# SCIENTIFIC AMERICAN

August
1932
•
35c
a Copy

# WHEN THE AUTOMOBILE WAS YOUNG

SCIENTIFIC AMERICAN.

THE ADVOCATE OF INDUSTRY AND ENTERPRISE, AND JOURNAL OF MECHANICAL AND OTHER IMPROVEMENTS.

NEW YORK, THURSDAY, OCTOBER 2, 1845.

STEAM-CARRIAGE FOR COMMON ROADS.

**The above appeared October 2, 1845 as a prediction.**

**In the fifties, the first horseless carriage was barred from the streets of Paris because of its speed (4 miles per hour). American readers through the Scientific American knew of the car and its possibilities.**

**When Cadillac brought out the V-type motor it advertised in the Scientific American to determine whether or not the radical design would be accepted by industrial executives.**

**When Chrysler was studying he read every issue. "It was my Bible," he declares today.**

**History in the making will be a record of what Industry and Science are producing and Scientific American has facilities second to none for giving it accurately and entertainingly.**

**A reader audience which demands such intellectual stimulation must be considered by the advertiser.**

L. S. Treadwell.

*Vice-President · Advertising Director*

# SCIENTIFIC AMERICAN

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

**EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor**

## CONTENTS · AUGUST · 1932



### SCIENTIFIC AMERICAN DIGEST

#### Of General Interest



#### Aviation



#### Chemistry in Industry



#### Health Science



#### Current Bulletin Briefs



#### The Amateur Astronomer



#### Commercial Property News



#### Book Review

# ACROSS THE EDITOR'S DESK

THE story of the experiments of a pioneer in any branch of science is always interesting, especially when his work has not received as much official recognition as its merits would seem to demand. Such is the case of Colonel Hugh D. Wise, U. S. A. Retired, who, in the 'nineties, conducted a series of experiments with kites which definitely pointed the way toward the modern airplane. During the course of this work, carried out for possible military uses, many things were learned about aerodynamics, and the forerunner of the aileron was developed. From kites, Colonel Wise took the step to gliders. The account of his work, scheduled to begin in our September issue, fills a gap in the history of airplanes. The article was written by the Colonel himself; a foreword by General William Mitchell firmly establishes the position of Colonel Wise as a pioneer in aviation.

●

The ordinary freight car is a prosaic sort of thing, in itself, but when one from a far-off railway is noticed in the yards of a local road, the glamor due to distance is built up around it. How did it get there, and who has kept track of it through all of its peregrinations? What sort of system is behind the obviously ramified freight carrying business? To answer these and other questions, we have had prepared a highly authoritative article on the subject which will appear next month. A series of specially posed photographs will accompany the text.

●

An editorial on page 75 of this issue mentions the latest addition to man's pre-historic ancestors. We are fortunate to be able to present to our readers, in our next issue, an account of this latest addition, Solo man, written for us by Dr. William F. F. Oppenoorth, who made the discovery in Java, only a few miles from the site where Dubois, in 1891-92, found the remains of *Pithecanthropus.*

●

A stupendous engineering project, Hoover Dam (formerly called Boulder Dam), has attracted the attention of engineers throughout the world, and has aroused the interest of the public to an extent seldom achieved by such problems. Now that the work at the dam site is well under way and plans for completion have matured, we have obtained for our readers an article on the subject. This article, we feel, gives more accurate information than the general public has heretofore been able to find. The article was prepared especially for us by Walker R. Young, construction engineer on the project, and may be considered the last word on progress to date. The photographs and drawings which will illustrate the article go far toward clarifying the project for the non-technical reader.

●

Have you ever thought of insects in terms of levers of the first, second, and third classes as taught in elementary physics? Such an approach to the study of the arthropods lends new interest to the subject. In an article, "The Muscular Power of the Insects," S. F. Aaron points out various facts about leverage systems as they operate to provide motive force for various types of insects. The article, scheduled for our next number, will be illustrated by the author's original sketches and written in the style and with the clarity with which our readers are already familiar.

●

The amount of research that is accomplished before a new piece of ordnance is produced is vividly put forth in an article now ready for publication. Casting cannon from steel has been attempted in the past, but until recently the results have been uniform failure. Now, however, the desired goal has been achieved, with results that show economy of manufacture together with satisfactory performance. The background of cannon construction, and the details of the new centrifugal method of casting from steel, have been incorporated in the article mentioned, prepared for us by Lieutenant Steven L. Connor, Ordnance Department, United States Army.

●

Constant vigilance is the cost of forest protection, and those concerned with this branch of conservation are always ready to adopt methods that will increase their efficiency. In the past we have published articles on forest-fire fighting and on the use of radio for communication between fire-fighting forces. Now the Forest Service of the Department of Agriculture has developed new, light, and completely portable radio equipment that should greatly increase the efficiency of their fire-fighters. The story of the work will be ably told by A. Gael Simson, in charge of the application of radio to forest-fire control in the National Forests, in an article which we have scheduled for our September number.

Editor and Publisher

# WHEN SPENDING IS ECONOMY

Throughout our lives we have been advised to economize—not necessarily to spend nothing, but to spend wisely. So most of us have learned the lesson of economy in money matters. ❦ Economy is more important in the use of time. Part of our waking hours belongs to others—to employers, to family, to friends—but a part belongs rightly to ourselves, to be respected, guarded, and invested as deliberately and wisely as dollars. ❦ Education is a safe investment because it can not be lost in speculation. It is not subject to market changes. It is ours to enjoy for the rest of our lives. A trained and skillful mind is the best known protection during business depression; and training prepares us also to reap the benefits during business recovery. In proportion to its costs education yields the best dividends in money and in those satisfactions and enjoyments known as cultural advantages. ❦ The facilities of Columbia University are offered you to help you invest your own time wisely and profitably. Here is a partial list of subjects available for study at home.

## COLUMBIA UNIVERSITY

*Offers Home Study Courses in the Following Subjects:*

Accounting
Agriculture
American Government
Applied Grammar
Banking
Business Administration
Business English
Business Law
Business Organization
Business Psychology
Chemistry
Child Psychology
Classics
Contemporary Novel
Corporation Finance
Drafting
Economics
English Composition
English Literature
Essay Writing
Fire Insurance
Foremanship
French
Geometry
German
Grammar
Greek
Harmony
High School Courses
History
Interior Decoration
Investments
Italian
Juvenile Story Writing
Latin
Library Service
Literature
Machine Design
Magazine Article Writing
Marketing
Mathematics
Personnel Administration
Philosophy
Physics
Playwriting
Poetry
Psychology
Public Health
Public Speaking
Real Estate
Religion
Secretarial Studies
Selling
Short Story Writing
Sociology
Spanish
Stenography
Typewriting
World Literature, etc.

Education pays in so many ways that the mere announcement that dependable university training is available to everyone should be sufficient, yet many postpone starting. They are convinced of its desirability but delay undertaking the work. They realize its value but put off the decision—so long in many instances that nothing but regret remains. ❦ Through personal correspondence with interested, capable members of our regular teaching staff you can master in proportion to your effort and ability many interesting subjects that should help you, and bring to you pleasure in social or business life. ❦ The fees for Columbia Home Study courses are arranged to cover the cost of preparing and teaching well the subjects that are offered. Payment of tuition may be spread over a period of months if desired. ❦ If the partial list herewith does not include subjects you wish, write us without any feeling of obligation. Members of our staff may be able to suggest a course or program of study that you will enjoy. ❦ A bulletin showing a complete list of home study courses will be sent upon request. In addition to the general University courses this bulletin includes courses that cover complete high school and college preparatory training.

COLUMBIA UNIVERSITY, Home Study Department, 15 Amsterdam Avenue, New York, N. Y. Sci. Amer. 8-32

Please send me full information about Columbia University Home Study Courses. I am interested in the following subjects:

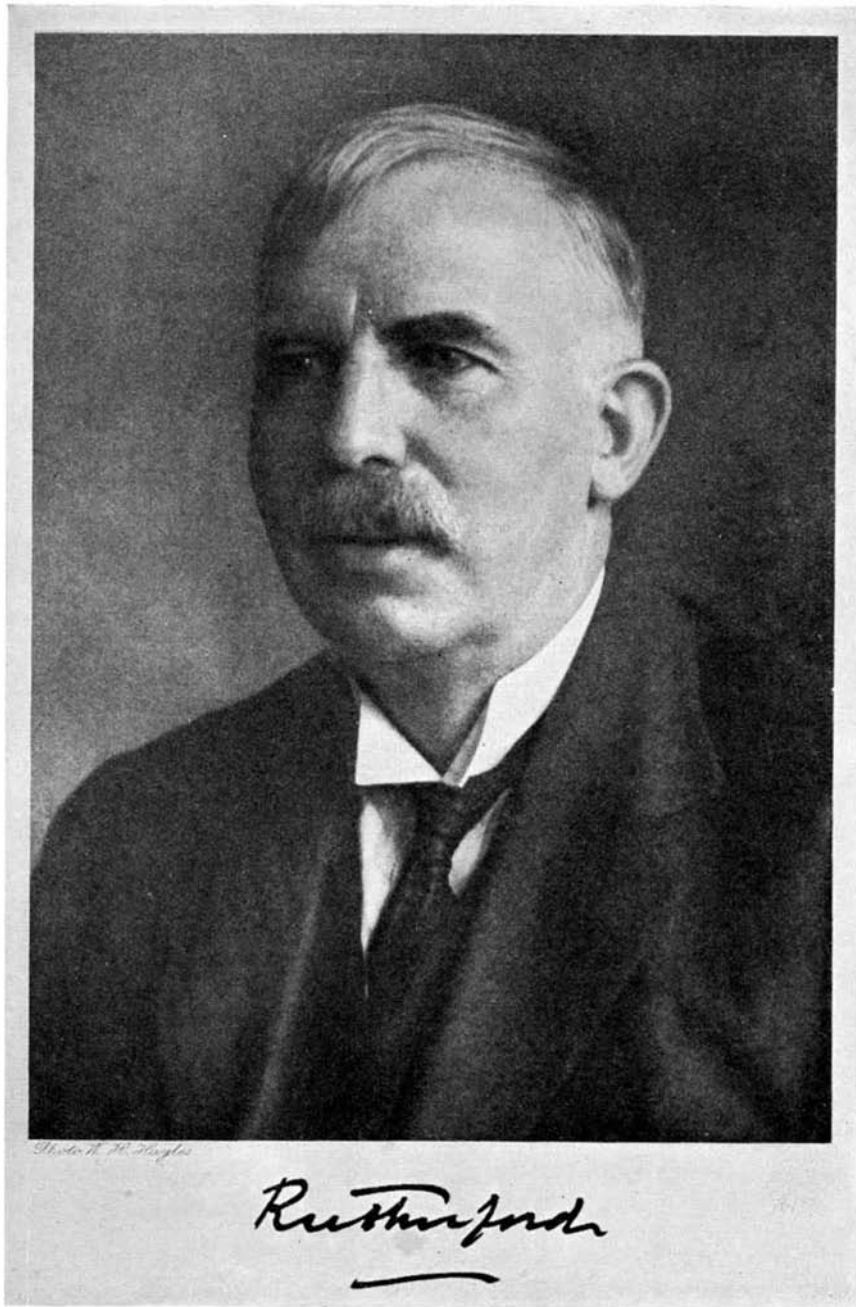
*Name*_____ *Occupation*_____

*Street and Number*_____

*City and County*_____ *State*_____

4258

SCIENTIFIC AMERICAN, August, 1932. Vol. 147, No. 2 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City.  Subscription price $4.00 per year. Foreign $5.00.

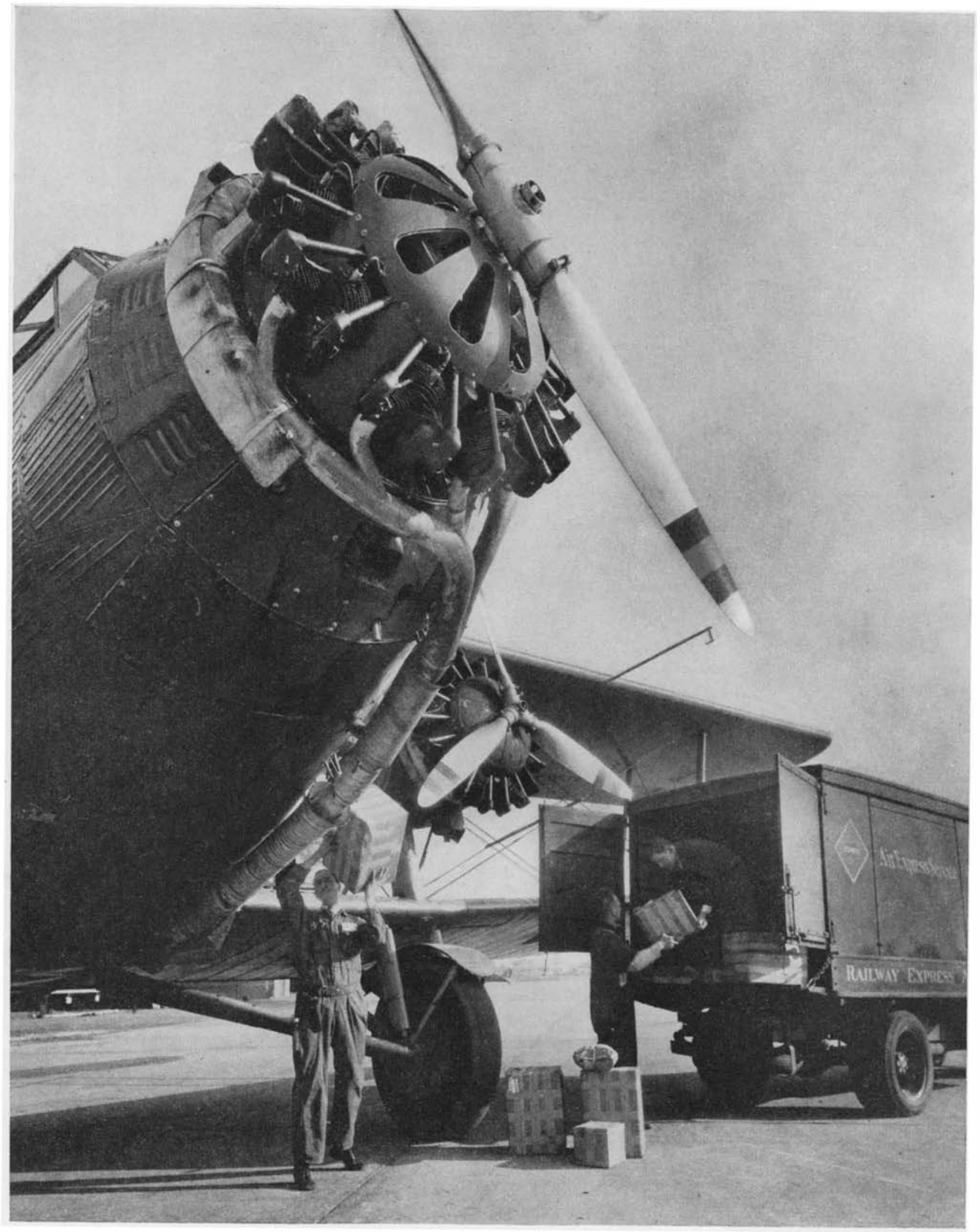


Courtesy of *Nature*, London

LORD RUTHERFORD of Nelson, until recently Sir Ernest Rutherford, is Director of the famous Cavendish Laboratory of Physics at Cambridge University, and by common consensus is the dean of the world's physicists. He was born a New Zealander (today he is called New Zealand's greatest son), and was educated at Cambridge in the same laboratory of which he is now the distinguished head.

Lord Rutherford combines two flairs: He has a flair for experimentation and, on account of his ingenuity in devising apparatus for difficult experiments in atomic physics, he has been described as the most skillful experimenter living. He also has a flair for leadership, his influence over other physicists at the Cavendish Laboratory having been truly enormous.

Of his experiments everybody knows; they led to our fundamental knowledge that the atom is not just a hard pellet, as was naïvely thought at one time, but is a whole world in itself. Of his leadership the French physicist, deBroglie, in a eulogy recently published in *Nature*, Great Britain's leading scientific journal, says; "The list of the physicists who have worked under his direction is a long sequence of names of which the greater number have attained fame." Two examples of this kind are presented in articles in the present number; the recent discovery of the neutron and the splitting of the atom are triumphs reflected from Lord Rutherford's inspiration to others.




## AN EIGHT-TON, 1575-HORSEPOWER LEVIATHAN OF THE AIR

AN unusual view of the nose engine, one of three 525-horsepower Hornets (see also page 45, July, 1932 SCIENTIFIC AMERICAN) that drive this one of the United Air Lines' coast-to-coast planes. These Boeing transports must climb from sea-level to 12,000 feet in their cross-country flights, carrying 14 passengers and 1000 pounds of mail and cargo.

Official Photograph, Airways Division, United States Department of Commerce

**An intermediate landing field showing keeper's quarters, garage, generating plant, and 24-inch rotating beacon**

# NIGHT FLYING WITH SAFETY

## Made Possible By the Men Who Keep the Beacon Lights Burning Along Our Airways

By ANDREW R. BOONE

RAIN swept across the intermediate landing field as the airmail plane circled overhead. H. P. Graham, the airway keeper, warm in his lighted office, knew what the pilot had not yet learned: The storm was moving northward along the plane's course, and the mail could not get through.

"Here, Deibert," he said to the airway mechanic, one of the 91 traveling experts who keep the nation's air lights in repair, "set these flares."

The keeper of the light switched on the radio. "Storm closing in ahead," he said into the "mike" to the pilot. "We're setting flares 200 feet inside east boundary."

Meantime Deibert took the pair of red flares, ran down the short incline to the field and, quickly driving them into the ground 15 feet apart, lighted both.

"Land immediately," was the message which they gave the pilot.

In a short time the flashing blades of the propeller appeared over the red boundary lights that marked the near end of the runway and soon the green wings of the plane settled down to safety.

As the plane taxied up to the fence and rolled to a stop, the pilot shouted through the falling rain: "I couldn't see the Del Mar light when I came through. Is she dark?"

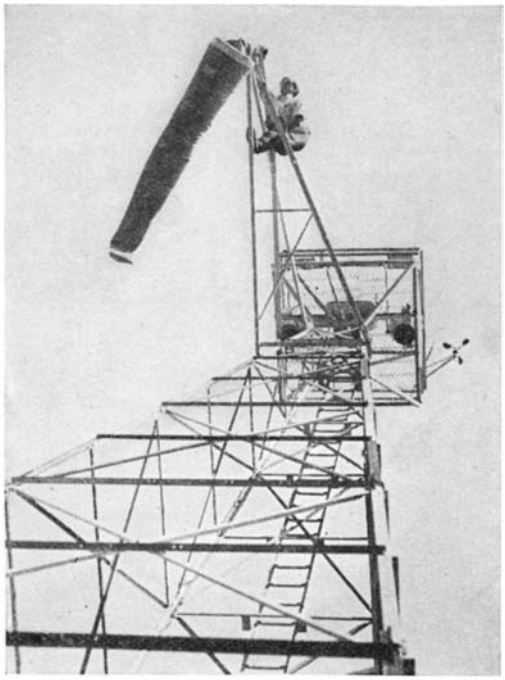
Keeping that and 18 other lights burning is B. T. Deibert's job. He patrols a 200-mile segment of the nation's airways for the Department of Commerce, visiting 19 lights in southern California twice each month; riding in comfort to each site in his auto truck, or walking—heavily laden with tools, light bulbs, cleaning fluids, and greases —across mountains to reach these lonely sentinels of the air.

BEFORE the pilot had disembarked from his cockpit, the airway mechanic had turned his truck south, bound for the light. Meantime the local airway keeper, after unlocking the toolhouse and supplying stakes and ropes to the pilot that he might tie the plane down until the storm lifted, returned to the clicking teletype to read the weather messages pouring in from other stations. These stations, located 50 miles apart throughout the airway chain, are manned by radio and weather experts who check hourly the sky, the weather, and local obstructions to vision.

Four minutes after he sat down at his machine, 11 stations, from Los Angeles to El Paso, had reported and on a single, narrow paper ribbon was written the weather for that airway.

The extraordinary effort made by the airways keepers and the traveling mechanics in aiding pilots both day and night are not confined to these routine tasks, however. Every day the keeper, even at the most isolated intermediate field, climbs the tall steel tower to grease the lighted wind sock, inspect the powerful light, and add a drop of oil to the lubricant in the wind vane. Assured that these instruments are working properly, he can determine from the ground all the weather information that flyers demand.

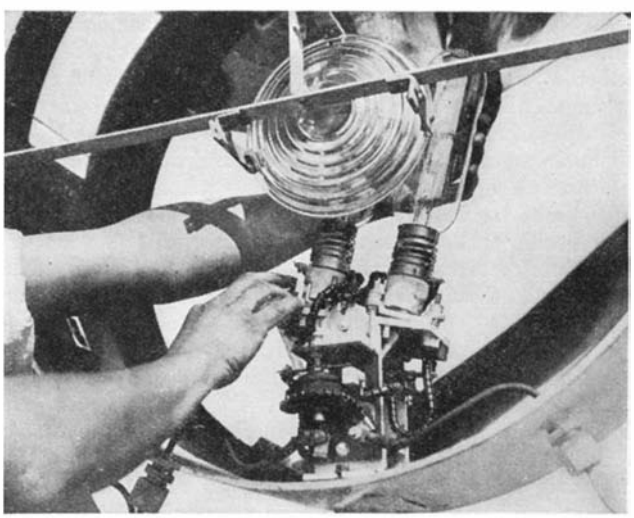
As the wind vane swings, lights flash below in the shack. These bulbs, of different colors, tell the keeper each instant of a shift in the wind. A telephone buzzer, on one wall, records the wind velocity as it turns the three-cupped anemometer atop the light tower. The keeper need only count the



It is essential to safety that an aviator know the direction of the wind at a landing field. At all emergency ports there is a "wind sock" to give this information, and it is illuminated at night. The photos at the left and right show the keeper of an intermediate landing field perched on narrow steel bars at the top of a tower, inspecting the wind-sock light

*Left:* More equipment that the intermediate field keeper must inspect and repair; the wind vane in the background, and anemometer at the right

*Right:* The radio sets at an intermediate landing field. The keeper can speak directly to the pilots of planes, informing them of weather conditions or relaying orders



The heart of a marker beacon whose beams are sometimes visible for a hundred miles. If the bulb behind the concentrator burns out, the spare will automatically take its place

*Below:* Airway Mechanic B. T. Deibert inspecting an airway light. He and other "traveling mechanics" often walk miles to inspect equipment, carrying tools and parts on their backs

buzzes over a certain period of time to determine the wind speed accurately.

But how high are the clouds? During the day he determines the ceiling by counting the seconds before a small, gas-filled balloon disappears in the clouds or high fog. At night, he trips a switch that sends a beam of light straight up from a light fixed to a standard 500 feet from the shack. Then the keeper steps outside and places to his eye a clinometer, a small device resembling in size and shape a round quart bottle.

As he looks through the clinometer at the top of the light, his line of vision passes two crossed wires. He sees both the light spot on the clouds and a portion of the surrounding dark cloud. After centering the wires on the bright spot, by a simple twist of a brass clamp he fixes in position a pendant that hangs vertically no matter at what angle the clinometer is held. Then by applying a mathematical table to the angle measured by the pendant and the clinometer, he learns in a few seconds the cloud height.

Seldom does a beacon light anywhere on the nation's air chain dim and die out. Two bulbs are fitted into each of the million-candle-power lights, although only one burns. Should the filament burn out, the light would dim momentarily while the other bulb is being pulled into upright position by an electrically operated mechanism. Of course, some other accident might prevent either from burning, but this is a rare exception.

Some 400 airway keepers man the lights and radio apparatus at as many intermediate landing fields, while the 91 mechanics move constantly from one to another of the 1750 beacon lights, checking the lights and power plants that keep them burning. These lights begin to burn automatically with the coming of darkness. An astronomical clock, which adjusts itself automatically with changing seasons, starts the engines which turn the dynamos to supply power.

Through the heat of deserts and deep snows of winter, the airways mechanics push to keep their rendezvous with the lone lights. Skis, boots, and sunburn lotions comprise part of their traveling equipment.

Whenever a hurry call comes for airplanes, whether to carry extra mail or rescue starving Indians in Arizona, the keepers of the lights stay at their posts to guide the planes on perilous journeys through the night. Some of the problems of keeping the lights burning throughout the year seem insurmountable, yet the powerful rays lead the modern mariners of the air on to safety through storms and fog.

AT the Donner summit in California, where many in the Donner overland party two generations ago perished in their push to California, the keepers tend their lights and radio range-stations through rains and blanketing snows in winter and spring. These two stations are located close together at the summit of the Sierra Nevada mountains, some 35 miles west of Reno, 7500 feet above the sea. The stations are 100 yards from a highway which is closed by snow during most of the winter. Help can come only by travelers on skis or snowshoes two miles over the summit from Norden Station.

During the last 40 years snows averaging 35 feet in depth covered this area, though sometimes it piles 65 feet high. These keepers go through the winter with a constantly dwindling food supply brought in before snows began to fall in the early autumn.

**Using the clinometer which indicates the height of the "ceiling"**

Not long ago a crew undertook to lay an electric line a mile and a quarter to a new light at Spencer, Idaho. Shortly after they commenced digging, a heavy snowstorm blew in on them. A sleet and hail storm followed. Yet the keepers continued pecking at the frozen earth and in a few days had set in place 30 sleet-covered poles, some of these erected in snow drifts high enough to cover automobiles. Despite the most severe storm in two decades, the light was burning 30 days after the storm had swept in on the site.

These beacon lights, spaced from 10 to 15 miles apart, and the lights at intermediate landing fields every 30 to 50 miles enable the nation's mail and passenger planes to fly right around the clock. By following the line of lights that stretch from the Atlantic to the Pacific and from Canada to Mexico, along the several airways, pilots steer clear of dangerous shoals in the air. They owe their lives and careers to the men who keep the lights burning.


**Installing a ceiling light on an intermediate landing field. This light will be used in connection with the clinometer shown in the photograph at the top of this page, and its rays can "spot" clouds 7000 feet high. Airway keeper's home is at left**

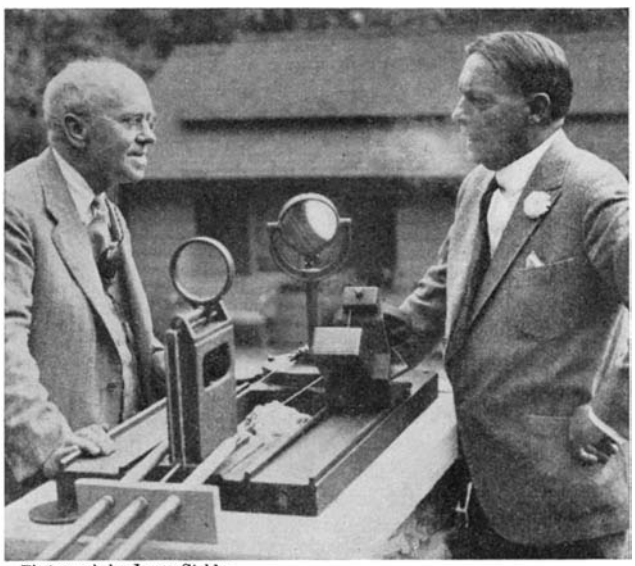
# ONE MAN WHO IS HAVING FUN

By ALBERT G. INGALLS

Photograph by the author

**Spectrohelioscope-photoheliograph**

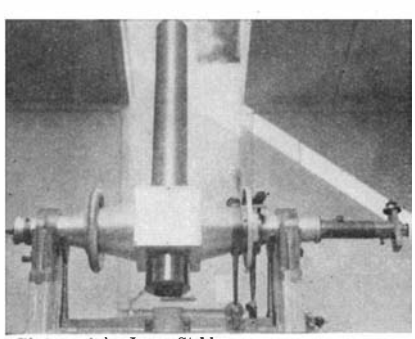
MOST persons of true scientific inclination can vividly recall boyhood days filled with fond dreams concerning a marvelously appointed workshop and private laboratory which they hoped some day to own. Did you not, gentle reader (to exhume a mannerism from the best-sellers of those naïve days), secretly aspire to possess something of this kind—a place where you could make all sorts of scientific apparatus and perform all kinds of experiments, becoming a real amateur scientist? On the roof you perhaps planned to mount an astronomical telescope, if not several. Sad to say, however, you lacked only one prerequisite: the needed cash. In this predicament you pored endlessly over many catalogs and over the SCIENTIFIC AMERICAN, too, and perhaps in this way you partly eased off or "sublimated," as the psychologists say, that vain longing while the cruel world of cold reality beat upon you—as on many of us it still beats.



Photograph by James Stokley

**Mr. Cook (right) and Russell W. Porter "talking it over" across a portion of the Hale spectrohelioscope**

A MAN who has realized such dreams as these is Gustavus Wynne Cook, whose estate near Philadelphia is something of an amateur scientific institution. Though a rich man, Mr. Cook makes in his own well-appointed shop on the top floor of his home much of his own scientific apparatus, and he makes it well. One piece of his workmanship is shown in the lower illustration on this page. Despite active occupation with business interests—he is president of the South Chester Tube Company, also of the South Chester Terminal and Warehousing Company, a director in one national bank, two trust companies, a sugar refining company, and an abrasive wheel company—Mr. Cook finds opportunity to be an amateur scientist and mechanic almost to his heart's content. He has been all through the early days of wireless and the later developments of radio, particularly short wave communication, and has also gone in heavily for the hobby of photography. In the latter he is a kind of professional amateur—an amateur with professional skill. The businesslike studio in his home is replete with equipment for art and exhibition photography. That home, too, is so filled in every corner of every floor and room with exquisite ship models of his own construction—dozens of them—that his family has almost been forced thereby to move out. He has been a breeder of fancy orchids; he is an artist in oils, water color, and pen and ink; he is a musician; and, withal, he is a skilled mechanic who could earn good days' wages in any shop as a machinist, tool maker, or instrument maker, if he had to. Mr. Cook is versatile.



Photograph by James Stokley

**The three-inch star transit**

Perhaps the finest piece of Mr. Cook's workmanship is a star transit three inches in clear aperture, a photograph of which is shown at the bottom of the page. This is of the "broken" type—that is, the incoming starlight is reflected by a diagonal mirror near the lower end of the tube and emerges horizontally through an eyepiece at one end of the axis. "Although I believe this is more difficult to build and adjust than the straight type, I am glad I undertook it," Mr. Cook states, "as it has proved most satisfactory." This instrument weighs about 300 pounds. A close inspection reveals that in detail of design and execution it is the equal of a professional instrument maker's job. The transit proper, that is, the part which carries the optical train, is mainly of aluminum, but the pivot bearings are rings of hard bronze shrunk on. A chronograph, also made by Mr. Cook, rests nearby on a small table and is driven by an electric phonograph motor.

THE center photograph, taken when an informal party of amateur astronomers recently visited Mr. Cook's suburban home, as many amateur (and professional) astronomers do, shows the only spectrohelioscope at present owned by an amateur. Mr. Cook definitely disclaims any suggestion that he made this instrument. It was purchased. The upper photograph shows the little building in which the business end of the same instrument is housed. It also houses a 40-foot photoheliograph which has a 5-inch lens photographically corrected, and an 8-inch Pyrex flat which is unsilvered and is wedge shaped so that the rear surface reflections are deviated about two degrees. This flat is mounted in an electrically driven coelostat made by Mr. Cook.

Another building of Mr. Cook's "Roslyn House Observatory" (see center photograph) houses an 8-inch Clark refractor with electric drive, while J. W. Fecker of Pittsburgh is building for him a 28½-inch Newtonian-Cassegrainian reflecting telescope with fork type mounting, plate holder, and spectroscope. Mr. Cook himself has under construction at present a motor-driven clock controlled by a crystal in a constant temperature room.

# OUR POINT OF VIEW

## Transatlantic Air Services

IN the Digest of this issue, Professor Alexander Klemin, one of our editors, discusses the prospective inauguration of transatlantic air services, and gives as his opinion that, with several rivals for the honor of being first to launch such a project, we may expect to see a number of air lines start across the Atlantic almost simultaneously. With many of the problems already solved by very nearly half a hundred flights across the north and south Atlantic, by plane and by airship; with routes and meteorological conditions well mapped; with plans for floating seadromes (Armstrong's) and for refueling ships made; and with the backing of their respective governments, in some cases the partial subsidizing of such projects by means of promised mail contracts, special planes for the purpose are being built in four or five of the greater countries that will benefit by transatlantic air services.

Fliers have spanned the northern Atlantic by the great circle route, by the Faroes and Iceland, by Newfoundland and Ireland, and by the Azores, and the south Atlantic from Africa to Brazil. The east to west crossing has proved to be more difficult on the whole than that from the American continents to Europe and Africa; the southern crossing least troubled by storms and fog. It naturally follows that one of the most seriously considered services should be one across the south Atlantic —from Europe to Africa and thence across the ocean to Brazil and return. Among the competitors for first honors in establishing transatlantic air services, it is therefore likely that either the Italians or the Germans will launch their services first, the former with planes and the latter with an airship and with planes.

Much experience has been gained across the north Atlantic but not enough to assure very dependable schedules should air services be established at this point. It must be remembered that at its present stage of development, the airplane is essentially a fair-weather machine and hasn't a very long range in stormy weather. Perhaps the Bermuda-Azores route might be open throughout the year, but the Greenland or Great Circle route would be unnavigable during certain stormy seasons of each year. It is not likely, therefore, that air services across the north Atlantic will be inaugurated in the very near future unless, perhaps, the American plane which Professor Klemin hints is being secretly built, turns out to be a most surprising "dark horse."

## Recovery

NO panacea has yet been found for our present-day economic ills although thousands of plans for assuring recovery have been advanced through books, magazines, every conceivable medium. One prerequisite to the successful working out of any of these plans is an abiding faith in the future to which must be coupled hard work. Since these two forces are extremely rare today, we find none of these plans working.

Industrial research was declared by Broderick Haskell, Jr., in a talk before the New York Section of the American Chemical Society, to be one of the strongest factors already making for recovery. "One has only to take stock of the new industries that have come upon the horizon since the last depression to realize what an important contribution successful research can make toward prosperity," he said. "The radio and radio broadcasting have given permanent employment to thousands; the sound picture forced the movie industry to invest millions of dollars in new equipment; commercial air transport is enjoying a record demand even under present conditions.

"Chemical science has provided synthetic nitrogen, alcohols, resins, plastics, and countless other products which have given rise to new enterprises in almost every instance. Rayon, chromium plating, and stainless steel are but a few of many more industries which have had their inception since the war and which in many cases have their best years ahead. Moreover, the list did not stop growing when the depression came upon us. Electric refrigeration and Cellophane have both come into their own since the close of 1929 and are steadily finding wider use. Television and the universal air conditioning of homes are industries in the offing."

Mr. Haskell thus elaborates what we have often remarked: that industry can not progress and prosperity can not be attained simply by resumption of production of standard articles by old processes; new inventions and improvements in old ones, and new, simpler methods of manufacture are urgently needed. As Mr. Haskell has said, some industries have made phenomenal successes during the past two years, but there are others that have been carrying on researches of note also, perhaps not so spectacular but important, nevertheless. This latter group may be marking time at present insofar as production is concerned, but they have faith in the future and as soon as financial conditions are better for them, watch their smoke—the smoke of their busy factories!

## Filling in the Gaps

SOME years ago Sir Arthur Keith, one of the world's two or three ablest authorities on the physical evolution of man from his ape ancestor, predicted that a whole welter of fossil forms, not only of man but of other man-like animals more closely related to ourselves than the living apes, would be discovered in future years. That prediction is moving slowly toward vindication. The most recent event, which doubtless will add one more to the six human types already known, is the discovery in Java of the fossils of what will be known as the "Solo man," not because he was a soloist but because he was found near the Solo River.

This fossil, discovered by Dr. W. F. F. Oppenoorth, Superintendent of the Geological Survey of Java, appears to provide a stepping stone between the famous *Pithecanthropus* (who was also a former resident of Java) and the modern Australian native race, our most primitive living type. It may be 100,000 years old. An article in which Dr. Oppenoorth describes his find reached our desk just too late to prepare for the present issue but is scheduled for the next.

This and other indications point toward one pertinent fact. It is already quite evident that the same stretching-out process which was applied a decade or two ago to the age of the earth is now being applied to the antiquity of man. Now that we have become accustomed to 1,000,000 years, science is asking for more. Sir Arthur Keith says there is nothing to make the existence of a human form in the Miocene Epoch an impossibility. This would indeed be a stretch—20,000,000 years! Yet the chances are we shall come some day to regard an estimate of that size as a commonplace. Our family tree is probably longer than we have thought. Our biggest practical problem is to trace it.

# AND NOW THE NEUTRON

By J. G. CROWTHER
Scientific Correspondent of the *Manchester Guardian*, England
Author of "Science for You"; "Short Stories in Science"

**With the discovery of the neutron, science now has one more physical entity to juggle with. Though some of the press appears several weeks ago to have given the impression that the neutron was a brand new lucky strike, physicists have suspected for years that some such thing was "hiding out" and if sought would sooner or later be brought to light by experiment. The accompanying discussion is more mature than it could have been had it been written earlier. It was especially prepared for the SCIENTIFIC AMERICAN by a writer, himself a Cambridge man, who is in close personal touch with the principals now engaged in the brilliant researches going on in the famous Cavendish Laboratory at Cambridge University, England.—*The Editor.***

THE modern theory of atomic physics has been erected on the results of sporting with atomic particles. By observing what happens when one atom bumps into another the physicist is led to deduce what the structure of atoms is like. Rutherford suggested that atoms are made of an extremely small positively charged nucleus with relatively distant electrons revolving around it as planets revolve around the sun, because particles shot at atoms go right through them except when they pass through a very small volume in the center, when they are deflected.

The positive charge of electricity in the atom appeared to be concentrated in a spot in the center; it was not spread all over the atom. The particles used in this shooting affair were the alpha-particles from radium, which consist of the nuclei of helium atoms. The machine-gun used by the gangsters of experimental atomic physics is the disintegrating atom of radium or a similar radioactive substance. When the radioactive atom explodes it shoots forth alpha-particles at 10,000 miles per second, beta-particles or electrons at nearly 186,000 miles per second, and some very penetrating wave radiations. It may send forth all or only one or two of these three sorts of radiations. Polonium emits alpha-particles only.

In 1912 Dr. James Chadwick, then a young man of 21 working with Rutherford, discovered that if an alpha-particle or a beta-particle shot out from a disintegrating atom were arranged to bump into the nucleus of another atom, this nucleus received such a shock that it vibrated violently and emitted a penetrating radiation or gamma ray. In 1919 Rutherford showed how an atom of aluminum could be disintegrated by arranging that an alpha-particle emitted by an exploding radioactive atom should hit the nucleus of an aluminum atom. The alpha-particle knocked a bit out of the nucleus of the aluminum atom, and this bit proved to be the nucleus of a hydrogen atom, or a proton. Soon afterward Blackett showed that the tracks of alpha-particles and the tracks of struck atoms of nitrogen and the bits knocked out of them, might be revealed by the Wilson cloud chamber expansion apparatus. These experiments showed that the nucleus of the nitrogen atom captures the alpha-particle which strikes it, while a proton is ejected.

By arranging atomic collisions the physicists learned the constitution, structure, and properties of atoms. Today this method of atomic research is much refined and developed. Many workers use it in order to discover more about the finer points in the structure of the atom.

IN 1930 Professor Bothe, now of Giessen in Germany, and Dr. Becker discovered that if atoms of the light metal beryllium are bombarded by alpha-particles they emit a radiation of quite exceptional penetrating power, much more penetrating than the radiations usually emitted by atomic nuclei caused to vibrate by impinging alpha-particles. These penetrating rays were apparently an extremely hard or penetrating gamma ray, which consists of waves similar in nature but shorter in wavelength than X rays. The new radiation was exceptionally interesting because it appeared to be a wave radiation intermediate in penetrating power between the ordinary gamma rays emitted by radioactive substances and the famous cosmic rays. It appeared to be due to waves shorter than gamma waves but longer than cosmic waves, so it might represent a near relative of the fascinating cosmic rays. Bothe and Becker had evidently discovered a very interesting radiation, and Dr. Millikan immediately saw how it might help toward the elucidation of the nature of the cosmic rays.

Toward the end of 1931 Mme. Curie-Joliot, the daughter of Mme. Curie, and her husband M. Joliot, started an investigation of the beryllium rays and measured their power of penetration by the thickness of material required to absorb them. They used polonium (which was originally discovered by Mme. Curie and named after her native country) as the radioactive source, because it emits alpha-particles only. Other radioactive substances emit mixtures of rays, and consequently produce complicated effects difficult to interpret. A small piece of beryllium was placed in front of the polonium. The alpha-particles from it shot forward and struck the nuclei of the beryllium atoms and caused the peculiar rays to be emitted. If these rays are allowed to fall on an ionization chamber they produce ionization in proportion to their intensity. If a sheet of lead is placed between the beryllium and the ionization chamber the rays are partly absorbed by the lead and the degree of ionization in the chamber falls.

