' We were able to make the machine for a total cost of $20, exclusive of the motor. Flat belts and pulleys are used to drive the three spindles at varying speeds. The diagram shows our belt and pulley arrangement, and Hindle on pp. 234-240, 'ATM,' gives the explanation.

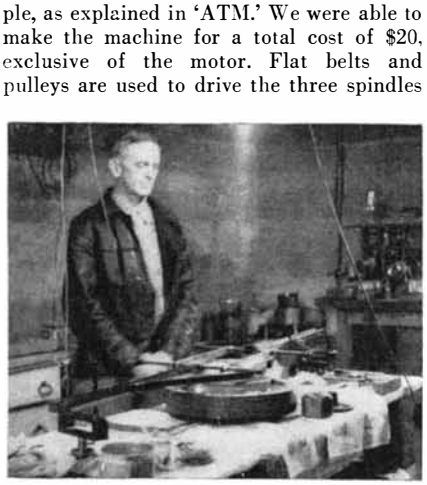

Figure 8: Wells and Hindle rig

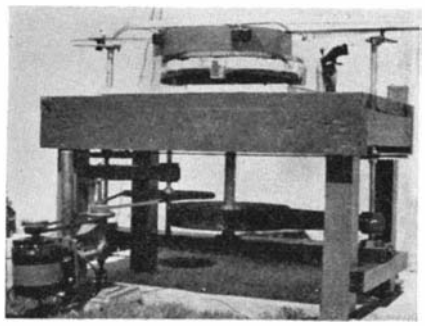

Figure 9: The Twins' Hindle rig

"As Hindle states, the machine gives an ovoid stroke, which can be varied at will by changing the bolt on the eccentric drive shaft. The stroke overhang can be varied by placing the drive bolt in different holes in the alligator. The side swing can be varied by changing the bolt on the other eccentric shaft. The rubber cleats on the alligator are not used to hold the mirror, but they are spaced about ¼" from the mirror's edge and act only as pushers. Their operation is unique for, because of the spacing between cleats and mirror, the mirror actually turns in a direction opposite to that of the tool which is rotating beneath it. This amount of mirror turning can be varied by changing the separation between the rubber pads and the mirror. At each swing of the stroke the mirror is pushed at a

place about ½" from where it was last touched by the rubber cleats.

"The ovoid stroke helps to keep abrasive and moisture on the tool—we were able to grind for ten minutes at a time without replacing grit or using extra water. In the finer grades we ground for 20 or 30 minutes at a time, only occasionally squirting water from a toy squirt gun along the edge of the tool. The ovoid stroke quickly carries any moisture to the center of the tool, where it is dispersed equally over the grinding surfaces.

"We were able, by means of this machine, to grind from No. 80 through emery in two days. By hand this would have taken two weeks. We ground for 1½ hours on each of six grades of Carbo., and fine emery. This

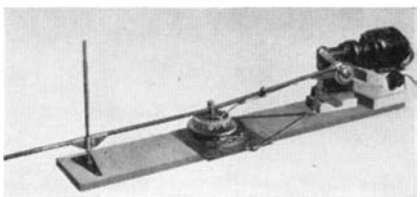

Figure 10: Hiner's Herschel-Lee rig

time is actual abrading time and does not include time out to change grit, etc.

"Ronchi tests indicate that we have a perfect sphere with the strokes we have been using.

"Our favorite polishing speeds have been near 4 r.p.m. for the tool, 40 r.p.m. stroke, and 10 r.p.m. side play. All the speeds have been varied from time to time, using strokes from 4" to 8", with a 2" to 4" overhang and a mirror rotating speed of about ¾ r.p.m.

"As can be seen in the picture, we used a small drill press to supply our power (1/3 h.p. motor) and to give us our first speed reduction and variable speed arrangement (by shifting the V-belt on the two multi-step pulleys).

"We had time to read 'ATM' and 'ATMA' during work and we don't feel a bit tired after 5 or 6 hours of polishing! The various motions of the mirror during polishing are equivalent to pushing the mirror over the lap at the rate of 1 mile per hour."

Figure 10 shows a small machine of the Lee type ("ATM," p. 160) made by W. B. Hiner, 123 Cleaves Ave., San Jose, Calif., polishing a 6" mirror. It makes 40 strokes per minute, of length from 2" to 10" (adjustable) and with tool and mirror turning in opposite directions, mirror on top. It will take up to a 12" mirror and has been used by Hiner on three mirrors. The Lee type of machine is generally similar to one described in an ancient book, "The Telescope," published in 1861 by the younger Herschel (Sir John), and designed and used by his father, Sir William Herschel.

