SCIENTIFIC AMERICAN

September
1932

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EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor

CONTENTS · SEPTEMBER · 1932

Billions of Dollars for dependable employment

LARGE sums of money have been mobilized through the open market operations and the loan and discount facilities of the Federal Reserve Banks, and by loans through the Reconstruction Finance Corporation.

Here is a great credit reserve—totalling billions of dollars—awaiting dependable employment.

Just as fast as suitable jobs can be found for this credit, confidence will be strengthened, trade will quicken, and men will be returned to work.

To help speed the effective employment of this huge army of credit dollars, committees of leading industrialists and bankers have been appointed by the Governors of the twelve Federal Reserve Banks—Boston, New York, Philadelphia, Cleveland, Richmond, Atlanta, Chicago, St. Louis, Dallas, Kansas City. Minneapolis and San Francisco.

Like the divisional staffs of a great army, these committees will work to consolidate our position, and straighten and strengthen our lines, so that a broad advance can be made.

Theirs is no simple task, but the readiness with which these industrial and banking leaders are joining together, and cooperating with national authorities, is a very encouraging factor in the present situation.

★ ★ ★

Housing Construction — An Opportunity

In previous depressions, a resumption of construction activity has been an important and vital factor in encouraging and stimulating business improvement. It assures employment of large numbers of men, not only directly, but also in the industries of supply.

There is undeniably an opportunity in many communities for construction of homes on a sound and economic basis, as well as a definite need for home repairs and improvements, and these matters will undoubtedly have early consideration.

The bringing together of worthy domestic building projects and substantial financing is typical of the many possibilities for beneficial action open to these committees in a wide range of fields.

The National Publishers' Association

"As the most nearly self-contained nation, we have within our own boundaries the elemental factors for recovery."

(From the Recommendation of the Committee on Unemployment Plans and Suggestions of the President's Organization on Unemployment Relief)

ACROSS THE EDITOR'S DESK

IF memory serves correctly, it was H. G. Wells who once said that man has constantly attempted to improve everything of importance in his life except the house which shelters him; it is, generally speaking, still made of the same sticks and stones and mud that his prehistoric ancestors used for the same purpose. But a change is coming. New construction methods are being developed. Wood frames are being replaced by steel; even walls are being made of sheet metal. Pre-cast concrete slab houses have already been built, and, to keep pace with the present industrial tempo, a hint has been heard of a *modern* house (not the "portable" wood-frame structure of the present day), built in factories and shipped "knocked down." A coming article goes into this all-important subject and tells something of what may be expected in the house of the future.

●

When the modern housewife wields her can-opener and produces a veritable banquet from the depths of metal containers, she is paying homage, perhaps unknowingly, to the genius of science. It is only by constant research, from which have grown efficient packing industries, that the vast array of present-day foodstuffs has been made available, perfectly preserved and ready for use in the home. Even with the progress that has been made, the work of the research scientist is not finished. Steadily he delves into the secrets of nature and brings to light new knowledge that leads to better canning processes. The story of this work is engagingly told in an article by E. F. Kohman, scheduled for publication in our next issue.

●

"Forgery is one of the branches of crime that each year takes a heavy toll from American business." Thus writes Elbridge Walter Stein, in an article entitled "Ultra-violet Light and Forgery," which will appear next month. As rapidly as the perverted mind of the white-collar criminal evolves new methods in his illegal business, it is up to science to perfect equally new and effective methods to forestall him. The quartz mercury vapor lamp is one of the instruments that has been impressed into the fight against crime, because of the abundance of ultra-violet light which it produces. Mr. Stein has written a lucid and accurate story of this use of ultra-violet rays. This use is of particular interest at this time because it has received the stamp of approval of at least one court, where the evidence of "black light" ended, even if only temporarily, the activities of a swindler.

●

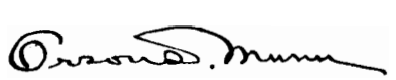
The field operations of the Oriental Institute in the Near East are constantly bringing to light new knowledge about the early inhabitants of that region. From the headquarters of the Institute itself we have obtained an extraordinary series of photographs illustrating their work, with extensive data, from which has been prepared a comprehensive article telling of the progress to date. This is scheduled for publication next month.

●

If scientists could but dip thermometers into the stars and attach pressure gages to their atmospheres, they could long ago have solved many of the secrets of astrophysics. But the barriers of space have kept mortals earthbound and only philosophy has enjoyed flights to the depths of space. There are other instruments of precision, however, that can take the place of the thermometer and pressure gage and that, if they can be read, will tell us much about the stars that has hitherto been concealed. These precision instruments are the atoms of the stars. How they are used and what they reveal is interestingly told in the article entitled "Physical Laboratories of the Stars," by Theodore Dunham, Jr., of Mount Wilson Observatory, which will appear next month.