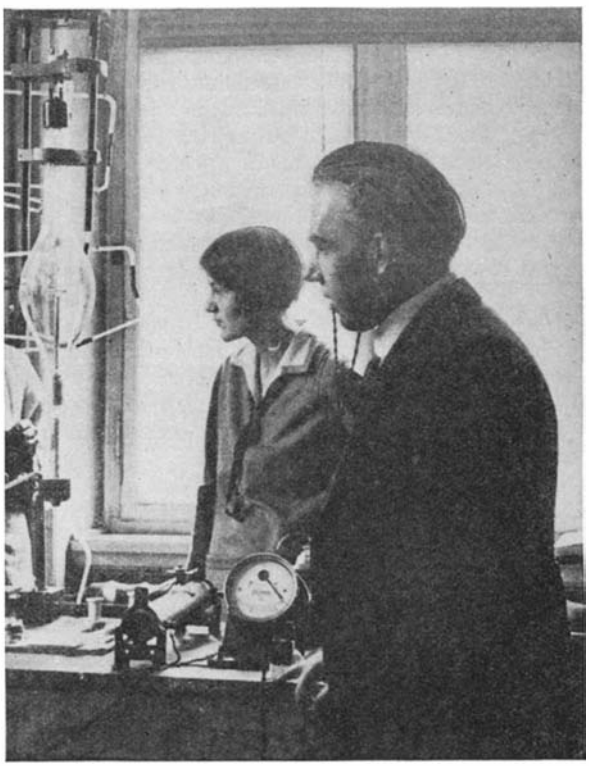
The Curie-Joliots made the remarkable discovery that if a layer of paraffin wax is placed between the beryllium and the ionization chamber the degree of ionization is actually increased, under certain conditions. This seemed strange, for it was difficult to understand how an obstacle to the rays could increase their ionizing power. They showed that this effect was due to protons, or nuclei of hydrogen atoms, struck out of the wax by the rays. The protons were ejected at a high speed, about one-tenth the velocity of light, as was proved by deflecting them in a powerful magnetic field. When the protons entered the ionization chamber they dissipated their energy within a shorter distance than the beryllium rays had done, and so enabled the beryllium rays to communicate their energy to ions in a smaller volume than they could have done directly, which caused the illusion

of an increase of ionizing power from the interposition of obstacles.

The Curie-Joliots assumed that the beryllium radiation was a wave radiation. When waves strike particles there is an exchange of energy, according to the law of the Compton effect. By measuring the energy of the ejected protons the energy of the beryllium rays could be calculated. Assuming that the rays were waves, the Curie-Joliots found that they must have an energy of about 50,000,000 electron-volts. The energy of the alpha-particles which excited them in the beryllium was not more than 6,000,000 electron-volts. 44,000,000 electron-volts of energy seemed to have appeared from nowhere, so the Curie-Joliots assumed they had discovered a new mode of interaction between waves and matter.

WHILE the Curie-Joliots had been making these interesting researches, Dr. James Chadwick and colleagues in the Cavendish Laboratory at Cambridge, England, had also been studying the peculiar rays from beryllium. They were the sort of phenomenon with which he had been familiar from the beginning of his career as a research physicist. He found that the beryllium rays would eject particles from other substances besides paraffin wax and materials containing hydrogen. He found that particles were ejected from helium, lithium, carbon, air, argon, and beryllium itself. When the rays were directed on to a chamber containing hydrogen, protons were knocked forward with speeds up to one-tenth the velocity of light. The particles ejected from the other substances were, in general, nuclei of their atoms which had recoiled after being struck by the radiation.

Dr. Chadwick measured the energy of some of the recoiling nuclei of nitrogen atoms and found that they were capable of releasing 30,000 ions in the ionization chamber, which means that they were able to detach 30,000 electrons from atoms they had bumped into. Now if these recoiling nitrogen nuclei had been struck by a wave radiation of 50,000,000 electron-volts energy they would not have been able to produce more than 10,000 ions. Dr. Chadwick explained that if the nitrogen nuclei had been struck by a particle of mass about equal to that of the proton, and moving with one-tenth the velocity of light, it would be able to produce about 30,000 ions. But the Curie-Joliots had noticed that the beryllium radiation could cause protons to move with about one-tenth the velocity of light. Of course this is what would happen if the beryllium radiation consisted of particles of mass about equal to those of protons, for the struck particle would bounce forward with the velocity of the particles of equal mass which had hit it. Thus Dr. Chadwick explained the high energy of the particles struck by the beryllium rays exactly, and without departing from the law of the conservation of energy. This was very strong evidence in favor of the beryllium rays being particles of mass 1.



**Professor Niels Bohr, whose recent discussions of the neutron are described near the end of the text**

There were several other consistent pieces of evidence which could be understood if the rays were particles, but not if they were waves. In conjunction with Webster, Chadwick had found that the beryllium rays were much more penetrating in the direction of movement of the alpha-particles which had excited them. This would be expected if the rays were particles, but not if they were waves. Webster found that alpha-particles from polonium excited rays in boron and fluorine which resembled the beryllium rays in having much greater penetrating power in the forward than in the backward direction. Another point: Dee discovered that the beryllium rays decreased in ionizing power after they had passed through obstacles. This is a property of particle radiations and not of wave radiations. When rays of waves pass through an obstacle there is a reduction of intensity but not of energy. Fewer waves get through, but those which do are as energetic as they were before they came to the obstacle. This result suggested that the beryllium rays were particles.

The original belief that the rays were waves arose from the experiments of Bothe and Becker, which showed that they were not measurably deflected by magnetic or electric fields. Rays of particles, such as alpha-rays or beta-rays, are deflected by strong fields. The failure to obtain such deflections with magnetic and electric fields seemed to show that the beryllium rays were waves. Particles such as protons, electrons and alpha-particles are deflected in virtue of their electric charges. A proton has a positive charge, and an electron a negative charge. These charges enable them to be deflected by a magnetic or electric field. Thus if the beryllium rays were particles, these must be without electric charge. Chadwick required a particle of mass 1 and without electric charge. Such a particle would explain all the observed results.

HE had not to look far for the idea of such a particle. If a proton and an electron are held extremely close together, almost in contact, they will form a particle of mass 1, for the mass of an electron is negligible, and without charge, because the positive charge on the proton neutralizes the negative charge on the electron. Such a particle had been clearly conceived by Rutherford in 1920. Rutherford's remarkable foresight in this matter will be discussed presently. Chadwick saw that a close combination of a proton and an electron was required. Such a particle could be named a "neutron."

Could the beryllium rays reasonably be supposed to be neutrons? Could the beryllium atom be expected to produce neutrons when bombarded by alpha-particles? Chadwick saw that this was reasonable. The nucleus of the beryllium atom contains nine protons and five electrons, that is, eight protons, four electrons, and a proton plus electron or neutron. When the alpha-particle, which contains four protons and two electrons, strikes a beryllium nucleus it is captured and a neutron is emitted. Thus

$$\underset{\text{(eight protons, four electrons, one neutron)}}{\text{beryllium nucleus}} + \underset{\text{(four protons, two electrons)}}{\text{alpha-particle}} = \underset{\text{(one neutron)}}{\text{one neutron}} + \underset{\text{(twelve protons, six electrons)}}{\text{one carbon nucleus}}$$

The bombardment produces one ordinary carbon atom nucleus and one neutron. If waves instead of neutrons were emitted, the atomic nucleus formed would be of a much less probable type. There are also energy properties de-

scribed by what are termed "packing-fractions" which are fitted by the neutron hypothesis but not by the wave hypothesis.

These are the evidences which led Chadwick to suggest that the beryllium rays are streams of neutrons. There is not one but several converging lines of evidence.

The real birth of the idea of a neutron is contained in Rutherford's Bakerian Lecture to the Royal Society of London in 1920. He was reviewing knowledge of the structure of atoms, after the achievement of artificial disintegration in the previous year, and passed on to speculations concerning possible sorts of matter which might exist though not yet discovered. He said:

"The idea of the possible existence of an atom of mass 1 which has zero nucleus charge [is involved]. Such an atomic structure seems by no means impossible. On present views the neutral hydrogen atom is regarded as a nucleus of unit charge with an electron attached at a distance, and the spectrum of hydrogen is ascribed to the movements of this distant electron. Under some conditions, however, it may be possible for an electron to combine much more closely with the hydrogen nucleus, and in consequence it should move freely through matter. Its presence would probably be difficult to detect by the spectroscope, and it may be impossible to contain it in a sealed vessel. On the other hand, it should enter readily the structure of atoms, and may either unite with the nucleus or be disintegrated by its intense field, resulting possibly in the escape of a charged hydrogen atom or an electron or both."

RUTHERFORD went on to suggest possible neutrons of mass 2, 3, 4, and so on. His remarks on the property of passing freely through matter are interestingly illustrated by absorption measurements which indicate that neutrons penetrate more than one mile of air, compared with the few inches which is the maximum range of the most energetic alpha-particle from radium.

Recently the study of the cosmic rays had focused attention on the possible properties of neutrons. Dr. Millikan and his colleagues had discussed the theory of their properties and some American physicists had published theoretical papers. In May, 1931 Langer and Rosen of the Massachusetts Institute of Technology published an interesting paper in the *Physical Review*. They suggested how neutrons might have a fundamental rôle in the evolution of matter. They conceived the neutron as a special form of the hydrogen atom, in which the electron and proton had come very close together. Assuming that this could happen, the evolution of the ordinary elements such as oxygen and iron out of the primordial protons and electrons became easier to understand:

In the beginning the universe consisted of protons and electrons, the two ultimate particles of electricity. Some of these came together and formed ordinary neutral atoms of hydrogen. Some of the atoms of hydrogen condensed into neutrons. As neutrons have no electric charge they have no difficulty in packing together, because they do not repel each other, as particles with like electric charges. Thus neutrons might be capable of making extremely dense material, millions of millions times denser than water. If a few odd electrons or protons happened to be ejected from such a conglomeration there might be condensations into little groups of protons and electrons which formed nuclei of the various heavy elements.

This suggestion made by Langer and Rosen is more credible than the usual view that the next element after hydrogen to be formed was helium, and that helium was formed by the accidental coming-together of four protons and two electrons. This would involve the simultaneous collision of six particles, which is extremely improbable. Besides, the possibility of dense matter being formed out of neutrons might help to explain the nature of the "white dwarf" stars. These are thousands of times denser than water and are supposed to be at extremely high temperatures. If they had a core of neutrons they could be dense and yet cool. The neutron may have remarkable possibilities in astrophysical theory.

A first-rate development in the theory of the neutron has already occurred. I was fortunate enough to be in Copenhagen, Denmark, in April and to attend the discussions on theoretical physics held there by Professor Niels Bohr. Bohr opened the discussions this year with a brilliant paper of his own on the theory of collisions between neutrons and other particles. His argument was based on the wave theory of matter. Matter itself is supposed to be made of waves, though of entirely different character from ether waves such as radio waves. Protons, electrons, neutrons, atoms, the earth, or any other material object, are supposed to be made of bundles of these peculiar waves. The size of the waves varies inversely as the mass, which means that electron waves are bigger than proton waves, and vastly bigger than earth waves.

When two electrons collide, two tiny bundles of waves of the same size collide. As the waves are of the same size they bounce apart elastically. When a neutron and an electron collide something quite different happens. The electron waves are much bigger than the neutron waves because the electron is so much lighter than the neutron. Consequently, the neutron bundle of waves behaves as a particle while the electron bundle of waves behaves as waves when a neutron and an electron collide. Thus a neutron may actually go through an electron.

Professor Bohr calculates that the chances of an electron and a neutron interacting when they collide are proportional to the square of the ratio of their masses. As the neutron is over 1000 times as massive as the electron, this means that the chances are less than a million to one. Thus electrons are scarcely ever disturbed when a neutron hits them, so no wonder they have been difficult to discover, and then only from their effects on protons and larger particles!

Photo Aerofilms, Ltd.

**The central portion of Cambridge University, showing the Cavendish Laboratory at "CL" near the center. Here the neutron was discovered and the atom split**

# ATOMIC ENERGY—IS IT NEARER?*

By WALDEMAR KAEMPFFERT
Corresponding Editor, *Scientific American*

**SOME weeks ago the scientific world was most agreeably surprised when word was flashed across the Atlantic that two young English physicists, Dr. J. D. Cockcroft and Dr. E. T. S. Walton, working in the Cavendish Laboratory of Physics at Cambridge, had split the atom, effected a transmutation of elements and as a by-product had succeeded in releasing some of the higher intra-atomic energy concerning which a great deal has been prophesied during the past three decades. The accompanying article is largely a commentary on that striking bit of news, which may later prove to have contained inestimable significance not alone in pure science but to the world at large.**
***—The Editor***

WHEN some wise historian of the remote future undertakes to interpret our time he will dwell less on our wars and our political upheavals than on our scientific achievements. And the early decades of the 20th Century will call for special comment, because it was then that physicists began an attack on the atom which resulted in discoveries that changed the whole character of chemistry and engineering. To that historian the experiment conducted by Drs. J. D. Cockcroft and E. T. S. Walton of Cambridge University, England, which resulted in the splitting asunder of lithium atoms and the reuniting of their shattered nuclei in new combinations, will be singled out as an example of the method which finally led to the voluntary transmutation of the elements, to the controlled release of the energy that holds matter together and thus to a revelation of the whole plan and method of creation.

This being a machine age, we pay less attention to the understanding of the cosmos that will come out of our attacks upon the atom than to the unlimited energy that will be ours when we have mastered matter. Our civilization is based on coal and oil. If the invention and introduction of the steam engine could make coal and oil of such importance that nations were willing to fight for them and that the whole character of our living and thinking was transformed, what will happen to society when the energy in the atom is placed at the command of engineers?

IF we are ever to utilize this energy we need something better than the hit-and-miss methods that must now be applied. When alpha particles from radium are directed on aluminum a nucleus is hit about once in a million times. At that rate an ounce of radium, costing several hundred thousand dollars, would not release enough energy from aluminum in a year to warm an ounce of water a degree or so. Cockcroft and Walton state that their protons hit the target only once in 10,000,000 times at 250,000 volts.

It is clear from this that we are only a little better off than the first savage who ever boiled water and saw steam rise. What did he know of the energy locked in the steam? How was he to divine that thousands of years after him engineers would be born who would devise cunning cylinders and pistons which would pump, haul, lift and do all that muscles would do? We are better than that savage in this: We know what mechanical energy can do. We know how much energy can be extracted from wood, coal, oil or a falling mass of water. We even realize the potentialities of the atom. This is the beginning of real progress.

We have still far to go before we can pretend to understand the atom and the secret of matter. But we have gone far enough to think of an engine which will harness the energy released in atom building. Not in our wildest speculations can we imagine what form that engine will assume. Perhaps some powerhouse engineer of the remote future will simply pour a few thimblefuls of sand into a disintegrating chamber. Perhaps he will actually change cheap metal into gold in the process of furnishing a city with light. Who knows?

What we have now in the form of engines, dynamos, and motors will seem quaint and amusing a few centuries hence. "To think that they actually burned coal to heat water and then used the steam to drive that funny engine and made the engine turn what they called a dynamo and in that way excited a current which they conducted to a lamp or a motor—how troublesome living and working must have been!" some boy will muse as he stands before a steam-engine of our day in a museum of the year 2500. Perhaps Lord Rutherford had something like this in mind when he said, years before Cockcroft and Walton came to his lectures as students in Cambridge, "the human race may trace its development from the discovery of a method of utilizing atomic energy."

Professor Millikan has often expressed the view that we are not likely to obtain enough energy for our industrial purposes by breaking down atoms through any electrical process. If we could collect all the radium thus far mined, the energy which it gives forth as it spontaneously disintegrates would not long suffice to run the peanut and popcorn roasters of the world, he has stated on more than one occasion. Too much work must be done on all the elements, except hydrogen, to make them give up their energy. "Man's only possible source of energy other than the sun is the up-building of the common elements out of hydrogen and helium or else the entire annihilation of positive and negative electrons," is the dictum he uttered at the Cleveland meeting of the American Association for the Advancement of Science. Probably this expresses the general view of physicists today.

The world is so obsessed by the preciousness of gold that whenever the subject of transmutation is broached it thinks only of increasing the monetary value of some base metal. To a physicist the change from lead to gold would be no more exciting than the change from nitrogen or aluminum to hydrogen which Rutherford effected long ago. True, if lead or mercury could be transmuted to gold the financial structure of the world might be threatened. But not for long. Some other standard of value would be adopted by international agreement.

A GIVEN weight of lead changing to gold would produce about a hundred million times as much heat as the same weight of burning coal. Hence a fraction of a grain of lead would do the work of a ton of coal. But the grain of lead turned into gold would bring only a fraction of a cent. The energy in the atom is worth far more than the price that the grain would bring in terms of gold. It is the owner of a coal mine or an oil field who has reason to worry if some day base metals could be cheaply

*Courtesy *The New York Times*

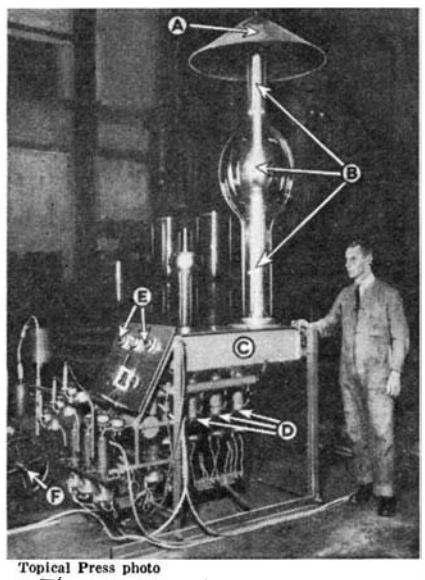
converted into what we now regard as precious metals.

When they directed a stream of high-speed electric bullets—protons—on a layer of lithium in an exhausted tube, Drs. Cockcroft and Walton were not especially concerned with the transmutation of elements or the utilization of atomic energy. They had but one object—to penetrate deep into the atom's core and thus satisfy that natural curiosity on which all scientific investigation is based. They had reason to believe that if their bullets were fast enough, transmutation of some kind would occur, and that some energy would be released. But neither they nor any one else expected that out of the lithium nucleus would come helium particles. Their work is of the utmost scientific importance because of the new methods that they adopted, and because of their results. To understand what they have done, we must consider what the atom is, and realize how difficult it is to tear it apart in order to learn how nature put it together.

AT this late day every one knows that an atom consists of a nucleus surrounded by electrons that vary in number with the weight of the atom. Hydrogen has one planetary electron. At the other end of the list is uranium with 92 planetary electrons. Between hydrogen and uranium lie the atoms of the other 90 elements, each atom having a number of planetary electrons that agrees with its numerical place in the Mendeléeff table of elements. Electrical forces are the cement that holds the atom together. Electrons are always negative. They are attracted by the positive nucleus. To smash the atom this bond must be broken; the mere stripping away of the outer rings of electrons is not enough. Most of the mass of an atom lies in the nucleus. It is the nucleus that determines just what kind of matter we deal with—whether it shall be a gas like hydrogen or a crystal like the diamond.

Originally, which means early in the present century, it was supposed that a nucleus consisted of positive electrons—positively charged particles which exactly counterbalanced the charges of the outer negative electrons. Later studies, notably those of Rutherford, showed that the nucleus is not so simple. It constitutes, in fact, a veritable atom within the atom. It is composed not only of protons, but also of electrons, in the case of elements higher in the scale than hydrogen. Physicists saw quickly enough that if they were ever to penetrate the secret of matter they must disrupt that nucleus.

A structure held together by force must be torn apart by force. And the binding force in this case is terrific. An atom is in itself invisible; the most powerful microscope that man can ever devise cannot magnify it so that it can be seen. The physicist who tries to disrupt the atom must smash indiscriminately. He cannot select a single atom and use it as a target. He must use millions of hammers on millions of atoms in the hope that an occasional telling blow will be struck. Even then he cannot know how successful he has been except by photographing the little




Topical Press photo

**The 600,000-volt apparatus used in the experiments at Cambridge. *A* is the sparking shield; *B*, inside glass cylinders; *C*, vacuum box where atoms were disintegrated; *D*, vacuum pump; *E*, snap switches; *F*, mechanical pump for use before fine condensing pump *D* is used**

tracks left by fragments of atoms that have been smashed.

The first man who succeeded in at least partly smashing an atom was Rutherford. He knew that he needed energy—that the blow struck must be violent. He cast about for the right kind of hammer. None that man could make would do. In radium he discovered the hammer that he needed. As it spontaneously disintegrates, radium shoots off alpha particles, which are the nuclei of helium atoms. They travel with a speed of about 12,000 miles a second, which is about 24,000 times faster than that of a rifle bullet—fast enough to go around the world in about two seconds.

Rutherford devised an apparatus in which different kinds of atoms could be hammered by alpha particles. They were both small and heavy, these particles. They crashed through the outer electrons easily. But at the nucleus they encountered the forces that hold the atom together. What physicists call a high-potential wall—an intangible wall of force—deflected them. Rutherford found it especially hard to make any impression on the nuclei of the heavy elements. With the lighter he was more successful. Nitrogen, boron, fluorine, aluminum, phosphorus were among those that yielded.

What was the result of this hammering? Always there came out of the nucleus protons—hydrogen nuclei. This was real transmutation. To change a score of different elements even partly into hydrogen was as startling as if lead had been changed into gold. But what was scientifically more important was the fact that always hydrogen nuclei or protons came out of widely different atoms. It was evident that protons, hydrogen nuclei, constituted the bases of all atoms—that the stuff out of which the universe was made must have been these protons and electrons.

The alpha particle method of attacking the nucleus of an atom has its decided limitations. If all the radium thus far mined and purified could be collected in one place it would give off only a known, fixed number of particles in a second. Furthermore, the speeds and energies of the rays from radium are not subject to control.

WHAT the physicist wants is an electric gun which he can load to suit himself—a gun which will make it possible to attain projectile speeds higher than those of the particles given off by radium. With such a gun either protons or electrons can be fired at atoms. The propellant is high voltage. Since voltage can be raised or lowered it follows that the blows struck are subject to some control.

Drs. Cockcroft and Walton are not the only ones who have devised an electrical method of hurling particles at atoms. Drs. M. A. Tuve, L. R. Hafstad, and O. Dahl of the Carnegie Institution of Washington have been experimenting for many months with protons to which energies as high as 2,000,000 and 3,000,000 volts have been imparted. Their methods are much like those of the Cambridge scientists. In either case the protons are artificially produced.

The whole problem of wrecking atoms reduces itself to high voltages. In order to generate voltages higher than any thus far attained, Dr. R. J. Van de Graaff is now constructing for the Massachusetts Institute of Technology a giant apparatus with which protons can be shot against atoms at 10,000,000 to 15,000,000 volts. His apparatus consists of two large spheres within which the experimenters sit. Electricity accumulates like water on the outside of a sphere. When there is more of it than the surface of the sphere can hold, it spills over to the other sphere in a blinding flash of artificial lightning. Imprison the flash in a tube and protons are carried to the target—the atom.

This method, applied on a less magnificent scale by Cockcroft and Wal-

ton, has led to dramatically unexpected results. Protons fired at lithium actually reached the nucleus. One proton was occasionally captured. Thus a new combination of protons and electrons within the nucleus became possible. Out of the nucleus flew two alpha particles—in other words, helium nuclei. Such is the explanation of their results advanced by the Cambridge scientists. Rutherford fired alpha particles at atoms and drove out protons. Cockcroft and Walton fired protons and obtained alpha particles.

The arithmetic of the Cockcroft-Walton achievement is easy to understand. The lithium with which the experiment was conducted had a mass designated by 7. The proton had a mass equal to 1. Since a proton was caught and imprisoned lithium's mass was raised to 8. The capture of the proton was like pressing a hidden spring and disrupting the atom. Out of the atom flew two alpha particles, each of mass 4. An alpha particle consists of two protons and two electrons electrically cemented together. Never was a result more unexpectedly obtained. Moreover, this is the first time that an atom has been disrupted by purely electrical methods.

More startling than the formation of alpha particles (helium nuclei) is the amount of energy released from the atom. Ten million shots were fired at 250,000 volts and one hit scored. At 400,000 volts, the highest attainable with the apparatus, the marksmanship was better. But—and here we must hold tightly to our chairs—the energy of each of the two liberated alpha particles was 8,000,000 volts. A total of 16,000,000 volts obtained for an expenditure as little as 125,000 and as much as 400,000! In the history of laboratory experimentation with the atom nothing more startling has ever happened. Yet it is not thus that we shall obtain atomic energy for the practical purposes of the future.

The discovery of Cockcroft and Walton dovetails neatly with that of Bothe and Becker. Last year Professors Bothe and Becker, who are members of the faculty of the University of Giessen, Germany, bombarded beryllium with alpha particles, after the fashion of Rutherford, who had knocked out protons from beryllium. Their particles, however, came not from radium but from polonium. They obtained rays as penetrating as those which would be generated by a 14-million-volt X-ray tube if we could build one—rays which could pierce three inches of iron and still retain one third of their intensity.

THE alpha particles entered the nucleus of the beryllium atom. A new type of carbon atom was created—a stepping-up of beryllium in the table of elements. And the building-up process was accompanied, quite as Einstein had predicted, by the release of energy which manifested itself in rays very much more penetrating or "harder" than the most powerful X rays that can be produced in a laboratory or than the piercing gamma rays emitted by radium.

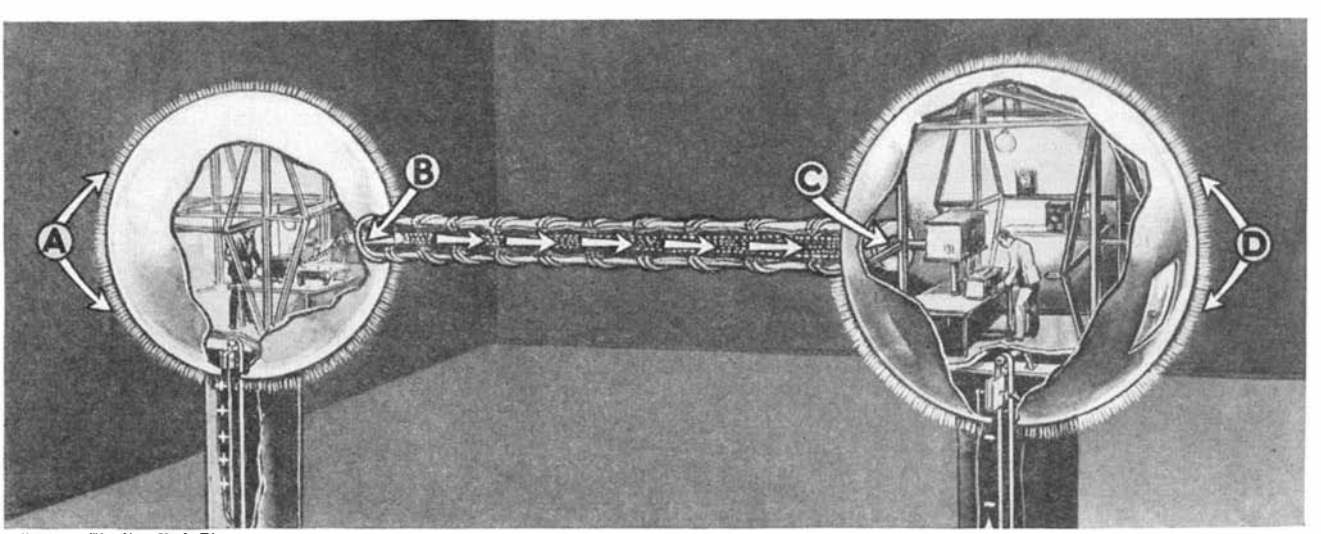
In the first erroneous accounts that came to us of the success achieved by Cockcroft and Walton, it was stated that hydrogen had been changed into helium with the liberation of energy. This is a building-up process of which physicists have long dreamed. Why energy should thus be obtained follows from Einstein. The atomic weight of hydrogen is 1.00778; that of helium, 4.00054, or a small fraction less than four times as much. When helium is created by the union of four hydrogen atoms something must become of matter equal to this small difference. This minute surplus becomes energy. The synthesis of a single gram of helium from one gram of hydrogen would produce as much heat as the combustion of 20 tons of coal.

Einstein has taught us that when an atom gives off energy it loses mass. The amount of mass which must be lost to yield energy is so small that it is scarcely perceptible.

Complete annihilation of a minute amount of matter—that is the engineering ideal of the Utopian who would dispense with coal, oil, and other fuels in the remote future. A single annihilated gram of matter, by which we mean the complete disappearance of its protons and electrons as atomic systems, would be more than enough, according to Haas, to lift a weight as heavy as all the buildings in New York combined to the height of the Empire State Building, or more than enough to raise the temperature of all the rooms in New York by several degrees.

Pessimists like Sir Oliver Lodge shudder when they speculate on the future. Man is not yet spiritually ripe for the possession of the secret of atomic energy, he reasons. Technically we are demi-gods, ethically still such barbarians that we would probably use the energy of the atom much as we used the less terrible forces that almost destroyed civilization during the last war.

Others are convinced that the new insight into nature which will be granted when the structure of the atom is at last known, and with it the method of controlling its energy, must be accompanied by a spiritual advance. Each new discovery about the atom makes man more consciously part of the world about him—links him with the stars, which are themselves composed of atoms, and with the dazzling light of the sun, which springs from atomic activity—and thus impresses him with the littleness of his greed and the puerility of his disputes.




Courtesy *The New York Times*

**To shatter the atom, Dr. R. J. Van de Graaff of Princeton is building this huge apparatus for the Massachusetts Institute of Technology. Surface *A* of sphere is coated with positive static electricity, that of *D* with negative electricity. If *A* is overcharged a bolt of 10,000,000-volt artificial lightning flashes across from *B*, disintegrating the atoms of *C***

# SOMETHING NEW—ALUMINUM JEWELRY*

By C. M. HOKE
Consulting Chemist

IN 18th Century Russia, they made stovepipes out of platinum. Undoubtedly they were good stovepipes, though a trifle heavy. But now platinum has found quite different uses.

In 19th Century France, they made jewelry out of aluminum. St. Claire Deville had found this white, malleable metal, amazingly light in weight, and naturally he had used it in making up jewelry and other decorative articles. Some of the original pieces may be seen to this day, in our museums, and they are not bad looking, either.

As late as 1854, the metal was worth almost its weight in gold. The regal guests of Napoleon III were served from aluminum dishes; but as the commercial era for the metal dawned some 30 years later, aluminum threw off its aristocratic cloak and went to work in the kitchen.

BUT many things have happened in the past 45 years. The demands for lightweight metals, combined with the development of modern metallurgy, have brought out a group of aluminum alloys characterized by strength and beauty. Aluminum is being used not only in science and industry—in trucks and buses, street cars and railroad cars, airplanes and dirigibles—but also once more in the manufacture of jewelry.

A hundred different materials are being made into novelty or "costume" jewelry—glass, silk, coral, natural and synthetic stones, Bakelite and other plastics, carved and colored wood, shell, and what not. The metals involved include brass, silver, German (nickel) silver, Britannia metal, and others. Because of its beauty, lightness, and permanence, aluminum promises to become popular.

Two outstanding novelties are shown in the illustration; the aluminum wrist watch and colored bracelets. The colors are lively pastel shades of blue, green, yellow, rose, and so on, and when combined with the silvery white surface of the metal, the effect is very pleasing to the eye—even the critical feminine eye.

To the metallurgist, the most interesting of these items is the watch. Both the case and the bracelet, as well as most of the inner parts of the watch itself, are made from strong aluminum alloys of the same general class that went into the framework of the Navy's new airship *Akron*—the world's largest.

**Examples of aluminum jewelry. The mesh of the bag is made from hard coiled sheet. Note the wrist watch**

These alloys possess the strength of structural steel, yet retain the beauty of aluminum. The non-aluminum parts, which constitute about 3 percent by weight of the watch, include the hands, main spring, and hair spring (which are steel), and the brass and steel balance wheel. The jewels, of course, are orthodox in every respect.

The watch is 65 percent lighter than a watch made from the usual metals, and it weighs, complete with the wrist band, a shade less than an ounce.

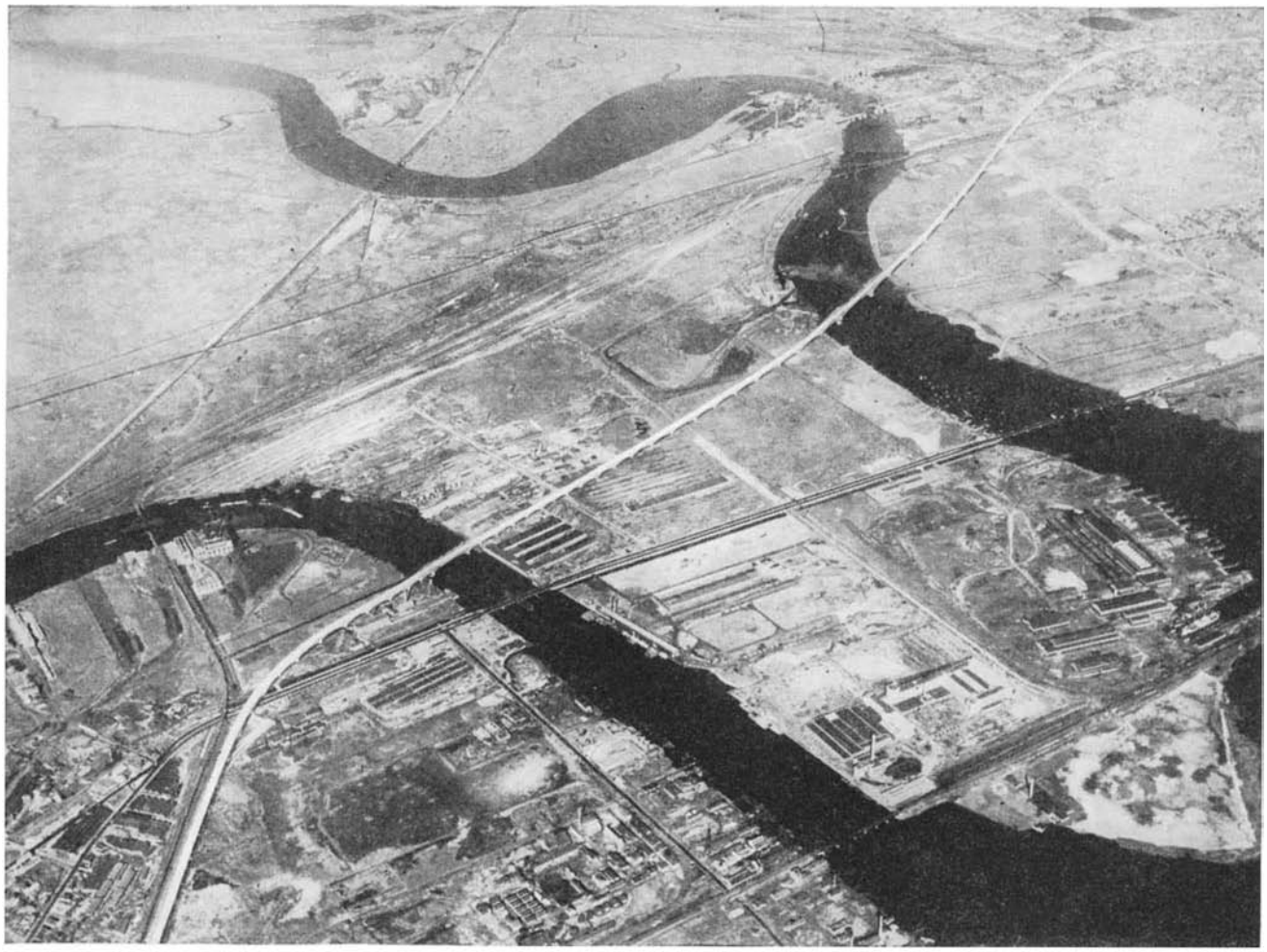
One question comes up repeatedly in any discussion of metals: What effect does it have on the skin? It is well known that many skins are irritated by nickel and brass, and especially so by chromium. Aluminum, however, under ordinary conditions does not injure the skin, nor does perspiration noticeably attack it. Aluminum arch supports and collar buttons are used without ill effect. Even if the skin be broken, contact with aluminum is said to have no unpleasant reaction.

One of the bracelets in the picture—it is lying across a corner of the mesh bag—shows a depression or fluting of its surface. In the original this fluting is colored a fine clear green. Others of the lot have a blue stripe, or a yellow or rose effect. This color is novel and arresting to the eye. It does not resemble enamel, or paint, but might be described as a transparent stain. Plainly it will not chip off. The "Alumilite" process, by which it is applied, is unusual. First the aluminum surface is given an anodic treatment—it is made the anode in an electrolytic bath—and becomes covered with a firm oxide film. This film of aluminum oxide has a strong affinity for certain organic dyes and mineral colors. When these dyes are applied to the prepared surface, the result is a smooth, hard, highly lustrous finish of real beauty.

IN view of the many advantages that aluminum has as a decorative metal, it is pleasant to learn that an effort is being made to confine it to carefully made articles, of tasteful design, to be retailed through shops of good repute. When cheaply made, the effect is far from attractive; when carefully made and finished by hand, the effect is sufficiently handsome to justify a fair price.

Beauty, permanence, workability, and rarity, are the virtues commonly associated with a jewelry metal. Certainly aluminum, the Cinderella of the metals, has beauty, and it compares well with the novelty metals (if not with the noble ones) in retaining its finish. Certainly aluminum is innocent of ill effects upon the wearer. And certainly it is workable. Rarity? There aluminum must hang her head. As a matter of fact, aluminum is the third most plentiful element in the earth's crust. Of course that does not detract from her beauty, permanence, or workability, and in the making of novelty jewelry, rarity is not an indispensable characteristic.

*Courtesy of *Brass World and Plating, Polishing, Finishing*



**Over two rivers and past huge factories: The world's longest high-level viaduct as it will appear when completed**

## A Super-Highway System Being Supplemented by

# A SUPER VIADUCT

## —Longest of Its Kind in the World

**By FRANK A. REDDAN**

ON the drab meadow lands between Newark and Jersey City the New Jersey State Highway Commission is working to complete by next November the world's longest high-level viaduct for vehicular traffic. The final contracts for the deck are now under way.

Representing a courageous conception of road-building, this structure and its adjacent links have been described as a marvel of engineering by authorities both here and in Europe. "The greatest highway project in the United States today," is the declaration of Thomas H. MacDonald, chief of the Federal Bureau of Roads. A noted magazine writer summed up his conviction in the phrase: "The most outstanding highway-engineering achievement in history."

States far removed from the metropolitan areas cannot visualize the traffic problems of New Jersey nor can they fully appreciate the pioneering spirit demanded of the Highway Board in setting a precedent for its solution.

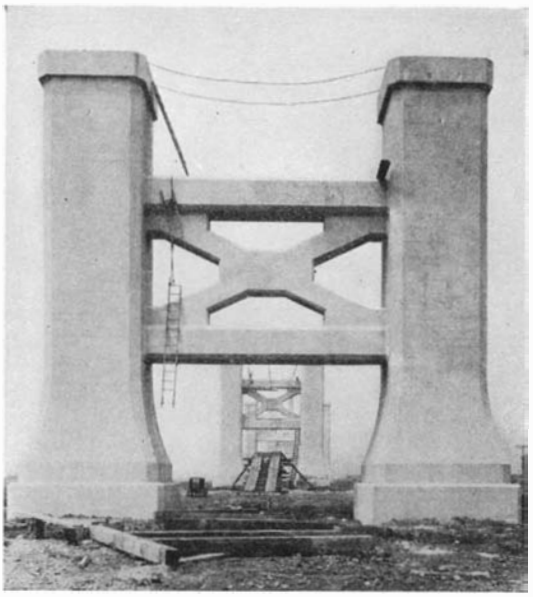
TO provide unimpeded arteries of travel to every part of the state, the viaduct is to be an important link in the comprehensive plan evolved by the Highway Commission composed of General Hugh L. Scott, chairman; Abraham Jelin; Firman M. Reeves; and Lawrence M. Hicks. They have already invested more than 150,000,000 dollars in trunk routes and when their projects are finished they will have used an amount in excess of 304,000,000 dollars. Every part of the state has been benefited by their accomplishments but the artery that has brought them the widest acclaim is the superhighway extending from Jersey City to Trenton and Camden. The viaduct is to be the last link to complete the picture of this particular highway.

More than 12,000,000 vehicles are now annually using the Holland Tunnel. The viaduct will serve this group as well as those from the New York ferries, and others with local destinations. To meet the unprecedented requirements of converging roads, the viaduct is to have five lanes with a yearly capacity for 20,000,000 vehicles. This will allow two lanes for travel in each direction and provide room for disabled vehicles, or, in times of peak travel, will permit the use of three lanes for the direction of the greatest flow. Probably setting a cost record for such a distance, the Highway Board has expended 40,000,000 dollars on 13 miles of this super-roadway between Jersey City and Elizabeth. The viaduct itself, in its three-mile stretch, will require a total of approximately 21,000,000 dollars.

In addition to the 900,000 automobiles upon its own registry list, New Jersey is compelled by its location between the populous centers of New York and Philadelphia to provide facilities for a continuous caravan in the interchange of commerce as well as for travelers from the south and west. With its multitude of resorts along its 150 miles of Atlantic seacoast, its mountainous vacation-land and highly concentrated industrial and agricultural sections, the state was faced by the need for a free flow of traffic. Although only 45th in size in the nation, it last year had the fourth position in the value of road construction placed under contract.

WHAT are termed the gateways, such as the Holland Tunnel, presented to the Highway Board a complicated condition in vehicular transportation. Local streets in the metropolitan area were already taxed beyond capacity. Monetary loss was being suffered by business concerns whose trucks were delayed in stalled lines as well as by the owners of passenger vehicles. The Highway Board was convinced that relief could be obtained through building an entirely new artery to give a minimum of delay, a maximum of safety and the greatest economy for the users. It was necessary to have the road treated as a factor in transportation similar to that for a railroad. Because of the large volume of traffic to be moved, studies were made of the cost for delay at draw-bridge openings and grade crossings as well as the effect upon the capacity of the road by grade and curvatures.

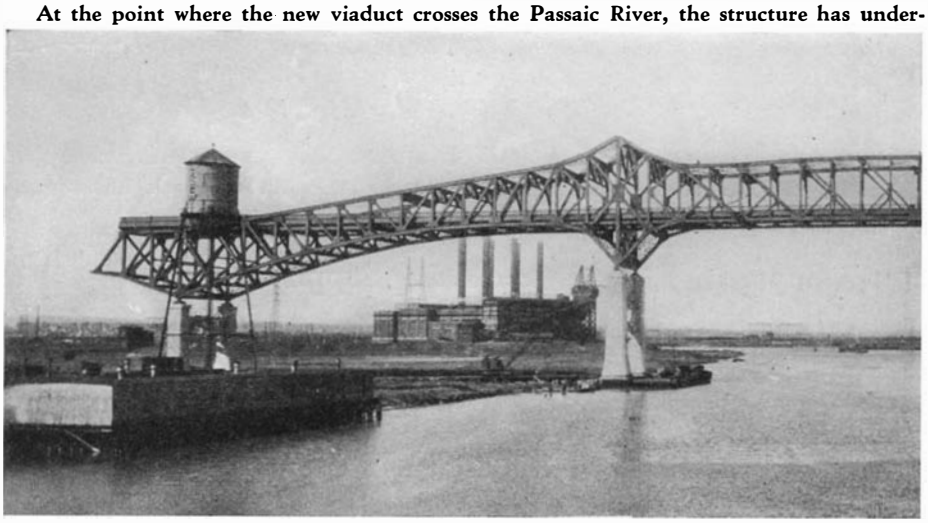
The figure of 12 cents per mile was taken as the average cost of operation of automobiles and upon the basis of 20,000,000 vehicles per year it was estimated that the reduction of each mile of traffic would lessen operating costs 2,400,000 dollars per year. This sum capitalized at 5 percent was held to justify the investment of 48,000,000 dollars to eliminate a mile of distance. Losses due to delays at intersecting roads were calculated at 7,000,000 car-minutes per year or 154,000,000 dollars. On the Lincoln Highway between Elizabeth and Jersey City, partly due to the opening of the draw-spans at the Hackensack and Passaic Rivers, a trip that should be made in minutes frequently requires as much as two hours. Through this circumstance the new era in road construction was made imperative.