We greatly regret that another group of machine descriptions, sent us earlier than the above, was lost in the mails when temporarily lent to an amateur who was building a machine, and was never recovered.

LAST August, F. M. Garland of Pittsburgh described here his methods of marking mirrors by different kinds of etching. We now discover that Lyman Nichols, 118 Liberty St., New York, N. Y., an amateur telescope maker, has developed special inks, black and white, for writing in white or black on glass and other smooth-surfaced kinds of materials. It does not etch but it is otherwise very solidly affixed.

CURRENT BULLETIN BRIEFS

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

DRAUCKER DAYLIGHT CALCULATOR is a pocket-size "slide-rule" device for either the movie or still photographer. It is very simple in operation and when properly set gives the correct diaphragm opening and shutter speed to be used under any photographic conditions. It is accompanied by a 12-page booklet of hints useful to the photographer. *Munder Electrical Company, Springfield, Massachusetts.—60 cents.*

COSMETIC MANUAL is a 94-page vest-pocket size book which presents formulas for the manufacture of all types of cosmetic preparations. Data are also given on manufacturing processes, precautions, hints, and general facts regarding the composition of creams and lotions. The Manual is available to manufacturers, chemists, and technicians. *Glyco Products Company, Inc., 148 Lafayette Street, New York City.—25 cents.*

LOW COST HEATING SYSTEMS is a 12-page illustrated folder showing up-to-the-minute designs of heating installations for small, low cost homes. It includes simplified plans of eight homes, together with material lists for the various heating systems adapted to each individual type. *American Radiator Company, 40 West 40th Street, New York City.—Gratis.*

TUBE-TYPE RESISTOR REPLACEMENT CHART is a handy wall chart which gives a complete listing of interchangeable and replacement tube-type resistors in various radio receivers. The chart consists of seven pages eyeletted together. It is of particular interest to the merchandiser or the radio service man. *Clarostat Manufacturing Company, Inc., 285 North Sixth Street, Brooklyn, New York.—25 cents.*

WIDER HORIZONS tells the story of corrected eye-glass lenses that are so designed that the glasses and defective eyes as a combination will function as satisfactorily as "perfect" eyes alone. In 16 pages are discussed the reasons why glasses are needed, how they are corrected, and how they can be of benefit to you. *Bausch & Lomb Optical Company, Rochester, New York.—Gratis.*

NICKEL—A VERSATILE AUTOMOTIVE METAL, by H. E. Blank, Jr., is a 12-page circular which presents in detail different applications of nickel alloys, in automobiles and aircraft. Illustrated with photographs and accompanied by a number of important tabulations. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

FOURTH ANNUAL REPORT OF THE FEDERAL HOUSING ADMINISTRATION gives the facts of the F. H. A. up to December 31, 1937, including a general review of the purposes and functions of the organization, its methods of operation, and other facts of interest to taxpayers and home owners. House Document No. 696. *Government Printing Office, Washington, D. C.—Gratis.*

INDO-AMERICAN TRADE RELATIONS, by the Hon. Nalini Ranjan Sarkar, is a survey of export and import trade between India and the United States. It is essentially a plea for better mutual understanding of the problems involved and for a new orientation of trade policy. *India Chamber of Commerce of America, Inc., 665 Fifth Avenue, New York City.—50 cents.*

MINERALS YEARBOOK, 1938, is the only official record of mineral production in the United States. In 1339 pages, including a comprehensive index, is presented a complete economic and statistical summary of the mineral industry. Technological progress, world conditions, and foreign trade are accurately reviewed. Included is a comprehensive survey of the bituminous coal industry. *Superintendent of Documents, Washington, D. C.—$2.00.*

THE STORY OF FAITH THAT LED TO FORTUNE tells the human-interest story of the life of Robert Gilmour LeTourneau, a man who has been largely responsible for the development of modern road building and repair equipment. The story shows what can be accomplished through tenacity of purpose founded upon common sense. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

LOCAL BIRD REFUGES, by W. L. McAtee, deals with means for attracting birds to the home and community. It tells of the economic and esthetic value of birds, how they may best be fed, and what measures should be taken to protect them from their natural enemies. The material is adaptable to all sections of the United States. Farmers' Bulletin No. 1644. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

NOTES ON FAULT LOCATION IN CABLES is a 52-page pocket-size booklet which will be useful to anyone concerned with trouble shooting in communication systems or electric-power transmission. It explains the methods involved, gives diagrams, and illustrates and describes the necessary equipment. Notebook E-53-441. *Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.—Gratis.*