●

Rifles have played an important part in the history of America from the earliest times to the present day. Exponents of out-door sports call rifle shooting one of the finest ways of training coordination between hand and mind. American manufacturing methods have developed the rifle to a high point of perfection and have made available to everyone rifles of high quality at low cost. A trip through a rifle factory is a fascinating experience that one of our editors has recently had. He has prepared an article on the subject, to appear next month, that will be the next best thing to the actual trip. We hope it will interest you as much as it did us.



Editor and Publisher

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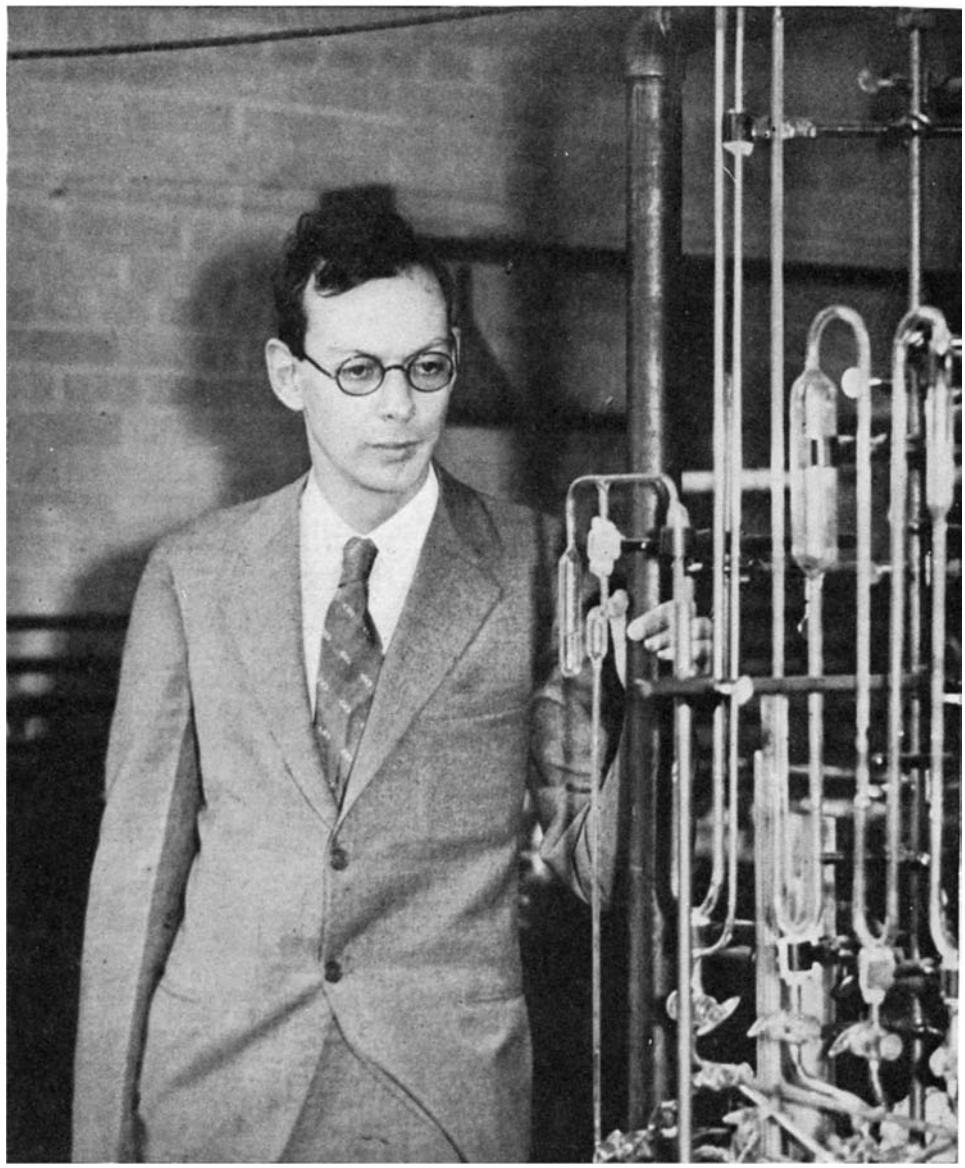
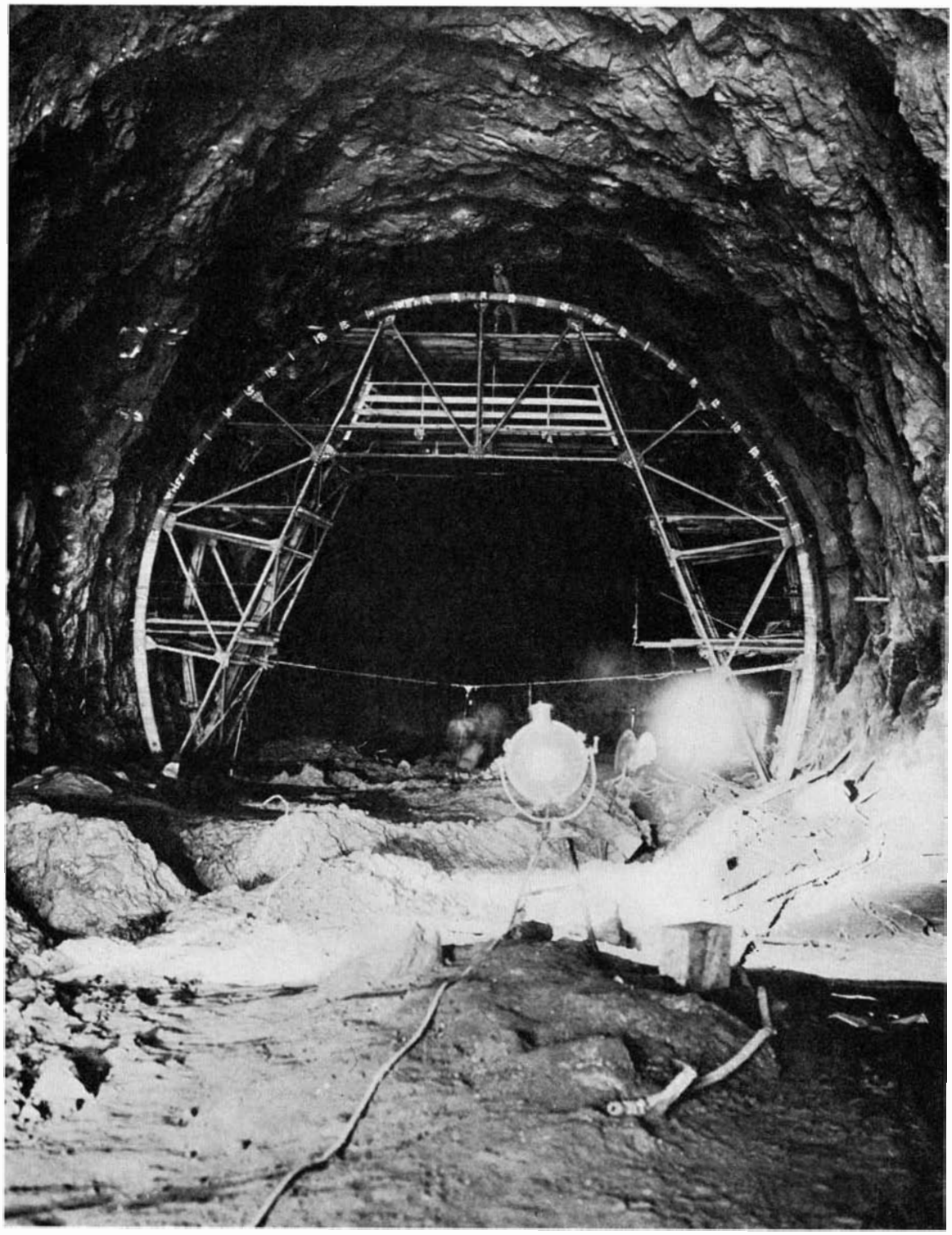