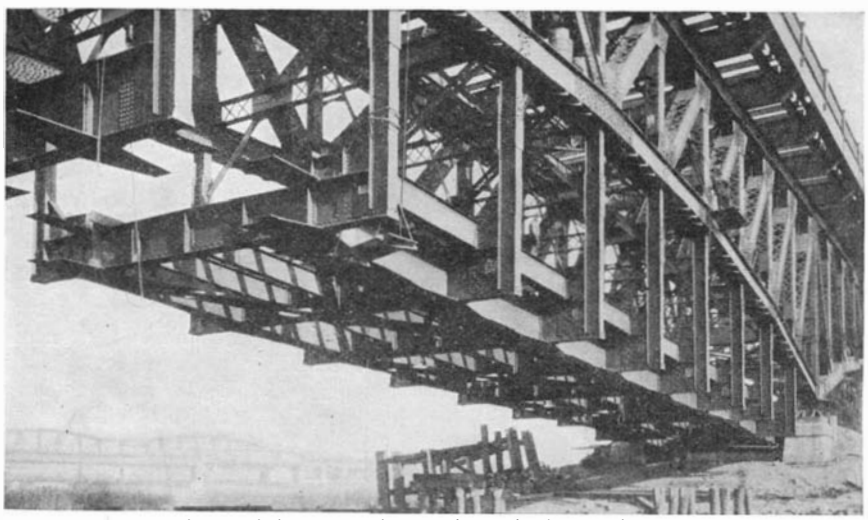


**An automobile (left center) serves to show comparative size of completed viaduct piers**

Near the Holland Tunnel plaza a depressed roadway was blasted through the trap rock in Jersey City to avoid the intersecting streets; a viaduct was built over the railroad yards of Newark to skirt the business center of that municipality and the line was carried around the business center of Elizabeth. At Woodbridge, a "clover-leaf" was designed for the intersection of the super-highway and Route 4 to eliminate all left-hand turns at grade and this arrangement stands pre-eminent as an example of engineering skill in road building. A new bridge was built over the Raritan River at New Brunswick at a cost of 1,600,000 dollars to connect with the Brunswick Pike which leads as straight as an arrow for 22 miles into Trenton. The Newark-Jersey City viaduct will complete the system.

**At the point where the new viaduct crosses the Passaic River, the structure has under-**

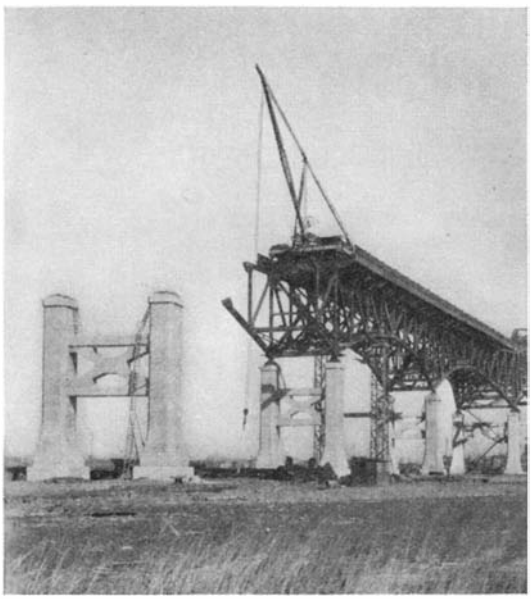




**Construction of one of the ramps that are being built into the structure to permit its use by local traffic of nearby districts without interfering with through traffic**

Studies were made of three separate plans of viaduct construction by the Highway Commission, namely: tunnels under the Hackensack and Passaic Rivers, bridges at an elevation of 35 feet, and the high-level viaduct with fixed spans over the rivers.

As approximately 20,000,000 dollars had already been invested in constructing the depressed roadway through Jersey City and the elevated artery around Newark it was decided that a new right-of-way between them should



**Erecting the arm of an anchor span by means of a traveller crane, near the Passaic River**

be built, leading diagonally across the meadow lands to reduce the distance to be traveled. A viaduct of sufficient height to clear masted vessels upon the rivers was also deemed an economy.

cumstance more than a score of contractors were engaged on the operation.

Considerable study on the viaduct was given in the design to merging the through-truss construction of the river spans into the deck truss construction of the flanking spans to add to the esthetic features by sweeping lines. The viaduct now gives a picture of massiveness but sturdy gracefulness.

In its construction there has been used 88,461 tons of structural steel or 20,000 more tons than were needed for the George Washington Bridge over the Hudson River. The fabrication of the members has taken more than 2,000,000 rivets.

A record depth for pneumatic drilling was established in the excavations for the foundations which were carried 147 feet below mean-high-water level for the bridge piers. Deposits of clay prevented water seepage and made it unnecessary to resort to the legal limit of air-pressure in caisson work.

The Hackensack and Passaic River spans are each 1400 feet long with clear central spans of 550 feet each.

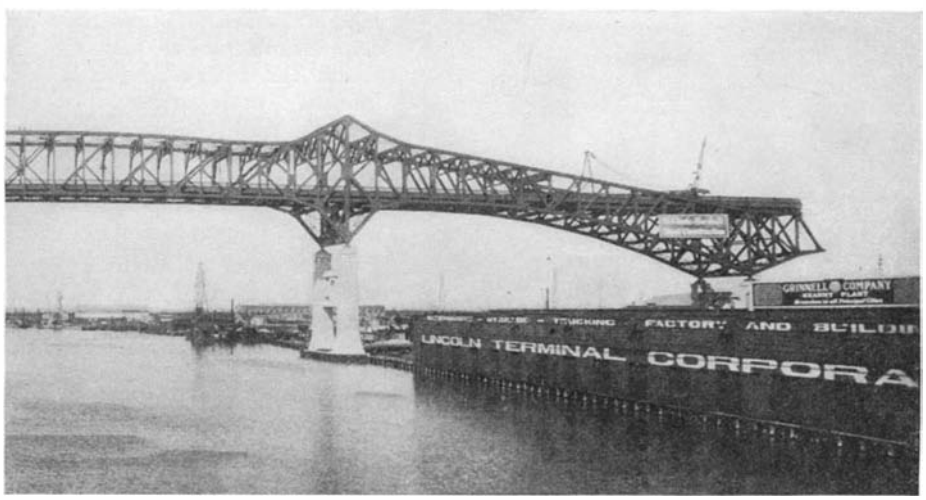
The viaduct is built upon pairs of reinforced concrete shafts linked together with reinforced concrete and capped by steel "shoes" which support arched spans of lattice steel. The arch spans carry the roadway between the towers and give the effect of lightness combined with strength. Shafts 90 feet high stand at each end of the bridge span to carry 10-ton "shoes."

THE largest contract on the foundations was handled by Arthur McMullen of New York at a price of 3,180,000 dollars. The average depth of all the foundations on the Hackensack River section is 95 feet, while the average for those on land only is 110 feet. The foundations vary in area as well as in depth, as the largest is 30 by 87 feet; another 20 by 90 feet; while the rest measure about 25 by 60 feet. All of the land foundations were sunk in normal atmosphere to within 20 to 40 feet of bed rock after which air-pressure was used. The river foundations were sunk under air-pressure entirely. The piers average 300 feet apart on land, and the central piers in the rivers are 550 feet apart. Each pier rests on a pedestal 21 feet square.

Contractors on the project are: the Tunnel Construction Company, the Foundation Company, Charles T. Kavanaugh of Bayonne, McClintic-Marshall Corporation, American Bridge Company, and the Phoenix Bridge Company.

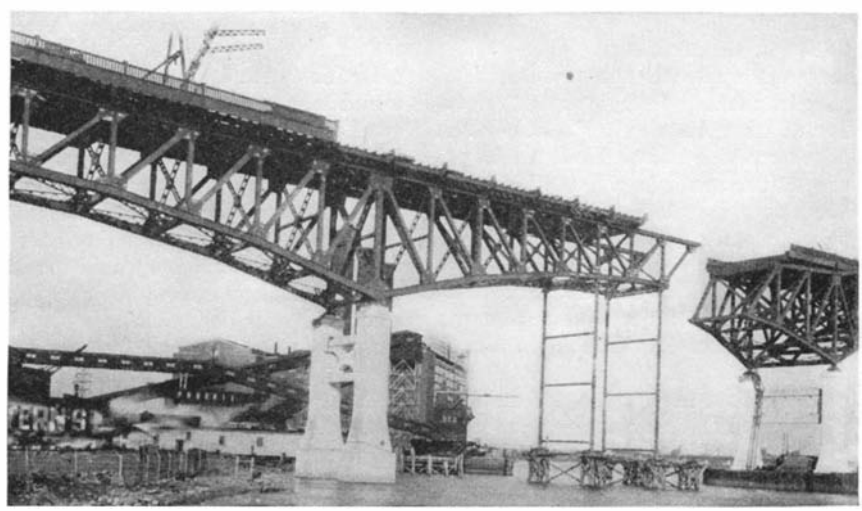
The viaduct was designed and constructed under the jurisdiction of the Highway Commission with J. L. Bauer as state highway engineer; Colonel H. W. Hudson, assistant construction engineer; S. Johannesson, engineer of design; and Morris Goodkind, bridge engineer.

**clearance of 135 feet, thus eliminating need for a draw-span for the passage of shipping**




To have fixed spans over the rivers, it was necessary to obtain an under-clearance of 135 feet; at other locations the viaduct has a height of 75 feet. The grades, however, have been made so gradual that they will not exceed 3.5 percent at any point. Ramps serve local vehicles for Jersey City, Newark, and Kearny. The minimum radius of curvature is 1000 feet on the New Jersey highway routes and wherever possible is as high as 10,000 feet to permit the maintenance of speed without danger. This standard is maintained on all projects.

The entire viaduct is of cantilever construction and was an immense project that had to be done in a limited amount of time to gain the benefit of the capital investment already made in adjacent links. Because of this cir-



**In erecting suspended spans over the rivers, central supporting members were used, mounted on a timber framework which, in turn, was mounted on piles**

# HOW AMERICA WAS FIRST PEOPLED

By MARIUS BARBEAU
National Museum of Canada, Ottawa

HOW America was first peopled is a question which the layman often tosses at whoever may give information. Yet it seldom meets with a satisfactory answer. Perhaps there is no ready answer available yet; and this may be given as an excuse. But the excuse itself is no longer valid, as we shall see in the light of what has been learned in recent years.

The antiquity of man is already well established for Asia, Europe and Africa; and the lack of sufficiently ancient remains in the two Americas makes it plain that these continents were peopled much later from outside. This is generally admitted. So it has been, on other grounds, since the days when Mormon inscribed on his tablets the creed that the Red Indians were the two lost tribes of Israel; and this reflects the popular belief of the time. But the manner in which tribal migrations proceeded on their way to the Americas is left out of the picture.

Is there really any evidence bearing on those migrations?

There is not, if we should be satisfied only with written historical records, for such do not exist—cannot exist. Writing and the preservation of archives are modern features, quite foreign to the people concerned here.

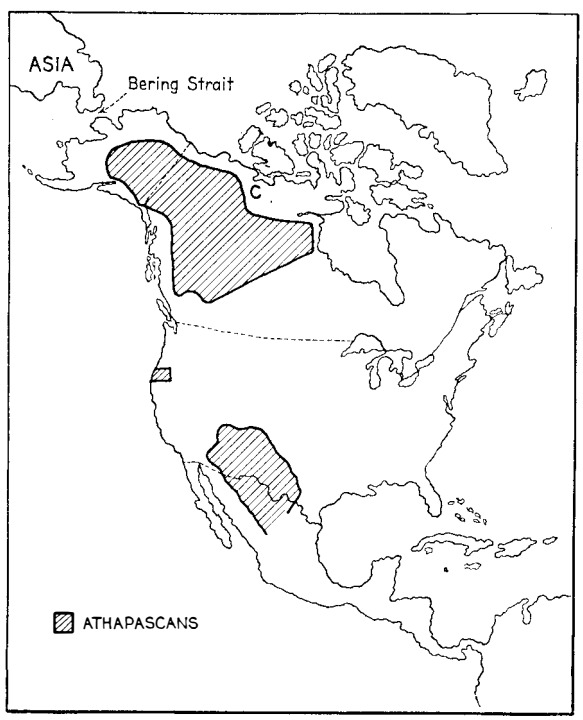
BUT, next best, there is circumstantial evidence. This can serve our purpose, and it has reached a measure of abundance that now challenges our attention.

To get rid of misconceptions we must approach our problem as a chemist making tests in a laboratory. Let us treat America for a moment as an empty vial in our hand, which we can shift from side to side until it stands much as it does to-day, about half way between other continents.

Wild life is what we must put back into it first—fish, fowl, and mammals, and we shall refill it with animal life to the brim, as it undoubtedly was in actual truth until not long ago. This is of the utmost importance, for the food will serve as a decoy at the psychological moment and the right place. Without it we cannot hope to proceed with our experiment; the vial would remain empty. Man, at least in the early stages of his culture, is found only where there is food—animal food by preference.

So we place sea foods in great abundance around the edges of our Western continents: salmon, seal, sea-lion, and whale, near the top; reindeer, caribou, mountain sheep and goat, moose and bear next, in the interior; then the buffalo farther down, and so forth.

If we should incline our vial toward Europe, let us say the Europe of the early Scandinavians or the Celts, it would soon attract some of the human specks searching the seas in small sailing ships for food or adventure. If we left it in that position long enough, it would draw to itself white fishermen and colonists in numbers, as honey draws the flies. America would soon be the homeland of many white people at a much earlier date than this actually happened. Can we doubt it, when we remember how the Scandinavians, in spite of huge distances and the smallness of their sea craft, landed in Iceland and in the 10th Century settled in Greenland, where they had a colony for 300 years? One of them, Eric the Red, even reached Labrador and Newfoundland in the Year 999. Later the Normans, the Bretons, and the Basques fished for cod on the banks of Newfoundland, perhaps even on the Gaspé Coast.




**Distribution of the Athapascan stock, which came over from Asia relatively recently. A part of it remained in the north, while another part pushed southward in a gradual, unconscious penetration**

But we must not leave the vial on that side long enough for any consequences. Instead let us now tilt it the other way, toward Asia, as it actually is on the map. The tip of Alaska is close to the Siberian peninsula. Bering Strait alone separates them, and it freezes up in winter. The distance between Cape Prince of Wales and East Cape on either side is only 40 miles. In clear weather one shore can be seen from the other. This gap is no barrier, not even to primitive man. The two Diomede Islands sit conveniently in between, as if they were intended to be stopping places. The archipelago of the Aleutian Islands farther to the south is also like a natural bridge that might tempt seamen to pass from one side to the other.

IN our experiment we have reached a stage at which things must actually have been, long ago. America was still virgin of man, but its hoard of animal life had gone on increasing without anything to check its natural growth. Asia on the other hand had been peopled for untold ages until even its periphery—Siberia, Kamchatka—was invaded by roving bands that could not hold their own elsewhere or were addicted to nomadism in the far north. Siberia to the present day has been the home of many tribes whom we call paleo-Asiatic—"old-Asia." These are the scattered remnants of a people that seems to have preceded the Mongolians or were in a remote way their forebears. They are Mongolian-like, but still they are far removed from the better-known Chinese and Japanese. The truth is that Asia at that time was full to the spout with people and in proportion it was depleted of game, while America was still empty and a real storehouse of food going to waste.

Some venturesome hunters or fisherfolk, perhaps pressed by hostile bands

behind, ventured across Bering Strait into Alaska. This was the first step in a process which, once initiated, was not likely to be interrupted. What had happened recurred as long as the food was there to draw the Siberian in search of new hunting and fishing preserves. In other words, the vial that was full had begun to drip into the one that was empty. This slow dripping must have lasted an age.

At what time the earliest Siberian migrations into Alaska occurred it is impossible to tell; it must have been fairly long ago, thousands of years. The human bones and artifacts recently discovered on the two Diomede Islands in Bering Strait have brought little or no light upon this question. They cannot be traced back to any given tribe on either side; neither are they far removed in type from what we already know. These finds prove only what we had guessed, that people had stopped there on their way; but they did not mean to stay.

It would be absurd to suppose, as has been implicitly done for generations, that such migration happened but once, and that the small initial nucleus thus transplanted into America gradually developed into the red man as we know him. Should this be true, it would have required ages to produce the present diversity among native races. All the Indians would be traceable back to a few common ancestors on this side of Bering, and their type would be fairly uniform. Nothing is further removed from the truth.

IN the first place, there is no red Indian. The Indians are brown or tan. Some, like the Haidas of the Alaskan frontier, are almost white. The term red as applied to them at the time of discovery is a misnomer. No one since then has been able to find the real reason for it—probably a trivial incident. You can match the shades of their skin and their hair with those of other people in other parts of the world—with the exception of those of the negro. Siberians, even Mongolians, are often difficult to distinguish from our northwestern natives. To the eye the two are surprisingly alike.

Thus a myth which should be fully exploded is that of the unity of the American race. There was no such thing as unity, even in a loose acceptation. The Iroquois of the Great Lakes, the Piegan of the Prairies, and the Tsimsyan of the Alaskan frontier, are further apart in type from each other than the Tsimsyan is from the Chukchee of Siberia. Indeed these last two look like close relatives—which, on the whole, they are.

There are a few native American races or physical types that stand in definite contrast to each other, although they often live in contiguous areas and have long mixed with each other, particularly at the frontiers, and nowhere is this contrast between two North American stocks more plainly in evidence than between, let us say, the Blackfoot that used to hunt the buffalo on the plains, and the Tsimsyan who fish salmon on the Nass.

I was greatly surprised when, sailing from Vancouver to Prince Rupert, I saw the northwest coast natives for the first time. These were unlike any other

Photo by Joseph Keele, 1905

**Two hunters of the Athapascan type from the Mackenzie River. They are both Siberian in type, particularly the one on the right**

Indians I had been used to elsewhere, either in actual life or in pictures. Any easterner who visits that locality will have the same experience—the feeling of having gone over the border to another continent.

No sooner had I walked down the gangplank at Alert Bay, north of Vancouver Island, than I saw a picture from real life which I shall never forget. An old Indian chief in his gala costume walked slowly, a long carved staff in his left hand, in front of large plank lodges of split cedar. Fantastic figures in wood carving and paint decorated the housefronts—the thunder-bird, the wolf, the grizzly-bear and the killer-whale. The chief, whose head was covered with a pagoda-like cap of woven roots, walked slowly past us, his face to the south. Never had I seen Buddha except in the form of ancient museum statues, squatting on labeled pedestals, but here he was, stately and alive for all to behold. His stature was low and bulky; his legs were short. His face was immobile and mysterious like that of a stone idol. Here was the most perfect Mongol I had so far beheld. But he was far from the only one of his type hereabouts. The women, squatting on platforms facing the sea, were sullen and motionless, like stone idols in a Chinese temple.

Unaware, we had passed beyond the real visual confines of America into the Orient—for the northwest coast is an advance installment, as it were, of what exists beyond the Pacific. It belongs somewhere near the tropics. The dark green drapery of the forests is heavy with sap and moisture. The inner channels reflect the tall trees and the mountains tipped with snow and glaciers, thousands of feet high. Fleecy clouds, bluish at dawn and red at night, stretch in patches about mid-way up the mountains, as they do in Nipponese watercolors. Here is the jungle as depicted in the tales of Conrad. The warm Japanese current brings in the balmy air of the South Seas and breathes it upon the rich greenery of the coast. Facing other vistas, we seemed to have come nearer to Japan or to Korea. The wood carvings, the totem poles, the Indians themselves with their bridled eyes, all told the same tale: Here we had turned our back upon the rest of America and we had stepped over the threshold into Asia.

SUCH direct impressions gave me a foretaste of what was to follow in the course of seven seasons of research I carried out in that country for the National Museum of Canada. Those people were exactly what they seemed to be at first sight—Asiatics, preferably paleo-Asiatics, whose ancestors had migrated over Bering Strait at a time not so far distant that it cannot be dimly remembered, perhaps one or two thousand years ago, more or less. That is a short time compared with other Indians elsewhere in the Western Hemisphere. It may be noted incidentally that about 60 percent of the native children in the northwest have what are called Asiatic dots—dark dots low down on the back. This is a very specific link between Asiatics and Americans. There are other common features.

All this is to say that the northwestern Indians do not quite belong to America as we know it best—most of us being easterners, used to vizualizing the Iroquois, the Siouans or the Algonkins, who are of a different type, long or oval faced, taller and further removed from our usual conception of the Mongolian.

I come back to my earlier statement: No such thing exists as a distinct race of American Indians, whose skin is red, and whose origin may be traced back to a common Garden-of-Eden-like cradle. There seem to be at least two or three types of Indians on the northern continent alone. These must go back to different waves of migrations that arrived here in turns, in different periods, and followed their path onward.

Their path—what path? That is what we shall now try to discover.

To avoid confusion we shall not cover too much ground nor too many people. One racial stock will suffice, the one most likely to yield to our handling in so limited a space, and one which is still the nearest to its original birthplace—the Déné or Athapascan of the far northwest.

Several tribes of this nomadic nation occupy the whole of the Alaskan peninsula with the exception of the Coast. They hunt the reindeer and the caribou on the frozen tundras, much as their remote ancestors must have done in northeast Siberia, a country much like sub-arctic America. Some of them may still camp at times close to Bering Strait, whereas others elsewhere might bump into hunting parties of the Eskimos, their coast neighbors and born enemies. But the peninsula, vast as it is, on the whole does not hold many of them, and we are only vaguely acquainted with their existence. They have never been studied, though we may consider them the missing link between two continents.

THEIR kinsmen to the south are much better known—the wild rovers of the northern ranges of the Rockies and northern British Columbia. These hold the clue to some of our problems of origin. Here we reach the core of our argument, for much depends upon whether we can recover from among these people any recollections of their tribal migrations with the direction of such movements, and grasp the underlying tendencies in their permanent mode of life.

The migrations and tendencies which we are seeking for our enlightenment are the very things which we find in overwhelming abundance among them at every point where we encounter them. These people one and all are inveterate nomads whose only law is the search for animal food wherever they can find it under an inclement polar sky and on a frozen ground almost wholly barren of nutritious vegetation. Much as the reindeer in its own seasonal migrations moves down to the forests and the grazing grounds for the winter where the snow is soft, the early hunters prowled around until they had found the herds, and thus they were led far to the south. They spread fan-wise in small bands, or rather family groups, in every direction.

In their treks to the south they encountered other bands of their own blood, engaged in the same pursuit as themselves. Repelled, they might have gone back to their tundras and respected their neighbors' frontiers, as other Indians elsewhere were apt to do in prehistoric times. But this they never did. They were born trespassers. Like the Tartars of Asia they were brigands, who knew of no fixed abode, never slept twice under the same star, and always coveted their neighbors' own.

Checked in their progress, they recoiled upon themselves, and in times of starvation, mostly in the winter, they fell upon their opponents before dawn, when they were asleep. The next day they were the lords of new preserves and their hunting ground under their feet had slid ever so little to the south,

Photo by Teit

**Is this an Indian or a Mongolian? Except for the dress it is often difficult to distinguish the two types. In this case it is an Athapascan woman from the Yukon River, Alaska—Nellie Nehass, a Tahltan**

where the sun grew warmer and the food more plentiful at every step.

Food and its harbinger, climate, drew them everywhere like magnets, and the void was left behind them—a void that invited others to follow, others still to come in the incessant trek toward the promised land of sunshine and plenty.

Nowhere within the reach of their forerunners to the south is food more plentiful and the climate milder than on the northwest coast, from mid-Alaska down; that is exactly the region where we find them at work to best advantage. I have studied in detail the traditions of two or three scores of their tribes in that country, and the unavoidable conclusion is that at every point they had been forcing their way, one by one, to the food troves which are common along the coast or up the rivers.

The progress of their penetration of the coast is the most impressive movement of people I have ever heard of, and the oddest. It is unique. No concerted invasion is to be observed anywhere, no warlike display, no really organized banditry, not even definite places where conflicts were staged. Instead, the slaughter at dawn of a few occupants by a few raiders—the raiders always being from the north. As the food and the climate improved farther south, the process was ever renewed, for it was a natural process, *unthinking, unaware of itself*, yet incessant, inexorable. To such a degree did it take place that the human contents of tribal or national boundaries among the three or four nations that I have studied changed materially through additions and seepage in almost every generation.

Those invaders of the north were a curse and a nightmare. But they could not help it, neither did they care very much. Naturally timorous, they would fight when cornered, and they had a knack of always finding themselves in tight corners. There was no peace, no security anywhere, not even to themselves, least of all when food lured them on. They were not immune to attacks from behind, and their newly acquired riches often fell to other hands. But they were on the march, though they did not know it. Their advance toward the south was like a natural law. Never was it retarded by the casualties with which they had to pay the price to the hands of earlier occupants.

The conflicts engendered by their migrations enhanced a native trait which is general among them. They were addicted to seasonal hallucinations and fits of terror: the terror of starvation which often caused them to slaughter each other, and still more the superstitious fear of an unseen northern enemy that might massacre them at dawn. A medicine of their own concoction!

Let us follow these Athapascans around a while to the various parts of North America where their blind destiny has led them in a seemingly very short time—certainly less than a thousand years.

These American Tartars shifted their abode so rapidly that we may expect to find some evidence of an orientation in their tribal recollections. In this we are sure not to be disappointed.

A BRANCH of the Athapascan nation, the largest, crossed the northernmost ranges of the Rockies and followed the rivers down to the Mackenzie, which empties into the Arctic Sea. They made its watershed their stamping ground, and they followed the game wherever they found it around the great northern lakes until they encountered the Eskimos of the Coppermine region [Note map, at C.—*Ed.*] and the Crees of the northern swamps. Much like their kinsmen of British Columbia, in most ways, they are perhaps of a purer stock for the lack of as many neighbors to mix with. They made friends with nobody. Native characteristics in consequence are much enhanced—or else they may represent a later migratory wave.

It is in the traditions of this group

that we find the best evidence of the direction they had been following in their trek into America. The early explorers among them, their observers, concluded that they were Asiatics, had crossed Bering on the ice, and since then had inhabited a country quite like that which they had left behind, and not much better, except that one was peopled and the other practically vacant. They had fled from powerful enemies that harassed them. But after moving into a new continent they found themselves deprived of metals, which was the common heritage of all Asia. Away from the sources of supplies obtained through barter they relapsed into the stone age—without, however, forgetting their loss, which they bitterly regretted. "They had seen no more iron on this continent," is how Petitot puts it down, except for some which they found on a tributary of the Mackenzie and knew well how to fashion into awls and needles.

Sir Alexander Mackenzie, the discoverer of their country, nearly 150 years ago, states that in their own belief they had come from another large continent, and that their progress had always been eastward. They had been the slaves of a wicked nation, and they had fled across a lake narrow and long, dotted with islands, and frozen in the winter (Bering). Then they had found a river where they saw a shining metal on the ground (Copper River).

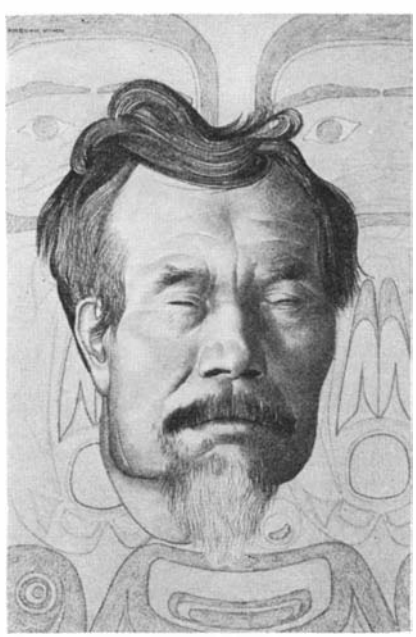
SIR John Franklin, about 1820, is equally explicit in his account of native recollections. The Liard River tribes of the Yukon had left behind, to the west, a summer-like country where fruits ripened and trees were different from those they knew; and they had crossed the waters on their way.

Father Petitot, a missionary for many years among them, in the 'sixties, and the best student of their history, devotes several chapters to the topic of their Siberian origin in the light of their traditions and customs. Thus little doubt is left on that score. He confirms his predecessors' views as to their Asiatic origin.

It would be a mistake to assume that this scattered nomadic nation, the Athapascan, crossed Bering in a single migration and after reaching this side grew from a small compact nucleus into its present ramifications—even though the language is fairly uniform throughout. In type, they are more diversified than in language, for they are far from homogeneous; the Loncheux, for instance, were said by Petitot to resemble the Hindus, whereas others were like Mongols or Tartars or Samoyeds. In other words, they belong more distinctly to Asia than they do to America.

How long they have lived on this side of Bering, is another question that invites speculation. It is not easy to come down to actual figures. Our knowledge embraces only about two centuries in the Northwest and four in Mexico, and that is only a day in the history of mankind. Yet, even in that short time, changes have taken place which cast a vivid light upon the last phase of prehistory. The northwest coast underwent transformation during this period, under the impact of the Athapascan invasions. Left to themselves it is likely that in another century or so their horde, blended with the earlier occupants, would have swept southward across the Columbia River. Their vanguard, the Chilcotin, as it is, was driving a spearhead upon the Fraser, close to the present American border.

ANOTHER phase of this Siberian invasion of America is indeed quite startling. It also furnishes a date—the earliest on record—of their arrival at a definite point. In their search for food, some of the advance Athapascan bands centuries ago chanced upon some buffalo herds. This food quarry was so much better than anything they had known in the north that it was destined to determine their future. The best-known among them are the Navahos and the Apaches of the Southwest, isolated from the northern body.



From a portrait by Langdon Kihn

**Thick-thighs, an Indian of northern British Columbia. He belongs to the invading stock of the Athapascans which stayed in the north**

At the time of the discovery of America the Navahos were still at what is now the Canadian border. At the present day they are typical herdsmen of the southwestern desert and their distinctive craft is the weaving of blankets and rugs. Both of these features are new acquisitions—European and Mexican.

The Apaches—the apex of the Athapascan thrust—were already at the Mexican border in the 16th Century. They are first mentioned by Coronado in 1541—which is an interesting date for us.

Bold and war-like, of the breed of the Tartars who had swept over Europe a thousand years before, the Apaches were bound to conquer the bounties of the promised land of the Corn Maiden to the south. Of this, not the least doubt. Who was there to resist their invasion? The peaceful Pueblos or the timid Cliff-dwellers were no match for them. And beyond, the Mexican villagers were not versed in the arts of war, but in agriculture and the pursuits of peace and stability. They were not prepared to resist invasions. The Mexicans had not erected a Chinese wall. The kingdom of Montezuma was faced with the Yellow Peril no less, yet perhaps was unaware of it. The barbarian of the north was watching his chances and mustering his forces for an attack; and he might have overcome the Aztec dynasty without a blow. Perhaps his name alone would have caused consternation and swayed everyone into subservience, like that of Attila sweeping Europe and planning the conquest of Rome.

But the white man—the Spaniard—reached Mexico first and made it his own booty. He had stolen a march on the Apaches, and this closed the door forever to the native invader from the north. Yet Geronimo, their warlike leader 300 years later—about 1880—had raided northern Mexico when he became a prisoner of state after a long and difficult pursuit.

WHAT would have happened to the Mexicans in the absence of the Spanish in the past 300 years? This can be only wild conjecture, yet with more than a grain of probability, the Apaches, having overwhelmed the Mexican dynasty, would have spared the Mexican civilization for their own benefit. It was the very thing they admired, they coveted, these beggars of the barren grounds. Instead of crushing it as the white man did, they would have respected it, assimilated it, and soon would have slightly improved upon it, as their kinsmen were doing in a different way on the northwest coast—the totem pole culture being largely their creation. After a few generations, with new blood in their veins, they would have started for a new conquest of the Incas of Peru!

History repeats itself. The Aztecs had subdued the Mayas, and the Central Americans at least once before had daunted Peru. Beware the northerner, the barbarian, who comes in as a thief and, daunted, sleeps with his boots in the bed of the princess, whose name is culture!

# THE COMING ECLIPSE

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

ALONG the broad track of the moon's shadow in Canada and New England many parties of astronomers will spend strenuous days in preparing their apparatus for a hundred seconds of observation on August 31. Hundreds, and it may be thousands, of times as many people will flock to the same region, not to observe the eclipse but to see it, and if the weather permits any view at all the great majority of these will see far more than the astronomers can permit themselves to do. The modern observer, of course, is never *looking* at the eclipse. His attention must be concentrated on the proper functioning of the apparatus by which he hopes to secure his photographs, spectrograms, measures of heat or what-not, and he is lucky if these duties leave him a few free seconds in the middle of totality to glance at the corona. A great deal of important work remains to be done during total eclipses. But this is usually highly technical. An observer who is photographing the star field around the sun to determine the Einstein effect, or seeking to measure the relative intensities of the violet and infra-red lines of ionized calcium in the chromosphere, or to obtain a moving plate photograph of the flash spectrum, will give incomparably more thought to the standardization of his plates before exposure and the development afterward than he can spare for the magnificent spectacle.

THE amateur astronomer and, for that matter, the ordinary sightseer, is really the fortunate one. He requires but simple preparations and all the grandeur and much of the scientific interest of the eclipse will be before his eyes.

First of all, of course, he, like the professional observer, must go into the zone of totality. This is fortunately a very easy matter, for the region is well served by railroads, criss-crossed by motor highways, and thickly dotted with summer hotels, camps, and cottages. Detailed maps are available, both from scientific sources and from tourist agencies, some of the latter being very good; so it need only be said here that the southwestern limit of the zone passes about three miles east of St. Albans and Montpelier, Vermont; Concord, New Hampshire; and Salem, Massachusetts; and also across Cape Cod at its elbow; while the opposite limit runs from the northernmost part of New Hampshire to Bath, Maine. Montreal is just inside the track, Boston about 15 miles outside.

Near the edges of the zone totality will be short, but in its middle half the duration ranges from 85 to 100 seconds—long enough for a good view.

**A BOOKLET entitled "Total Eclipse of the Sun, August 31, 1932," obtainable from the Superintendent of Documents, Washington, D. C. for 25 cents (stamps not acceptable), contains detailed meteorological and astronomical data on the eclipse, with a large map. A last-minute circular from the United States Naval Observatory indicates a shift of the path of totality westward by approximately seven tenths of a mile.**

Weather probabilities are much the same from the Saint Lawrence to the ocean, the chance of clear sky being not far from the proverbial "50-50", except on the higher mountains where cloudiness is more likely.

THE tourist has therefore a very wide choice of location. Only one real obligation rests on him—to keep well away from the stations occupied by professional observers. Any outside disturbance, worst of all the vibration of automobile engines or the glare of headlights, may seriously interfere with the work for which these people have crossed the ocean or the continent; and their observing stations, though carefully chosen, offer no better chance for *seeing* the eclipse than 10,000 others. So let the workers have a half mile or mile of free space around them. The rest of New England is yours.

The sun will be high in the west at the hour of totality, about 3:30 P.M. Eastern Standard Time, and any open space will give an adequate view of its surroundings. A wide view, especially to the north and west, gives a better chance to watch the approach of the shadow and the changing lights and colors on the landscape. Two practical hints may be appropriate: Accommodations should be engaged well in advance, for they may be crowded. Everyone should repair to his chosen station and park his car if he has one by 2:30 P.M. Standard Time and, above all, *extinguish the lights of his car* before totality. One inconsiderate motorist may otherwise spoil the view for many spectators.

The early phases of the eclipse, until most of the sun's disk is covered, are of quite minor interest. They may be followed with the aid of dark glasses—not the ordinary pale gray spectacles, but so thick that the sun can just be seen comfortably through them. A bit of deeply fogged photographic film is quite satisfactory. Test it out on the uneclipsed sun a day or two before and be sure it is dense enough. Too much light will tire the eyes and unfit them for the real spectacle.

Another simple way of following the moon's advance is to make a small hole not larger than will admit the lead of an ordinary pencil in a piece of cardboard eight or ten inches square. Hold this up at arm's length, at right angles to the sun's rays, and cast its shadow on any white surface also perpendicular to the rays, six feet or more away. The pinhole image of the sun before the eclipse will be round; during its progress all the crescent phases will be clearly shown.

AS THE eclipse advances the light will fade, producing the impression of late afternoon, but the colors of sky and landscape will be curiously unfamiliar. This change is often attributed to the fact that the light from the sun's edge is redder than the average, but this effect is small. Moreover, the writer has noticed just the same abnormal colors in clear winter California weather when smudging in the orange groves has filled the sky with gray smoke which greatly weakens the sunlight without changing its color perceptibly. It seems probable therefore that the peculiarity is that the light of the nearly eclipsed sun is not nearly as yellow as that of the setting sun. We instinctively associate the faint light and yellow glow, and when we have one without the other it seems strange.

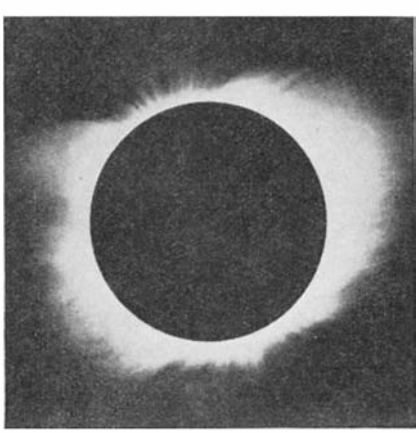
As totality approaches the moon's shadow can be seen, to the northwest, in the present case, darkening the sky

and advancing at terrific speed. Shadow bands, which are the shadows of the streaks of uneven density in the upper air, also appear on all sunlit surfaces. At the eclipse of 1925, when the sun was low and the air unsteady, these bands were very conspicuous on the snowy ground and added greatly to the weirdness of the moment. This time, with a high sun and no snow, they will probably be much less prominent, and those who wish to see them will be wise to spread out a large white sheet or something of the sort on the ground.

At the last moment the whole world suddenly darkens, like a train entering a tunnel. Anyone who has ever experienced this can readily believe the ancient tales that eclipses stopped battles at the height of the fighting.

AT this "zero hour" there is so much to see that we must choose in advance. The flash spectrum may be observed with simple means (see below), or one may watch the disappearing crescent of the sun break up into separate specks of light (Baily's beads) as the mountains on the moon's edge cut it off, or attention may be devoted to the approaching shadow in the sky until it actually overwhelms the observer.

When the eclipse is really on, the one great spectacle is the corona. The dark moon hangs in the midst of a pearly white glow full of delicate and beautiful structure. At the present eclipse, when the sunspots are decreasing toward minimum, we may expect something intermediate between the "maximum type" of corona—bright, irregular, and extending about equally far in



**The corona in 1900, when there was a "minimum" in the sun-spot cycle. It is flattened at the poles**

various directions—and the "minimum type" with curved rays near the sun's poles and long streamers parallel to its equator.

If there are any good-sized prominences, which at this stage of the solar cycle is unlikely, they will show as brilliant red spots right on the edge of the moon. A field glass will be of much value in showing them as well as other details. It should of course be carefully focused beforehand on some distant terrestrial object. Though totality seems so dark, it is really about as bright as a night with full moonlight. The brighter planets and stars appear, but not the fainter stars. The easiest stars to pick up will be Arcturus, high up south of the zenith, and Regulus, about 10 degrees to the right of the sun and a little lower. Jupiter will be on the same side of the sun but only four degrees from him and should be very conspicuous. Mercury will be about 8 degrees west of Regulus—that is, below and to the right in the sky—and, almost equally bright, Venus will be low on the horizon and unobservable.

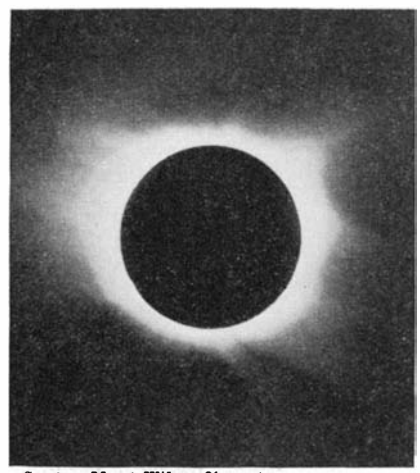
As the third contact approaches, the inner corona suddenly brightens on the moon's western edge and for a second or so the total atmosphere or reversing layer can be seen shining with a bright steely light. Then, instantaneously, a shred of the dazzling photosphere appears and extends into an arc along the moon's edge. The inner corona is far brighter than the outer. During totality, contrast effects almost conceal this and make the moon's disk look darker than the sky outside the corona. But as soon as the first speck of sun comes out the outer corona vanishes in a twinkling, while a narrow inner ring remains visible for 20 or 30 seconds, giving the often described "diamond ring" effect with the bright speck of sun as the jewel. Meanwhile the sky fills with light, the stars fade out, and a great spectacle is over.

ALL that has so far been described can be seen with the naked eye or a simple field glass. A small telescope is only of moderate usefulness, though it may give a fine view of detail in the prominences. But it must be carefully focused and pointed in advance toward the sun, making allowance for the diminution until totality.

Interesting photographs of the partial phases may be made with cameras of moderate size, with of course a small stop and the shortest possible exposures. With a focal length of a foot, however, the sun's image is only one-eighth of an inch in diameter, so one must not expect too much. With such an instrument, however, a good picture of the "diamond ring" can be obtained with an exposure of a second or so just at the right instant.