FEEDING WILDLIFE IN WINTER is a 22-page pamphlet that gives practical suggestions for assisting upland game, water fowl, small mammals, and big game in getting through those months of the year when their natural food supply is at its lowest ebb. Photographs and drawings illustrate the compact and comprehensive text. Farmers' Bulletin No. 1783. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

TEACHING CONSERVATION OF WILDLIFE THROUGH 4H CLUBS, by Ruth Lohmann, is published in an endeavor to create among the youth of this nation a knowledge of wildlife and a demand for its conservation for the future. Miscellaneous Publication No. 291, U. S. Department of Agriculture. *Superintendent of Documents, Washington, D. C. —10 cents (coin).*

LEGAL HIGH-LIGHTS

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

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

Exhausted Combination

INVENTORS frequently ask whether a patent can be obtained on an old combination of elements where one of the elements has been improved. The question is not free from difficulty. However, the generally accepted rule is that where the improvement of one of the elements of the combination results in a new functional relationship between the elements or in a new mode of co-operation, a patent on the combination can be obtained. Where, however, the improvement of the element does not change the coaction of the several elements or parts of the combination and the elements continue to act and co-operate in the usual manner, no patent can be obtained on the combination.

This principle is exemplified in a recent suit for patent infringement involving a patent on a casement window structure. The claims of the patent were drawn to the combination of a frame, a window sash, and an operator for the window sash whereby the sash can be opened and closed. The combination of the three elements was, per se, old. However, one of the elements, namely the operator for the sash, was improved. The Court found that the improvement of the operator did not change the co-operative relationship of the several parts and that the operator still worked in the same manner to open the sash. As a result the Court concluded that the patent was invalid.

The Court succinctly stated its reasons for invalidating the patent as follows:

"All of Doering's claims cover a combination which includes the elements of window-frame, sash and operator, and many of them contain other elements. The invention, if any, consisted merely in the improvement of one of these elements—the operator. If there were some new functional relationship between the operator and the other parts of the structure, it would be permissible to claim the entire combination. There is, however, no new mode of co-operation involved."

Nolan Act

AS previously pointed out on this page, the World War not only profoundly affects the present-day politics of the world but also affects the current administration of the patent law. Ordinarily, where a patent is obtained abroad by an inventor he must file his application for his United States patent on the same invention within one year of his filing date abroad. During the World War, communication between the various countries of the world was seriously affected and many inventors were unable to comply with this requirement. Shortly after the World War the Nolan Act was passed which permitted inventors who had filed applications abroad during the World War to file applications for the same invention in the United States prior to September 3, 1921.

A recent suit for patent infringement involved a patent which was applied for under the Nolan Act. The defendant who was charged with infringing the patent contended that the patent was invalid for the reason that the United States patent was not based upon the same invention as the foreign patent and that the Nolan Act only extended the privilege to file applications in the United States for the same invention as was patented abroad during the World War. The basis of this contention was that the claims of the United States patent were different and covered different subject matter from the claims of the foreign patent.

The Court pointed out that the foreign patent disclosed the same invention as the United States patent and held that it was unnecessary that the claims cover the same subject matter. In this connection the Court stated:

"In the Patent Office the disclosures of the foreign patent and not the claims always have been taken into account * * * The French patents disclose the invention that is set forth in the United States reissue patent."

Damages or Profits

BUSINESSMEN frequently inquire as to the measure of damages in a suit for unfair competition. In other words, when a Court determines that a defendant in a suit is guilty of unfair competition, how does the Court determine the amount of damages that should be paid to the injured party? Most of the courts of the United States, including the Federal courts, hold that the injured party is entitled to recover either profits or damages, but not both.

The profits consist of the profits realized by the infringer from the sale of the infringing article. The theory upon which this is based is that an infringer should be required to turn over his gains to the true owner upon the same principle that a trustee is required to turn over to the beneficiary any profits that he has realized by a wrongful use of the trust property.

Damages are based upon the loss of sales or income resulting from the defendant's infringement. In this connection it is not ordinarily presumed that the plaintiff would have made the sales made by the defendant if it were not for defendant's infringing acts and it is necessary for the plaintiff to prove by competent evidence that he actually lost sales or that he was forced to reduce his prices due to the defendant's infringing acts. This principle was recently reaffirmed by the Federal Circuit Court of Appeals in the Sixth Circuit. It will be readily appreciated that in most instances it is easier for the injured party to prove the profits realized by the defendant than to prove the actual damages sustained by the injured party.

Copyrighted Moving Pictures

THE Federal copyright laws do not prevent the several states of the Union from regulating the display of copyrighted moving pictures within their territorial limits, according to a recent decision of the Federal Court in North Dakota.