OSCAR RICE

THE 1000-dollar prize donated by Dr. A. C. Langmuir and awarded annually by the American Chemical Society in recognition of the accomplishment in North America of outstanding research in pure chemistry has this year been presented to Dr. Oscar Rice of Harvard University. This prize, unlike the majority of honors, does not reach its recipients late in life when they are already sated with glory but, by the wise terms of its donor, it is made available when the young scientist is under 31 years of age.

Dr. Rice, whose present age is 29, was born in Chicago, the son of a Viennese immigrant. When the father died, the responsibility for the education of the son rested entirely on the mother. It was pursued in Chicago and California. Later Dr. Rice conducted research in chemistry at the University of California, at the California Institute of Technology, and at the University of Leipzig.

He is immersed in the study of what might be called molecular and atomic physics and chemistry, and is fortunate in being able to use with facility and vigor the elaborate mathematical weapons now available for such problems. He is a quiet man with an engaging smile and much modesty.



SMOOTHING THE BORE OF A HOOVER DAM TUNNEL

IN constructing the four great tunnels which pass around the end points of the future Hoover Dam, trimming jumbos like the one shown were used to remove all projecting rocks from the walls and ceilings of the tunnels after the drilling jumbos had done their work. Following this operation, all tunnels are to be given a thick lining of concrete. The trimming jumbos are of comparatively light truss work and are equipped with working platforms. A man on the top platform of this one gives a size comparison of the jumbo and of the tunnel in which a comparatively large house might be built at any point with much space to spare.

Looking upstream in Black Canyon. Downstream portals of tunnels 1, 2, and 4 are visible while that of tunnel 3 is hidden by the point at left of tunnel 4. Intake works of Boulder City water supply in foreground

HOOVER DAM

Purposes, Plans, and Progress of Construction

By WALKER R. YOUNG
Construction Engineer, Boulder Canyon Project

IN THE Black Canyon of the Colorado, where the river forms the boundary between the states of Arizona and Nevada, the Government of the United States through the Department of the Interior and directly by the Bureau of Reclamation has started construction of Hoover Dam.