These photographs may be taken with a fixed camera. To photograph the outer corona requires a time exposure, preferably of 30 seconds or more, during which the sun's diurnal motion will ruin the picture unless some following device is employed. Exposure of five or ten seconds with a lens of large aperture may, however, give interesting though slightly blurred photographs.

To see the flash spectrum, which is one of the most interesting of all the phenomena, the observer must be provided with a replica grating. When looking through such a replica one sees an unmodified central image of a luminous object flanked on either side by spectra, with the violet nearest the center and the red farthest; followed



Courtesy Mount Wilson Observatory

**Solar corona at the time of the eclipse in 1925, when the sun-spot cycle was approaching a maximum**

by fainter but more extended spectra of the second and third orders. With a narrow source of light no slit is necessary. Before attempting to observe the eclipse the amateur should practice with other light sources till he is familiar with his grating. Admirable practice is furnished by the mercury and neon lamps which are so widely used for signs. Looking at a mercury sign one sees the greenish central image and on each side the spectra—two images close together in the yellow, brighter ones in the green and violet, and another fainter violet image farther out. Neon gives a multitude of yellow and red images which usually overlap in confusing fashion. But by finding a tube which from a proper vantage point appears as a straight and narrow line of light the confusion vanishes and a beautiful spectrum of some 20 sharply defined lines is revealed.

TO observe the solar spectrum one has only to view the sun through any narrow crack such as may be obtained by partially closing a window shutter. The long continuous spectrum crossed by the dark brown Fraunhofer lines is then easily seen.

Prepared by this practice the observer may watch the sun just before totality begins. The ordinary solar spectrum with its dark lines shows at first, changing as the photosphere vanishes to the bright lines of the chromosphere—hydrogen in the red and blue and helium in the yellow. The green coronal line may be visible, but it is faint and much harder to see.

# NEW INDICTMENTS AGAINST INSECT PESTS

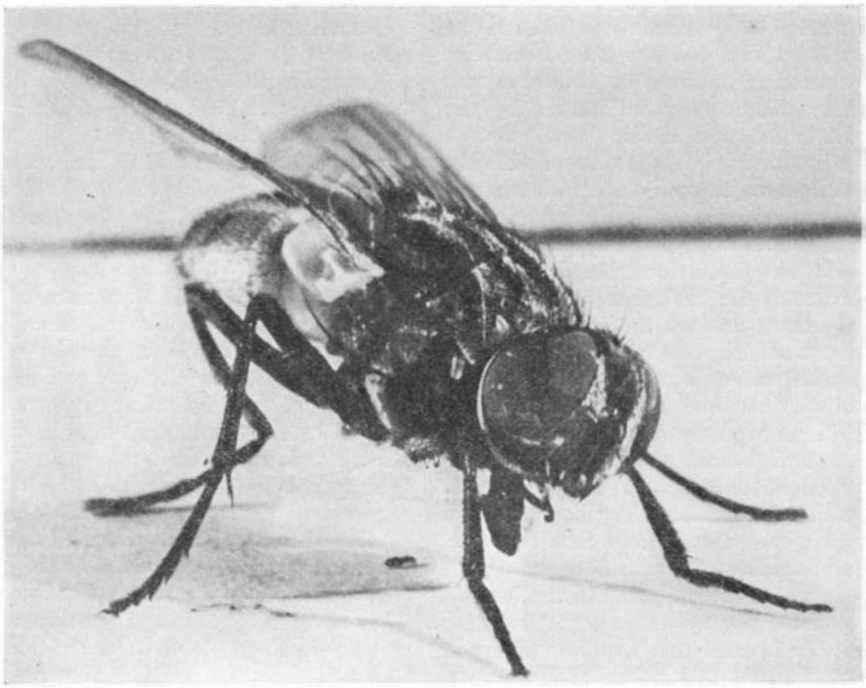
FROM prehistoric times, man has been bothered by insects but it has taken an aroused, scientifically-minded civilization to appreciate the true menace of these pests, particularly those which invade the home. Civilization has been nourishing the insect. Unwittingly, man has been playing into the clutches of some of his most dangerous "public enemies"—the fly, the mosquito, and the roach. Recently, however, the connection between insects and the spread of disease has been recognized and scientists have developed effective weapons to be directed against the pests; particularly, special chemicals which are fatal to insects but harmless to man or beasts.

A scientific body has been organized to study the insect problem in all its phases, particularly those which concern home protection. Known as the Rex Research Foundation, with headquarters in Chicago, this body has drawn up new and severe indictments against household insect pests and is co-operating with health departments, sanitary boards and other agencies in a nation-wide renewal of the battle against the seven principal "public enemies"—flies, mosquitoes, roaches, moths, fleas, bedbugs, and ants.

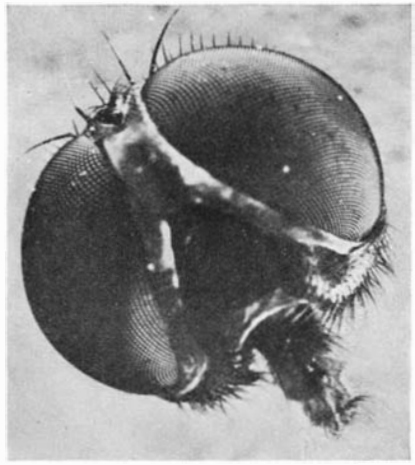
Known for years as one of the filthiest things alive, the fly has been convicted as the carrier of at least 30 diseases. It contributes directly to the death of at least 75,000 persons annually by spreading disease. Flies are held responsible for 85 percent of the typhoid cases in cities and 95 percent in rural districts. They multiply with terrifying rapidity. In one season, from May 1st to September 30th, a female fly may produce nearly 5,598,720,000,000 offspring. One fly may carry as many as 6,000,000 germs. Its body and even its wings, apparently smooth and shining, are covered with small hairs and bristles which offer excellent lodging places for germs as it crawls over filth.

**It would take many Empire State Buildings to house a fly's offspring. During the summer one fly and her progeny might produce, if nature did not interfere, about 5,598,720,000,000 flies**

THE fly's eating habits and, in fact, every phase of its conduct are dirty and disgusting in the extreme. To soften its food so that it can be swallowed, the fly vomits upon it, leaving hosts of dangerous germs upon unconsumed portions of its meal. Flies will travel from one to 30 miles for food. At one feeding, they will eat half their weight in food and will gorge themselves in half a minute or less if not disturbed. In spite of some decrease in the fly population in cities, their numbers are enormous in many parts of the country and even in centers fortunate to have every modern sanitary convenience flies appear at the least encouragement. The warm summer season is most favorable to their multiplying.

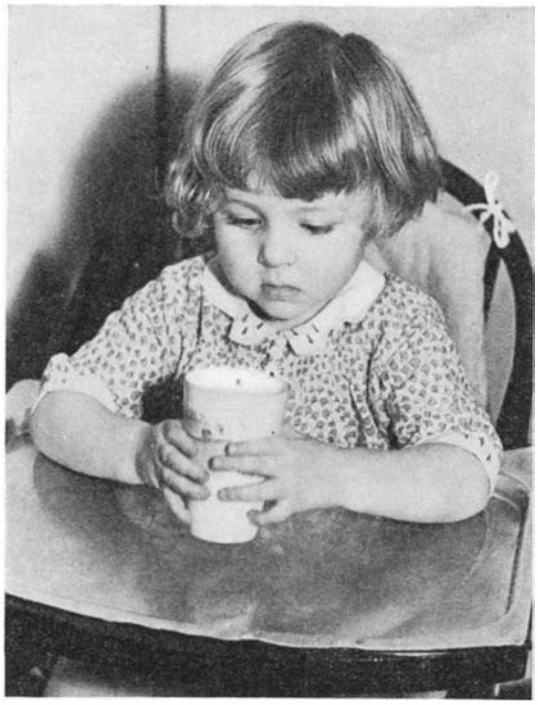


**The house fly is the filthiest of all insects. They will eat half their weight at one feeding in half a minute or less, and will travel as far as 30 miles for food**



**Front view of a fly's head showing compound eyes and filthy mouth**

The mosquito has been hated for generations because of its painful bite. Sixty kinds are found in the United States. Mosquitoes are condemned chiefly as carriers of malaria and dengue or breakbone fever which sometimes becomes epidemic in the southern states. The mosquito's principal menace lies in the fact that it is likely to inject germs directly into the blood of its victim. The itching and swelling caused by its attack are largely due to a poison substance released during the biting to thin the blood so that the liquid can



**Thousands of children like this one are the victims of fly-borne diseases every summer**

easily be swallowed by the mosquito.

Cockroaches are the "Methuselahs" of the insect world as they frequently live to be four years old. There are 43 species but four are important as household pests. These filthy insects carry

**Here is shown the female of the dreaded fever spreading mosquito**

the germs of diphtheria, typhoid, dysentery, tonsilitis, leprosy, and malignant tumors. Next to the fly, the cockroach is the most dangerous as a carrier of disease.

Moths devour some 250,000,000 dollars worth of textiles and other materials annually. They feed on animal fibers almost exclusively and are the housewife's constant enemy. Killing the miller moths does little good as the eggs usually have been laid before the moth flies. The larvae which hatch from the eggs do the damage. They live and grow fat on furs and fabrics. Under favorable feeding conditions many devour wool, fur, and other animal fibers equal to about 12 times the weight of the miller. The use of effective chemicals applied under pressure and directly at the areas where the larvae are at work, has proved especially helpful in combating the moth.

Bedbugs carry dysentery, smallpox, typhus, anthrax, infantile paralysis, relapsing fever, bubonic plague, and leprosy. Their painful bites, vile odors, and menace as disease spreaders make them especially obnoxious and dangerous. Bedbugs are so foul-smelling that birds will not touch them. Chemical sprays have proved most efficient in combating them.

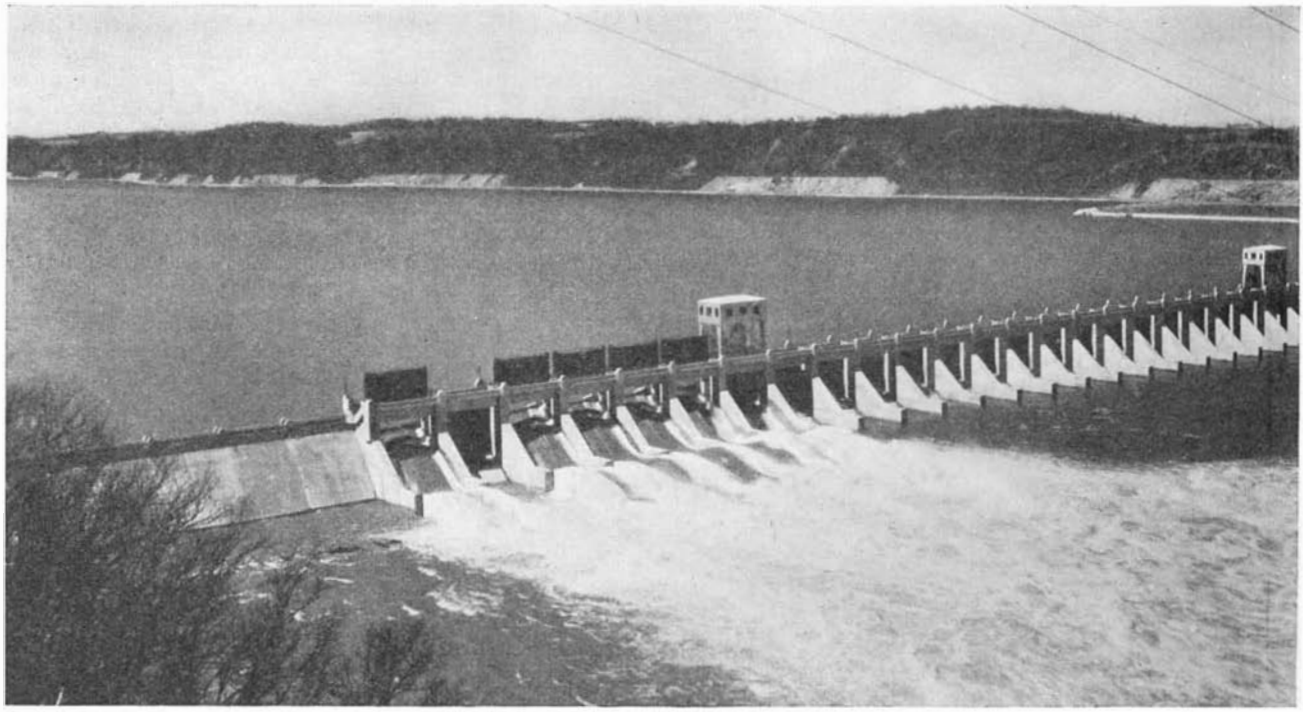
Ants and fleas are properly classed with the other "public enemies" as devourers of materials and spreaders of disease. Fleas have been associated with animal diseases and with bubonic plague. There are 6000 different kinds of ants but four of them do the most damage—the tiny red variety, the small black ant, the carpenter, and the pavement ant. The timely and proper use of chemicals is proving especially effective in curbing them as large numbers of the insects can be reached at one time with such treatment.

Interesting research lies back of the development of the "chemical warfare" against insect pests. Scientists discovered a vulnerable spot in the household pests through their breathing apparatus, consisting essentially of exposed pores on each side of the insect's body. The chemical sprays used, while harmless to man and animals, have the peculiar property of paralyzing the insect's breathing organs. The victims therefore quickly suffocate after coming in contact with the materials, usually applied as a fine mist from spray guns. Such chemical sprays are available for quick and easy use in the home.

AN essential ingredient in the most efficient sprays is the extract of a certain species of dried chrysanthemum flowers. The substance was discovered by accident. Near a bunch of wild flowers which had become withered were observed many dead insects. The matter was investigated by scientists who discovered the effect of this flower extract on the insects' breathing apparatus. After further research, ways were found by which the substance could be properly mixed to form a dependable spray. Science therefore has supplied a new and powerful weapon to train against the insect hordes and man is afforded a superior advantage over his ancient foe.

The battle is far from won. It is estimated that there are from 200,000 to 1,000,000 kinds of insects in the world, thousands of them harmful to man. The world's insects far out-weigh all the human beings, animals, reptiles, and birds put together. The war between man and insect will be a long one but for the time being, the home, at least, has been made reasonably safe, thanks to the work which has shown the way to direct the terror of the battlefield—"chemical warfare"—against the insect armies.

**Besides adequate screening, chemical sprays may be used which, while harmless to man and animals, have the peculiar property of paralyzing the insect's breathing organs. The sprays are usually applied as a fine mist from hand spray guns**



**The new hydro-electric development on the Susquehanna River at Safe Harbor, Pennsylvania. The wires of a transmission**

# MORE HARNESS FOR THE SUSQUEHANNA

## Safe Harbor, Linked With Conowingo and Holtwood Plants, Completes Harnessing of Historic Eastern River

THERE is no river in America quite like the Susquehanna. Flowing through Central New York, Pennsylvania, and Maryland, it traverses one of the richest and most populous parts of the United States.

Travelers by rail know the long bridges near its mouth in Maryland, where the traffic of the Atlantic seaboard crosses on its way from New England and New York to Washington and the South, and the great spans at Harrisburg which carry the trains from Philadelphia to Pittsburgh and the West.

Motorists following the Susquehanna Trail from tidewater in Maryland to the Finger Lake region of New York know the beauty of the river and the historical associations of the towns and cities which, from the early days of the country, have grown up to serve the commerce of the fertile agricultural valleys, mining regions, and manufacturing communities.

Those who live along the river know its vagaries, its treacherous rocks and rapids, the fury of its tantrums in flood stage. Yet few know that the Susquehanna drains the largest area of any of the rivers flowing into the north Atlantic south of the St. Lawrence. The upper reaches of the river in New York are farther north than the boundary line between Massachusetts and Vermont. The drainage area is 26,000 square miles. The basin lies between the Appalachian and Piedmont Plateaus. Few know that toward the end of its journey of 448 miles from Lake Otsego in New York to the headwaters of Chesapeake Bay in Maryland the average flow of the river is 39,000 cubic feet per second, that its minimum flow has been 2000 and its maximum 725,000 cubic feet per second.

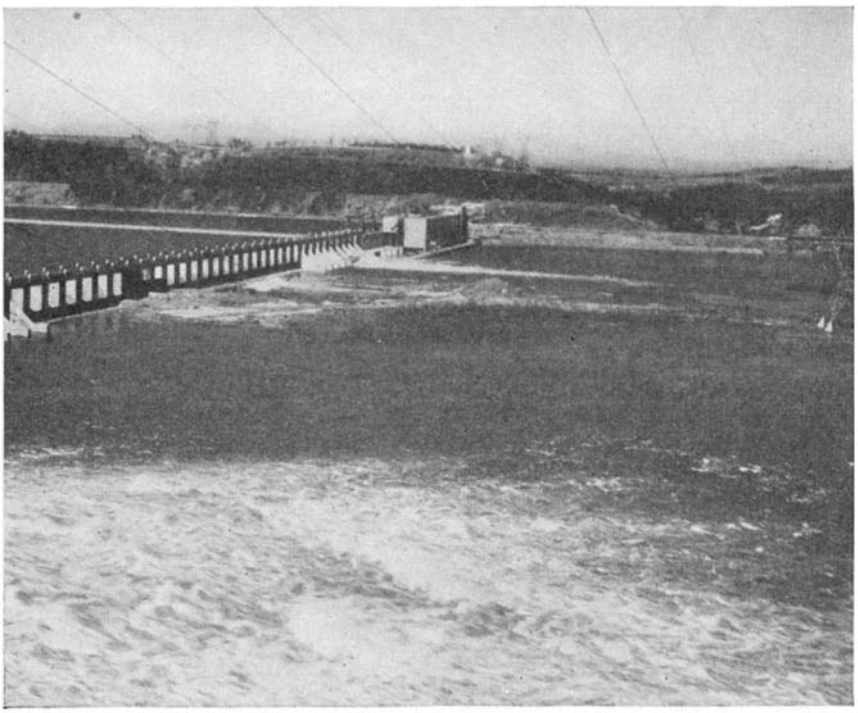
Doubtless, the lack of general appreciation of the importance of the Susquehanna basin is due to these temperamental traits of the river itself, which prevent its use for navigation.

THE subjugation of the Susquehanna, the real taming of the river, has been in the field of hydro-electric development. Engineers have just slipped in place the third set of harness to put the river to work in the 40 miles where it drops 225 feet between Columbia, Pennsylvania, and Chesapeake Bay.

At Safe Harbor, Pennsylvania, a mile-long dam and power house, stretching from the Lancaster to the York County banks of the river, now impounds 41,000,000,000 gallons of water. Some 30,000,000 dollars will be represented in the initial installation in the power house of six turbines, with a total capacity of 255,000 horsepower. Foundations have been provided for six more turbines, which will give the development of the Safe Harbor Water Power Corporation 510,000 horsepower at this point.

The magnitude of the undertaking at Safe Harbor places it in the forefront of American hydro-electric developments as to size but, like the river itself, the Safe Harbor development is a different thing altogether from the usual enterprise of that sort. Engineering advances that have been made at Safe Harbor can be traced back to engineering difficulties that were met and overcome at the Holtwood development on the Susquehanna eight miles below Safe Harbor.

In 1909 the McCall Ferry Power Company, which was constructing a hydro-electric plant at what is now known as Holtwood, went into the hands of a receiver. The federal courts appointed J. E. Aldred as the receiver. In co-operation with interests with which he had developed great water powers in Canada and elsewhere, Mr. Aldred organized the Pennsylvania Water and Power Company, which bought the McCall Ferry plant at a sheriff's sale. In 1910, engineers of the new Aldred company had completed



line swing from overhead to a tower at extreme right in the river below the dam

the unfinished dam, built a transmission line to Baltimore 40 miles away, and were selling the river power to the Consolidated Gas Electric Light and Power Company of that city.

Since that time there has been a progressive co-ordination of the operation of the water-driven generators in the river with steam-propelled turbines in Baltimore. In periods of low flow of the river the hydro plant is used to take care of the peak demands and in times of high flow the process is reversed so that the hydro turbines can use a maximum of the water in the river and the steam plants take care of the peaks.

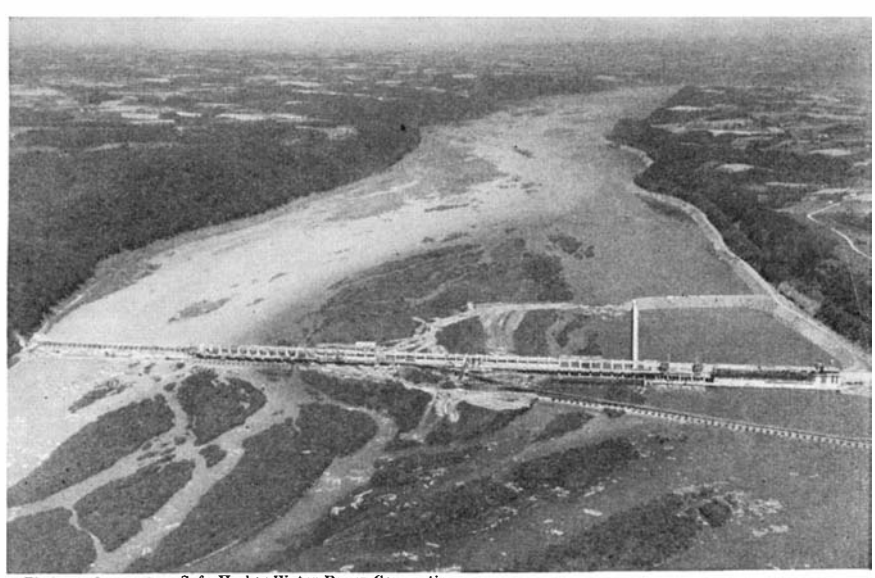
BUT here again the Susquehanna is a different kind of river. In its passage through the anthracite regions of Pennsylvania, it washes down-stream particles of coal which are deposited in the slack water. Dredging of this deposited river coal is an old industry at Harrisburg and elsewhere along the river. With the stoppage of the waters by the Holtwood dam, deposits of coal have formed in large quantities between Holtwood and Safe Harbor. Studies made by the power company disclose that there are 10,000,000 net tons of coal which this different sort of river has brought down-stream and deposited in the pond of the hydro-electric plant. To utilize this coal dust, there has been built adjoining the hydro station a pulverized fuel power plant. To date, the company has dredged from the river and burned under the boilers of the steam plant at Holtwood 285,000 tons of river coal. The steam station has an installed capacity of 30,000 horsepower but is designed for an ultimate capacity of 200,000 horsepower.

During the 21 years of operation at Holtwood, emphasis has always been placed on the value of research. Exhaustive studies of the vagaries of the river and the balancing of the loads of public utilities which buy the power, have led to better utilization of the hydraulic energy year by year. Investigations of means to prevent interference from sleet on transmission lines, protection against lightning, and the elimination of difficulties from ice in the river have overcome many obstacles. New switching apparatus and new types of machinery bearings have been developed, and extensive work has been carried on to prevent corrosion of turbine parts.

While this research was reflected in better operation at Holtwood, the knowledge gained was applied to plans for the new and greater development at Safe Harbor. Studies for Safe Harbor had been conducted for 15 years prior to the time when the men who had directed the operations at Holtwood decided that the time had arrived to give practical application to these plans by building a new plant. The plans provided a development which would be interconnected with Holtwood and so designed that there would not only be additional power but a supply so co-ordinated as to make the two plants, operated as a single development, one of the largest and one of the most effectively utilized sources of hydro-electric power on the continent.

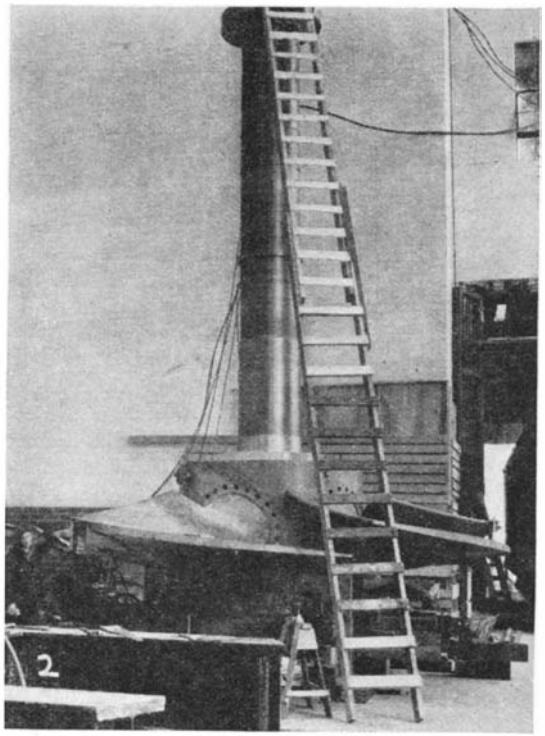
CONSTRUCTION of the Safe Harbor plant hinged upon the electrification of the Pennsylvania Railroad. By developing the transmission lines of the Pennsylvania Water and Power Company into a regional system supplied by the hydro and steam plants at Holtwood, and by the hydro development at Safe Harbor and the steam stations of the Consolidated company at Baltimore, there was created a combined hydro and steam system with resources of 750,000 horsepower which can readily be increased to upwards of 1,000,000 horsepower. This enabled the group to execute one of the largest power contracts ever negotiated, an agreement to supply in its entirety the energy for the electrification requirements of the Pennsylvania Railroad from the Susquehanna River through Baltimore to Washington and environs, including the yards in Virginia.

The progressive steps in the utilization of the water power at Holtwood and Safe Harbor revolve around the strategic location of the plants in ref-



Photographs courtesy Safe Harbor Water Power Corporation

An airplane view of the Susquehanna River during construction of the new dam, looking up the river and showing the well-cultivated nature of the district



One of the propeller-type water turbine runners, showing automatically adjustable blades

erence to population, industrial districts, railroad electrification; and the financial and engineering comprehension that has evolved a successful method of marketing the power of a temperamental river so that economies could be gained in steam stations through the supplemental supply of hydro power, and so that economies could also be gained in hydro generation through supplemental supply of electricity from coal burning stations. These accomplishments to their credit, Mr. Aldred and his associates directed their efforts toward inclusion in the Safe Harbor design and equipment of all the advantages resulting from their research in this eight miles of river where they are now using the water twice instead of once.

AMONG these efforts were studies which they caused to be made in Europe of the Kaplan type of turbine runner. They also built at Holtwood an experimental hydraulic laboratory which is unique in the United States. This laboratory, housed in its own building, is in reality a miniature power plant. Here, under full designed head, the company and manufacturers experimented with intakes, scroll cases, draft tubes, and turbine runners. As a result of these studies, the ratings of the turbines at Safe Harbor were materially increased.

Studies of erosion, the pitting of water wheels with small cavities caused by the impact of the water upon the turbine wheels, were carried out under local conditions with the water wheels at Safe Harbor and Holtwood. While the results of tests in the Holtwood hydraulic laboratory reduced the cost per horsepower in the Safe Harbor development, the research will be beneficial to all who are interested in the art of hydro-electric engineering and in the manufacture of generating equipment.

Their plans in shape to proceed with the Safe Harbor development, engineers of the power company located a trap-rock dyke on a farm near the site of the new dam. A quarry established there provided all of the rock required for the construction and sufficient stone for use in the relocation of nine miles of the track of the branch line of the Pennsylvania Railroad which parallels the river. After the completion of the dam and power house, and before dismantling the rock crushing equipment, sufficient stone was excavated and crushed to provide for the extension of the power house for the additional six units to be added later.

After permission to begin work in the river was granted by the federal and state authorities in the spring of 1930, as many as 4000 men were employed on the site at one time and about 8,000,000 dollars was paid out in wages.

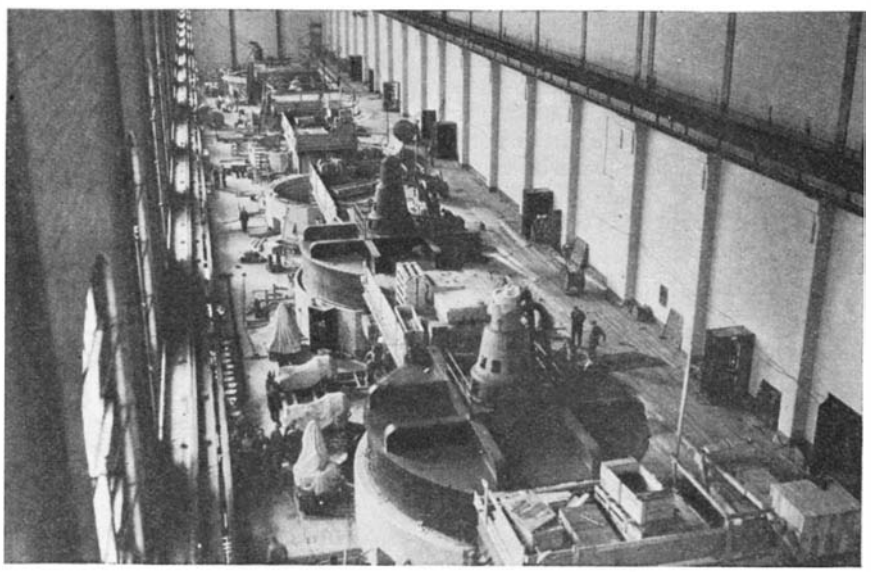
The job required the excavation of 1,130,000 cubic yards of rock and the use of 460,000 cubic yards of concrete, 18,000 tons of structural steel, and 5500 tons of reinforcing steel. To "unwater" the river, which is a mile wide at this point, three cofferdams were used. There were 16,000 carloads of material delivered to the site in addition to 12,000 carloads of crushed stone from the company quarry. Twenty miles of standard gage railroad track were in service at the dam site during construction. The railroad equipment used by the contractors consisted of twelve steam locomotives, seven gasoline locomotives, nine flat cars, two railroad hopper cars, sixty-five 12-yard air dump cars, and six locomotive cranes.

THE dam raised the level of the water 53 feet and formed a lake covering 10 square miles. The dam is divided into two non-overflow and two spillway sections. The latter contains 32 gates which, when all are open, can discharge 1,000,000 cubic feet per second. Each gate is 35 feet high and 48 feet wide and weighs 90 tons.

The four turbines now in operation are Kaplan, or automatically adjustable blade propeller-type turbines, 220 inches in diameter, 109.1 revolutions per minute, rated at 42,500 horsepower each. They discharge 8000 cubic feet per second at 55 feet head. One of the two units to be installed next year is being especially constructed for railroad supply and will be the first large single-phase water wheel unit built in this country.

Power from the plant is transmitted at 220,000 volts over a new 70-mile transmission line to Baltimore.

The Safe Harbor dam forms a lake 10 miles in length. Back-water from the Holtwood dam forms a lake covering the eight miles below Safe Harbor. Seventeen miles below Holtwood is the important hydro-electric development at Conowingo, supplying power to Philadelphia. The three dams have thus created a series of lakes extending for 35 miles.

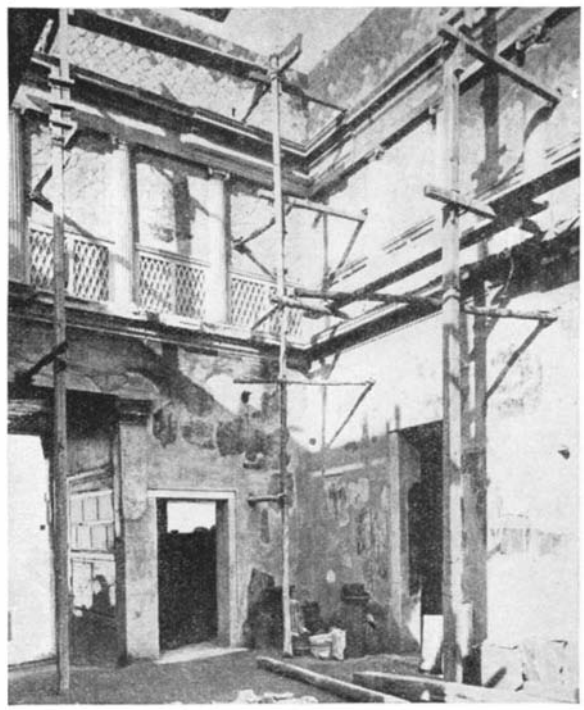


Interior of the power house at Safe Harbor while equipment is being assembled. Two of the Kaplan water turbines in the foreground are nearing completion

# FROM THE ARCHEOLOGIST'S NOTE BOOK

### Herculaneum Emerges From Solidified Mud

THE deep, hard stratum of solidified mud which has kept Herculaneum a treasure house is yielding great finds to the archeologists who have the encouragement of Premier Mussolini. Every building, every house is being explored and restored as far as possible, in order that we may gain an insight into the Roman social life of the 1st Century A.D. The last four years have been more productive of results than the preceding half century. Herculaneum, with its noble houses and quiet streets, is far more tranquil than cheap advertising Pompeii a few miles away. In one case, two stories have been laid bare and one house seems to have had even a third floor. The frescoes and mosaics are left in position instead of carting them off to nearby Naples. The conditions were such that many wooden objects and woodwork have been preserved. In one of the shops will be found a press used to press pleats in a toga and evidence of twin beds with a lamp between has been found. This brings us very near to our 20th Century standards of living. The structural and architectural evidences in both Herculaneum and Pompeii give a wonderful cross-section of life in these carefree and pleasant cities which met the same tragic fate, one by mud and one by ashes, from a common enemy—the crater of Mount Vesuvius.



**In the courtyard of a two story house being restored at Herculaneum; it was destroyed by mud in 79 A. D.**

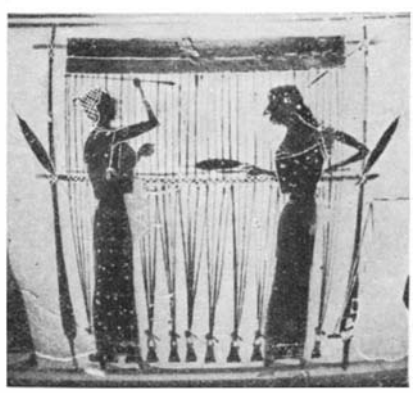
### An Historic Orgy

THE Metropolitan Museum of Art has recently acquired one of the rare early examples of black-figured ware. This is a magnificent krater or mixing bowl. There are 29 figures in the frieze or band, each about nine inches high. The subject is the return of one Hephaistos after he has been made drunk by Dionysos, the god of wine. The job was complete, as is seen by the Bacchanalian revels. In spite of the convention of this primitive art the picture has life, for it is full of individual touches.

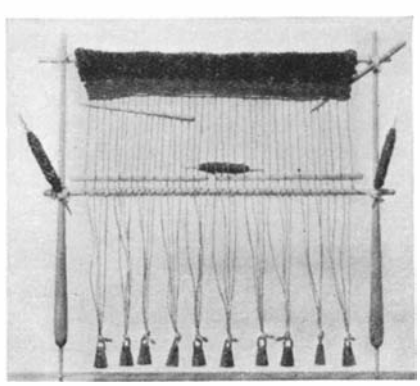
***Above:*** **A black-figured krater or mixing bowl; about 550–540 B. C.** ***Below:*** **Detail showing return from a "wild party" of gods and men**

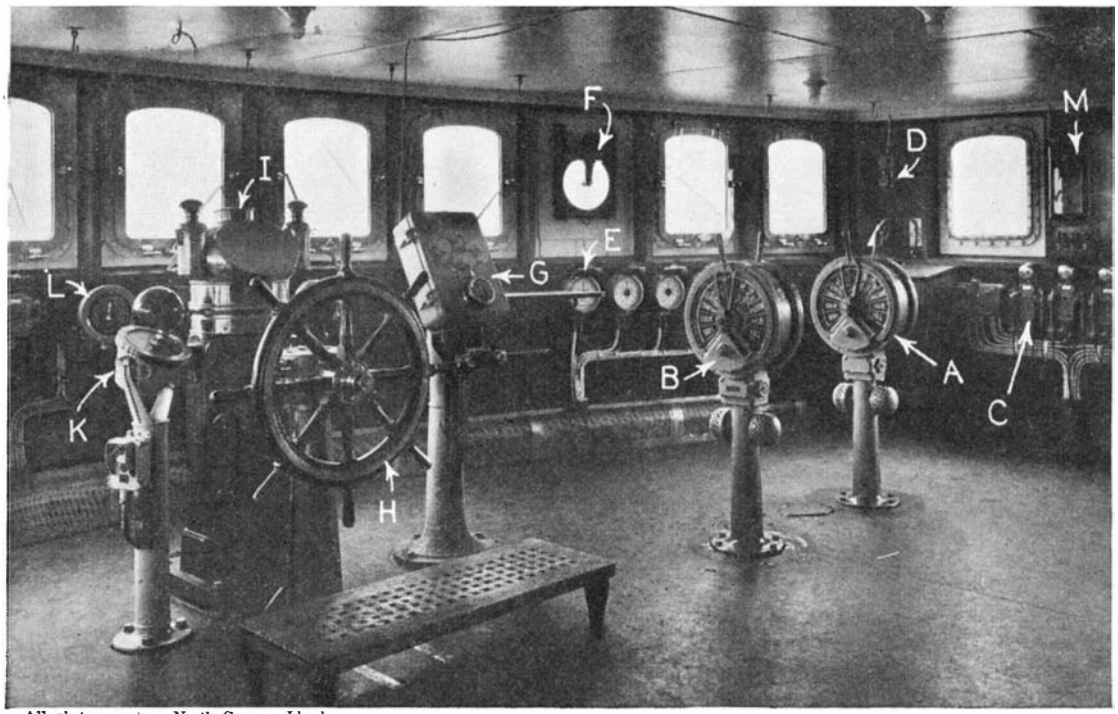
### Model of Greek Loom

USING as models the series of wool-weaving pictures from the Athenian jug illustrated in our March issue, the technicians of The Metropolitan Museum have constructed an actual loom which works. This vase painting has taught us much about the methods and resourcefulness of Greek weavers.



***Above:*** **Operation of weaving wool, from a painting on an Athenian jug.** ***Below:*** **Working model of loom from the graphic representation**






All photos courtesy North German Lloyd

**The bridge is filled with aids to navigation. *Above: A* and *B*, telegraphs to engine room; *C*, telephones; *D*, control for gyro compass; *E*, revolution counters; *F*, clear view window; *G*, "metal Mike;" *H*, wheel; *I*, magnetic compass; *K*, gyro compass "daughter"; *L*, rudder indicator; and *M*, course recorder**

# ON THE CAPTAIN'S BRIDGE

**By A. A. HOPKINS**

THE scene is the Port of New York; a revenue cutter leaves the Battery at 7:15 A.M.; let us assume that we all have that rare thing, a cutter permit for a visit to an incoming liner. The cutter is filled with revenue and immigration officials and a sprinkling of ship's news reporters and photographers. We tie up at the dock at Quarantine and wait for our ship. About 9:30 we see a little speck on the horizon which rapidly increases in size until we recognize the chunky but speedy *Bremen*—holder of the west to east crossing record in 4 days, 14 hours, and 30 minutes.

When opposite Quarantine, down goes the Bremen's bow anchor and the little flotilla which we have joined goes alongside. First comes the doctor's boat. They make fast and go aboard to examine passengers and crew. Then down comes the yellow flag at the foremast and we climb up the steep ladder and are hauled into the ship through a square port in her side. Meantime three mail boats have been taking off 3000 bags of mail. A tug has also put aboard a man in a checked suit and a cap. This is the docking pilot who succeeds the Sandy Hook pilot when the ship is abreast of the dock. Technically, both pilots are expert advisors to the captain who is always the supreme commander, but actually they give the orders which make it possible to thread the big ship through the intricate fairway and to dock her safely.

The anchor is up and we proceed to the huge pier with its waiting landing crew. We are then taken up through deck after deck until we arrive at the officers' quarters which are immediately behind and below the bridge. We are about as high out of water as the top of an eight story building is above the level of the street. One of the first officers greets us and we are made at home.

FROM the bridge may be obtained an unobstructed view forward. It is an enclosed room with many windows; on each side are open-air wings. Behind the enclosed bridge are the chart room, the radio direction-finding room, and rooms housing the meteorological and fire detecting devices. The bridge is the brain of the ship, the supreme stronghold of the captain and his chief officer. When at sea in fine weather these men are on the bridge about five hours a day but in fog or foul weather one of them is there continuously. There are three first officers and one of them is always on watch. Second officers and men have their own special duties and there are always six on duty.

Let us begin with the quartermaster who steers the ship. He manipulates a rather small wheel which sets in motion a mechanism which operates the ponderous rudder. The magnetic compass in its huge binnacle is used only should the gyroscopic compass fail—a remote contingency. The gyroscopic compass on which the quartermaster depends is not on the bridge itself but is amidships far below. The gyroscope continues to rotate in one plane and protests when any factor tries to change this plane. These "protests" are transferred to the compass cards of five repeater stations, one of which is by the wheel. These are known as "daughters," the main gyroscope being called the "mother."

The automatic steering device or "metal Mike" as it is usually called, is a mechanical helmsman which keeps the ship on an unerring course. It is used only in clear weather and never at night. Hand control is more flexible; for example, the quartermaster, if he sees a great wave coming, can alter the course so that the big ship rides it more easily.

Eight engine room telegraphs transmit orders and connect the brain of the ship with its heart—the engine room. These great clock-like affairs also acknowledge the receipt of the signal in

the engine room. The telephones serve to communicate oral orders to the engine room and other parts of the ship. The fog siren is located on the lookout mast or crow's nest and is actuated from the bridge, as are also the two great sirens and two whistles on the forward stack. They can also be blown from the open wings. The open wings of the bridge are equipped with wind deflectors for the comfort of the men on watch.

ONE of the most interesting objects on the bridge is a glass covered board showing the cellular construction of the ship below the water line, each bulkhead door being indicated by a miniature lamp. Turn an adjacent wheel and the lights begin to flash, showing that the 42 watertight doors have been closed. While the hydraulic pumps are always in commission the doors could be closed manually in a few minutes instead of the 30 seconds.