The state of North Dakota passed a law prohibiting the operation of motion picture theaters which are owned, controlled, managed, or operated in whole or in part by producers or distributors of motion-picture films.

A company engaged in the business of producing and distributing motion pictures brought suit against certain officials of the state of North Dakota to restrain them from enforcing the act, contending, among other things, that the law impaired rights protected by the Federal Copyright Law in that the motion pictures displayed in the theaters were copyrighted. The Court rejected this contention and sustained the validity of the North Dakota statute, holding that any remote effect that the statute might have upon the rights of the producers or distributors under the copyright law did not amount to an invasion by the state of North Dakota of the field exclusively reserved to the United States government.

Martha Washington

THE name of the first First Lady of the Land was involved in a recent suit for unfair competition brought by a candy manufacturer against an ice cream manufacturer. The candy manufacturer contended that he had used the name Martha Washington as a trade mark for candy for many years and that the defendant had recently started using the same name as a trade mark for ice cream. The candy manufacturer contended that the ice cream manufacturer adopted the name Martha Washington for the deliberate purpose of trading on the good will and reputation built up by the candy manufacturer.

The ice cream manufacturer made a motion to dismiss the suit on the ground that ice cream and candy were not goods of the same descriptive properties, were not in direct competition, and that, accordingly, the use of the name Martha Washington on ice cream did not infringe any of the rights of the candy manufacturer.

The Court denied the motion and refused to dismiss the suit, holding that in a suit for unfair competition it was not necessary that the goods be in direct competition if there was a likelihood that the plaintiff's good will would be endangered by the defendant's actions. In this connection the Court stated:

"In a suit for unfair competition, it is sufficient to show that plaintiff's good will is likely to be endangered by the defendant's use of plaintiff's name or mark. It is not necessary to allege or prove direct competition between the products of each."

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WE'RE CRAMMING THIS PAGE WITH "COPY" BECAUSE WE WANT **SCIENTIFIC AMERICAN** READERS TO KNOW **ALL** ABOUT THE NEW

U. S. CAMERA MAGAZINE

BACKGROUND—Four years ago, there was a large void in American photography. The leading photographic nation had no photo annual worthy of American photography. Seeing this need, U. S. Camera, an *annual* of the best in photography, was established. It became an immediate success, a best seller every year it has been produced.

Then, partly because of this success, picture magazines started blossoming. Yet, paradoxically, the period did not bring forth a fine photographic magazine—one devoted to the best in photography. The challenge of producing such a magazine is as clear today as the challenge of producing the annual was four years ago. The opportunity and the challenge are again accepted. With Edward Steichen, Anton Bruehl, Tom Maloney, Willard D. Morgan and Phillip Andrews as editors, U. S. CAMERA MAGAZINE, a quarterly, is being published October, 1938.

IMMEDIATE EVENTS LEADING UP TO PUBLICATION—You may say —"another picture magazine!"—and with all good right you can say it in a world alive with photographs, photographs, photographs. But to your question, we make answer in this wise. We ask you to consider today's "picture" magazines. You will find that every magazine today is dealing with a *phase* of pictures and not photography in all its breadth and scope. But what magazine gathers to itself all the color, thrills, beauty, suspense and fun of photography?

WHAT YOU WILL FIND IN U. S. CAMERA MAGAZINE—U. S. Camera Magazine will not hang its hat on sex, instruction, news or any of the specialized departments of photography, but will till *every* acre in the field. In it you will see the art of the best photographers in the world. You will see color photographs that will make you gasp. You will see documents of photography that have never been shown before. You will see man and horse and machine caught at their best and worst. You will see the strange and wonderful things of science. Every subject which eventually reaches the pages of U. S. Camera Magazine, will be presented without heed of expense or time, with every possible attention to its photographic excellence.

One thing will be cardinal—every picture, regardless of its subject or use, will carry its own history: Camera, exposure, lighting, lens, aperture, equipment and other data on its taking, with comments by the photographer himself.

THE MEN BACK OF U. S. CAMERA MAGAZINE—Nucleus of the magazine's editorial staff are the men who made U. S. CAMERA yearbook the leading American photographic annual. These men know photographs, know the photographers, and know what's going on in the world of light and lenses. The permanent editorial staff is composed of: *Edward Steichen, Anton Bruehl, Willard Morgan, Tom Maloney and Phillip Andrews.*

To them, add this active advisory board: *Lejaren Hiller, Arnold Genthe, Will Connell, George Hurrell, Tom Underwood, Ted Cook, Dorothea Lange, Arthur Gerlach, M. F. Agha, Valentino Sarra, William Rittase, Edward Weston and James Doolittle.* An editorial board such as this could never be gathered together for a magazine of lesser scope and broadness. Their active interest assures the magazine of the highest type of craftsmanship—the taste and skill which have made them leaders in their various branches of photography.