On September 17, 1930, constructional activities were formally inaugurated by Secretary of the Interior Ray Lyman Wilbur, and since that date, under the supervision and control of the Bureau of Reclamation, headed by Commissioner Elwood Mead, the building of the dam has progressed rapidly. Construction operations are carried out under the direction of R. F. Walter, Chief Engineer of the Bureau of Reclamation, represented in the field by the writer.

Location of the gigantic project in respect to the familiar nearby points

The site for the structure is located 270 miles downstream from the crossing of Bright Angel trail in Grand Canyon; 100 miles upstream from Needles, California; and 440 miles from the river's entrance into the Gulf of California.

At the dam site in Black Canyon, the river flows between sheer rock walls of volcanic origin which have been darkly stained by the weathering of centuries. At low water surface, elevation 645, the canyon is from 290 feet to 370 feet in width; and at elevation 1232—the crest of the proposed dam—from 850 feet to 970 feet wide.

Bed rock in the center of the river channel was disclosed by diamond drilling between elevations 525 and 535. Present plans require excavation of the dam foundation to elevation 505. Thus the dam will have a height of 527 feet from foundation to crest with towers and parapet ornamentations rising 40 feet or more above the crest. The dam, of gravity type, arched upstream on an axial radius of approximately 500 feet, will have a width up and down stream of 650 feet at the base and 45 feet at the top. The crest will be 1180 feet in length, measured along the curve.

Elevation 1232 for the crest of the dam was chosen in order to obtain a reservoir of 30,500,000 acre-feet maximum capacity. This volume will allow utilization of 5,000,000 to 8,000,000 acre-

SCATTERED through various newspapers and magazines, there have been for years discussions of some features of the gigantic 165,000,000-dollar Hoover Dam project. Little attempt has been made to give a picture of the whole. The accompanying article, however, does just that. In it, Mr. Young outlines concisely and clearly the plans for the project, its three-fold purpose, details of the work that has been done on it to date, and the program of future construction.

—The Editor.

feet of the reservoir as a silt pocket, 12,000,000 to 15,000,000 acre-feet for active and regulation storage, and 9,500,000 acre-feet for flood control.

The estimated volume of silt carried by the Colorado River through Black Canyon averages about 137,000 acre-feet annually under present conditions. As this quantity will decrease with upstream development, it is expected that the total silt deposits in the reservoir will be less than 3,000,000 acre-feet at the end of 50 years.

Part of the storage facilities of the reservoir are intended to assure a dependable supply of water for irrigation purposes to the Palo Verde Valley near Blythe, California, to the Yuma (Federal) Project near Yuma, Arizona, and to the Imperial Valley in California. The remainder of the storage may be used to furnish an assured source of water supply for the cities and towns in southern California and the development by irrigation of lands in Arizona, California, and Nevada.

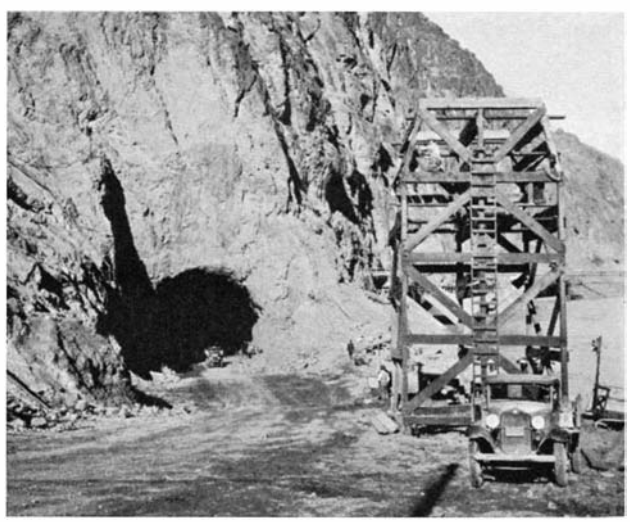
The upper 9,500,000 acre-feet of the reservoir volume will allow control of floods of the magnitude of 200,000 second-feet above the dam to 48-000 second-feet below; and a flow of 300,000 second-feet, the largest thought to have occurred in recent times, to 75,000 second-feet.

The dam and power plant have been designed to furnish 1,600,000 to 1,800,-000 horsepower of installed capacity depending upon the requirements of the contractors that purchase the power. It is expected that the continuous firm power output upon completion of the dam will be approximately 663,000 horsepower. This will make available four and a third billion kilowatt hours annually upon completion of the dam which it is estimated will decrease during the first 50 years by eight and three quarters million kilowatt hours per year as a result of upstream irrigation development which consumes part of the water. According to present plans, the turbines will operate initially under a maximum head of 582 feet, a minimum head of 422 feet, and an average head of 520 feet. On this basis, a continuous flow of 17,000 second-feet of water will be required, which is approximately equivalent to a yearly flow of 12,000,000 acre-feet.