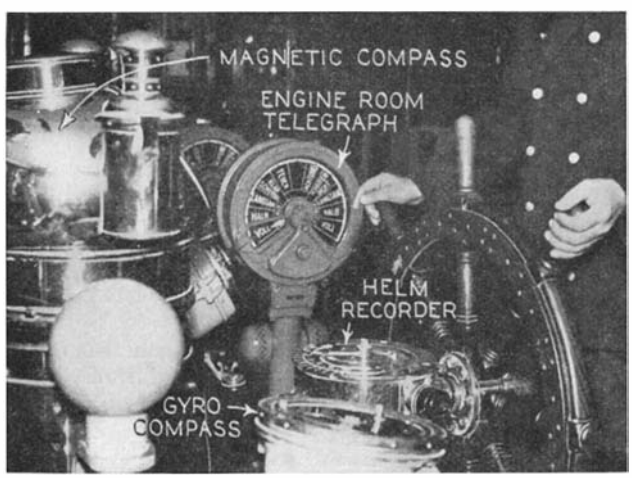
In the Svenska log—the speedometer of the ship—a small pipe takes in water at the bottom of the hull and this water drives a small water motor which indicates on the bridge the speed of the vessel relative to the water. Every revolution of all four propellers is also indicated on the bridge.

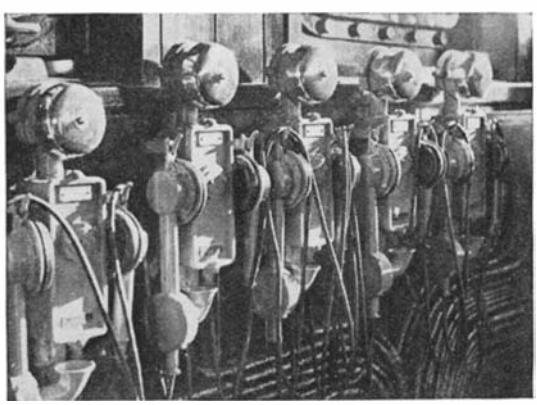
The chart room is back of the bridge and here the navigating officer makes his calculations and plots his course. Adjacent are the submarine signals, the fathometer, and the radio direction-finder which were described in the SCIENTIFIC AMERICAN for January, 1930. Draft indicators, roll and pitch indicators, meteorological instruments, and thermometers set in the hull which indicate the approach of an iceberg are also present. Many of the instruments on the bridge are for the sole purpose of indicating or recording the functioning of devices located elsewhere in the ship. Astronomical observations are made of the sun in the daytime or of the stars at night.

When the ship is outbound from New York, the docking pilot first assumes control. He stays in the picture for only seven minutes, until midstream is reached; then he disappears on the last of the nosing tugs. The ship is then under her own power and the Sandy Hook pilot is in charge. In about an hour he goes down the Jacob's ladder into the night and a small dory, and the captain is once more in supreme command.


**Six officers and men are on duty at all times. The bridge is 75 feet above the water and besides navigational instruments houses devices for working the ship**

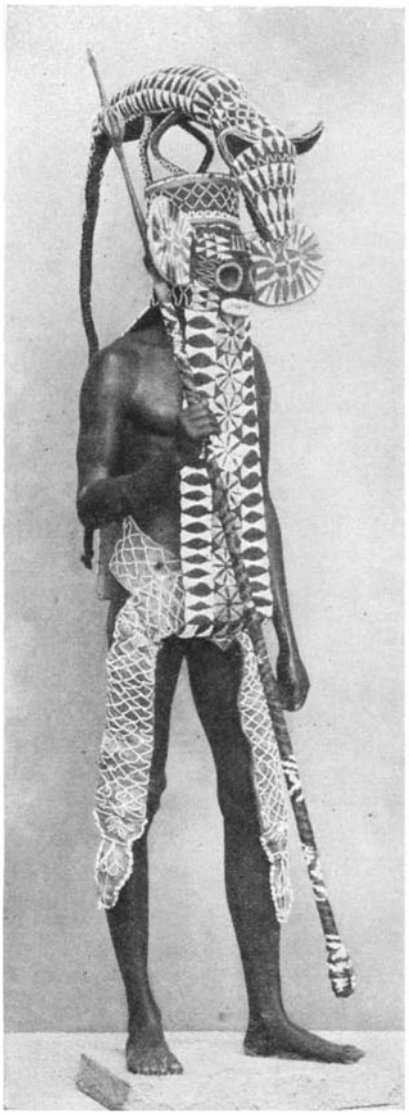
**The quartermaster steers the ship with the aid of the gyro compass, one of the "daughters" being at his side. If this fails there is always the magnetic compass**



**The sturdy telephones connect to engine room, lookout mast, and other points where oral communication is desirable**

**Chart room where officers plot course with the aid of instruments and observations**



**Medicine man, Cameroon. Belt is in form of double-headed snake**

# SERPENT WORSHIP

By WILFRID D. HAMBLY
Assistant Curator of African Ethnology, Field Museum of Natural History

PRIOR to my journey in Angola and Nigeria as leader of the Rawson-Field Museum Expedition of 1929-30, I had collated a considerable amount of evidence respecting serpent cults and beliefs of Africa. A survey of the literature dealing with the serpent in relation to human beliefs and practices reveals a vague and inconsistent use of the word "worship." The majority of writers have shown themselves willing to gather under this heading almost any form of cult or belief relating to the serpent.

The difficulty of supplying a rigid and logical definition of an act of worship is indisputable; in practice, confusion of thought may be avoided by using the word only in connection with certain beliefs and acts. These might reasonably include ideas of a superhuman being, a priesthood, provision of a special house or locality, and also the employment of sacrifice and ritual procedure. The word "cult" may be used to designate beliefs and acts whose nature is less clearly defined than is the case with concepts and ceremonies surrounding an act of worship. In a third category is a large and miscellaneous assortment of beliefs. These include a use of the fat of snakes as medicine; wearing of amulets to guard against snake-bite; magical means, other than amuletic, of curing snake-bite or becoming immune to the poison.

Pythons of some species attain enormous size, have great crushing power, are non-poisonous, are easily tamed, seldom attack human beings, and are slow to bite if handled gently. With these points in view it is not difficult to understand why the python should have been selected as a suitable snake for captivity in temples. The reptiles are easily controlled by the priests, and at the same time are harmless to those who come with petitions and sacrifices. The python god is the god of wisdom, earthly bliss, and benefaction.

IMAGES of the python are made in iron; these are representations of both the male and female reptile. Along with offerings of this kind are gifts of water in calabashes. All offerings have to be placed near to the banks of rivers or on the shores of lagoons, for the python god loves water. In the enclosure around the temple are sacred trees. Snakes are free to wander, but the priest retrieves them. Before he does so, he purifies himself by rubbing certain fresh green leaves violently between the palms of his hands. Then prostrating himself before the reptile, he carries it gently home. Opposite the python house are the schools where any child who has been touched by a python has to be kept at the expense of the parents, so that he may be taught the songs and dances peculiar to the worship. In olden days adults were similarly liable.

A native who meets a python says, "You are my father and my mother." The native then cries to the god, "My head belongs to you, be propitious to me." The punishment for a native who killed a python accidentally was burial alive. For the same offense a European was to be decapitated.

A. B. Ellis mentions 2000 wives of the python temples; these are secretly married to the priests with unknown rites of initiation. The ordinary duty of the wives is to bring water for the pythons, to make grass mats, to decorate the temple at festivals, and to bring food for the dancers. In these rites there are excesses in which the wives give themselves up to libertinage. They say the god possesses them, and he it is who makes them pregnant. Ellis notes that by 1890 there was a decline of custom noticeable, if comparisons were made with the year 1886. The annual procession was abolished; so also were the severe penalties for offenses against the python god. "The temple is now visited only once a year by the headman of Whydah, who presents animals for sacrifice, while invoking the good offices of the god on behalf of the king and the crops."

In former times, on the evening preceding the procession, the priests and Danh-si (python's wives) went around the town, announcing the approach of the festival. They warned all the inhabitants to close their doors and win-

**Temple for python worship in Dahomey. It is a conical grass-thatched hut built of poles**

# IN AFRICA*

**Native of the French Sudan and sacred snakes. Pythons are not poisonous and are easily tamed**

dows and to abstain from looking into the streets. The natives believed that the penalty for watching the procession would be an attack by maggots which would burst from all parts of their bodies.

THE priests and wives armed themselves with clubs on the morning of the great day. Then they ran around the town, clubbing to death any dogs, pigs, and fowls that were wandering in the streets. This was necessary, because animals might annoy the python god. It was said that dogs worried him by barking, while poultry pecked at his eyes. A hearty meal reduced the python to a comatose condition in which he allowed himself to be carried around in a hammock with the procession. First came a body of priests and wives armed with clubs for the destruction of stray animals. Following them were men beating drums and blowing horns. Next followed the hammock in which the python was reposing, and around this danced four priests and four wives, quite naked. The procession continued a whole day, and at night an orgy was held in the python's honor.

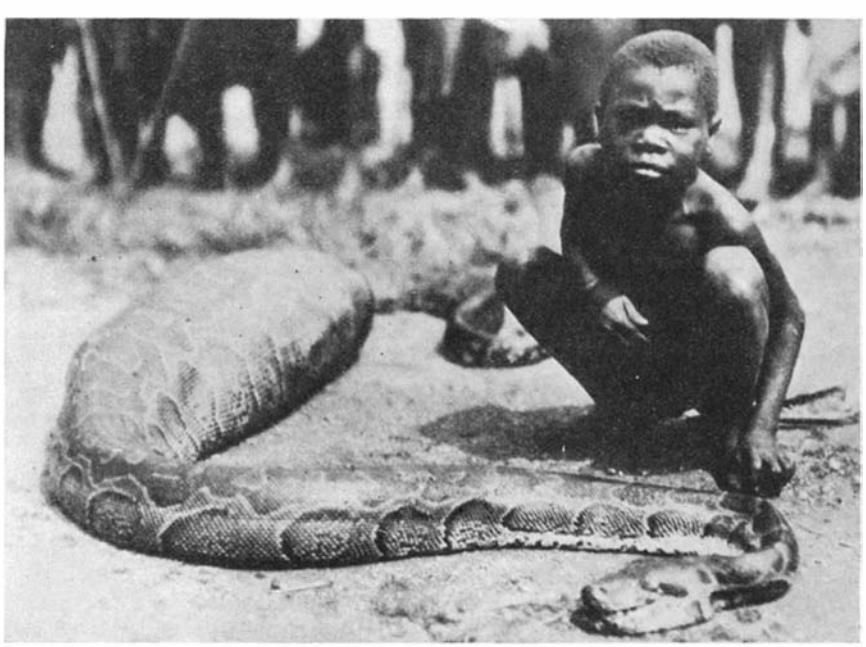
Very seldom is a human being attacked by a python, but, if such an event happens, the priest is the only one who may effect a rescue. If a python has to be carried to the sacred enclosure because of its depredations, its prey is allowed to remain with it. The snake is handled carefully so that it may not be annoyed or hurt. Anyone who fails to report an accidental injury to a python is cursed by the ancestral spirits, who inflict sickness or death. These penalties may be avoided by intervention of the priest. The punishment for wilfully killing a python is death. This sentence may, however, be remitted if the offender pays a fine, offers a sacrifice, and takes a bath in sacred mud. "These rules are milder than they were before the days of British administration. Formerly the penalty for killing a python was death even in the case of a chief. Old penalties survive in the interior districts." A public levy is made for giving elaborate burial rites when a python dies from natural causes. Every python (is said to have) a human soul within it; this must be liberated by ritual after the death of the reptile. Any offense against the snake is an offense against the ancestor. When a python has been killed, the people will not admit the extermination of their ancestor.

Worship of the python is confined almost entirely to one clan, in Budu, South Uganda. The temple is situated on the shore of Lake Victoria Nyanza, on the bank of the river Muzini. The temple is a large conical hut built of poles and thatched with grass. The floor of this structure is carpeted with sweet-smelling grass. On one side of the building is the sacred place of the snake and his guardian, a woman who is required to remain celibate. Over a log and a stool, a bark cloth is stretched for the python to lie upon. In one side of the building there is a circular hole so that the python is free to go to the banks of the river. There the reptile feeds on goats and poultry which are tied to posts near the water. In addition to this the python is fed daily on milk from sacred cows. White clay is mixed with the milk. The reptile lies over the wooden stool and drinks the milk which is offered in a wooden bowl held by the priestess.

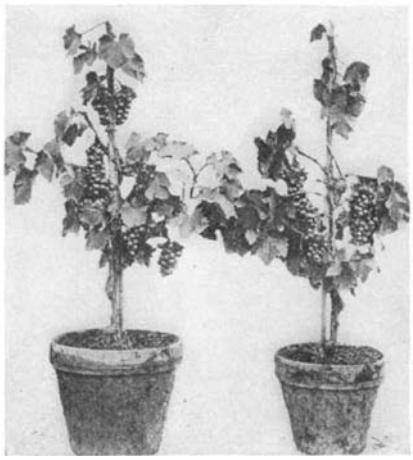
THE python is supposed to give success in fishing. He has power over the river and all that is in it. For this reason a special meal is given to the python before the keeper goes out to fish. The names of the python are male names. The time of worship is at new moon. Newly married men, also the husbands of barren women, make sacrifices and requests to the python, within whose power (is said to be) the assurance of fertility.

For seven days before an act of worship no work is done in the vicinity of the temple. The ritual is then repeated on each of seven successive days.

*Abridged from a publication of the same name in the Anthropological Series by kind permission of Stephen C. Simms, Director of the Field Museum, Chicago. Only parts of the section relating to python worship are used.



**Congo python which has just swallowed a goat, and shows it. Pythons have great crushing power but rarely attack a human being. The priests easily control them**



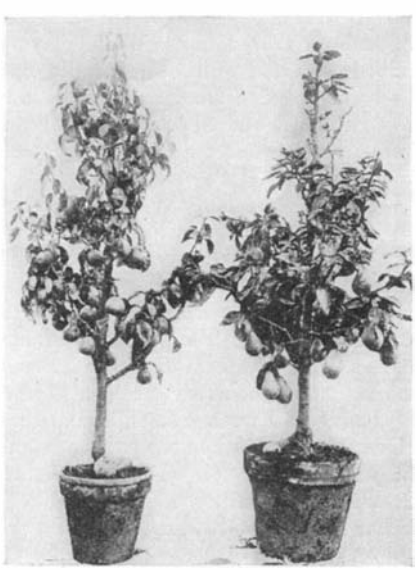
Potted grapes growing on stunted grape vines are an indoor novelty

# INDOOR FRUIT ORCHARDS

By A. N. MIRZAOFF

STRANGE as it may seem at first thought, it is entirely possible to raise in the home mature fruit trees that bear as regularly and plentifully, in proportion to size, as those of the outdoor orchard. On the dining-room table or a near-by window shelf, a large flower pot may be placed to hold the soil which supports a fully matured fruit tree—apple, pear, peach, and so on—which differs from its brothers of the orchard only in size. To understand how this may be done, it will help to know something of the background of the propagation of dwarfed trees.

One of the ever-interesting features of Japanese horticulture is the miniature landscapes which are familiar to all. Displayed in the windows of Japanese novelty shops and florists, these tiny gardens never fail to excite curiosity. Here are tiny houses, surrounded by beautifully landscaped grounds, all within an area of a few square feet. A river with its bridges, a lake with tiny ships on its silvery surface, roads, gardens, fields—all are to be found in the more pretentious Japanese miniature works.



Pear trees no larger than rose bushes capable of bearing delicious fruit

It is not surprising, then, that the Japanese, in order to carry out their miniature landscape gardening with the utmost realism and fidelity, have developed a method of propagating dwarf trees for this purpose. The system of successfully stunting the growth of trees that normally reach great heights has been developed through generations and some specimens of the results have attained an age of 200 years. The whole system of culture of these tiny trees may be summed up as the reversal of nature's own method. It is based on the survival of the unfittest, so to speak, rather than on the survival of the fittest.

Dwarfed plum tree; its ordinarily rapid growth has now been arrested

A little over 75 years ago a Japanese gardener landed in southern France and secured a position on a large estate in that country. Five years later, this Japanese gardener was known to every landscape artist and to every horticulturist throughout Europe. So many wonders had he performed in dwarfing pine trees, that he accumulated a fortune as a consultant in horticulture. The secret, however, he never disclosed, but other horticulturists began studying his work. In less than a decade, what the Japanese horticulturist believed was his own secret, was a secret no longer. A French horticulturist then introduced a method of dwarfing that had for centuries been kept secret by the masters of China and Japan. By the Japanese, this method of dwarfing trees is called "tsukurimono." It was at first exclusively restricted to the dwarfing of a number of various varieties of pine and spruce trees, and no attempt was made to dwarf fruit trees until recently.

A fig tree successfully grown in a flower pot is a task for the expert

YOU have seen miniature forest pines growing in ordinary glazed flower pots gayly decorated with scenes of Japan—Fujiyama, bridges, and pagodas—and you have no doubt said to yourself, "I wonder how they do it?" "Do they cut the roots, do they cut the branches, or do they stunt them with chemicals?"

As we walk through a forest we see that some trees grow to gigantic proportions, while others of the same family seem weak, undernourished, and puny. The rocky slopes of mountains supply little moisture and less plant food; therefore the young plant, deprived of its natural share of nourishment, does not thrive so well here as the tree that grows in rich soil on the lower slopes. Here the trees receive the benefit of sun and the richness of soil, and grow to be fine specimens of their family. With the right amount of sun, the proper kind of soil, and the proper amount of moisture, spruce and pines grow to magnificent proportions.

Now that the basic facts are known as to why some trees grow large and other trees of the same family fail to attain the proper proportions it is a

# Ancient Oriental Horticultural Dwarfing Methods May Be Applied to Common Fruit Trees

**Good sized luscious apples can be plucked from this dining table tree**

comparatively simple thing to grow stunted trees in your own home, but it takes a degree of patience which is generally associated with Job the Patriarch.

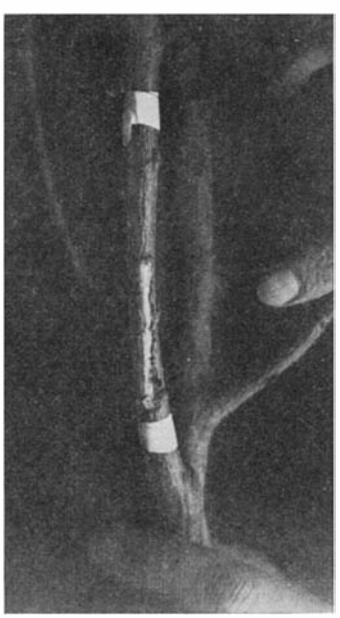
The method of dwarfing consists of continual pruning of the roots combined with cutting of the branches to induce more compact foliage and to prevent the loss of too much moisture. This method is applicable to pine trees to be used for decorative purposes. Where dwarf fruit trees are to be raised in flower pots the method becomes slightly complicated. Fruit trees do not bear fruit properly unless they are grafted, hence before planting any fruit trees in flower pots we must first have the grafted trees.

SUPPOSE, for example, you desire to dwarf an orchard of peach trees. You can buy the small trees from a nurseryman or you can plant peach stones from well-ripened fruit of good quality. If you wish to buy the plants see to it that they are not more than two years old. Be certain, also, that the trees which you purchase have been grafted. It is probable, however, that you would prefer to do the job from the bottom up.

If you want to grow your own trees from peach stones, plant them in the fall. They will germinate in the spring and will grow to about a foot in height. The following spring they are ready for grafting. The grafting of the two year old peach trees must be performed on the main stock by cutting it about three inches above the soil. Make an incision in the stock and insert into the incision and seal the scions which are obtained from another healthy tree. For those not familiar with the process of grafting, it would be advisable to consult a good book on horticulture.

In the summer the scions will bud and grow to a height of three or four feet. The third year they are transferred to the flower pots. It is then that the real work of dwarfing begins.

Surgical methods are applied, first by cutting out the tap root which usually grows in the center of the plant. This is best done by the so-called strangulation method. Fine picture wire or for that matter any small wire is tied at the base of the root and the process of strangulation will be completed in a couple of months. This prevents the tree from taking too much nourishment and its growth is therefore retarded.



**Slit the bark between bands, then bind with soil and cover with moss**

Meanwhile, some of the branches with excessive leaf growth are pruned in order to prevent too much evaporation of moisture through the leaves. In the treatment of the soil very little nourishment is provided. Just enough to keep the tree alive but not enough to cause rapid growth. A few pebbles scattered in the dirt will prevent the roots from growing thickly.

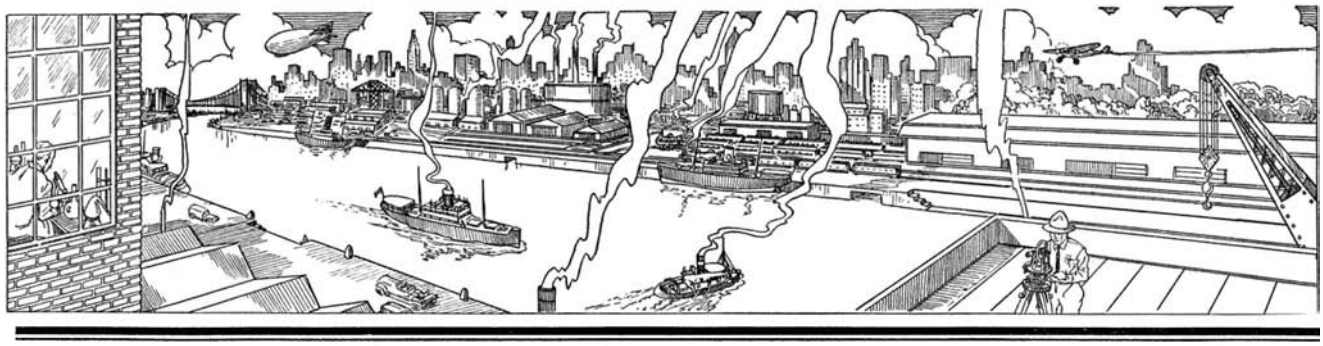
The fourth, fifth, and sixth years the same surgical operations are continued, either in early spring or in the late fall, until it is evident that the tree no longer has a tendency to rapid growth and gradually settles down to increase the thickness of its main trunk, which is the sign of ripe age. At this stage the tree commences to bear healthy fruit on the few branches that are left for its existence.

**Pruning branches prevents growth of leaves and conserves moisture**

The dwarfing characteristics can be perpetuated artificially by the so-called vegetative method of propagation. The bark of a branch is slit a number of times and soil is bound around the injured part for a space of four to five inches. Around the soil, place plenty of thick moss. Tie with a string. Keep the soil moist at all times until roots have formed. Then cut at the base and plant in fresh soil in a flower pot. The cutting need be made by this means only if one wishes to develop a great number of dwarf offsprings of fruit trees.

The rewards obtainable from growing dwarf trees will more than pay for the time, the care, the patience necessary to grow them successfully, because the fresh fruit picked from your own orchard growing right in the home will make you feel that you have really produced something worth while.

**The tap root is "strangled" with wire and limbs cut to retard growth**



# THE SCIENTIFIC AMERICAN DIGEST


**Conducted by F. D. McHUGH**

Contributing Editors

ALEXANDER KLEMIN

**In charge, Daniel Guggenheim School of Aeronautics, New York University**

A. E. BUCHANAN, Jr.

**Lehigh University**


## Clothing Reform

MODERN housing and modern men's clothing, asserts Dr. Bachem, professor of bio-physics in the University of Illinois School of Medicine, are crimes against nature in their exclusion of natural stimuli to the skin. Man, he warns, is paying a heavy penalty for this transgression.

One important function of the skin, per-

**Tipping the scales at less than a pound: a woman's clothes are used to demonstrate conclusively that women are the beneficiaries of a very practical clothing reform**

formed by a complicated mechanism, is heat regulation, he explains. The perfect working of this mechanism determines to a large extent a healthy constitution.

By living in closed rooms, by dressing in heavy and tight fitting garments, we have allowed this mechanism to cease functioning and its branches to degenerate, so that we cannot withstand even small variations of temperature, usually reacting with a cold even to the most moderate exposure. It is the fear of such exposure, together with the dictates of fashion, that has led the stronger sex to overdress so that their bodies constantly move in what is essentially a tropical climate within their garments.

Fashion and science have now reached the point where a break may occur unless fashion gives way. It should not be difficult to design a garment without a narrow collar and a tight belt, so that air ventilation is permitted.

Disposing of vest and coat should not carry the stigma of social misdemeanor, but should be permitted as a means to allow the body to cool off, to admit some light, and to increase its vitality.

## Insect Spray Keeps Cats and Dogs Away

THE problem of keeping cats and dogs out of flower beds, shrubbery, and in general where they are not wanted, appears solved by the United States Department of Agriculture.

Simply spray the flowers, shrubs, or premises with a dilute nicotine sulphate spray and cats and dogs will avoid them, the department says. The spray is harmless to plants and is very offensive to animals. It is widely used against sucking insects. As cats and dogs have a keener sense of smell than humans, they can smell the spray even when it is applied so thinly that people are unaware of its presence.

Commercial preparations usually contain 40 percent of nicotine sulphate. Such preparations should be used at the rate of one and one-half teaspoonfuls to a gallon of water. The spray evaporates and should be renewed after rains, or about once every two weeks in ordinary weather.

## Relieve Asthma by Artificial Fever

ARTIFICIAL fever produced by electrical heating gave relief to 42 sufferers from intractable asthma, Drs. Samuel M. Feinberg, Stafford L. Osborne, and Meyer J. Steinberg of Chicago have reported to the American Medical Association. Nineteen of the 42 patients were free from asthmatic attacks for considerable periods of time following the treatment.

The Chicago physicians based their treatment on the observation that the fever caused by scarlet fever, pneumonia, or an abscess usually resulted in at least a temporary improvement in the asthma. Artificial fever has likewise been helpful in treating many other conditions. The experimenters therefore devised a bag into which the asthma patient is placed, after having been carefully anointed with oil and wrapped in blankets. The temperature is then raised to about 104 degrees and kept there for about eight hours under careful observation. Of course every precaution is taken first to determine whether the patient can safely take the treatment.—*Science Service.*

## Stainless Steel Coins

THERE is not one among us who has not at some time or another—perhaps very often—felt a bit of squeamishness about handling the badly corroded, dirty green copper cents that turn up so frequently, evidently from someone's hoard. This revolt of our hygienic selves is accentuated by the tendency among children to place coins in their mouths—and cents, or pennies as they are incorrectly called, are usually the coins of childhood.

Photographs: Holland Institute of Air Conditioning

**Man has worn ridiculously heavy clothes since the Old Stone Age and has never had the benefits of a real clothing reform. This man's clothes, obviously *not* designed for comfort, weigh nearly six pounds**

How much better it would be were our cents made of chromium steel alloy—that marvelous modern product of which the housewife's ever-clean kitchen knives are made! John H. Pearce, of Seattle, Washington, thinks so, and we concur and pass

along his suggestion to the powers that be. Besides being as cheap as, or cheaper than, the copper that now goes into our cent, stainless steel would not corrode no matter how long it is hoarded in the child's bank or handled with perspiring hands, would wear longer because it is harder, would leave no disagreeable odor on the hands, and would be a very attractive coin. If there should be any question of distinguishing it from other white metal coins, a hole could be punched in its center as is the case with so many European coins.

## Finds Lost Golf Balls by Chemistry

A CHEMIST of Girard, California, J. E. Priddy, lost so many dozens of golf balls in the "rough" that he tried some experiments suggested by his chemical knowledge of certain odors which attract insects. According to *Industrial and Engineering Chemistry,* he saturated his golf balls with chemicals designed to attract white butterflies which are numerous about the course where he plays. Now, when he loses a golf ball he sits down and watches to see where the butterflies congregate.—*A. E. B.*

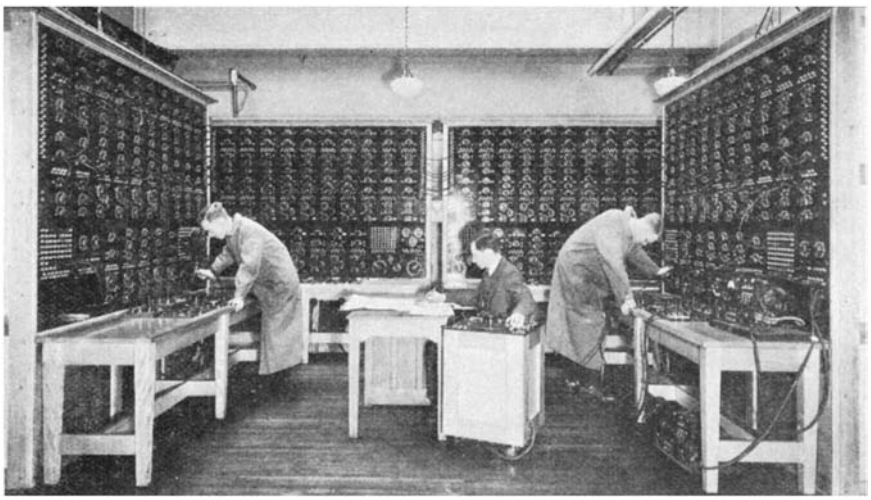
## Boxing Match Scoreboard

THERE are scoreboards for baseball games, football, and, in fact, practically every kind of sport, but strangely not much thought has been given to the development of a scoreboard for boxing matches. "Strangely," we say because, if we are to take the word of fight fans, there is often a chance for fraud in the final decision of the referee when the spectators have to depend upon the referee's memory as to which contestant has won the greater number of rounds on points.

Sensing this need, Charles M. Amory, of Palm Beach, Florida, has developed a scoreboard which will indicate to an entire audience the referee's decision of the winner of each round. Suspended over the ring, this scoreboard is a closed square cabinet-like affair, each of its four sides perforated in squares somewhat like a baseball scoreboard. The upper row of squares are numbered (by perforation) for the rounds, and each square of the two lower rows has a perforated star. Individual lights behind each number may be lighted to show the rounds that have already been fought and a light behind the upper or lower star of each vertical pair will indicate the winning contestant in that round.

Underneath the scoreboard are other, stronger lights which supply the necessary illumination for the ring.


**Suspended above the "squared circle," the new scoreboard records the fight**



**A miniature power system in a laboratory: the power system analyzer**

## Power System Analyzer

A MINIATURE electrical power system, condensed into a few square feet in a laboratory, but capable of simulating the operating conditions of a super-power system hundreds of miles in extent, is being used at the Massachusetts Institute of Technology for important studies in power transmission.

In effect, this model power system includes not only hundreds of miles of transmission line and underground cables, but the water-wheel generators in great hydro-electric plants and the huge steam turbine generating units in cities. This miniature power system was built in the Electrical Research Laboratories of Technology by H. L. Hazen and M. F. Gardner under the direction of Dr. Vannevar Bush, with the General Electric Company lending the aid of its specialized manufacturing facilities in producing important electrical parts.

The various units of the Network Analyzer, as the apparatus is called, are built with their individual control panels having dials and sockets much as small radio sets. These units slide into compartments in the steel framework so that the aggregate arrangement of their panels gives the appearance of large letter boxes around three walls of a postoffice. All the units can be connected by simply plugging them together with cords such as a telephone operator uses on a switchboard.

As there are units to represent not only transmission lines but complete generating stations and the loads of towns and cities, it is possible for the operators to study by the analyzer the way the current flows in whole power systems, the effects of building new lines, and the changes necessary with the growth of the cities and their demands for power. It offers a means for the engineers to study on a small scale the conditions not only of existing networks, but of contemplated power systems. They can thus anticipate many of the problems of generation, distribution, and consumption before construction is started.

About 200 volts in this miniature network may be used as the equivalent of 200,000 volts in a super-power system, and the range of operations may be extended to produce artificially all conditions of generation and transmission covering an area of several states.

The effects of summer storms which sometimes cause serious interruptions in power, plunging cities and towns into darkness, can be safely produced on this model network by the simple expedient of short-circuiting the system where lightning strikes. With the "line" thus short-circuited or broken, research engineers will be able to read on dials and meters the riddles of re-routing the power and overcoming such interruptions. Not only will it indicate the conditions on the wire during such interruptions of nature, but it makes possible the faithful reproduction of the violent surges of the huge power house generators following these disturbances, everything taking place on a miniature scale.

## New Waterproof "Suede" Fabric

SHOES having uppers covered with a new fabric which has been developed by a division of the duPont company, look like suede, wear like suede, and are waterproof. This new material is known as Doe-Tex and is a waterproof fabric with the full-surfaced softness of suede. It is made

in a large number of effects, including shark skin, buffalo, caracul, and pig skin, as well as brocades, embroidered and quilted patterns, and plain suede effects. It is available in a wide variety of colors. Among the purposes for which Doe-Tex is intended are men's and women's sports garments, shoes, belts, handbags, dress accessories, and novelties. Also it may be used in making beach sandals, caps,

**Use of the new camera range-finder is as simple as sighting a rifle**

screens, book bindings, bridge table covers, and pillows, and it may be used in upholstering furniture.

## Uses for the Rarer Metals

ONE of the features of the modern developments of metallurgy is the extent to which small quantities of the less common metals, either in the pure state or as alloys, are finding employment in various branches of industry. Many of the so-called rarer metals exist in combination in abundance in the earth, but are extracted with difficulty from their ores. When a sufficiently great demand for a particular metal arises, however, it is often found that methods can be developed to produce the metal at a reasonable price—an economic proposition which has proved to be true in the case of aluminum, in particular.

Metallic barium (99.95 percent) has recently been produced as a commercial article and is supplied to manufacturers of ignition equipment in the motor-car industry, in which it is used in a high-nickel alloy. In the radio industry, the metal is used as a "getter" to clean up the last traces of gas in vacuum tubes. It is expected that the consumption will increase to a substantial amount in the near future.

The electrical and radio industries now employ pure molybdenum metal in the form of rod, sheet, and wire. Cerium, when alloyed with iron, zinc, or other base metals, produces pyrophoric alloys, which are used in pocket-lighters. Cerium metal and ferrocerium are also powerful reducing agents and offer excellent opportunities for industrial research. Both the metal and its alloy can now be produced at a relatively low cost and abundant sources of raw material are available. Caesium and rubidium are used in the manufacture of photo-electric cells. Caesium is also useful for eliminating the last traces of air from vacuum tubes. Recently, metallic lithium has found employment as a de-oxidizing agent in the refining of copper; it does not appreciably reduce the electrical conductivity of the copper.—*A. E. B.*

## Focusing Range-Finder for Cameras

AMATEUR photographers, even those of advanced standing, have long deplored the fact that it is necessary with the compact folding camera either to guess the focus or to carry along with them extra gadgets which may be used to find the focus more or less accurately. This difficulty has now been surmounted by E. Leitz, Inc., of New York, in its new Model D Leica camera which has a built-in range-finder. This new device automatically focuses the camera lens while the photographer is sighting the subject to be photographed; the picture is seen in exact focus right up to the moment of exposure.

Automatic focusing is obtained in the new camera by connecting the objective helical mount with the built-in range finder adjustment. In operation, the Leica user looks through the range-finder sight while turning the lens mount until the two images become one. At this moment the shutter release button is pressed and the exposure is made.

The Leica camera weighs less than a pound, yet it is instantly convertible into a speed, portrait, aerial, or panoramic camera. It is particularly useful for making pictures under difficult light conditions.

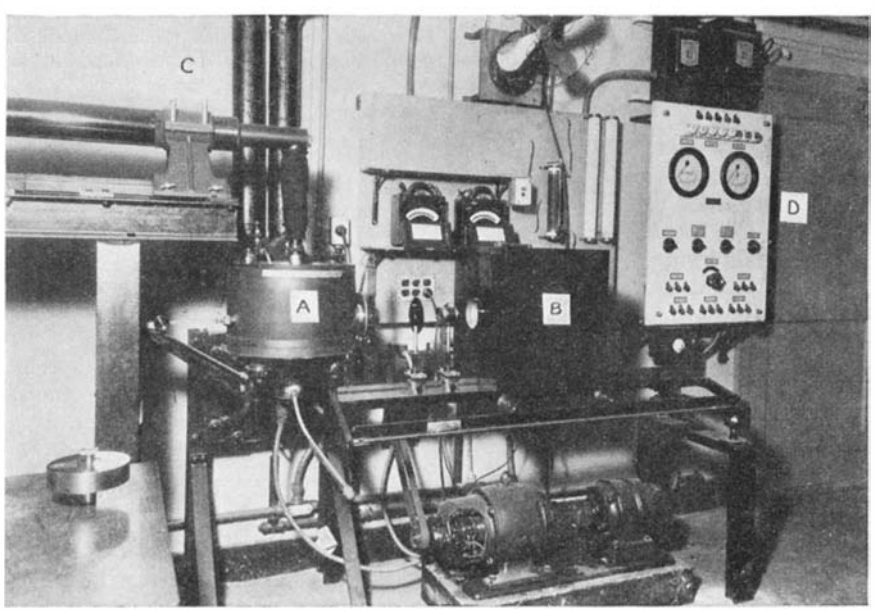
## Seeing the Ultracentrifuge Operate

SOLUTIONS of many synthetic and naturally occurring materials, such as rubber and the proteins, glue, and Oil-dag, contain particles which are larger than atomic and molecular sizes, yet much smaller than the limit of visibility of the microscope. In recent years we have begun to realize the importance of an accurate knowledge of the average size of these particles, partly from a purely scientific point of view, and partly from a commercial standpoint, for the uses of industry.

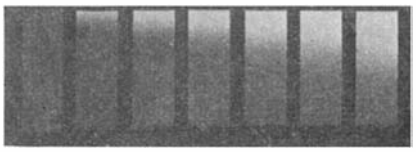
As examples of the importance of correct particle size one might mention the coloring matter in writing ink. Unless the particles are sufficiently small, settling and agglomeration occur which render the ink unfit for use. The action of heat on the particles of gelatin in glue affects its adhesive properties partly because of a change in the particle size. If rouge for polishing optical surfaces contains some coarse particles, scratches may be produced. The particle size of relatively coarse suspensions of substances like clay can be estimated by measuring the rate of settling under the influence of gravity. However, this method is inapplicable to the materials mentioned above because a measurable settling might require weeks or months.

The ultracentrifuge, from the Latin *ultra*=beyond, in the sense of *more than*, was developed by The Svedberg, of the University of Upsala, Sweden, and his associates, to furnish a reliable method for studying colloidal solutions containing extremely small particles. Of course, the idea of centrifuging to remove suspended material was not new because cream, for example, has been separated from milk in this way for many years. The new feature of the ultracentrifuge lies in the fact that the observer is able to watch and photograph the rate of movement of the suspended material while the machine is rotating at high speed. A displacement of even one millimeter, about one twenty-fifth of an inch, yields information on the distribution of particle size. Speeds of 40,000 revolutions per minute can be developed which are equivalent to a peripheral speed of 300 yards a second, approximately the muzzle velocity of a 0.22 caliber rifle bullet. Centrifugal forces 100,000 times that of gravity are produced. In other words, a pint of water would weigh 50 tons if such a gravitational force existed.

A photograph of the low-speed type of ultracentrifuge, capable of producing a centrifugal force about 10,000 times that of gravity, is shown in one of our illustrations. The centrifuge is contained in the water bath "A", and consists of a small synchronous motor directly connected to a cylindrical rotor bearing the transparent




**"A" contains the cell (holding the solution to be studied) of the ultracentrifuge; "B" is the source of illumination; "C" (upper left) is the front end of the camera**



**Beginning at left, with solution of horse blood, the rectangles show half-hour intervals in the sedimenting process with the ultracentrifuge**

cell of glass or quartz containing the solution to be studied. A point source of illumination is contained in the lamp-box "B". The front end of the camera is shown at "C", and the control board at "D".

To give an idea of the power of the high-speed centrifuge, the illustration above gives a reproduction of the photographic record of the centrifuging of a 1 percent solution of hemoglobin prepared from horse blood, and subjected to a centrifugal field of force 87,000 times that of gravity. In three hours the molecules of hemoglobin have sedimented about one quarter of an inch whereas under gravity the particles would have sedimented only three millionths of an inch in the same length of time.—*J. B. Nichols, E. I. duPont de Nemours & Co.*

## Course in Scientific Crime Detection

THE Philadelphia College of Pharmacy and Science will offer a one-year graduate course in scientific methods of crime detection, leading to the degree of master of science in chemistry.

Beginning in September, 1932, there will be classes in finger-printing and finger-print analysis; the study of weapons, projectiles, and ammunitions; various methods of collecting and recording scientific evidence; analysis and identification of foods, drugs, fibers, textiles, and miscellaneous materials; making and interpreting maps, plans, and drawings; the study of poisons and their separation and identification from food, blood, and cadaveric material; and laboratory periods devoted to training and observation, particularly emphasizing micro-chemistry, photomicrography, and crystallography.

The college is also establishing a museum, which will be open to police officials from all over the world, and in which will be kept such articles as samples of every brand of cigaret manufactured anywhere in the world, patterns of tire treads of every make, every grade of paper and twine used, and analyses of different types of soil.—*A. E. B.*

**The *Los Angeles* "narrowcasting" over the General Electric factory**

## What Is Needed in the Aircraft Engine

THE views of Major General James E. Fechet, former chief of the Army Air Corps, on what is needed in the aircraft power plant are authoritative, at least as far as Army requirements are concerned. Speaking recently before the Society of Automotive Engineers, General Fechet urged first of all the development of chemically cooled engines.

The aircraft engine employing such a chemical as Prestone (which has a boiling point much higher than that of water) can have the liquid in the radiator carried to a much higher temperature than would be the case with water. Therefore the radiator works at a higher temperature difference in relation to the atmosphere, radiates heat more rapidly and can be made much smaller. A smaller radiator means less head resistance. The chemically cooled engine of large power may, therefore, give a better all 'round combination than the air-cooled engine. There are a number of troubles to be considered, such as seizing up of the piston when working in cylinder walls at a higher temperature, but such difficulties are being rapidly overcome.

With the new fuels being developed, it is possible to give the fuel-air mixture some degree of "boost" or a few pounds of additional pressure at ground level, without danger of knock. But a supercharger which is entirely suitable for giving a fair "boost" at ground level may not be powerful enough to give the necessary supercharging at altitude, where a larger volume of air has to be handled (since the air is then very rare). General Fechet advocates a geared-type supercharger for ground boosting, together with a gas driven turbo-supercharger which can be cut in by the pilot at altitude. We believe that this combined system is entirely practicable. It should result finally in increased power at ground level, and almost complete maintenance of power up to altitudes of 30,000 feet.