HOW U. S. CAMERA MAGAZINE WILL LOOK—It will be the largest and most expensive photographic magazine in the world. No effort will be spared to make it the finest piece of publishing of its type. It will appear quarterly. It will cost 50¢ a copy.

SIZE: An unusual size has been selected, measuring 11½" x 12¼". This format permits spreads of unusual power with emphasis on large illustrations.

PRINTING: The finest type of letterpress printing by one of the ace American printers will be used in U. S. Camera Magazine. There will also be gravure inserts and color inserts. Inks will be specially chosen to bring out the best in each illustration and only fine-screen halftones by one of the leading eastern engravers will be used.

PAPER: Expensive coated stock of heavy weight will be used to assure printing and engraving methods of finest results.

BINDING: Modern wire binding has been decided upon not only because it improves appearance and permits the reader to spread the magazine flat, but because it assures permanence to each copy.

OUR CHARTER OFFER TO SCIENTIFIC AMERICAN READERS: You now know what you will find in the big and many pages of U. S. Camera magazine. You will want this magazine—and we are going to make it easy for you to make sure of your first issue and all the quarterly issues which will appear during the next year. For $1.75 you can immediately earmark issues for your library. Just fill out the coupon below and send with your check today—or, instruct us to send a bill later.

THESE FIRST ISSUE FEATURES ARE A SAMPLE OF EDITORIAL CONTENT.

A GOOD PICTURE
—by Edward Steichen

ARTISTS SHOULD PHOTOGRAPH
—by Rockwell Kent

COLOR PORTFOLIO—large size color photographs by **Anton and Martin Bruehl and Arthur Gerlach.**

LUKE SWANK'S AMERICA
—by Beaumont Newhall

THIRTEEN SECONDS
—by Torkel Korling

LEJAREN HILLER—the model and the photographer.

COME ON KID, SMILE
—by Ruth Nichols

WHEN YOU BUY AN ENLARGER
—by Willard Morgan

AMERICAN ACES—Hollywood's **Will Connell.**

U. S. CAMERA PREVIEW—eight full pages from the new U. S. Camera Annual 1939 and many other articles and features.

IMPORTANT NOTE AND COMBINATION OFFER—In presenting U. S. CAMERA MAGAZINE to Scientific American readers, we want to stress the fact that the Annual will continue as in the past. The current issue of the Annual, off the press November 9th, is in as many ways in advance of its predecessors as each issue has been over that it succeeded. Your interest in photography entitles you to become a charter subscriber to both the magazine and the annual at the special rate quoted below. U. S. CAMERA ANNUAL sells at $2.90. Four issues of the Magazine cost $2. We offer both to Scientific American readers for only $3.75, a saving of over 24%. Act Now.

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381 FOURTH AVENUE, N. Y. C.

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PROOF THAT EVERY CAR IS THREE-CARS-IN-ONE

THEY CAME AND SAW... hundreds of motor mechanics and oil men...why modern cars are really three cars in one. At the Ethyl Motor Clinic popular makes of cars were run on the three grades of gasoline sold today. The entire audience *saw* the results in speed and power projected on a large screen. This test, and others, definitely proved that modern cars have three grades of performance depending on which of the three grades of gasoline is used.

THE THREE GRADES OF GASOLINE SOLD TODAY GIVE MODERN CARS A TRIPLE PERSONALITY

Automobile mechanics tell us that it's the car owner "who doesn't know what it's all about" that runs into the most trouble. Fortunately, the basic facts about what a man can expect from his car on each of the three grades of gasoline are so simple that you can easily understand them. Here they are:

Poor performance with "low grade" gasoline

There is no anti-knock fluid (containing tetraethyl lead) in "low grade" gasoline. Power is lost because the spark *must* be retarded by your car dealer to prevent "knock" or "ping."

Good performance with "regular" gasoline

Most regular gasoline has in it anti-knock fluid (containing tetraethyl lead). The spark can be considerably advanced for more power without "knock" or "ping."

Best performance with gasoline containing "ETHYL"

Gasoline "with ETHYL" is highest in all-round quality. It has *enough* anti-knock fluid (containing tetraethyl lead) so that the spark can be *fully* advanced for maximum power and economy without "knock" or "ping."

ETHYL GASOLINE CORPORATION, *manufacturer of anti-knock fluids used by oil companies to improve gasoline*