THE principal features of the dam are as shown in the comprehensive simplified plan at the bottom of the opposite page.

According to the present construction program, the first procedure in the building of the dam will be to drive the four diversion tunnels, each 56 feet in diameter; to excavate the two spillways, each of which will have approximate dimensions of 650 feet in length, 150 feet in width, and 100 feet in depth; and to drive the 56-foot diameter inclined tunnels from the spillways to the outer diversion tunnels. All of these 56-foot bores will be lined with concrete having an average thickness of 36 inches.

The next step will be to begin construction of the intake towers and canyon wall outlet works. The upper and lower cofferdams will then be built, diverting the river through the diversion tunnels.



Outlet portal of the Nevada inner tunnel. Scaling rig for removing loose rock from the tunnel roof is at right

While the river is flowing through the tunnels, excavation for the dam and power plant will be completed, concreting of the dam will be started, and the wings of the power plant will be built. The 55-foot diameter tunnels from all intake towers will be excavated, a 30-inch lining of concrete placed and four 17½-foot steel pipes erected within the tunnels. The spillways will be lined with concrete; construction of the canyon wall outlet works will be started; the tunnels of 27-foot average diameter, connecting the tunnels from the intake towers to the power plant, will be excavated; a concrete lining placed; and 17½-foot diameter steel pipes erected.

Water will then be diverted through the outer tunnels while the upstream tunnel plugs are poured in the inner tunnels, the four gates installed in each plug, and the trash-racks at the inlet portals are completed.

Following this construction, the steel bulkheads, which have been erected above the inlet portals of the outer diversion tunnels, will be dropped, diverting the river through the trash-racks and the slide gates of the inner diversion tunnels. Concrete plugs approximately 300 feet long and keyed into the walls of the tunnel will be constructed in the outer bores immediately upstream from the spillway tunnel entrances. The intake towers will be finished, and water, controlled by the gates in the inner tunnel plugs, will start rising in the reservoir.

The downstream cofferdam will be removed and the river channel cleared to the original stream bed. When the water surface back of the dam rises to the cylindrical gates in the intake towers, the slide gates in the inner diversion tunnel plugs will be closed; the Stoney gates, previously erected at the outlet portals of these tunnels, will be dropped; and water will be diverted through the downstream intake towers and the canyon wall outlet works. The power plant can be placed in operation at this time as some of the electrical equipment will have been installed and connections made between the plant and the intake tunnels.

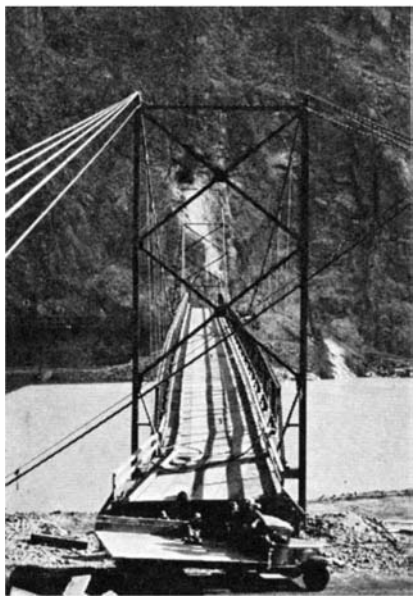
STEEL pipes will then be placed in the inner diversion tunnels leading from the upstream intake tower tunnels downstream to the plugs in the diversion tunnels. Each of these plugs will be equipped with six 72-inch needle valves. Connections will be made between the steel pipes and the power plant.

The last work will be to complete the concreting of the main dam, to build the parapets and architectural features along its crest, install elevators, stairways, and other features in the dam, erect the connecting structure between the wings of the power plant, and complete the installation of machinery in the plant.

Under normal operating conditions all water will flow past the dam through the intake towers, the turbines of the power plant, and the outlet valves of the downstream plug in the inner diversion tunnels, or through the canyon wall outlet works. In case of floods, the excess flow will be taken by the spillways, this flow being controlled by the drum gates installed on the spillway crests.

To build the dam and the power plant within the period estimated for its completion and within the appropriations authorized for the construction, it was necessary to provide electrical power in large quantities for construction purposes, make provisions for transportation by rail of the immense amounts of materials required for the project features, and to build connecting highways of a type consistent with heavy and rapid transportation of men and supplies.