Other requirements set forth by the speaker were reduction gearing for all types of engines, so that there would be better co-ordination between propeller and engine; a variable pitch propeller; and finally the substitution of fuel injection for the conventional carbureter.

There is plenty of room for research and invention even in the highly advanced power plants of to-day!—*A. K.*

## Talking on a Light Beam

THE wonders of applied physics seem endless. One of our photographs shows the naval airship *Los Angeles* apparently slicing the moon in two. This was not actually the case, but John Bellamy Taylor, Consulting Engineer of the General Electric Company, was doing something almost as marvellous. He was "narrowcasting" a 15-minute radio program from a height of 2500 feet. This program was picked up and put on a nationwide broadcast network. The great advantage of the new method is that the voice is completely confined within the narrow light beam and can only be received by special apparatus focused on the beam, therefore giving a method of secret communication.—*A. K.*

## Statistics of Transoceanic Flights

THERE has recently been held in Rome the International Congress of Transoceanic Pilots. The delegates of many countries faced a heavy round of celebrations at the hands of the Italian Government and Italian aeronautical associations, though they found time for serious discussion of such aspects of transoceanic flying as meteorology, navigation, radio communication, and international air regulations.

The United States representative was Captain Holden C. Richardson, U. S. N. Ret., one of the American officers in the famous transatlantic voyage of the NC flying boats, the first successful attempt to cross the ocean by air. Richardson flew in the *NC3*, which left Trepassey Bay,

**John Bellamy Taylor with "narrowcasting" apparatus in the gondola of the airship *Los Angeles***

Newfoundland, on May 16, 1919 and alighted 200 miles from Horta in the Azores.

It is impossible for us to give the complete chronology of transoceanic flying, but what glorious memories the names of the American aviators recall! Reade, Bellinger, Towers (1919), and other officers and men of the American Navy. Smith, Arnold, Nelson, Harding (1924) in the famous 'round-the-world flight of the Army Air Corps. Lindbergh in 1927, though it seems but a short time since the solitary pilot winged his way across the Atlantic. In the same year, Chamberlin and Levine; in the same year, Byrd, Acosta, Noville, and Balchen. This year Reichers achieved a partial success, and Amelia Earhart Putnam shows that a woman can achieve what once we thought only Lindbergh capable of doing. Mrs. Putnam took off alone from Harbor Grace, Newfoundland, May 21, and landed in a pasture near Londonderry, Ireland, the next day, making the flight in the record time of 14 hours, 56 minutes.

It may be interesting to summarize how the record of success stands to date:

Across the Atlantic, Europe to North America; four successes in 27 attempts.

From North America to Europe; 16

successes were attained in 31 attempts.

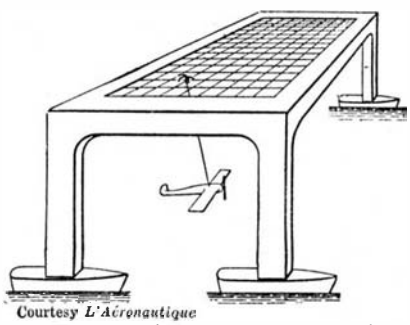
In the southern Atlantic, from east to west; 21 successes in 26 attempts.

In the southern Atlantic; two successes in as many attempts from west to east.

Across the Pacific, east to west; eight successes in 12 attempts.

Across the Pacific, west to east; four out of five.

Some of these flights advanced aviation greatly. All stirred our interest and enthusiasm. We are sure that sooner or later regular transatlantic services by heavier-than-air machines will come. Even now regular services are being planned across the southern Atlantic, from the west coast of Africa to Brazil, with an anchored tramp steamer to break the journey for refueling.



Courtesy *L'Aéronautique*

**Stopping a plane on a moving mesh as explained in the next column**

It is an open secret that several of our manufacturers are designing flying boats for use on the Florida, Bermuda, Azores, Portugal route. These machines should have cruising speeds of close to 150 miles per hour, and a flying range with partial passenger load of 2000 miles. The northern route via Iceland is also being seriously considered. We believe that when the time comes several transatlantic services will be established almost simultaneously.—*A. K.*

## Novel Ideas on Launching and Landing

THE French are very fond of general ideas and novel conceptions. A student of the history of invention might well find that many "ideas" originated in France, though the development of such ideas in the form of practical inventions was due to other Europeans or to the active minds of Americans.

In aeronautics, many instances of this French love of new conceptions occur. For example, as far back as the 'eighties we find a patent of Penaud and Gauchot which portrays the modern airplane in almost every important element. However, the gliding experiments of the German Lilienthal, and the practical genius of the Wright brothers were needed to convert the French dream into reality.

French writers of ability and reputation also seem to have less dread of adventurous thought. It is doubtful whether an American technician would associate his name with a radical departure such as the disappearance of the conventional landing gear and the launching and landing of aircraft by special aerial devices. In *L'Aéronautique*, M. Camille Rougeron, Chief Engineer of the French Navy, dares to consider this very thing, and his views, fantastic as they may appear to-day, may be realized in the not far distant future.

M. Rougeron starts from the following premise: It is desirable to dispense with the landing gear, because the landing gear decreases speed, increases the structural weight, and hence diminishes the pay load.

Further, it is desirable to load the airplane very heavily per square foot. The wings are then reduced to a minimum area and offer less resistance. Also when the wings are heavily loaded, they fly a greater angle of incidence and the plane can be made to cruise at the optimum angle when the ratio of lift to air drag is at its maximum.

Again, it is desirable to be able to make a take-off or to alight within highly restricted areas, in the heart of a city, perhaps, to eliminate the reproach that time saved by the airplane in flight is more than balanced by the time wasted in traveling to a distant airport.

With the airplane as it stands today, these objectives are difficult of attainment. We certainly cannot dispense with the landing gear. To load an airplane very highly per square foot means a very long take-off run, and a dangerously high landing speed. With transport airplanes of even conventional loading per square foot, large landing fields (hence distant landing fields) are necessary.

Our Navy launches its airplanes by catapult in a distance of some 50 feet. The *Akron* releases small planes in the air and hooks them on again. Why not follow the Navy's example?

With an acceleration equal to that of gravity or 32 feet per second in one second, a plane having a landing speed of 60 miles per hour could be launched in a distance of approximately 50 feet. It certainly is an attractive idea to be able to launch a transport airplane into the air in such a short distance! M. Rougeron then considers methods of alighting.

First, he considers a moving wire netting as shown on this page. The plane without landing gear, heavily loaded per square foot, would hook on to the moving wire mesh and be brought to rest without much shock and very quickly. Another suggestion is shown in a second illustration. Here the airplane hooks on to a cable which is stretched between two high poles or towers. The cable passes over pulleys and is connected on each side with heavy weights. The airplane, therefore, receives both a backward and an upward pull, with obvious advantages.

Still another suggestion comes from this fertile mind: the provision of launching and landing platforms on extremely high buildings—the Eiffel Tower in Paris, or the Empire State Building in New York City, let us say. The Newark Airport would then be but a few minutes flight from the business center of New York City.

Our readers must not imagine that these suggestions meet with unqualified or immediate approval. There are innumerable problems to be met, in aerodynamics, in stability, in the effects of the gusty air above a city, in the cost of the necessary platforms, in the excessive demand made on the pilot's skill.

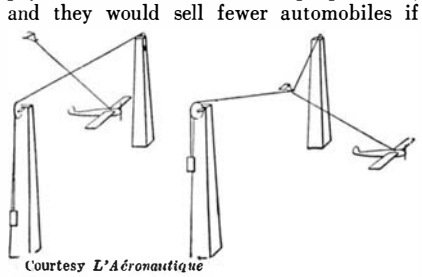
Still, who knows?—*A. K.*

## An Aviation Summer Camp

"CASEY" JONES, the famous flier, has had a distinguished career in athletics, with 12 major letters to his credit, and has been a successful physical director. It is, therefore, quite reasonable that he should guide the destiny of a Summer Aviation Camp, the first to be established in the United States. The camp is being conducted at Valley Stream State Park, Long Island, New York, a few minutes from the airport. Swimming alternates with aerodynamics, tennis with navigation and meteorology, track with practical work in the aircraft engine shop. What could constitute a more novel, delightful, and instructive vacation?—*A. K.*

## From One-Piece to Two-Piece Flying Suit

IN other branches of engineering, the design of clothing is not considered an essential feature of the technician's duties. Our automobile manufacturers certainly pay little attention to what people wear, and they would sell fewer automobiles if purchasers had to invest in special clothing. In aviation, however, the design of appropriate clothing for Army and Navy aviators becomes an important technical problem. Practical aviators and skilled tailors co-operate. Learned arguments and weighty specifications are the order of the day. Thus, the Army Air Corps after much cogitation is replacing all its old pilots' suits with new equipment.



Courtesy *L'Aéronautique*

**Illustrating another way of shortening the landing run of a plane**

The old one-piece winter suits, according to many complaints, were too bulky and heavy. The weight was from 14 to 16 pounds. They were too difficult to get into and out of unaided. The wind went

**The Stinson tri-motored airliner described on the opposite page**

down the collar and through the interlocking fasteners, and they kept the body warm only if the temperature did not fall below zero.

A new two-piece suit has been tested at –40 degrees, Centigrade, and found adequate. Horsehide is used instead of calfskin, because it is less bulky and heavy, non-scuffing and more flexible. The lining and collar are of lamb shearling, fur-tanned and electrified—a process by which curly wool is submerged in acid and made straight. Interlocking fasteners are used the entire length of arms, trouser legs, and jacket to facilitate getting into and out of the suit. Leakage of air through the fasteners is prevented by an overlapping arrangement of fur. The two-piece suit fits better than any one-piece garment. Trousers are put on by putting the arms through suspender straps and zipping up the legs; the unzipped trousers lie flat and blanket-like upon a table. Many an Army aviator will bless the ingenious makers of this new suit.—*A. K.*

## The Interior of an Airliner

SOME people still think of flying as an adventure in wind and cold. Anyone examining the interior of a modern airliner, however, will find it comfortable, even luxurious. One of our photographs shows a three-quarter view of the Stinson Model U, equipped with three Lycoming engines of a total horsepower of 720, with a wing area of 574 square feet, a weight, empty, of 6230 pounds, and a useful load of 3070 pounds. The top speed is 141 miles per hour, and the cruising range at 122 miles per hour is 350 miles. The Stinson Model U is not among the fastest transports of the day, but it gives a nice combination of low first cost, adequate speed, good flying characteristics, and particularly good accommodation for pilots and passengers.

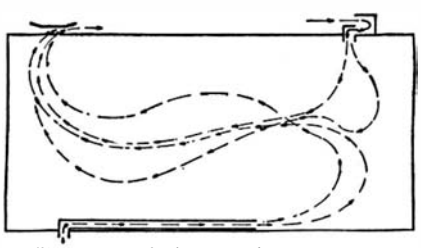


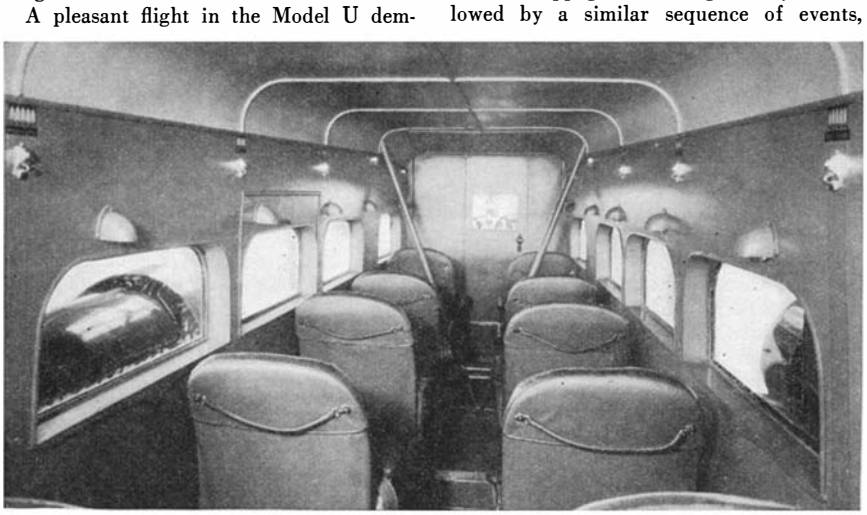
**Diagram of the ventilating system in the cabin of the Stinson airliner**

A pleasant flight in the Model U demonstrated fully the manufacturer's claims as regards cabin design. Rubber-mounted engines and ply-metal construction of the cabin eliminate noise to a great extent so that conversation is entirely possible. Chairs, wide and deep, of the steamer type with loose backs, yield to every movement of the body. Individual clothes hangers and individual reading lights are provided for each passenger. Windows are large and have their corners rounded for more pleasing effect.

Strange to say, the windows are never open. The airplane designer is anticipating the skyscraper of the future where ventilation and lighting are to be purely artificial—so modern architects tell us. The heating and ventilating systems are controlled from the pilot's cockpit. Hot-air pipes, utilizing the exhaust of the center engine, are placed at the bottom of the cabin where they serve effectively to keep the passengers' feet comfortable. The ventilating scoop is placed above the cabin, well toward the rear, where the outside of the fuselage is in a region of positive air pressure. The ventilating scoop is carefully designed so that the air is freed from moisture and follows a sinuous path before entering the cabin, so that there is no direct impact of cold air into the cabin.

The air deflected downwards into the cabin (following the path shown in the sketch) is warmed by the hot-air pipes and is then drawn out at the front end of the cabin by means of a venturi or suction producing tube, which is aided by the fact that the outlet is situated in a region of suction above the fuselage. Thus there is produced a natural system of ventilation where aerodynamic and thermodynamic effects are combined.

As time goes on, more and more attention will be given to interior cabin design. —*A. K.*



**The comfortable, well-ventilated interior of a modern airliner**

## Preventing Backfires

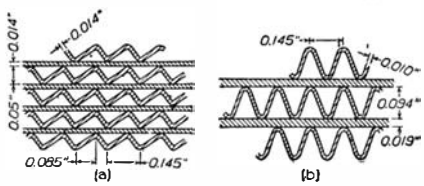
ACCORDING to a study of French aviation accident statistics, 28 percent of the fires occurring in flight are attributable to backfiring in the carbureter.

During flight, fires begin because of intake valve failure; the valve breaks or fails to seat properly, the engine backfires into the intake manifold, and the mischief is done.

In an otherwise innocuous crash, the sudden stoppage of the engine may be followed by a similar sequence of events, and flames emerging from the carbureter may be deadly in their effects.

To avoid backfires entirely is too much to hope for. The practical method of attack is to prevent the backfire from reaching the carbureter bowl. Attempts have been made on the principle of the Davy safety lamp (now more than a hundred years old and still used extensively in coal mining) in which heat is removed from the flame by a sheet or sheets of wire gauze. The wire gauze works splendidly in a miner's lamp but has not enough heat-absorbing power for our immensely powerful aircraft engines.

The National Advisory Committee for Aeronautics, still working on the principle of the Davy safety lamp, has gone a step further, however, by employing a flat-plate type of flame arrestor, inserted between the carbureter and the intake manifold.




**Cross-sections of flame arrestors to prevent danger from backfires**

This arrestor is only about three inches long. The cross section of the arrestor is seen to consist partly of flat and partly of corrugated sheets of metal. The device weighs a fraction over three pounds.

The arrestor was inserted between carbureter and engine intake, a spark was used to ignite the mixture two or three times a second, and the backfiring was allowed to continue for 20 to 30 minutes. Despite the severity of this test, under no circumstances could a flame be made to penetrate the arrestor plug. There was, moreover, no noticeable change in the performance of the engine, the arrestor offering little resistance to flow of the mixture.

The device is therefore likely to be very useful from the point of view of aviation safety.—*A. K.*

## Tubing to Resist Vibration

THE Army Air Corps and particularly its Matériel Division is always experimenting, and its range of research is comprehensive. The tubing used in the gasoline system of an airplane, for an example, is a vital element. Copper and sometimes aluminum are employed. The endurance of such tubing under vibration has been vastly increased by vulcanizing a special rubber compound to tubing and fittings. This greatly prolongs the life of the tubing, and even if the metal pipe should break, the fuel is still prevented from leaking. This may seem to be only a minor advance, but a single leaky tube may bring a large multi-engined transport down in an emergency landing.—*A. K.*

## One Type of Deafness Sex-Linked

TWICE as many women as men are affected with the type of deafness known to physicians as otosclerosis. This and other facts point to an hereditary origin for this physical defect, Dr. Charles B. Davenport, of the Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, told a recent

meeting of the Eugenics Research Association.

The hereditary mechanism by which this particular type of deafness is handed on from father to son, or more accurately from father to daughter, consists of two defective genes, one of which is in the sex-controlling chromosome. The sex-linked gene, it is thought, acts in some way to upset the body's use of the bone-forming food calcium, while the other works directly to produce the deafness. The disease may also be associated with a disturbance of the pituitary gland, a gland which in youth and middle life exercises considerable control over bony changes.

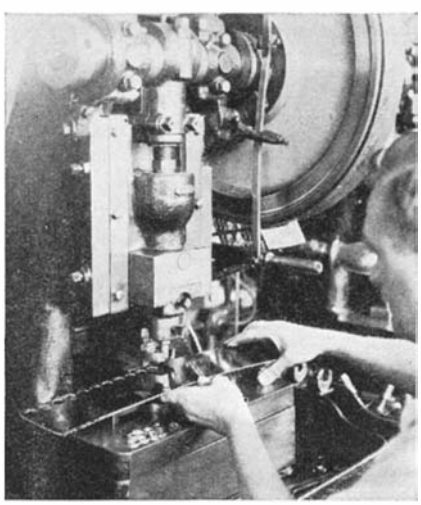
Otosclerosis is not the ordinary hardness of hearing which comes on in later years and which involves a destruction of the auditory nerve. It is a type of deafness caused by hardening of the membrane around the small chain of bones in the ear, causing the closing up of the oval window leading into the vestibule of the inner ear. It is usually first noticed at adolescence.

It is believed that when a father is affected with this type of deafness, his daughters have a much greater chance of inheriting the defect than his sons have. On the other hand, if the mother has it, more of the sons will be affected. In other words, it is what geneticists call a sex-linked characteristic. Where both parents are affected an extraordinarily high percentage of the children will be affected, and the marriage of first cousins from a family having a history of this type of deafness is especially apt to give rise to deaf children. —*Science Service.*

## Lignite Used for Fertilizer

THE use of brown coal (lignite) as a fertilizer has been investigated in practical trials by German chemists who find that the productivity of many plants, such as potatoes, tobacco, and others, can be increased by the addition of controlled quantities in the soil. By the use of large quantities of lignite, however, growth is reduced because its acid nature restricts the reducing and adsorptive power of the plant. This deleterious effect, however, can be lessened by treating the coal with ammonia first.

Thermally inferior coals are quite applicable to fertilization. The action depends on the presence of humic acids in the coal which influence the permeability of the plant cells for accepting nutrition; the nitrogen content, however, has no effect. The action of the normal fertilizer is greatly increased by the slight addition of humic compounds. It is believed that the soil exhaustion that accompanies the continued use of artificial fertilizer is due to the reduction in humic compounds within the soil and can be alleviated by replacing them.—*A. E. B.*



## New Grain Fumigant Effective

FOUR hundred and fifty thousand bushels of wheat owned by the Grain Stabilization Corporation was fumigated at Baltimore, Maryland, recently with a mixture of ethylene oxide and solid carbon dioxide (Dry Ice) in the proportion of 1 to 10, according to *Chemical Markets.* The use of these chemicals for the fumigation of grain was developed by R. C. Roark, principal chemist in charge of the insecticide division, and H. D. Young, an associate chemist, of the Bureau of Chemistry and Soils, and R. T. Cotton, a senior entomologist of the Bureau of Entomology. Experiments made with this fumigant by the chemical engineering division of the Bureau of Chemistry and Soils have indicated that with proper supervision of the fumigation operations the fire and explosion hazards are low.—*A. E. B.*

## Sinus Trouble Remedies Better Understood

BETTER understanding of the various remedies for sinus trouble appeared in a recent discussion of the subject by members of the American Medical Association.

X rays are rarely helpful, in the opinion of Dr. Ralph A. Fenton of Portland, Oregon. Ice bags and cold packs are helpful in some cases, while heat mobilizes the fighting power of the tissues, but also produces more swelling, Dr. Fenton explained. He also advised measures to help raise the patient's general resistance to disease germs. Solutions of silver nitrate and iodine, once popular, are best used only after operations, physicians have found. Chlorine, hailed because of its wartime use in fighting germs, has proved too irritating to the nasal tissues in many patients. Astringent solutions are also irritating if used too often. The chief value of local remedies is as cleansing agents, removing the products of decomposition, and as healing agents for the irritated areas.—*Science Service.*

## New Soy Bean Oil Process

THE South Manchurian Railway, under Japanese control, is looking for capital to assist it in exploiting the Manchurian soy bean industry, according to reports received from the United States Consulate General at Mukden. Oil will be extracted from the beans, according to tentative plans of the railway company, by the use of alcohol instead of benzine, and the cake produced in the course of extraction will be used for making yeast and feed for poultry. The company is said to have a patent on the new method of extraction.—*A. E. B.*

## Lawn "Brown Patch" Remedies

ONE of the most troublesome diseases of lawns is "brown patch," a fungus disease which makes its appearance in the summer. It spreads quickly from a small spot and kills the grass. Lawn specialists of the United States Department of Agriculture advise fighting this disease with chemicals, with different grasses, and with careful watering.

Courtesy National Jewelers Publicity Ass'n.

**Contrary to popular opinion, the delicate platinum wedding band is not all hand made. In this group we see, at left, blanks being punched by a heavy machine from a sheet of platinum. In the center and upper illustrations the ring is being cut and polished by hand**

In an established lawn infected with brown patch the department advises applying an ounce of bichloride of mercury (corrosive sublimate) to each 1000 square feet of lawn. This may be dissolved in water or mixed with fine soil in sufficient quantities for even distribution. The lawn should be well watered immediately after the chemical is applied, to prevent burning. This treatment should be repeated every time the disease appears. A mixture of an ounce of bichloride of mercury and two ounces of calomel applied in the same manner is more lasting than the bichloride alone. Several commercial preparations also serve the same purpose. Before treating, however, one should make sure that the brown patch is the result of disease

and not due to drying out or some other cause.

Brown patch attacks chiefly bent grass, and to a less extent the fescues. As a means of reducing the damage from the disease the department advises seeding lawns with Kentucky bluegrass where the soil and climatic conditions are favorable or with a mixture of nine parts of bluegrass, nine parts of Chewing's fescue, and two parts of redtop.

Brown patch may appear overnight in a lawn. It spreads most in damp, moist weather. Watering the lawn in the morning checks the spread of the disease and creates a less favorable condition for it.

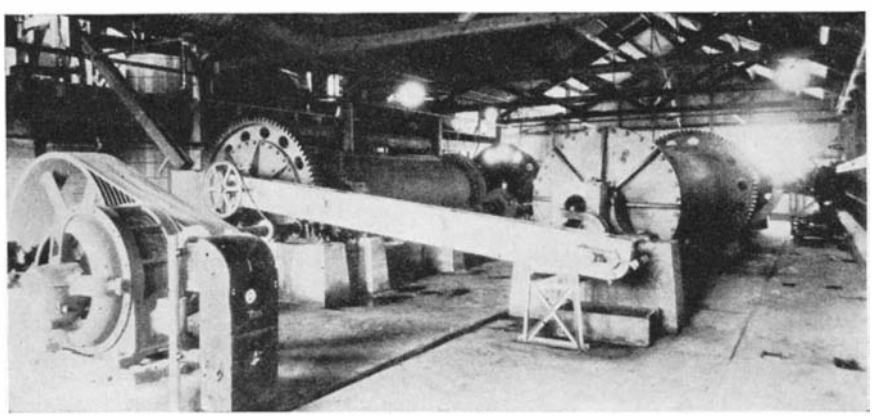
## Factory Makes Home-Grown Rubber

IF you were led blindfolded into the factory of the Intercontinental Rubber Company, at Salinas, California, and then told to look around and guess what kind of a plant you were in, you would probably size it up as a metallurgical operation wherein some metal was being extracted from its ore. The belt conveyors, grinding mills, dust collectors, screens, and "thickeners" would all confirm your guess, but in this case appearances are deceitful, for this mill is making rubber—rubber from the home-grown shrub, guayule. The valuable sap, or latex, is being removed from the four-year-old plants which contain rubber in their roots, trunk, branches, twigs, and leaves. Since the latex is distributed all through the plant, the whole shrub is uprooted when it is mature and is chopped up into half-inch sections to begin its trip through the factory.

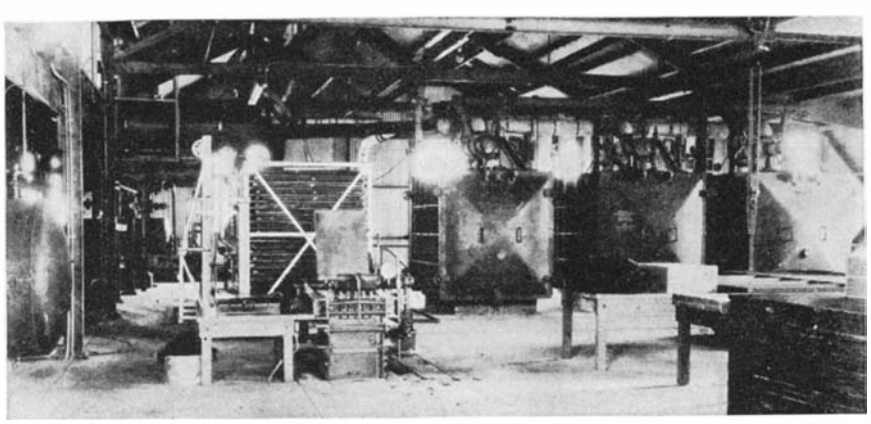
There is nothing new or mysterious about guayule as a source of rubber (See SCIENTIFIC AMERICAN, July, 1928 and June, 1931), for efforts to utilize it began way back in 1888. It was not until quite recently, however, that improved methods of extraction and preparation established its commercial importance, exemplified by the new plant at Salinas which produces 15,000 pounds of rubber daily from guayule cultivated on a 6000-acre plantation nearby.

The chopped shrub is carried by screw conveyors at the rate of 5000 pounds per hour to the grinding mills where the cells containing rubber are broken down. This "slurry" is screened and washed repeatedly to separate the rubber from the cellulosic material and dirt, the rubber finally being skimmed off and dried under vacuum to 1 percent moisture. The dried rubber is pressed into 200 pound blocks under hydraulic pressure of 2500 pounds.

"A certain quantity of the resinous material which has been kneaded into the rubber by the process of removing the fibers is contained in the present product," says P. D. V. Manning, describing the new plant in a recent issue of *Chemical and Metallurgical Engineering*. "This resinous material is desirable as most of the available guayule rubber is used in coating or 'frictioning' the cotton cords used in tire casings. Guayule rubber also has a wide and proved field of usefulness in inner tubes and as a plasticizer of tire-tread stocks. Such uses would take care of the annual output of 100,000,000 pounds which is 10 percent of the normal domestic rubber consumption. At a time when the demand arises, the resinous material can be wholly or partially removed."—*A. E. B.*



**Guayule plants, the source of home-grown rubber, are uprooted (top picture) when about four years old, and allowed to dry on the ground until the moisture content drops. Later the shrubs are macerated and then rolled around in the cylinders (of the tube mills shown directly above) with pebbles which grind and break down the cells filled with rubber. *At right:* Drying ovens where the agglomerate obtained from guayule plants is dried under a 29-inch vacuum—the final stage in the manufacture of rubber from the guayule shrub**



## Vitamin A Helpful in Children's Ear Infections

INDICATIONS that vitamin A is helpful in preventing and treating ear infections of children appeared in a study reported by Dr. Claude C. Cody, of Houston, Texas, to the American Medical Association.

Dr. Cody found that the addition of cod-liver oil to the diet of many infants and children during the past few years has been accompanied by a decided decrease in the number of cases of acute abscesses of the middle ear. It cannot yet be definitely said that the cod-liver oil has brought about this result, but the evidence is strong enough to warrant continuing its use, in Dr. Cody's opinion.

In treating the disease, a nutritious diet is second in importance only to draining the abscess, Dr. Cody said. He found in a series of cases that adding large amounts of vitamin A to the diet reduced the period of discharge, made repeated incisions less frequent, complications of the mastoid bone less frequent, and the return of hearing more prompt.—*Science Service.*

## Worried or Tired Children in More Danger of Accident

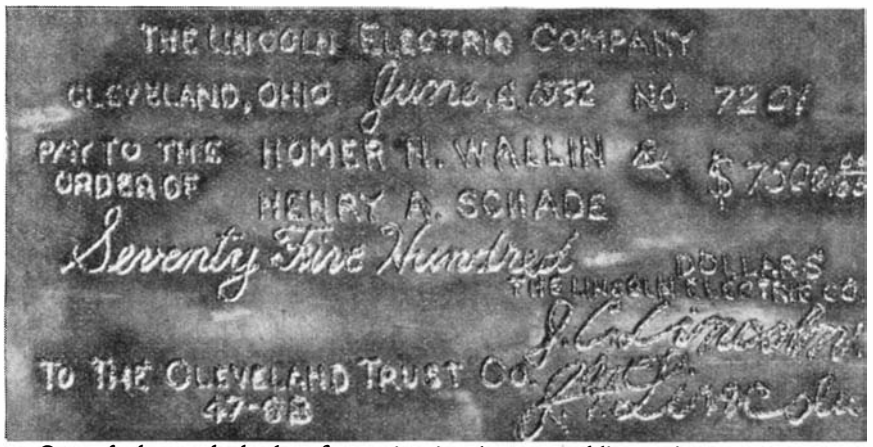
EVEN children who have been given plenty of safety instruction are injured in accidents. This is often due to the mental or physical state of the child at the time he is exposed to danger, says Dr. Herbert J. Stack, lecturer in safety education at Columbia University.

The worried child, because his mind is preoccupied, is especially prone to accident, Dr. Stack has found. As an example he cited one little girl who was seriously injured by an automobile. The police report read, "Crossing street at intersection against the lights." But Mary said, "I was worried about Mother. Mother has been sick, you know. I wanted to hurry to get home to her, and so I ran fast."

Parents and teachers are urged to provide safe adventures such as scouting and camping for the venturesome youngster who would otherwise hang on the rear end of

trolley cars. They are also urged to protect the child from fatigue, because the children who are mentally and physically tired are more susceptible to accidents.

"Those of us who have to dodge taxicabs and other vehicles on our busy streets and highways know how many narrow escapes we have had when we were tired," Dr. Stack said. "In the world in which we live, we must have full possession of our faculties to avoid accidents. In New York City we find that street accidents to children reach their peak in the hours of the late afternoon. It must not be assumed that there are not many other factors that contribute to this peak, but it is probable that fatigue has an important place."—*Science Service.*




**One of the steel checks—first prize in the arc welding prize competition**

## Winners in Arc Welding Competition Paid with Steel Checks

IN peace as well as war the Navy cooperates and competes with the Army. This was demonstrated when Lt. Com. Homer N. Wallin, and Lt. Henry A. Schade, both of the Navy, working in collaboration on the paper submitted, won first prize in the Second Lincoln Arc Welding Prize Competition sponsored by The Lincoln Electric Company of Cleveland, Ohio. Second prize was won by Major G. M. Barnes, of the United States Army.

A résumé of the savings to be effected by using arc welding extensively in all industries as shown by the approximately 400 papers submitted in the competition indicates an estimated saving to industry of almost a billion dollars a year, provided the process was used as extensively as possible.

The jury, under the direction of Prof. E. E. Dreese of Ohio State University, awarded first prize of 7500 dollars to the two naval officers who submitted the prize-winning paper. The title of their paper is "The Design and Construction of an Arc Welded Naval Auxiliary Vessel."

Major G. M. Barnes, Chief of Design and Engineering, Ordnance Department, Watertown (Mass.) Arsenal, won second prize of 3500 dollars for his paper "Manufacture of Ordnance at Watertown Arsenal Revolutionized Through Arc Welding."

The third prize of 1500 dollars was won by H. H. Tracy, of Los Angeles; a fourth award of 750 dollars went to Gustav F. D. Wahl and Harry E. Johns, Kiel, Germany; H. J. L. Bruff of Harrowgate, England, won fifth prize of 500 dollars; a sixth of 250 dollars went to William H. Zorn of Wyandotte, Michigan; and 35 additional prizes of 100 dollars each were awarded for other papers.

The first prize-winning paper describes the construction of an arc welded auxiliary vessel for use with the fleet at San Pedro. The hull is conventional ship-shape in form and is 118 feet long, with a full load displacement of 300 tons. Speed, 10 knots.

Arc welding has been in use by the Navy since 1917 when sabotaged engines of seized German liners were repaired by this process. Since displacements of naval vessels have been limited by international treaties, the Navy has begun to look upon arc welding as a standard method of construction. The process is supplanting riveting over a wide range of applications in increasing amounts on each new ship, as it becomes more and more evident that lighter structures of equivalent strength, rigidity, and shock resistance may be obtained by welding.

In addition to the partial use of arc welding on large ships the Navy has substituted welding completely for riveting on a considerable number of smaller ships. The welded vessel was built at a 10 percent saving over riveted construction. In addition a riveted ship of the same size, being 17 percent heavier, has a correspondingly reduced carrying capacity. The total savings, direct and indirect, during the lifetime of the arc-welded vessel, will be enormous and out of all proportion to the savings in first cost.

Arc welding had never been used in the construction of gun carriages until the 3-inch anti-aircraft mount (mobile) described in Major Barnes' paper was built. This piece of ordnance was subjected to severe road tests in addition to the impact forces due to firing. The principal parts of the carriage are highly stressed and of intricate design.

The substitution of welded steel members for castings in the piece of ordnance described by Major Barnes has shown such decided advantages in strength, weight saved, and lower costs that it has brought about the adoption of welding as an approved method of manufacture for ordnance structures.

The first three prize winners received what are believed to be the most unusual checks ever issued. The checks, for 7500, 3500 and 1500 dollars, respectively, were "written" on ⅛-inch sheet steel. Each check was 24 inches long and 10 inches wide.

Welding operators relieved the treasurer's office of the detail of filling out the checks. All information, including date, amount, payee, and the name of the bank was arc welded. The checks were signed by the arc-welding process.

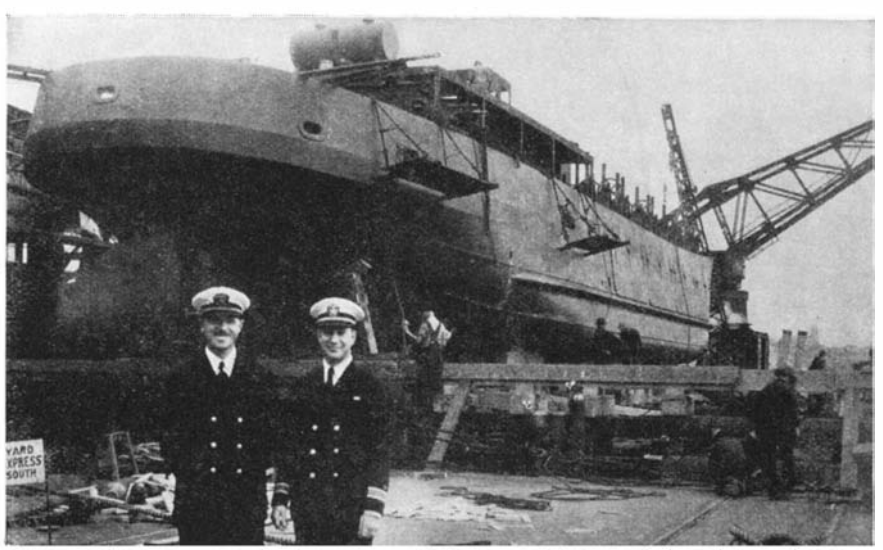
The prize winners will endorse the checks by the same novel method and when the panels of steel are presented to the banks and paid, they will be returned to the bank of issue, where guards will cancel them with the aid of a sub-machine gun.

## Turnip Sauerkraut is New Farm Food

THE farmer who used to put down a barrel of cabbage sauerkraut each fall may add another product to his list. Turnip sauerkraut is a new appetizing food suggested by the United States Department of Agriculture.

The department finds that a good sauerkraut can be made from medium-sized, purple-top turnips. They should be firm, sweet, and juicy in order to allow proper fermentation and flavor. The fleshy part of the root is ground or shredded and mixed with salt at the rate of 4 ounces of salt to 10 pounds of turnips. The mixture is then packed in stone jars, weighted down, and allowed to ferment.

Turnip sauerkraut may be stored at a low temperature for some time, the de-



**The winners of the first prize and the arc welded vessel they discussed**

partment says. It has a sharp flavor, closely resembling good cabbage sauerkraut. Most of the turnip flavor is lost when the kraut ferments.

## Rabbit Raisers Warned Against Big-Profit Lures

EASY money and lots of it from the rabbit business, held out as a sure return by promoters who seek to sell breeding stock, can not be realized in most instances, says the Bureau of Biological Survey of the United States Department of Agriculture. The bureau advises people intending to start rabbit raising to investigate thoroughly the local possibilities of a market and the risks of the business before going into it.

The unemployment situation has led some unscrupulous promoters to take advantage of conditions and to sell rabbits to people who are entirely unfamiliar with the field. They predict big returns. Many of the concerns that promise to buy back the meat or fur, or both, are interested primarily in selling breeding stock at very high prices.

## Poisonous Mexican Toads

A MONSTER toad that may diffuse a deadly gas when frightened or in pain is among the weird Mexican amphibians described in a scientific monograph just issued by the Smithsonian Institution.

This creature inhabits the hottest portion of the North American continent, its range extending over the Mexican line into Arizona and California. Although the exact nature of its poison is unknown, according to Dr. Remington Kellogg of the Smithsonian staff, some of the accounts of persons who have come in contact with it indicate that it may even kill animals from a distance with some effusion from its body.

One account in the Smithsonian monograph is by M. E. Musgrave of the United States Biological Survey whose terrier attacked one of these toads and shook it to death while he stood about five feet away. When the terrier dropped the amphibian a large police dog came up and barely touched its nose to the dead creature, which was again grabbed by the smaller animal.

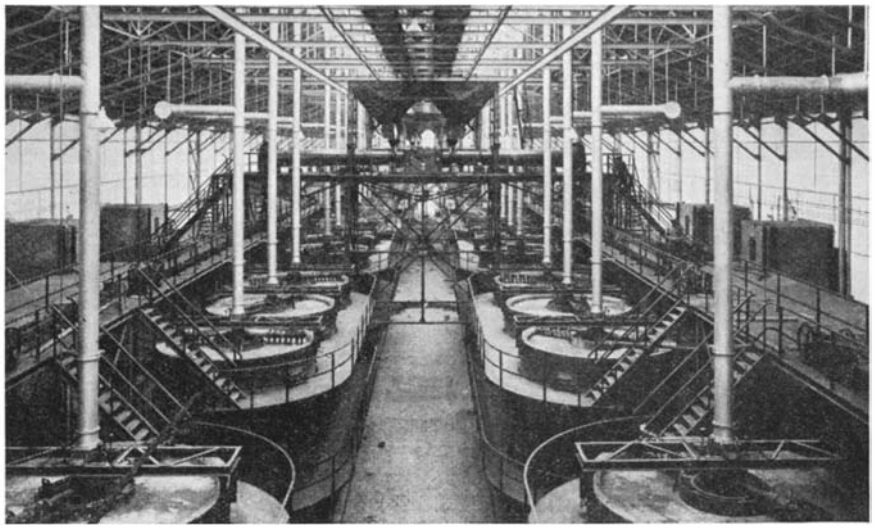
"I thought no more about it," says Musgrave's account, "and started back to the house, the police dog following. He had gone no more than 100 feet when his front legs crumpled under him and he pitched forward. His legs and body appeared paralyzed.

"Immediately I realized that something was wrong and looking over to where the little terrier had been I saw her lying on the ground, her feet crumpled under her and her face in the dirt. I felt her heart and found the action slow. She could get no air into her lungs. Within two or three minutes from the time she first bit the toad she died. Bloody foam oozed from her mouth and nose.

"About this time I became very sick myself. My head was swimming and there was a lifting feeling in my lung cavity. It affected me rather peculiarly, as I wanted to walk and keep on walking. The effects did not wear off for about 30 minutes. The old police dog revived in about three quarters of an hour."

Musgrave does not know whether he received the poison dose while the terrier was shaking the toad or when he was trying to revive the dying dog. He detected no odor at any time. Later he handled without bad effects a toad of the same species sent to the Biological Survey headquarters.

Other similar incidents are recorded and some veterinarians in the region frequented by the toad are said to be familiar with its effects.

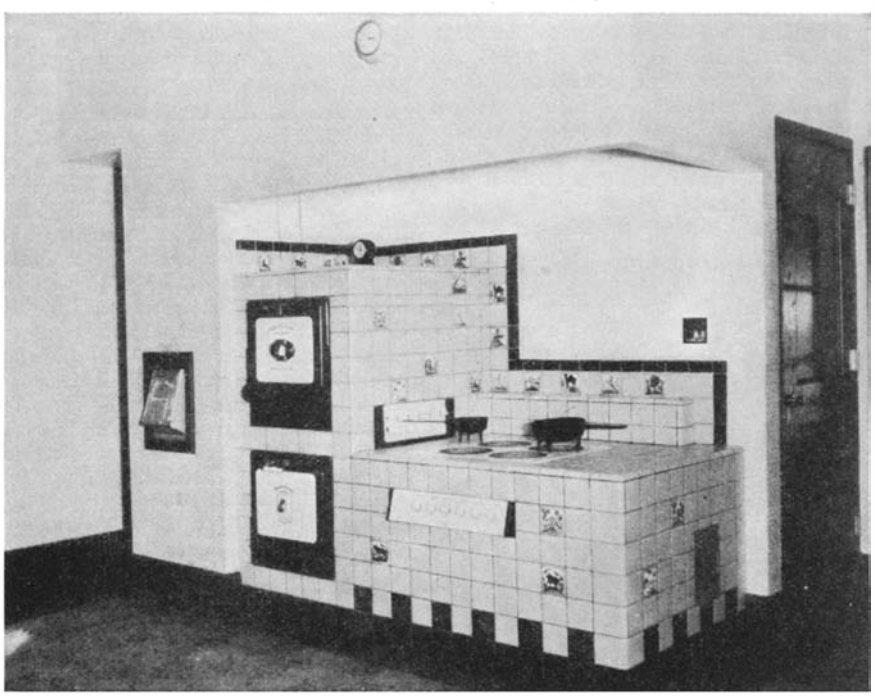


**Double row of roasting furnaces in the sulfuric acid plant described below**

## Sulfuric Acid in Holland

WHEN it comes to the manufacture of sulfuric acid, there is new meaning in the expression "doesn't it beat the Dutch?," as will be gathered from the accompanying view of a magnificent new acid plant in Holland. The photograph shows the double row of roasting furnaces in which iron pyrites are roasted to drive off the sulfur dioxide gas which is the starting point in acid manufacture.

This plant has a capacity of 640 tons of sulfuric acid per day. Note the conveyors along the roof trusses which feed ore to the furnaces; the cinders from the roasting process are also discharged automatically at the rear of each furnace. Scenes such as these are illuminating to those who have pictured Holland as a land of dykes, wind-mills, and wooden shoes.—*A. E. B.*



**The Dutch oven has gone modern, as evidenced by this illustration of one in a home in Alliance, Ohio. It is of yellow tile trimmed with black, and inset are two 18-inch-oven Westinghouse electric ranges and four platform "burners"**

## "Wrapped in Cellophane"

EVERYONE knows Cellophane, the transparent paper wrapping which is used on almost everything these days. Not everyone realizes, however, that it is made out of the very same viscose (cellulose solution) from which rayon is made. Originating in France, it was brought to this country, where its development in both quality and marketing by the duPont organization is an outstanding achievement, says H. J. Shimer in *Industrial and Engineering Chemistry*.

When Cellophane was first introduced to the public in 1924, its price was high—

$2.65 a pound. Plain Cellophane has been reduced in price 13 times in eight years to the present price of 45 cents a pound. The fact that it was not particularly water-resistant led the duPont Company to improve the product by waterproofing it. This moisture-proof Cellophane, now about four years old, has had eight price reductions from $1.65 to 70 cents a pound.

This farsighted marketing policy of voluntarily reducing the price has been an important factor in the success of Cellophane. By forecasting the demand in advance of trade requirements, and by increasing the facilities not only of the original Buffalo plant, but by new plants at Old Hickory, Tennessee, and at Richmond, Virginia, the duPont Cellophane Company has been able to take care of an increasing volume of orders. The potential markets for Cellophane have hardly been scratched, although it may seem that every conceivable thing is now wrapped in it.—*A. E. B.*

## Metal Adhesives and a New Protected Metal

JOINING fibrous materials to steel has been accomplished in the past with various types of adhesives. Adhesives such as solid bitumen have been successful for a large number of purposes, but it has been only recently that an adhesive has been proposed which permits the application of materials such as asbestos paper and felt, as well as various cellulosic papers, and also permits distortion of the coated metal.

When fibrous papers and felts are rolled on to sheet steel coated with soft and low melting metals and alloys at ordinary temperatures, certain localized sections show evidence of slight sticking of the fibrous material to the soft metal. If, however, the temperature of the steel is raised progressively, and the process of rolling, followed by cooling, is then carried out, it has been observed that the adhesion increases, until, when the soft coating metal or alloy becomes liquid, the adhesion between felt and steel is at a maximum.

The metals commonly useful as metal coatings for steel are valuable as adhesives for this purpose; ordinary galvanized, tinned, or terne-plated steel lend themselves to the process. Other alloys, particularly those possessing low melting-points, may also be utilized.

Asbestos paper, felt, cellulosic papers, and linen, cotton, and wool fabrics have been attached to steel in this manner with varying degrees of success. Asbestos and cellulose are more promising than the other materials, because the bond formed is sufficiently strong to make possible the mechanical working of the resultant laminated sheet. The ductile nature of the metal bond between felt and steel makes it practicable to subject this material to forming operations, such as shearing, bending, corrugating, and mild pressing, without destroying adhesion between the felt and the metal.

This use of metallic adhesives has led to the preparation of a new type of protected metal called "Robertson Bonded-Metal." Steel is coated in the above described manner with suitable fibrous surfaces, formed to the desired shape, and the felt surfaces are then saturated to render them impervious to corrosive agencies. Additional protection or decorative effects may be superimposed on the surfaces in the form of paints, lacquers, synthetic resins, veneers, or metal foils.

As this process is still in the developmental stage, it is somewhat difficult to predict with accuracy the future fields of application for metallic adhesives. It seems probable, however, that they should be useful in the paper industry. Also, future research should make this type of adhesive available to the textile manufactures and to the realm of low-temperature insulation. Then, too, the building trades offer potential markets for roofing, siding, and paneling built up with these materials; manufacturers of novelties have already indicated that they have outlets for various forms which the bonded metal will take.

## New "Chamber of Torture" for Lamps

THERE was a time when all a newly-made lamp needed to do to prove its right to existence was to withstand a "flash" test. It was placed in a test socket and lighted for an instant. If it burned, it was a good lamp. If not, it never left the factory. But the laboratory scientists were not satisfied with a mere "flash test." They felt that, in addition to burning, lamps must show an ability to stand up under the rigors of transportation and mishandling. Consequently, numerous tests and inspections were instituted. Among these were the "drop" test, in which a lamp was dropped to the floor from the height of a man's waist.

And now has come the king-pin of all testing equipment—a device which puts its predecessors to shame. Its designers of the Lamp Development Laboratory of the General Electric Company call it the "gravity impact tester," but an imaginative layman would term it "the chamber

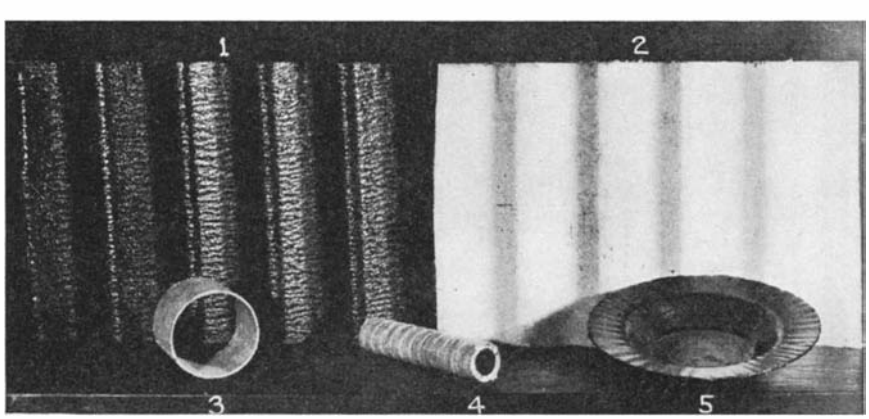
"Torture chamber" for lamps

of torture." Any defective lamp entering its cruel compartments may well abandon all hope. The gravity impact tester is not intended for breaking lamp bulbs; rather is its purpose that of testing the strength of the interior parts of the lamp which, of necessity, are of delicate construction.

In the gravity impact tester are eight boxes or compartments, the ends of each of which are covered with hard battleship linoleum of about one quarter inch thickness. The compartments are of varying lengths, and have collapsible narrow shelves on each side. These shelves are of such height as to allow the lamps to fall a predetermined distance, when the machine is rotated, which distance is stepped up from the first box to the last. By the law of gravity, the lamps strike the floor harder in each successive compartment because they have fallen from greater heights and thus have acquired greater velocity. The successive velocities of impact are 6, 7, 8, 9, 10, 11, 12, and 13 feet per second.

It is to be noticed that there is no definite way in which the lamps drop while inside the test compartments. They may land on their bases, or on the tops or sides of the bulbs, so that the effect of almost any accidental blow which might be sustained in shipment or in careless handling is duplicated and its effect foreshown.

The gravity impact tester is primarily employed to test a percentage of all newly-made lamps, but is also used for ascertaining the strength of any experimental lamps before they are placed on the regular manufacturing schedule.




**Examples of protected metals. 1; Asbestos coated terne (roofing tin) plate saturated with asphalt, coated with bitumen, and corrugated. 2; Asbestos coated terne, unsaturated and corrugated. 3; Asbestos coated terne, unsaturated and rolled. 4; Iron pipe, felt coated. 5; Dish drawn from asbestos coated terne**

## Springs Replace Sash Weights and Pulleys

SOME 280 years ago, the universally used casement window of the time gave way before a new invention from Holland: sashes that slide up and down. The Dutch also hit upon the idea of sash weights, sash cords, and pulleys. While this system of window sash balancing has

many disadvantages, it has endured for nearly three centuries.

Now, however, there comes news of a new system, developed by the Curtis Companies, Inc., with headquarters in Clinton, Iowa, which makes use of a strong tension

**Strong tension springs used to replace the usual window sash weights**

spring to balance the sashes. Since this spring takes up hardly any more space than the old sash cord alone and has no weight box, it can be seen that window mullions can be made much narrower than heretofore. Thus waste space is reduced, providing more wall space or more glass space as desired. Our photograph shows the method of installing a sash using the spring.

Silentite windows, as the Curtis Companies' sashes are called, also have a built-in weather strip which effectually prevents leakage of air and at the same time serves to prevent rattling of windows.

## Schwarz Cycle Engine Differs from Otto Cycle

AN internal combustion engine operating on a cycle somewhat different from the conventional Otto cycle has been developed by Alfred Schwarz, and the patents thereon are controlled by the Schwarz Cycle Engine Corp. of New York, according to an article in *Automotive Industries*. The chief feature of the cycle is that during the compression stroke air compressed by a pump or compressor—which latter may be built integral with the engine—is forced into the combustion chamber, thereby adding to the air or oxygen content of the chamber at the end of the compression stroke and at the same time creating considerable turbulence therein.

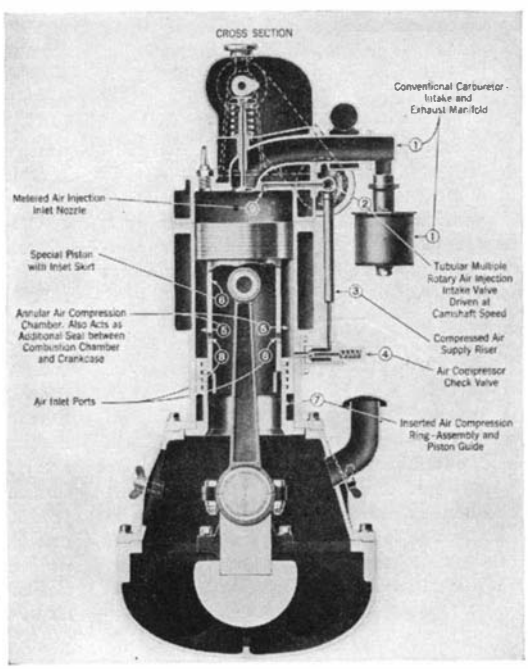
A cross-sectional view of the engine in diagrammatic form is shown on this page. The general arrangement of the principal parts is similar to that in the conventional automobile engine. Exhaust and inlet valves are arranged in the cylinder head, and a carbureter, 1, is connected to the inlet valve port in the usual manner. The valves are shown as being operated from an overhead camshaft.

The piston, however, differs from the conventional design and is of the stepped type. Below the ring belt it is reduced in diameter, and at the bottom of the cylinder there is an annular insert or air compression ring in the bore, which serves as a guide for the reduced portion of the piston. Between the cylinder wall, the wall of the reduced portion of the piston, the shoulder on the piston, and the air compression ring, there is formed a chamber of variable capacity which serves as the pump chamber. Air enters this chamber through ports in the wall of the reduced portion of the piston when the latter approaches the top end of its stroke. As the piston moves down, these ports are closed by being masked by the air compression ring. During the remainder of the down stroke of the piston air is compressed in the annular chamber, 5.

The air thus compressed passes through the check valve, 4, and the compressed-air supply riser, 3, to the rotary valve, 2, which is driven at camshaft speed. This valve extends the whole length of the engine and forms, together with the risers, a compressed air supply reservoir. The interior of the tubular valve is open to each riser during the latter part of the down stroke of the corresponding piston. Communication between the interior of the valve and any particular cylinder is established when the piston in that cylinder is 130 degrees from the end of the compression stroke. The air valve remains open until the piston is 10 degrees from the top of the compression stroke, and during this 120 degrees of crank motion, since the air in the reservoir is under higher pressure than that in the combustion chamber, additional air is forced into the combustion chamber through the nozzle, 9.

The amount of air which is being blown into the combustion chamber through the nozzle, 9, is said to amount to about 20 percent of the amount of air normally in the cylinder charge, and this air is blown in under pressures of 150 to 175 pounds per square inch. It is stated that the exact point of the cycle at which the air-injection valve closes is of no great importance, since air injection ceases automatically when the combustion pressure exceeds the pressure of the compressed air.

As may be seen from the cross-sectional view, any spray of oil in the crankcase cannot strike the cylinder walls directly, since these walls are shut off from the crankcase by the piston wall. Lubricant is carried to the cylinder wall, however, by the air which is compressed in the air-pump chamber and which is drawn through the crankcase, where it picks up some of the oil mist therein.




**A cross-section of an engine which operates on the Schwarz cycle showing the stepped piston, the air compression ring assembly, and other general details**

The claims made for this engine are that it develops a greater torque than a conventional engine of the same cylinder dimensions and that its fuel economy is higher.

Engines designed to operate on the Schwarz cycle have also been run on fuel oil. When using fuel oil it is necessary to use an additional element for starting when cold. This may be either a small auxiliary gasoline supply which is used for a short time while the engine is being brought up to normal working temperature, or an outside nebulizer in the by-pass to carbureter. This nebulizer is provided with a small electric heating unit, which is operated only during the starting period.

## Activated Carbon Used in Dry-Cleaning

THE objectionable odor that sometimes clings to garments returned by the dry-cleaner has been the subject of recent study by the National Association of Dyers and Cleaners. It is due to traces of staleness or of foreign odors in the cleansing solvent. When the solvent becomes dirty it is "regenerated" or cleaned and then used over again. This repeated use of the batches of solvents is an obvious economical necessity, as is also a cheap and efficient method of regenerating each batch to give a "white" liquid ready for further use.

Research on methods of regenerating has resulted in the adoption of a modification in the alkali method of cleaning solvents. Two types of solvent clarifiers were converted recently to a new system using activated carbon, 5000 gallons of solvent being circulated in the test. All traces of yellow tints and of residual odors were eliminated by use of a weekly consumption of 14 pounds of carbon at first and only 11 pounds at a later stage.

Activated carbon, which first came into use in gas masks during the World War, is carbon which has been heated to temperatures above 800 degrees, Centigrade, after treatment with activating agents of a mineral or gaseous nature. Chlorides or other salts of zinc, iron, calcium, and am-

(*Please turn to page* 120)

# CURRENT BULLETIN BRIEFS

## Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

DRUG STORE ARRANGEMENT (Domestic Commerce Series No. 57, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce), by Wroe Alderson and W. H. Meserole, is a study which illustrates in a comprehensive way the opportunity for co-operation between government and business in the execution of a major research project designed to contribute to the solution of vital trade problems. There are 78 illustrations and plans. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

EFFECTIVENESS IN NATURE OF THE SO-CALLED PROTECTIVE ADAPTATIONS IN THE ANIMAL KINGDOM CHIEFLY AS ILLUSTRATED BY THE FOOD HABITS OF NEAR-ARCTIC BIRDS (Smithsonian Miscellaneous Collections, Publication No. 3125), by W. L. McAtee. The author shows how little the alleged protective devices have to do with choice of food by vertebrates. *Smithsonian Institution, Washington, D. C.—75 cents.*

YEARBOOK OF THE CARNEGIE INSTITUTION OF WASHINGTON FOR 1931 is a large unbound volume of 488 pages and describes the multiplicity of problems of America's best known research organization. *Carnegie Institution of Washington, Washington, D. C.—$1.00.*

COLORS FOR SANITARY WARE (C.S. 30-31, Bureau of Standards) has a colored plate and gives a complete summary of the project. *Superintendent of Documents, Washington, D. C.—20 cents (coin or money order).*

TOURING GROUNDS OF ENGLAND, SCOTLAND, AND WALES is a booklet issued for the general guidance of members of the Automobile Association to aid in the selection of tours. *The Automobile Association, Fanum House, New Coventry Street, London W. 1, England.—Gratis.*

THE SELECTION OF DINNERWARE FOR THE HOUSE (Circular No. 21), by Arthur S. Watts, discusses the characteristics of the various wares from which one must choose when buying a set of dishes. *Engineering Experiment Station, Ohio State University, Columbus, Ohio.—Gratis.*

THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO (Third Edition of the Handbook) was issued in commemoration of the dedication of the new building of the Oriental Institute, December 5, 1931. The operations of the Oriental Institute comprise 13 undertakings in the Near East of which 12 are still in progress. This pamphlet which is beautifully printed gives full information about all the expeditions. It has 61 engravings. *Oriental Institute, Chicago, Illinois—30 cents postpaid.*

**TO make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.**

**Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.***

SAFETY PRACTICES IN CALIFORNIA GOLD DREDGING (Bulletin No. 352, Bureau of Mines), by S. H. Ash. As in many other industries of the country, considerable safety work has been done, and at present the gold dredges of the state are among the most adequately guarded types of mechanical equipment. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE USE OF OIL AS A QUENCHING MEDIUM IN HEAT TREATING (*Lubrication*, April, 1932) is a useful article on a subject where the literature is slight.—*The Texas Company, 135 East 42nd Street, New York City.—Gratis.*

POINTERS ON THE CARE OF WIRE ROPE IN USE is a valuable little folder which gives advice on how to conserve the life of wire rope. *Broderick & Bascom Rope Company, St. Louis, Missouri.—Gratis.*

BROADCAST ADVERTISING IN ASIA, AFRICA, AUSTRALIA, AND OCEANIA (Trade Information Bulletin No. 779, Bureau of Foreign and Domestic Commerce, Department of Commerce) is the third of a series of bulletins on this subject; the others deal with broadcast advertising in Latin America (No. 771) and broadcast advertising in Europe (No. 787). *Superintendent of Documents, Washington, D. C.—10 cents each, (coin). Order by number.*

THE AQUARIUM is a new publication edited by William T. Innes and others. Mr. Innes is a well-known writer on goldfish and tropical fishes. The first number is excellently illustrated. There are 350 goldfish farms in the United States, to say nothing of hatcheries of tropical fish, so every new publication will be warmly welcomed. The editor says the enormous overproduction of the printing press has never invaded the aquarium hobby. *Innes Publishing Company, 129 North 12th Street, Philadelphia, Pa. $2.00 a year, single copies 20 cents.*

SECOND REPORT OF LIAISON COMMITTEE ON AERONAUTIC RADIO RESEARCH (Aeronautics Branch, U. S. Department of Commerce). It is the purpose of the committee to assist in focusing the aeronautic radio research work of governmental and industrial organizations on the early solution of the most pressing problems with a minimum duplication of effort. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

THE WUNDERLICH TUBE describes a detector combining the functions of full wave rectification, audio-amplification, and automatic volume control. There are two pamphlets available, one by Norman E. Wunderlich and one by Professor L. E. Terman, Sc. D., of Stanford University. *Arcturus Radio Tube Company, Newark, N. J.—Gratis.*

ANNUAL REPORT OF THE DIRECTOR TO THE BOARD OF TRUSTEES FOR THE YEAR 1931 (Report Series Vol. IX, No. 1). Publication 306 is a 285-page book giving all the activities of the great Field Museum of Natural History. It is illustrated with 22 plates. *Field Museum of Natural History, Chicago, Illinois.—$1.00.*

SERVICE is a monthly digest of radio and allied maintenance. It is a newcomer in this special field. *John F. Rider Publications Inc., 1440 Broadway, New York City. —$2.00 a year, 15 cents a copy.*

ARCTURUS MECHANICAL DATA SHEETS deal with radio transmitting tubes, power amplifiers, and mercury vapor rectifiers. There are five bulletins in all. *Arcturus Radio Tube Company, Newark, N. J.—Gratis.*

THE MOTION-PICTURE INDUSTRY IN CONTINENTAL EUROPE IN 1931 (Trade Information Bulletin No. 797, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce). This is the fifth annual publication on the subject. Exports of motion pictures have fallen from 122,000,000 feet in 1930 to 75,000,000 feet in 1931 and revenues have declined accordingly. This pamphlet gives the reasons. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

OCEAN EXPRESS. THE STORY OF THE BREMEN AND THE EUROPA, by Eric Hodgins, is a delightful 90-page book describing a landsman's view of the working of the entire ship. He was given exceptional facilities during a voyage to see everything from the bridge to the engine room and the vast commissary stores. He describes what he saw with rare ability. The illustrations from photographs by Hanns Tschira are splendid. *North German Lloyd, 57 Broadway, New York City—25 cents.*

# THE AMATEUR ASTRONOMER

**Conducted by ALBERT G. INGALLS**

THE Cassegrainian telescopes which were inspired by the Hindle monograph have begun to come into blossom, though we have published descriptions of several Cassegrainians made previous to the publication, or rather circulation, of that piece of instructive literature, copies of which are still available to all who have

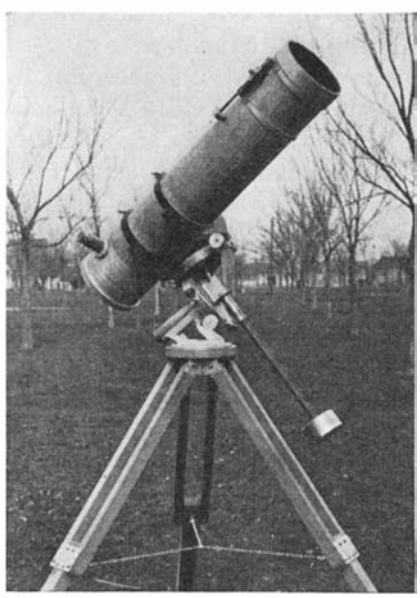
**Linde's No. 1 Cassegrainian**

made Newtonians. The first job à-la-Hindle is by Paul Linde of Crossville, Tennessee, who went under the wire April 22 with the telescope shown above. He has little to say about it. "I finally finished the 10-inch Cassegrainian," he writes, "and it came out to be just about right—not quite as good as it could be, but much better than I expected. With a half-inch eyepiece it brings out the details of the moon's surface very clearly and sharply. I expect to make another and larger one next winter."

Running in and out of North Platte, Nebraska, with his freight engine is our old friend H. O. Bergstrom, engineman, who has been a telescope making addict for several years, his first job being shown in "Amateur Telescope Making," page 71. Mr. Bergstrom writes us that he is about to abandon the throttle and take up farming, but is still interested in telescope making. His Cassegrainian, shown on this page, was made before the Hindle instructions became available. Incidentally, he says he stumbled on to the Hindle test independently. His telescope employs a diagonal near the primary, in addition to the secondary convex mirror, throwing the light out to the side. This is a well-established practice employed on some of the large telescopes.

In the May number we showed a photograph of a 15-inch Cassegrainian telescope made by Dr. H. Page Bailey of Riverside, California, and this, too, employed a diagonal in addition to the regular secondary. Dr. Bailey has also made a 24-inch Cassegrainian mounting of similar type, shown at the bottom of the page. This mounting temporarily carries a 16-inch primary mirror and was made by him (presented, it is said) for the Richardson Observatory at the San Bernardino Valley Union Junior College. Incidentally, Dr. Bailey reflects some of the pessimism regarding the quality of the Cassegrainian contained in Russell W. Porter's chapter on that type (A.T.M., page 64) when he says, "I much prefer my 12-inch Newtonian for personal use. It has a large field and lots of light."

It is about time we created a new "Birthday List of Honors," as the King of England does (we hope you gather the modest inference), since several new workers have now qualified for membership in the Cassegrainian Club. Mr. Linde is hereby dubbed a Nabob or, properly



**Bergstrom's portable job**

speaking, in India a Nawab; Mr. Bergstrom, now that he has shifted to farming, is to be called a Field Marshal; Dr. Bailey a Maharajah; Harold Lower, whose 12-inch Cassegrainian was shown in the May number, a Shiek, as he lives not far from a desert. All you have to do to win fame and a title is to finish a Cassegrainian.

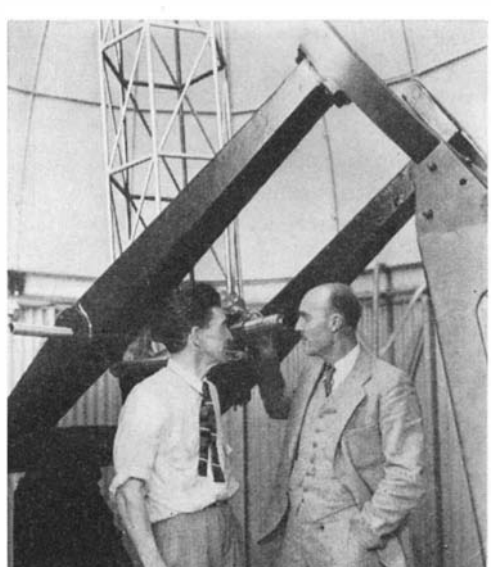
But, avast this nonsense.

In the June number we published a list of amateur telescope maker's clubs. To this list should now be added "The Amateur Telescope Makers and Astronomers of Grays Harbor," Washington, with 11 members in April and growing. Seven telescopes are sported by this young organization. Its members are studying astronomy, a chapter of Russell, Dugan and Stewart's "Astronomy" having been assigned to each for report at meetings. C. H. Rose of Aberdeen, Washington, is the secretary, and correspondence with other amateurs is invited by this organization.

A great deal of correspondence is constantly going on among amateurs throughout the country and in fact throughout the whole world. That is one purpose we originally had when we began publishing the full addresses of amateurs whose telescopes have been described. It has drawn very many of the fraternity together and made many friends.

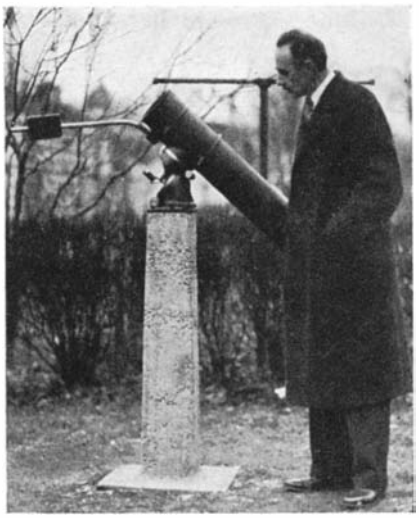
We learn that a society of amateurs, teachers, college professors and others has been organized in Providence, Rhode Island, under the name of "The Skyscrapers' Amateur Astronomical Society of Rhode Island." If you are interested in astronomy you are invited to apply for membership. The president is the Rev. J. G. Crawford of Saunderstown, Rhode Island, who has a church at Wakefield, same state, and is known locally as "The Vicar of Wakefield." The Rev. Mr. Crawford has made a fine 10-inch telescope and observatory, of which we have a photograph but as yet no description.

"The Astroscope" is the name of a budding periodical issued by the "Amateur Telescope Makers of Chicago," at 10728 Artesian Avenue, Chicago, W. S. Buttles, editor. The Chicago amateurs are invading astrophysics. Papers read before a recent meeting were entitled: "The Structure of the Atom and the Interpretation of the Spectrum"; "The Possibilities of Large Telescopes"; and so on. It sounds professional. Someone, evidently possessed of standardizing inclinations, appears to have had his way in this club, for we learn that the telescopes are to be standardized on two focal lengths: three feet and six feet; designs are to be "standardized;" drawings, patterns and castings will be made available; polar axes are to be of steel, cells and tubes aluminum—that is, "standardized." Are we not already too standardized in this country?



**Bailey (left) and 24-16-inch Cassegrainian**

In Pittsburgh the "Astronomical Section of the Academy of Science and Art" has been studying too. Here is the program of a recent meeting: "Stellar Magnitude of the Sun," by Arnold; "Sizes of the Solar, Lunar, and Planetary Disks in the Telescope—How Determined," by Seiple; "Dingle's Introduction to Modern Astrophysics," by Souther. Leo J. Scanlon is the



**Heard and his 6-inch telescope**

secretary. They met on Friday, the 13th, too—probably all dead by now.

It is a long time since we have published descriptions of any plain, simple Newtonian telescopes made by amateurs, as we used to, though we have exactly 40 such descriptions on hand at present. Such telescopes as this have been made by hundreds of previously inexperienced amateurs, using the practical instructions in the SCIENTIFIC AMERICAN book "Amateur Telescope Making." "I have worked many kinds of materials but this experience with glass has been extremely interesting," J. A. Heard, 4306 Belvieu Avenue, Baltimore, Maryland, writes, concerning his telescope. "The mounting is of the Springfield type with some slight changes in detail. I have used a 0.3-inch eyepiece and find wonderful definition right out to the edge." Such a telescope will magnify 50 to 100 diameters and enable its owner to perform serious astronomical work. The cost is low—about 25 or 50 dollars, plus some hard work. All this is stated for the information of new readers who have not previously followed this department and become inoculated with the telescope making bug. Jump in.

There has been some question as to who originated the slit test described last month. Evidently no one person was wholly responsible; the idea was a growth. Porter's notebook dated 1918 contains a detailed sketch of it; he only recently developed it. Anderson, Carpenter, Jacobson, others, contributed. Two amateurs independently hit on it and used it: James Critchett of Julian, California, and Daniel E. McGuire of Shadyside, Ohio. Porter put it on the map and had the most to do with it, but it's nobody's test.

Finally, don't forget the annual get-together of amateur telescope makers, to be held at *Stellafane*, Springfield, Vermont, Saturday August 27. Come by train, motor, 'plane, or shank's mares. For information, write "The Telescope Makers of Springfield," Springfield, Vermont.

## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 115)

monium, and free phosphoric acid, are examples of impregnating agents for activation, while steam, nitrogen, and oxides of carbon are common activating gases. The nature of the activation process has received various explanations, the most prominent of which are those which hold that activating gases effect the removal of complex hydrocarbons which are absorbed in the pores of charcoals obtained by simple carbonization. Similarly, the inorganic impregnating compounds are stated to prevent the deposition of hydrocarbon complexes on the active pore surfaces.—*A. E. B.*

### United States Leads in Aluminum Production

CONSIDERING aluminum and bauxite (aluminum ore) production by countries, the United States leads all others in production of the metal, and France leads in production of bauxite, according to the United States Bureau of Mines. Six countries supply about 88 percent of the total aluminum produced in the world. In order of output, they are: United States, Canada, Germany, France, Switzerland, and Norway. Three countries—France, Hungary, and United States—supply 66 percent of the total bauxite produced. Four other countries—Dutch Guiana, Italy, British Guiana, and Yugoslavia—supply 32 percent. Of the seven chief producers of bauxite and six chief producers of aluminum, only two countries—the United States and France—appear in both groups.

Many new uses for aluminum have developed in recent years, and relatively high prices for tin and copper have encouraged intensive research to effect substitution of aluminum for those metals. Aluminum is now employed extensively wherever lightness, durability, and strength are important. The size of structural elements made of aluminum and its alloys is increasing rapidly, due to more extended use of these metals in the superstructures of buildings, in the construction of railroad coaches, airplanes, and automobiles, and for other purposes.

Large structural shapes of strong aluminum alloys, available in sizes up to 85 feet in length and 14 inches in depth, have been produced for use in railroad and railway car construction, for trucks and buses, and for such units as cranes and hoists.

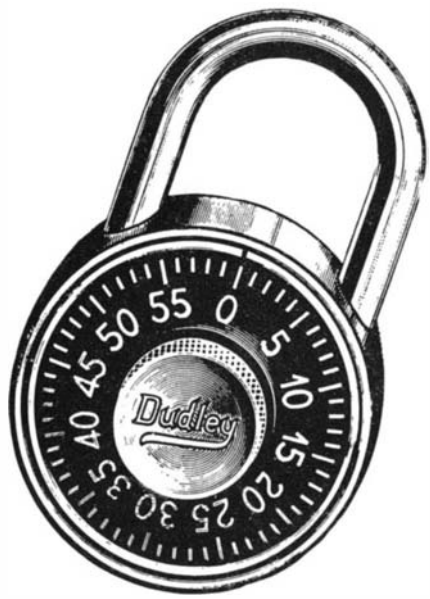
Strong aluminum-alloy wire has been introduced by a prominent fence manufacturer as a new material for woven fence and barbed wire. Another manufacturer has started the production of aluminum window screening. In both instances durability is the prime advantage of aluminum. The resistance of aluminum to atmospheric corrosion is also responsible for a steady increase in the use of the metal as a roofing and sheet-metal material and for an even sharper increase in its use as an ornamental metal on the exteriors of office and public buildings.

The use of aluminum paint has expanded rapidly both in the industrial and in the building field. An important development is the completion of tests of aluminum paint as a priming coat on wood, applied to the lumber before shipment from the mill.

The consumption of the metal in the electrical industry for aluminum cable and bus bar accounts each year for an average of about 16 percent of the country's production of aluminum.—*A. E. B.*

### Unique Combination Padlock

COMBINATION padlocks are not new. The Dudley Lock Corporation, however, has added a new wrinkle, or perhaps we should say a new twist, to this most




**A new combination padlock that, locked, conceals the last number**

useful safeguard. That company's new Rotodial is not only self-locking but, with the action of locking, the dial jumps automatically to a new point, thereby concealing even the last numeral of the particular combination. It twists itself and conceals all clues as to the combination.

Besides the usual advantageous features incorporated in such locks, the Rotodial and its almost twin, the Rotopoint, are powerfully built, and for either there are 216,000 possible combinations.

### Chemistry in the Gasoline Ads

SINCE producers of motor gasoline have "gone technical" in their advertising, such phrases as "vapor-cracked," "mercury-process," "octane rating," and so on are finding their way into every motorist's vocabulary. The latter term, particularly, is commonly used in describing the anti-knock properties of various gasolines. We are indebted to *Chemistry and You*, by Arthur M. Maas, for a terse explanation of this term.

Octane is not something that is put in gasoline, but is a liquid hydrocarbon, and an expensive one, used by research chemists as a standard for measuring knock in gasoline. A sample of the gasoline to be tested is run in a special laboratory engine, and made to produce its knock. Then octane and another hydrocarbon, heptane, are mixed and run in the engine, the octane being increased until the knock is duplicated. The amount of octane used is rated

on a 1-to-100 scale, and gives the octane number of that gas. The knock is not gaged by ear, but by a bouncing pin and electrical currents, to give accuracy.

A high octane gasoline has much better pick-up because acceleration can be forced without knock. Knock is premature explosion, and means greatly decreased power. Higher compression engines are possible with knock-free gas. "Regular" gasoline has around 60 octane; the present Ethyl standard is 78; about 70 is superior; about 80 is premium; "third grade" rates around 55. These rates differ, however. Nobody knows yet exactly what causes certain fuels to produce knock, but the kind of crude oil and the method of refining have much to do with it.—*A. E. B.*

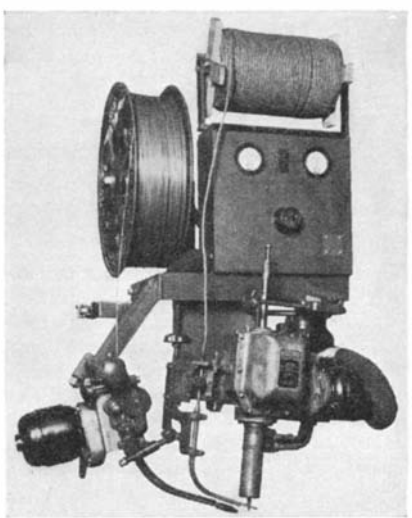
## Diamond Substitutes

TWO principal hard-metal compounds are used to replace diamonds as dies in wire-drawing, says the publication, *Wire and Wire Products*. One consists of 75 to 95 percent tungsten and 25 to 5 percent cobalt; the other of tungsten carbide containing 3 to 7 percent carbon. Nickel, cobalt, or iron are used as binding materials.

## Shielded Arc Welding Technique

IN arc welding it is often desirable to shield the arc while the metal is molten so that the oxygen and nitrogen of the atmosphere will have no opportunity to be absorbed and change the metallurgical characteristics of the weld. The layman has perhaps often wondered how it is possible to perform this operation around the sputtering arc.

We have been fortunate in obtaining the photograph shown on this page which may be used to explain this technique. The photograph shows a new wire feeding head for automatic arc welding with the shielded arc process which was developed by the Lincoln Electric Company, of Cleveland, Ohio.



**A view of a shielded arc welding unit. Technique is explained here**

The shield used is not mechanical but gaseous, the gas surrounding the arc and "smothering" it in the same way that inert gases are used in fire extinguishers. In this case the gas is supplied by a fibrous autogenizer—a sort of rope—which is fed from the reel on top of the head directly into the arc flame. This autogenizer burns and forms a gas which excludes the oxygen and nitrogen of the atmosphere while the metal is molten. The welding head utilizes a carbon arc around which is superimposed a magnetic field which directs the arc stream on the line of fusion. The welding metal is supplied from the reel mounted at the side of the machine.

## Child Identification With Animals Studied

SELF identification of children with animals, a form of behavior manifested among toddlers the world over, is being investigated by Dr. Ales Hrdlicka, Curator of Physical Anthropology of the Smithsonian Institution.

The intensity with which youngsters enter into this form of activity—to the extent that sometimes they seem almost completely to lose awareness of their own selves—leads Dr. Hrdlicka to the belief that it may be a manifestation of philogenetic inheritances from far removed prehuman ancestors.

Dr. Hrdlicka has for years conducted a study of the animal-like anomalies and behavior of young children. The animal identification display appears to be an especially frequent phenomenon. It may or may not accompany such manifestations as walking naturally on all fours.

It goes so far, reports to Dr. Hrdlicka indicate, that children seem to speak and understand the "language of animals," imitate their gestures in such minute detail that it is difficult to believe the behavior is purely imitative, and consider themselves as lower animals rather than human beings. There are instances of youngsters who for weeks at a time will not respond to their own names, which they know perfectly well, but will come immediately when their mothers address them as dogs. Among lonely children in particular this form of behavior may develop and continue for a long time. There seems to be a recognition of kinship which passes out of consciousness after early childhood.

Dr. Hrdlicka is engaged in collecting instances of these sorts of behavior from all over the world. He is eager to get authentic reports from parents and others in constant contact with very young boys and girls. There is no reason to believe, he says, that these forms of behavior indicate any inferiority. Quite the contrary, in fact, is often shown by the further natural development of the "animal children."

One instance recorded by Dr. Hrdlicka was reported to him by a scientist who found a small boy and a pig wallowing together and grunting at each other in a mud puddle in the yard of a lonely western farmhouse. The child, who had no human playmates and whose parents were too busy to give him much attention, considered himself a pig, and behaved in every particular like the quadruped. The two seemed to understand each other. The boy now is an honor student in college.

Another child developed a special proficiency at imitating horses. He would render every sound a horse makes with its hoofs and his parents could not break him of the habit for a time. Still another boy imitated perfectly the bark of every dog

in the neighborhood and seemed to have a mutual understanding with the animals. The proficiency with which some primitive people can call and understand wild animals, Dr. Hrdlicka believes, may be a survival of this identification period rather than an entirely acquired art.

Here are some other animal-like manifestations reported by parents to Dr. Hrdlicka:

Grasping objects from the ground with the teeth while walking on all fours, and carrying them in the mouth as cats carry mice or dogs carry balls.

Hoarding shiny pebbles or other small, bright objects in the same manner as squirrels or blue jays.

Holding a nursing bottle with both the fingers and toes while drinking from it. A cat, trained to take milk from a nursing bottle, held it in precisely the same way. This seemed the only natural way for the quadruped.

Biting and snapping at person's legs when angered while walking on all fours. A behavior practically identical with that of a puppy.

Rolling on the floor for extended periods like a happy, playing kitten.

Nibbling at grass or other herbs, not indiscriminately, but apparently to satisfy certain cravings.

Statements that a human child brings into the world with it a very limited range of reactions to its environment, based largely on rigidly controlled experiments, break down when one studies the actual behavior of many children, Dr. Hrdlicka holds. They are in fact bundles of ancestral, human and prehuman, tendencies and inclinations, which manifest themselves in a hundred of more or less evanescent activities, if given a chance to come to the surface.

## Restless Research

DISCONTENT is one of the outstanding characteristics of research engineers. Industrial executives say continued progress depends on this restless dissatisfaction with things as they are. Besides discovering and developing new things, research engineers often learn that old, accepted ideas have been wrong and that methods and calculations heretofore in use give untrue results.

For example, heavy coiled springs, like those under railroad cars, often broke although they had been built sufficiently strong, according to accepted design standards and formulas.

Here was a case where more accurate data was needed, so a Westinghouse research engineer, A. M. Wahl, made some unusual tests involving powerful presses and delicate measuring instruments. He found the actual shearing stress in such a spring was very much greater than that accepted by engineers.

He also found that stress piled up inside the spring until it was two and one half times as great as on the outside where measurements had always been taken.

With these new facts it was a simple matter to design and make springs of the proper cross section and strength to eliminate breakage under the required loads.

## Alumina in Electrical Insulators

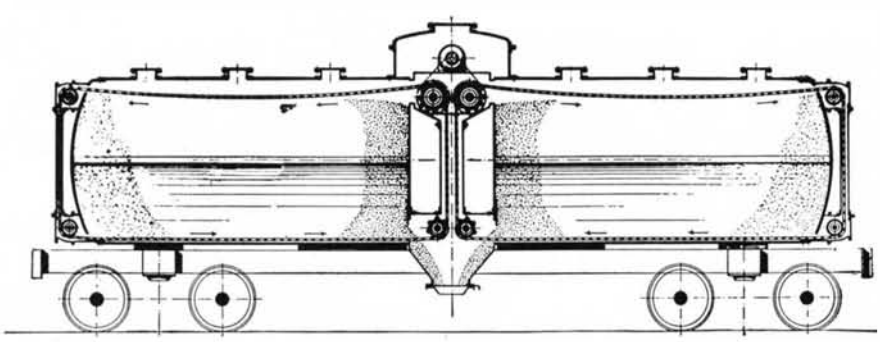
A NEW electrical insulating material, similar to porcelain but very much less affected by high temperatures, is being produced in Germany under the name "Sinterkorund"—sinter-corundum. The new material is made by fusing pure aluminum oxide at a temperature of 1800 degrees, Centigrade. It is entirely crystalline, like granite. Its thermal conductivity, which at 16 degrees, Centigrade, is about 20 times as high as that of porcelain, is quite insensitive to temperature change; its electrical insulating properties are also preserved up to very high temperatures. At 400 degrees, Centigrade, the specific resistance of this material is said to be about 100,000 times that of porcelain, and at 700 degrees, Centigrade, it is 100 times that of molten quartz.