A transmission line, now operating at 88,000 volts, was constructed a distance of 222 miles from San Bernardino, California, by the Southern Sierras and Nevada-California Power Companies to a substation on the rim of Black Canyon above the dam site. The Union Pacific Railroad Company built a standard gage railroad 22.7 miles in length to Boulder City from a point on the main line 7.1 miles south of Las Vegas, Nevada, and at Boulder City constructed a 300-car interchange yard. The United States, by contract, constructed a standard gage line 10.2 miles in length from a connection with the Union Pacific at Boulder City to a point on the rim of the Black Canyon above the dam site. The State of Nevada, assisted by Federal Aid funds, built 23 miles of 22-foot oil surfaced highway from Las Vegas to Boulder City, and the Government, by contract, continued the road to the rim of Black Canyon.



One of two suspension bridges for trucking during construction work

A LOCATION for a construction camp was chosen and the town site of Boulder City was laid out. A water supply was provided for the town, bringing the water nearly seven miles from the Colorado River by four pumping lifts through 10-inch and 12-inch pipes to a 2,000,000-gallon storage tank on the hill above the town. The river water, containing an average of 6000 parts per million of silt and 400 of hardness in terms of calcium carbonate, was required to be desilted, softened, and purified before it was turned into the mains of Boulder City.

On March 4, 1930, bids were opened for construction of Hoover Dam, power plant, and appurtenant works, and contract was awarded to Six Companies, Inc., of San Francisco, the low bidder.

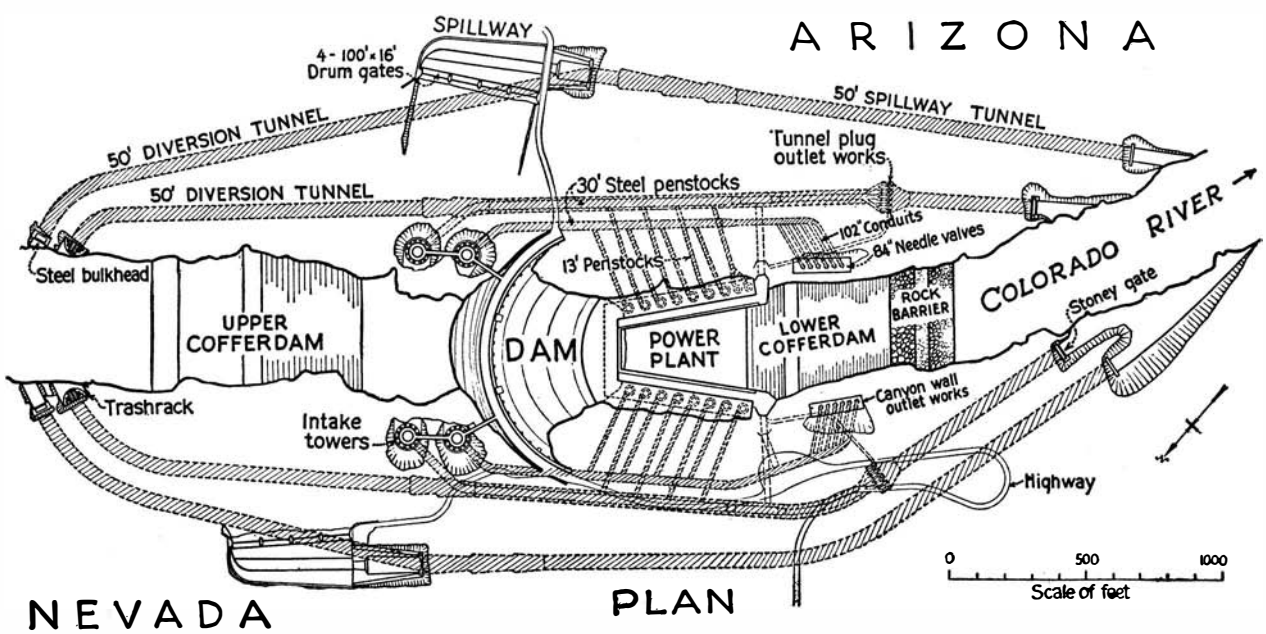
Under the direction of General Superintendent F. T. Crowe, work was started on March 11, laying out a camp and building a road into Black Canyon. In May, adits 10 feet by 12 feet in section were started from canyon walls at the dam site to intersect the locations of diversion tunnels at the top of their proposed sections. Upon intersection with the tunnels, pioneer bores 12 feet by 12 feet in section were driven as top headings in both directions from the adits. The principal purpose for driving these pilot bores was to provide ventilation for tunneling operations for the full size section and to ascertain the structural characteristics of the rock formation. Standard tunneling operations were used in these pilot tunnels, employing, for the greater part of the work, mucking machines and electric locomotives.

While these pilot tunnels were being driven, the inlet and outlet portals of the diversion tunnels were being cleared preparatory to excavating the entire tunnel section from the roof down to a bench 15 feet above the invert. In most instances these 41-foot by 56-foot tunnels were preceded by the driving of the 12-foot by 12-foot top headings, but in some tunnels enlarged headings were started directly from the portals.

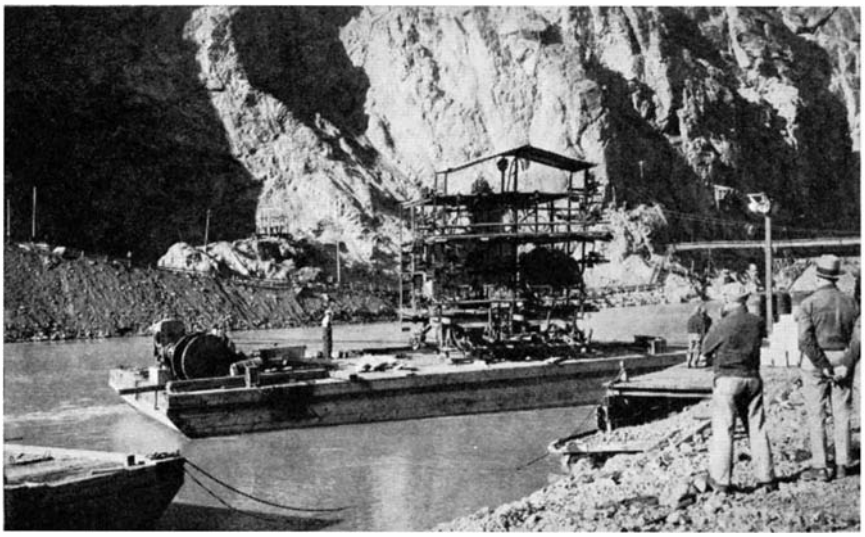
A special "drilling jumbo" was designed and built by the contractor for the consummation of this work. As shown in an accompanying illustration, air drills were installed on horizontal steel bars fastened to a steel frame work, the whole mounted on a 10-ton truck.

THE procedure in tunneling operations, assuming the 12-foot by 12-foot pioneer tunnel had been excavated in advance of the enlarged headings, was first to blast the wing sections on both sides of the pioneer tunnel outward to the 56-foot tunnel line and ahead of the 41-foot by 56-foot section about 25 feet. This procedure allowed better breaking when the enlarged heading was blasted.

After this top bench had progressed its allotted minimum distance and the muck was removed from the face of the tunnel, the 56-foot section was outlined in white paint as directed by Government surveyors. The drilling jumbo was then backed into position at one side of the tunnel, jacked and blocked securely in place; water and air lines were connected; and drilling was started. Under ordinary conditions 48 holes were drilled at each setup of the jumbo, to depths as great as 20 feet, in less than two hours. The jumbo was then moved to the opposite side of the tunnel and drilling resumed in a similar manner. Holes were loaded from the jumbo while drilling was in progress, allowing one completed line



Hoover Dam and appurtenant works. Two cofferdams will protect dam work while river is diverted through tunnels



The drilling jumbo used for drilling the 41-foot by 56-foot headings, as described in article, being transferred across the river by cable-controlled barge

of holes to remain between the drilling and loading operations.

While these operations were in progress, the top heading crew had drilled and loaded the wing sections on both sides of the pioneer tunnel and had placed a load of about 30 sticks of dynamite on the floor of the pioneer.

Men and equipment were removed from the tunnel, and wires were connected to delay fuses and the headings shot in 15 delays. The first blast broke down the wings. The others followed in order from top and center downward and outward, the last delay removing the lower corner and setting off the charge laid on the floor of the pioneer tunnel to clear it. Less than 2000 pounds of 40 percent explosive were used for each blast of the large face and the wing sections. Each charge broke to a depth of approximately 16 feet, moving 1000 yards.

THE smoke and powder fumes were cleared from the tunnel by blowers and fans.

As soon as the tunnel face was clear, a 30-horsepower Caterpillar tractor, equipped with a "bulldozer," a blade installed on the front of the tractor and capable of being raised or lowered by the operator, emerged from the pioneer tunnel and pushed all muck off the upper bench on to the floor below. A 60-horsepower Caterpillar cleared the tunnel floor for the electrical shovel which moved up to the heading, trucks followed it in, and removal of the muck was started.

All rock hauled from tunnels was required to be dumped above the river high water surface and at a location where it would not be washed into the river. This necessitated hauling the rock into side canyons and required considerable ingenuity on the part of the contractor to locate approved dumping grounds and build roads to them.

Excavation of the 41-foot by 56-foot tunnels was started on October 3, 1931, and on April 2, 1932, headings of this section had been holed through in all four tunnels. During January, bores of this enlarged section were being driven from eight headings. Nearly 1700 lineal feet of tunnel were excavated during the week ending January 23, moving in this period approximately 116,000 cubic yards of rock.

After the 41-foot by 56-foot tunnels had been driven, "trimming jumbos" were placed in operation to remove all rock projecting from walls and roof within the required tunnel section. This type of jumbo consisted essentially of two steel trusses, each shaped to the periphery of approximately a 35-foot rise of a 50-foot diameter circle which were placed about nine feet apart. The trusses were connected to the steel frame work and supported timber working platforms. The jumbo was mounted on car wheels and ran on parallel rails placed accurately to line and grade.