Sinter-corundum is suitable as insulation for motors used in aviation, and is also well adapted as a material for chemical apparatus (crucibles, dishes, and so on), since it is not attacked by hydrofluoric acid, molten alkalies, and the like. Furthermore, because of its hardness, it is suitable for cutting tools, whet-stones, guides for wire or thread, and also as material for mill lining and grinding rolls. It is also to be recommended as a fireproof construction material.

Sinter-corundum may be applied wherever its property of electric insulation at very high temperatures is needed; for example, as supports for the heating element in electrically heated apparatus, also in such heavy-current applications as arc-insulating material, electric furnaces, and so forth.—*A. E. B.*

## Tank Car for Solids

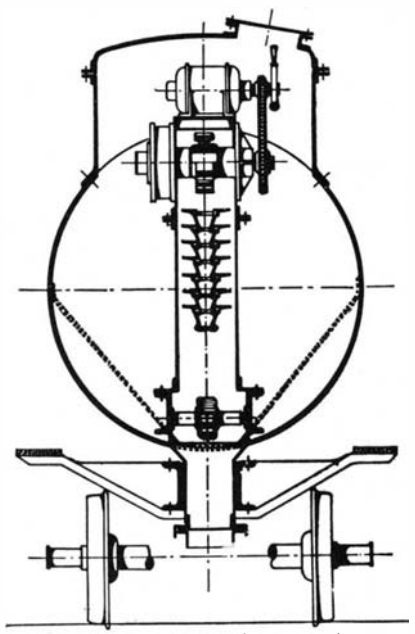
A TANK car in which granular materials can be handled as conveniently as liquids are handled in ordinary tank cars is the latest development of the General American Tank Car Corp., which calls its new conveyance the "Dry-Flo" car. In outward appearance it is an ordinary tank car except that it has six filling doors on top. Inside, the car is divided into three com-



A longitudinal cross-section of the new tank car designed to transport solids

partments, as shown by the cross-section view. Power driven drag chains are pulled from both ends to the central discharge compartment.

It is predicted that this car will cut distribution costs on many chemical products by eliminating the necessity of bagging



**Transverse section of new tank car showing the drag chains and motor**

and packaging. In the cement industry, for instance, sacking costs two dollars per ton —an item which can be practically eliminated by the use of this new method of shipment. Another estimate of savings, made for an oil company that uses hydrated lime instead of the 10 percent less expensive and 28 percent more effective quick lime—the latter being dangerous and disagreeable for men to handle—shows a potential saving of 3000 dollars per month or 1000 dollars per car.—*A. E. B.*

## Rubber Burned in British Grates

RAW rubber now selling for less than kindling wood is being used to light open fires in many British homes, it is reported in rubber circles.

Cut into strips, one pound of rubber costing about 5 cents (U. S.), will serve to kindle seven or eight ordinary fires. Although not generally realized, crude rubber burns easily without any offensive smell. The British owners of rubber plantation shares are encouraging the use of rubber in starting the coal fires of England in order to dispose of the excess of this material that has depressed the price below the cost of production.—*Science Service.*

## Goggles for Glass Blowing

ASSURING maximum protection and comfort for the eyes while at the same time offering perfect observation of the incandescent work in or out of the flame, new glass blower's goggles are an important contribution towards precision glass blowing.

The new goggles, now introduced by the Burgess-Parr Company, Inc., of New York, are based on the use of a special didymium glass which possesses the unique characteristic of transmitting all light except the objectionable yellow glare from incandescent glass. The pinkish lenses, adequately protected against accidental breakage, are mounted in a newly designed bakelite frame which is non-inflammable.

Although the lenses appear surprisingly transparent to most light, they are nevertheless completely opaque to the particular glare of incandescent sodium glass, thereby entirely eliminating the only serious and bothersome light encountered in working glass. The transparency to other light makes it entirely practicable to wear the goggles indefinitely, since they do not materially interfere with normal vision when looking for objects on the work bench or elsewhere. When observing a piece of glass in the flame through these goggles, one sees only the red glow of the glass. Not only are the eyes greatly relieved, but far more accurate work is possible since the exact outline of the glass can be seen at all times. Much time is also saved.

The goggles are also suitable in cyanide case hardening, eliminating the terrific glare.

## Bacteria Produce Vegetable Oils

BACTERIA that do the work of powerful pressing machines by liberating oil from vegetable cells were described before a recent meeting of the American Chemical Society by Dr. John W. Beckman. The newly discovered bacillus, *delbrueckia,* attacks the tough cells of an oily vegetable, such as coconut meats, and by devouring the cell walls liberates the pure coconut oil which floats to the top of the vat, thus becoming available for industry's manifold uses at a lower cost than that incurred by any process involving mechanical pressing.

The bacillus is obtained from brewers' malt. It is said that an infusion of this bacteria will remove all the oil from a vat of dry coconut meats in six days. The color of the oil is said to be superior to that obtained by the usual pressure methods.—*A. E. B.*

## New Photo-Electric Unit

A SINGLE unit photo-electric relay which combines the amplifier, photo-electric cell, and light source within a single case, greatly simplifying the work of installation, is now being produced by the G-M Laboratories, Inc., of Chicago.

An advantage of this type of unit lies in the fact that no separate and bulky light source is required. The rays from the lamp behind one lens are focused on a special mirror, and reflected to the lens in front of the photo-electric cell. This mirror can often be mounted in a space too small to accommodate a separate light source, or in a location where it would be difficult to bring in special wiring to supply lighting current.

Removal of a small front plate permits ready adjustment. All wiring and interior parts are attached to a central section of the relay entirely independent of front and back covers. The case is of cast aluminum and so designed that the entire unit may readily be weather-proofed for outdoor use. In addition, this unit is capable of operating at speeds as high as 600 light interruptions per minute.

# COMMERCIAL PROPERTY NEWS

**Conducted by SYLVESTER J. LIDDY**

Member of the New York Bar

## Supreme Court Refuses to Modify "Packers Consent Decree"

THE United States Supreme Court, in a recent opinion written by Mr. Justice Cardozo, has reversed a decision of the Supreme Court of the District of Columbia modifying an earlier decree of the same Court familiarly known as the "packers consent decree."

In 1920, the Government filed a complaint under the Sherman Anti-trust Act against the five leading meat packers in the United States, Swift and Company, Armour and Company, Wilson and Company, the Morris Packing Company, and the Cudahy Packing Company, together with their subsidiaries and also their chief officers. The charge was that by concert of action the defendants had succeeded in suppressing competition both in the purchase of live stock and the sale of dressed meats, and were extending their monopoly into other fields of trade. The alleged acts consisted of agreements apportioning the percentage of live stock to which the members of the combinations were severally entitled; the acquisition and control of stockyards and stockyard terminal railroads; the purchase of trade papers and journals whereby cattle raisers were deprived of accurate and unbiased reports of the demand for live stock; and other devices directed to unified control.

It was also charged that they had set about controlling "substitute foods," products ordinarily handled by wholesale grocers or produce dealers. Through their ownership of refrigerator cars, branch houses and other facilities, they were in a position to distribute "substitute foods and other unrelated commodities" with substantially no increase of overhead. They were also charged with fixing prices so low over temporary periods of time as to eliminate competition by rivals less favorably situated.

The defendants filed a stipulation with their answer to the Government's bill providing for the entry of a decree enjoining them from maintaining a monopoly and from entering into or continuing any combination in restraint of trade and commerce. In addition they were enjoined both severally and jointly from (1) holding any interest in public stockyard companies, stockyard terminal railroads, or market newspapers, (2) engaging in, or holding any interest in, the business of manufacturing, selling or transporting any of 114 enumerated food products, (principally fish, vegetables, fruit, and groceries), and 30 other articles unrelated to the meat packing industry, (3) using or permitting others to use their distributive facilities for the handling of any of these enumerated articles, (4) selling meat at retail, (5) holding any interest in any public cold storage plant, and (6) selling fresh milk or cream.

Several attempts have been made in the past to modify this consent decree both by the parties thereto and by the California Co-operative Canneries Corporation which claimed that the decree interfered with the performance of contracts between it and Armour and Company. The Supreme Court, however, refused to modify this decree.

The present action was brought by Armour and Company and Swift and Company to modify the decree to allow petitioners to own and operate retail meat markets, to own stock in stockyard companies and terminal railroads, to manufacture, sell, and deal in various groceries and to permit others to use their distributive facilities in handling such commodities.

The Supreme Court of the District of Columbia granted relief from the decree to the extent of allowing the petitioners to manufacture, sell, and deal in groceries and to permit others to use their distributive facilities in handling such commodities. The Government and the National Wholesale Grocers Association, who obtained permission to interplead, appealed from this decision, and the Supreme Court of the United States reversed the decree of the lower court and refused to modify the injunction. In the decision written by Mr. Justice Cardozo and referring to the practices originally charged against the defendants, the Court stated:

"The case comes down to this: the defendants had abused their powers so grossly and persistently as to lead to the belief that, even when they were acting separately, their conduct should be subjected to extraordinary restraints. There was the fear that even when so acting they would still be ready and able to crush their feebler rivals in the sale of groceries and kindred products by forms of competition too ruthless and oppressive to be accepted as fair and just. Wisely or unwisely, they submitted to these restraints upon the exercise of powers that would normally be theirs. They chose to renounce what they might otherwise have claimed, and the decree of a court confirmed the renunciation and placed it beyond recall."

**MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.**
***—The Editor.***

## Cable Patent Claims Invalid

CLAIMS of the Frederickson patents for an armored electric cable and for an improvement in anti-short bushing, have just been declared invalid by the District Court of the United States for the Eastern District of New York.

The claims involved, all of the claims in the first patent and claims 1, 2, 3, and 7 in the second, were found by the court to be anticipated by prior art; United States, British, and French patents; and publications.

"The first patent is said," in the opinion of Judge Galston, "to relate to improvements in the construction of electric conductors having a metallic outer sheath. The second patent provides for a bushing of a particular configuration adapted to protect the insulated wire against abrasion from the end of the metallic conduit, and to be inserted readily in position in the end of the conduit."

"These two patents," Judge Galston concluded, "to my mind present no evidence of invention. The electrical cable art at the time of the filing of the application for the earlier patent on Dec. 7, 1927, was exceedingly well developed.

"It seems to me that the inventor did nothing more than to take a standard form of lead sheet or armored cable and protect the ends of a severed portion by using a bushing which was well known in the art.

"So that if one's reading of the prior art has been a little too severe in its application to the aggregation of the earlier patent and to the simple business of the second patent, it would, nevertheless, be true that the patentee's contribution to the art, if any, was but slight and obvious. Such an improvement or contribution should not be rewarded with the stamp of validity of the patents granted."

## Candy Trademark Decision

IT was recently held by Assistant Commissioner Moore that Oxford Confectionery Company, of Oxford, Pennsylvania, is entitled to register, as a trademark for candy confections, the term "Diskomint," notwithstanding the prior use by Life Savers, Incorporated, of Port Chester, New York, of the term "Pep-O-Mint" on similar goods.

In his decision the Assistant Commissioner, after stating that there could be no exclusive right to the use of the term "Pep-O-Mint" as was settled in the case of L. P. Larson, Jr., Co. v. Lamont, Corliss & Co., et al., and that the ruling in that case was to the effect that "Pep-O-Mint" performs no function other than descriptiveness, said:

"This ruling of the court appears to be in harmony with the testimony of the opposer's witnesses, in which it is stated that the words Pep-O-Mint, Wint-O-Green, Vi-O-Let and so on, which are applied to the opposer's packages, are indicative of the flavors of the confections within the respective packages."

With reference to the allegations as to the goods being annular in form and with reference to a design patent for a confection or gum having that form, he said: "This patent was granted for a term of seven years and expired June 16, 1921. On the expiration of this patent the annular

form of the confection became public property and no one at this time is entitled to the exclusive right to a confection having such form."

He then said: "As the opposer's mark 'Pep-O-Mint' does not have the function of a trademark, but only of a grade mark, and as the opposer, under the decision of the court above referred to, is not entitled to the exclusive right to said word even as a grade mark, and as the form of the opposer's confection is public property, it is not clear that the opposer has any legal standing as an opposer in the instant case. If the applicant's mark is registrable over the common word peppermint it is registrable over Pep-O-Mint. The question has not been raised but what it is registrable over peppermint."

With reference to the similarity of the two marks, the Assistant Commissioner said: "The word 'Diskomint' is not confusingly similar to the word 'Pep-O-Mint' either in form, sound, or signification."

## Permanent Exhibit of Historical Patents

THE exhibit of the models of patented inventions on permanent display in the Commerce Building, Washington, D. C., very well typifies the models submitted to the Patent Office by inventors prior to 1880.

The models in the Commerce Building include such historic pieces as the Gatling gun, the "gun mount" used on the Union war ship *Monitor* in the Civil War, and a number of Edison inventions related to the printing telegraph, as well as the John Erickson heat engine. The Biglow carpet loom will be added to the display in the near future.

The more historic models such as the first telegraph instrument, the reaper and binder, the Howe sewing machine, Edison's incandescent lamp, the Lincoln boat model, and others were placed in the National Museum some years ago.

A group of historic patent applications are kept in the office of Commissioner Thomas E. Robertson, of the Patent Office. Among these is one issued to Abraham Lincoln in 1849 on a "mode of buoying vessels."

The original application and some of the correspondence between Lincoln, who was a young man in Illinois at the time, and Commissioner Edmund Burke are in this collection. The original records show that an attorney by the name of Z. C. Robbins represented Lincoln, and that the latter paid 30 dollars into the Treasury in connection with the patent that was granted on May 22, 1849.

This collection also contains the fourth patent issued by the Government of the United States. It was signed by George Washington on Jan. 29, 1791, and granted Francis Bailey of Philadelphia a patent on a process of "punches by type, et cetera." This patent was approved by a board consisting of Secretary of State Thomas Jefferson, Secretary of War Knox and Attorney General Edmund Randolph prior to being signed by the President.

A British patent, issued Aug. 13, 1858, to John Henry Johnson of Glasgow, "a gentleman," also is in this display. It was approved by a representative of Queen Victoria and has a wax seal of the United Kingdom, one inch thick, weighing nearly two pounds, attached to the patent by a cord. Another seal is fixed to the document indicating that John Henry Johnson paid Her Majesty's treasurer £5 as a fee. The patent was "an improvement in the treatment of crude rubber, et cetera, for the manufacturing therefrom of what are usually called hard rubber articles."

## Basic Aviation Patent Suit Dismissed

A LONG-STANDING suit over basic patents covering the conventional control of airplanes, known as the stick and rudder control, was dismissed in the United States District Court in Brooklyn. The action was looked upon as the final disposition of a test case which, if successful, would have been instituted against most of the airplane manufacturers in this country. The suit was brought by Robert Esnault-Pelterie, French scientist of Boulogne-sur-Seine, France, against the Chance Vought Corporation division of the United Aircraft and Transport Corporation which manufactures most of the observation planes for the navy and marines.

The case was tried last November and the French scientist made a special trip here in order to testify. The opinion of Judge Marcus B. Campbell of the court was that there was no infringement on any patent of Robert Esnault-Pelterie in the mode of control of the Chance Vought military airplane.

The citations by the plaintiff of decrees of French courts over similar issues were ruled out of evidence by Judge Campbell on the ground that they were not properly authenticated. As to the well-known "joy stick" control of ailerons and elevator in aircraft he said:

"There certainly was no novelty in the use of a well-known device, the lever. As for the so-called 'bird tail' unit for control I can find no invention."

He was referring to a patent granted Esnault-Pelterie in this country in 1914 for modifications and improvements of one of his French patents dated 1907.

## Philippine Trademarks

THE Federal Trade Mark Act of 1905 cannot be regarded as intended to displace the Philippine statute relating to the registration of trademarks in the Islands so far as the latter applied to local commerce, the Supreme Court of the United States ruled in modifying and affirming the decision of the insular courts in the cases of American Trading Company et al. versus H. E. Heacock Company.

"We must assume," the court held in an opinion written by Chief Justice Hughes, "that it was the intention of the Congress in the Federal Trade Mark Act of 1905 to provide, with respect to trademarks used in commerce between continental United States and the Philippine Islands, a protection similar to that which was accorded by the act to the use of trademarks in interstate commerce. As to the latter, the Federal statute did not attempt to create exclusive substantive rights in marks, or to afford a refuge for piracy through registration under the act, but to provide appropriate procedure and to give the described protection and remedies where property rights existed."

The court also held valid in the cases the registration by the Heacock company under the Philippine statute of the trademark "Rogers" on flatware, nickel, silver-plated, or silver, and, after modifying it, affirmed an injunction restraining the American Trading Company and Wm. A. Rogers, Ltd., from selling in the Islands similar goods bearing the mark, registered in the United States, of "Wm. A. Rogers." The court modified the injunction granted by the lower court so as not to prevent importation of the products. The Heacock company's registration was valid, it was declared, even though it was that of a dealer who handled in the Islands wares that were originally manufactured in the United States by the International Silver Company.

The finding of the lower court that in the Philippines the word "Rogers" had acquired a secondary meaning as applied to the goods of the Heacock company which for many years was the only dealer in the flatware in the Islands and that the word did not have the significance of a family name, as in the United States, was upheld. The Supreme Court found it unnecessary to consider the respective rights in relation to the use of their marks in continental United States.

## Fireproofing Patent Claims Invalid

CLAIMS 1 and 4 of the Sutter patent covering fireproof insulating materials have been held invalid by the Circuit Court of Appeals for the Fifth Circuit. "Taken at their face," the claims are ruled by the court to be too broad and merely to embrace the prior art. If limited to the present process practiced under the patent, and the product thereof, the court held that there is an insufficient disclosure.

The appellate court affirmed the decision of the District Court for the Southern District of Mississippi in the case of Zenitherm Company, Inc., versus Art Marble Company of America et al. The patent is claimed to be practiced, the opinion explains, in producing the insulation material known as "Zenitherm." The claims were found not to be infringed, if limited to the process practiced, by the defendant company's manufacture of its product known as "X-ite."

The materials, their mixture and the pressure called for by the broad claims 1 and 4 of the patent, it was found, are shown in patents in the same and allied arts. No proportion of ingredients nor degree of pressure is said to have been disclosed by the patentee or claimed by him as producing any new result.

The argument for the validity of the claims, according to the opinion of Circuit Judge Sibley, "comes from confusing the claim with the present product 'Zenitherm.' It seems to be a meritorious and perhaps a novel product, deserving of a patent, but its proportions and the secret of its manufacture are not to be found in this patent." While noting that it was unnecessary for the patentee to disclose things already well known, the court said "he is in the dilemma either of there being nothing new to disclose, and hence no novelty, or else having failed to disclose that which was new, with a consequent invalidity of his patent."

# Books SELECTED BY THE EDITORS

## RIDDLES OF SCIENCE

*By Sir J. Arthur Thomson, Emeritus Prof. Nat. Hist. Univ. Aberdeen*

ONCE more the noted author of "The Outline of Science" and many other semi-popular, semi-scientific works has turned out a book which will be widely read because, like all the others, it is chock full of interest. This book of 387 pages contains over 50 little scientific discourses—chats, so familiar a tone have they—on subjects which most of us find to contain more than theoretical interest. For example: How did life begin?; Why do we fall asleep?; Are animals ever afraid?; Why do we laugh?; How does our hair turn gray?; Why must we die?; Is there natural wireless?; Do animals think?; Is telepathy a fact?; Why do we dream? The subjects mainly concern life—biology in some form—and the book answers a host of questions that have occurred to all of us. A good sale for this fascinating book is predicted.—$3.70 postpaid. —*A. G. I.*

## THE RELIGION OF SCIENTISTS

*Edited by C. L. Drawbridge, Sec. Christian Evidence Soc.*

THE preface of this book states that it contains an *unbiased* account of the results of a questionnaire sent out by the Christian Evidence Society to all the Fellows of the Royal Society, on the subject of their religious beliefs. It contains most of the scientists' answers in quoted, detailed form, the questions having been: (1) Do you credit the existence of a spiritual domain? (2) Do you consider that man is in some measure responsible for his acts of choice? (3) Is it your opinion that belief in evolution is compatible with a belief in a Creator? (4) Do you think that science negatives the idea of a personal God as taught by Jesus Christ? (5) Do you believe that the personalities of men and women exist after the death of their bodies? (6) Do you think that the recent remarkable developments in scientific thought are favorable to religious belief?

Leaving aside the question of whether data obtained in this manner, that is, by a questionnaire whose answers might conceivably be used to arouse prejudice against scientific men (only 200 scientists answered), there is a question of whether the answers actually were interpreted in an "unbiased" manner. The evidence indicates that many more scientists believe in a Creator than in survival after death.—$1.40 postpaid.—*A. G. I.*

## WONDERS OF THE SKY

*By Mary Proctor, F. R. A. S.*

FEW of the regular readers of this magazine will find this little 96-page book satisfying because it is rather light. But those who have tried but failed to interest members of their family in astronomy, because the books look so formidable, will find this book just the thing. It is easy to read, is entertaining, and contains just about enough astronomy to arouse further curiosity. Authentic, as far as it goes.—65 cents postpaid.—*A. G. I.*

## THE OUTLOOK FOR TELEVISION

*By Orrin E. Dunlap, Jr., Radio Editor,* New York Times

THIS is a really "different" book on television. It is not of the "how-to-make-it" or "experimenter's manual" variety, but is a survey of all that has been done in television, and of what may be expected in the future. It is concerned mainly with the commercial side of television and with the development of the art from that standpoint. The person who wishes to be fully informed about television, without the necessity of delving into the technical side of it, will find the chronological development of this book of great value. In an epilogue the author has grouped the opinions of eight prominent men as to the possible uses of television for advertising and publications, exploration, education, the home and the theater, religion, war, politics, and the stage and screen. An important appendix gives a "Calendar of Wireless-Radio-Television" dating from 640 B.C. to April 7, 1932. Well printed, nice format, half-tone illustrations.—$4.20 postpaid.—*A. P. P.*

## EARTHQUAKE DAMAGE AND EARTHQUAKE INSURANCE

*By John R. Freeman, Engineer*

THIS monumental, 904-page book, written by a well-known engineer (past president both of the A. S. M. E. and A. S. C. E.), is essentially a *practical* work for the engineer and architect and not for the student of seismology as a pure science; that is, it is not for the geophysicist as such. It deals with human safety, not theory, and contains the most complete collection of data yet extant on the measurement of earthquake hazard in various parts of the world. It also contains studies of every notable earthquake. The risk of earthquake damage is shown to have been greatly exaggerated. Good, sound engineering construction can reduce it to a very low figure. This work also contains much matter on earthquake insurance. The book has two serious faults: it is repetitious; and owing to the horrible style of typography evidently chosen by the author the text makes most irritating reading all through.—$7.25 postpaid.—*A. G. I.*

## THE EVOLUTION OF HUMAN BEHAVIOR

*By Carl J. Warden, Asst. Prof. Psych. Columbia*

THE general topic of human evolution is exceedingly broad and hence can be approached from many diverse angles. Most of the books that have appeared in this field up to the present have dealt almost exclusively with the evolution of man's bodily structure. Quite aside from this limitation, many of them are too detailed and technical to be of much value to the general reader.

"In the present volume, behavior rather than bodily structure has been stressed. The writer believes that the evolution of human intelligence, with its almost limitless capacity for cultural development, should be regarded as the central theme of the general problem. The facts of structural evolution must find their larger meaning in terms of the cultural evolution which they have made possible. The psychological approach, growing out of this conception, offers a new orientation in interpreting the biological and sociological factors involved. The present treatment is as non-technical as could well be without sacrificing something of scientific accuracy."

This is one more interesting popular book on human evolution.—$3.20 postpaid.—*A. G. I.*

## HUMAN STERILIZATION

*By J. H. Landman, Ph. D., C. C. N. Y.*

WHATEVER you believe concerning the vexed problem of sterilizing criminals, the mentally deficient and some of the diseased, for the intended good of society, this book will give you

a complete, detailed, scientific history and general background concerning the whole subject, with a full bibliography of further literature. Thus it is exhaustive. The author is America's leading authority on human sterilization.—$4.20 postpaid.—*A. G. I.*

## THE MONGOL IN OUR MIDST

*By F. G. Crookshank, M. D.*

THIS is the third edition, entirely rewritten and enlarged to 512 pages, of a work which has been well known to students of evolution and anthropology for a number of years. In the widely accepted, orthodox theory of primate origins, the three races of man are traced to an earlier common human stem; likewise the four anthropoid apes are traced to an earlier common ape stem of their own; and then these two main stems as a whole are traced to a still earlier common stem of all. This is the standard or monogenetic theory. In Dr. Crookshank's "polygenetic" theory the negro and the gorilla, because of their resemblances, are traced to a single common ancestor, the white race and the chimpanzee for the same reason to another, and the mongol race with the orang to a third. These three subgroups are then traced to the ape ancestor of all. The argument for this bizarre but attractive hypothesis is more compelling than might at first seem likely, though practically none of the qualified anthropologists today accept this hypothesis. The various arguments are presented from the one-sided point of view of a strong advocate rather than judicially, but the book makes most interesting reading.—$4.50 postpaid, imported.—*A. G. I.*

## ANIMAL LIFE AND SOCIAL GROWTH

*By W. C. Allee, Prof. Zoology Chicago University*

AN approach to the science of ecology which is the scientific study of the home life of animals and plants. It studies their habitats and their environment, their communities and aggregations. It is a relatively new approach to natural history, but as developed by the author it has none of the ear-marks of a text-book. Far from it. One reads along in the pleasantly flowing style of the many contacts of animals and insects with humans which the average person has never realized. All in all it is quite up to the other volumes in this "Century of Progress Series."—$1.10 postpaid.

## OWEN D. YOUNG

*By Ida M. Tarbell*

OF the many biographies which have placed Miss Tarbell in the front rank of writers of discernment it seems safe to say that in none has she been so fully en rapport and so happy in her delineation as she is in sketching this new type of industrial leader. There is a joyous, hopeful, and progressive note throughout, for even as she herself says, she writes as she finds the facts and if in this case it happens to approach a eulogy, the facts are as they were found. No more engaging personality can be found in public life today and so this story is most timely and profitable. We predict it will rank high in the lists of best sellers.—$3.15 postpaid.

## JUST FISHING

*By Ray Bergman*

THE outstanding contribution to the literature of angling, by one who has mastered the art of clear-cut, accurate presentation to the layman. Here is no maze of scientific piscatorial nomenclature, nor cut-and-dried data regarding the lives and theoretical habits of fish. The book is concerned with *just fishing*, and is written after years of experience on American streams, rivers, and lakes. The author draws on a vast fund of information, practically acquired, and often uses the anecdotal form to drive home a certain point. He deals at length with all the common fishes of this country—the trout, bass, pickerel, pike, muskellunge, salmon, and so on—and gives eminently practical information as to how best to lure them with rod and line. The sections on fly fishing are particularly worthy of note; here is told much about the art that usually is learned only through long and often costly experience. This book must not be confused with the ordinary, garden-variety of books on fishing; it is obviously a work of love, and with its many full-color plates, half-tones, and drawings is worthy of a place beside the finest edition of the "Compleat Angler" that ever left a press. 418 pages, 6½ by 9 inches, good heavy paper, well bound. —$5.25 postpaid.—*A. P. P.*

## A NEW WAY TO BETTER GOLF

*By Alex. J. Morrison*

IT is one thing to know the game but it is quite another to be able to express that knowledge so that others can readily understand and, what is most important of all, be able to carry out the instruction. Such a gift has the author and there will not be a single "Mr. Over A. Hundred" who will not find it most profitable to read and reread what this "Pro." says. He has been able to prove all he contends by pupils who have vastly improved their game as a result of his instruction. In fact, this reviewer has spent much too much time on this book, with the whimsical wish that it had been available when he was a golf addict. Splendid, unique photographs and illustrations complete this best of all golf instruction books.—$2.15 postpaid.

## THE TRUTH ABOUT HOOVER

*By Herbert Corey*

THERE seems to be a most malicious tendency to vilify Presidents, though just why the present incumbent should be the subject of such insidious attacks it is hard to understand. At any rate here are the facts as deduced from official papers and records, and from the testimony of the men themselves who had the best knowledge and were in the best position to judge. Regardless of righting an odious wrong this biography is most interesting for it gives in detail the events of a most successful career about which little has hereto been known.—$2.65 postpaid.

## THE JOY OF IGNORANCE

*By T. Swann Harding*

IN the midst of an incessant battle on the part of religions, manufacturers, advertisers, charlatans, physicians to whose advantage it is to have one believe certain things, the author decided to accept none without investigation. Using science as a guide, though not accepting it as infallible, he began to search things out for himself and finally evolved a few guiding facts and ultimately even a helpful method. The result of this individual quest for scientific truth is this book, an entertaining and informative guide to effective living.—$3.20 postpaid.

## THE LAST CRUISE OF THE "CARNEGIE"

*By J. Harland Paul, Surgeon and Observer.*

THIS account of the last prolonged voyage of the famous non-magnetic ship *Carnegie*, the sailing yacht that covered all the oceans with her tracks only to explode and burn at Samoa, is written in running narrative style but it is essentially a scientific man's narrative. Through it one may get not only a fine cross-sectional picture of the daily scientific routine on a ship wholly devoted to science but incidentally a picture of the science of oceanography.—$5.20 postpaid.

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

ORSON D. MUNN, President — LOUIS S. TREADWELL, Vice-President
JOHN P. DAVIS, Treasurer — I. SHELDON TILNEY, Secretary

EDITORIAL STAFF · ORSON D. MUNN, EDITOR

ALBERT A. HOPKINS — ALBERT G. INGALLS — LOUIS S. TREADWELL
A. P. PECK — F. D. McHUGH
PROFESSOR HENRY NORRIS RUSSELL — PROFESSOR ALEXANDER KLEMIN

CONTRIBUTING EDITORS

A. E. BUCHANAN, Jr., Lehigh University.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

WALDEMAR KAEMPFFERT, *New York Times*.

SYLVESTER J. LIDDY, New York Bar.

M. LUCKIESH, Director, Lighting Research Laboratory, Incandescent Lamp Dept., of General Electric Company, Nela Park, Cleveland.

D. T. MacDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company; Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research; and President, Society for Psychical Research (London).

W. D. PULESTON, Captain, United States Navy —Technical Adviser on Military Matters.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 147, No. 2. Price 35 cents a copy. $4.00 a year. Foreign $5.00. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries $5.00 a year, postage prepaid. Canada $4.50 a year, postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises never authorized. "Scientific American" registered United States Patent Office.

# Bunk!

—says the famous

## ALEX MORRISON

DON'T LOOK UP!

DON'T HURRY BACKSWING!

DON'T PULL IN!

DON'T DROP LEFT SHOULDER!

DON'T OVERSWING!

BE SURE TO PIVOT!

KEEP LEFT ARM STRAIGHT!

# . . . and he guarantees to Improve Your Golf in Just Five Days!

AT LAST Alex Morrison has done what thousands have urged him to do: put his way to learn the correct swing within reach of every one anxious to improve his game.

"Alexander the Great" is, as Bob Davis says, "the Wizard of Golf Instruction." His instruction brought Babe Ruth down into the 70s—enabled Doug Fairbanks to shoot 72 (on a par 71 course) in Los Angeles—helped big-framed Rex Beach shoot 154 for 36 holes in tournament play, and slender Clarence Budington Kelland get into the 70s. He has taught Jack Dempsey, the slight Charles Chaplin and the bulky Paul Whiteman, Grantland Rice, Rube Goldberg, Paula Stone, Annette Kellermann, and scores of others. Whatever golf lessons he chose to give were given at a charge of $200 for 12 lessons.

He is on the staff of American Golfer, has written for Ladies' Home Journal, American Magazine, Popular Science, and others. He has given lectures and exhibitions all over this country and Canada. Although this left him little time for tournament play, Alex has demonstrated that he can play the game with the best of them. In addition to defeating several of the leading players he has set many course records. Recently he tied the course record at winged Foot (the scene of the 1929 American Open) with a 68. He has no less than 30 attested scores ranging from 65 to 69 over championship length courses; a few of them, for example, the Brackenridge Park at San Antonio with a 69; Pasadena Golf Club, 69; the Detroit Golf Club (South Course), a 66; and 69 at Denver Country Club.

This fellow is considerably worried about his wind-up. The correct swing banishes all worry about ANY stage of a shot.

### *For Those Bewildered by a "Plague of Don'ts"*

Alex Morrison has just gotten out a book which clearly describes and pictures his simple way of learning the correct swing. There need be no question in your mind about being able to learn through a book like this one. It is sold not on promise but on performance—on a definite guarantee that it will improve your game, or cost you nothing.

So many "don'ts" are running through his mind that they show in his knees, his shoulders, and his whole stance.

If you know Alex Morrison, you know that he is the arch enemy of Golf DON'TS! His last fifteen years have been spent to help the man so typical of thousands of golfers: the man who stands grimly before his ball "concentrating," with his knuckles white with tension, and the cords in his neck swelling with strain. Alex Morrison is out to help the fellow who really gets too little amusement, satisfaction and benefit from the game—who merely exchanges business worries for golf worries—who is in a constant panic about doing the wrong thing.

### *The Secret of the Correct Swing*

If you are "stymied" by your apparent inability to apply seemingly simple principles, if the usual advisory jargon and generalities haven't gotten you anywhere, if you realize that mere intense concentration, will-power, and practice alone is not the real answer—then you will be interested in how Alex Morrison can change your whole viewpoint, in his book, "A New Way to Better Golf."

First, he tells you how to banish mental tension and nervous strain, and how to play with muscular freedom, mental relaxation.

Then he analyzes the eight stages of the Correct Swing—not "correct" because it is the way he does it, but correct because of the structure of your own body. For years Morrison has studied anatomy and mechanics. As he has proven, when the proper muscles cease to function the wrong ones take charge—and you inevitably get a bad shot.

In simple terms and clear photographs he shows these eight stages. He proves by actual photographs there is not even a "pivot" in it! He gives you no such advice as is bewildering and killing the game of the gentleman pictured above. Then, having shown you how to get the Correct Swing, he shows how easy it is to put it into practice—in every shot, from drive to putt.

### Alex Morrison

GRANTLAND RICE, Editor of *The American Golfer* says, "Alex Morrison has been working for years on simplifying and developing a clear picture of what is needed to play better golf. He is something more than a fine teacher of golf. He is also one of the few who have made a close study of breaking up tension, which is the curse of every game played."

REX BEACH says, "Morrison knows more about his business than I will ever know about mine. He has taken the golf swing apart and examined it, oiled up loose parts, re-assembled them and put the whole thing into smooth running order. To watch him execute a shot is to realize that he has mastered the elusive principles of the golf stroke to a nicety which makes the swing of most experts look crude. You will find here the soundest, the simplest, the most sensible help you have ever found."

"If the Pulitzer Fund were to offer a reward for golf instructors," says BOB DAVIS, "Morrison would grab the coin every year. He is the most celebrated golf instructor alive."

## SEND NO MONEY

*5 Days' Examination and a Double-Guarantee*

| The Morrison Golf Guarantee | |
|---|---|
| If Your Present Score Is | In One Month You'll Score |
| 130 | 115 |
| 120 | 110 |
| 110 | 100 |
| 100 | 92 |
| 90 | 85 |
| 85 | 80 |
| 80 | 77 |
| 75 | 73 |

Send no money with the coupon below. When the book is handed to you, pay the postman only $2, plus postage charges. Read it for five days. If you are not "sold" at once—OR if you put Mr. Morrison's suggestions into practice and *within one month* you don't reduce your score in accordance with the little chart shown here, you may return the book and your $2 will be refunded.

Clip and mail this coupon—without money—now. SIMON & SCHUSTER, INC., Dept. 278, 386 Fourth Avenue, New York City.

### Some of the Good Golfers Who Have Followed Morrison's System

DOUGLAS FAIRBANKS
Formerly in the high 80s.
Now in the low 70s.

CLARENCE B. KELLAND
Formerly in the 90s. Now in the 70s.

PAUL WHITEMAN
Formerly over 100.
Now in the 80s.

REX BEACH
Formerly in the 80s.
Now in the 70s.


SIMON & SCHUSTER, Inc.
Dept. 278, 386 Fourth Ave.,
New York City

Please send me Alex Morrison's new illustrated book, "A New Way to Better Golf." When the postman delivers it I will pay $2, plus postage charges.

It is distinctly understood that, if I care to, I may return the book within 5 days. It is also understood that, if putting Mr. Morrison's instructions into practice does not—within one month—reduce my score as indicated in the schedule shown above, I have the privilege of returning the book. In either case my $2 is to be refunded at once.

Name.....

Address.....

City..... State.....

☐ Check here if you are enclosing $2 herewith, thus saving postage charges. Same refund privileges apply, of course.

# Climb down inside your Engine

# SEE *the difference Ethyl makes*

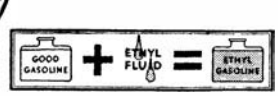
THE true story of gasoline has always been hidden behind the steel walls of your engine. Squeezed by flying pistons, trapped by clicking valves, caught in terrific heat—there's where gasoline shows its true colors.

But what happens is no longer a secret. Detroit engineers put a quartz window in the top of an engine and took high speed photographs of the actual combustion of motor fuels. Now you can SEE the difference Ethyl makes.

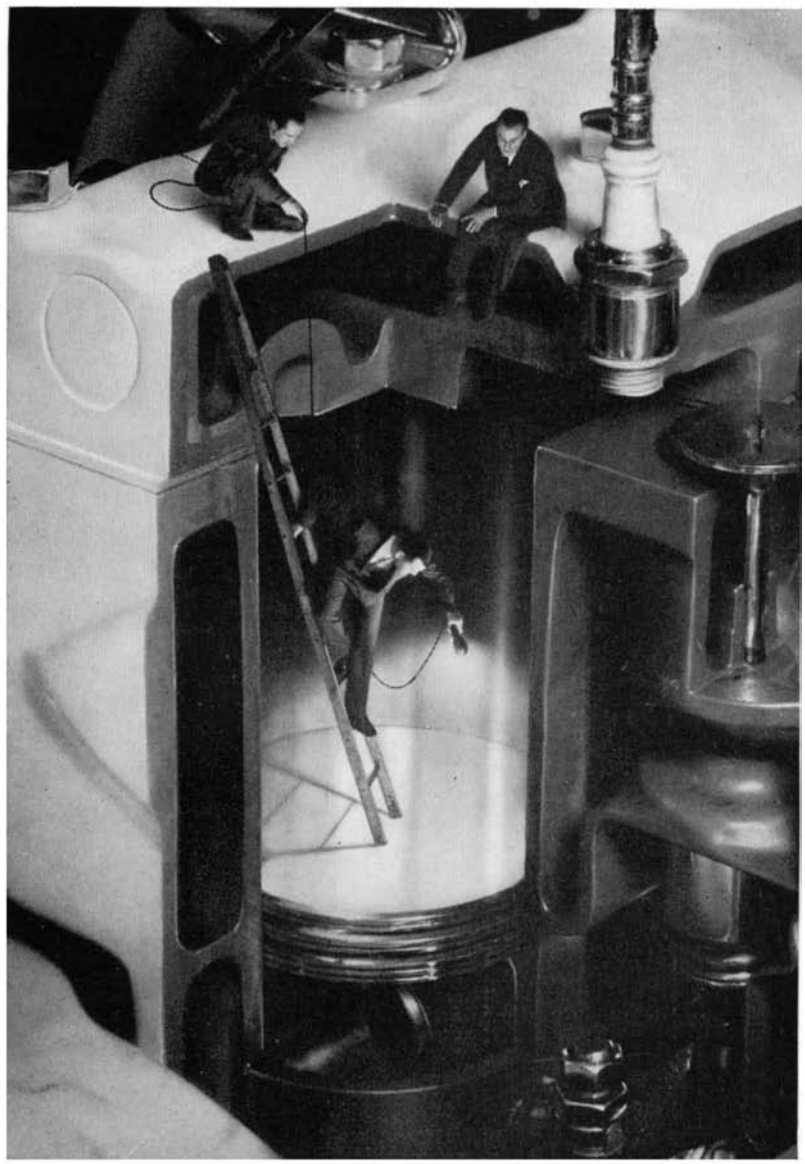
Look at the pictures below. On the left, ordinary gasoline is wasting power in a violent explosion. Its furious energy hammers against the cylinder walls, causing harmful knock, overheating, and engine wear-and-tear.

On the right, you see how Ethyl Gasoline delivers power smoothly, driving your car with an even stride—you see why it delivers *more* power and leaves *less* waste heat.

Now *feel* the difference Ethyl makes. Stop at an Ethyl pump, fill up with the new, higher standard quality Ethyl Gasoline. Notice instead of irritable power that you're almost afraid to use, Ethyl will give you the thrill of flowing, steam-pressure smoothness—plenty of power when you need it and freedom from harmful knock. Ethyl Gasoline Corporation, New York.

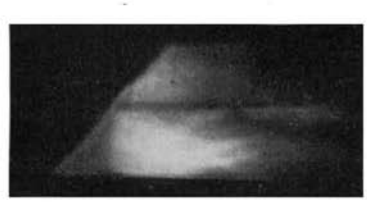




*Ethyl fluid contains lead*



**Slow-motion movies of the actual combustion**

The wasteful explosion of ordinary gasoline. The vertical line of light shows the almost instantaneous flash that signals its sudden death! See how short its life is in contrast to the picture at the right.



The smooth combustion of Ethyl Gasoline—whether your motor is idling or under strain. The Ethyl fluid in it controls combustion, makes the gasoline deliver power evenly throughout a relatively long life.



# *Buy* ETHYL GASOLINE