THE lower 15 feet in the invert section of the tunnel was removed in a similar manner to that in the section above it. The drilling jumbos used in the enlarged tunnels were remodeled for drilling this lower section by removing the upper deck and adding an extension to each side so that the entire face of the heading could be drilled from one set-up. Twenty-five holes were drilled for the round and approximately 750 pounds of 40 percent explosive were shot at each blast, advancing the heading 16 feet and breaking approximately 320 cubic yards of rock. The sequence of operation for removal of the invert was similar to excavation of the 41-foot by 56-foot section of the tunnel.

On May 23, 1932, removal of the invert sections was completed, on which date practically the only excavation remaining in diversion tunnels was the haulage ramps at the outlet portals. Thus in a year's time more than three miles of 56-foot diameter tunnels had been driven, removing approximately one and one half million cubic yards of rock.

Excavation for spillways on both sides of the river and for the intake towers on the Nevada side are under way at the present time. During January, 1932, 7-foot by 14-foot pioneer bores were started in the inclined tunnels to spillways, from the roofs of the outer diversion tunnels, and on May 1 had progressed a lineal distance of nearly 500 feet. The inclined spillway tunnels will be 56 feet in diameter when excavated and will be lined with concrete averaging 36 inches in thickness.

Pioneer tunnels as pilot bores 7 feet by 14 feet in section are also being driven from the roofs of the inner diversion tunnels toward the bases of the upstream intake towers.

(To be concluded)

Difficult road construction work in a cliffside: Looking upstream along Black Canyon highway, with retaining wall and lookout point beyond point of rocks

OUR POINT OF VIEW

Dr. George K. Burgess
Dr. George F. Kunz

TO us, the deaths of these two internationally known figures, one noted in the field of pure science and the other noted in a specialized branch of science, proved a double shock. Both had long been close, sympathetic, and helpful friends of SCIENTIFIC AMERICAN, and both had been the source of much of our inspiration. Both died early in July of cerebral hemorrhage, Dr. Burgess at the age of 58, and Dr. Kunz at the age of 76.

Dr. Burgess had been the Director of the Bureau of Standards since 1923, and with the founder of the Bureau, Dr. Stratton, had largely shaped the fine growth of that important institution. He was a metallurgist of the first rank and it is said that if he had chosen to commercialize his findings in that field, he would have amassed a great fortune. Instead, however, his services, through his valuable scientific work with the institution before he was appointed Director and through his able guidance of it thereafter, saved for American industry many millions of dollars. Dr. Burgess was born in Newton, Massachusetts, was graduated from Massachusetts Institute of Technology in 1896 and from the University of Paris in 1901, taught in universities for two years, and then came to the Bureau with which he remained until his death.

Dr. Kunz, for more than half a century recognized as the greatest of American experts on gems, was a mineralogist, and had been, since the age of 23, vice president of Tiffany and Company. During his active life, he figured prominently in the professional and civic life of New York. He was a special agent of the United States Geological Survey from 1883 to 1909, was in charge of the department of mines at the Paris Exposition of 1889 and of the Kimberley Exposition in 1892, and held many similarly important positions. A rare honor was conferred on him when transparent spodumene, a mineral which he discovered, was named kunzite. He also discovered many other gems, including one of the rarest in existence, the milky-blue-white diamond which he named tiffanyite after his firm. Dr. Kunz was born in New York, educated in the public schools and Cooper Union, and received degrees from Columbia University, the University of Marburg, and Knox College.

Are There White Indians?

FROM time to time travelers and explorers coming out of South America report having heard of white Indians living in some inaccessible jungle of that southern continent. These reports get into newspapers because the person making them is usually accredited or otherwise seems above suspicion. But because the newspapers do not emphasize that the evidence they give is based upon hearsay, a large part of the general public has gained the impression that white Indians are a fact.

The Museum of Comparative Zoology of Harvard University recently labeled this white Indian talk as a hoax. To hear such a legend is said to be one of the commonplaces of travel in South America. Since it was first heard years ago, many scientists have endeavored to trace it to its source, to find some truth in it, but so far it has remained a mystery—but an intriguing mystery nevertheless, and therefore one to command the attention of explorers as well as newspaper readers. Whether or not it is actually a hoax—as it seems to be—we are not in a position to state, but in any case, our advice is to take such reports with something more than a grain of salt.

Back to Earth

THE idea that, in years to come, the period of adversity through which we are now passing will be considered as marking America's coming of age, has been expressed by several thoughtful people. As at no time in the past, the average man is concerning himself with the complex economic, social, philosophical, and psychological principles of the American system. This introspection is rapidly bringing us back to earth; our old pioneer courage is returning; and we are beginning to consider something more than personal gain as the ultimate end of all things.

One of the most far-reaching and, for the future of the country, a most promising result of the country-wide effort at readjustment is the happily revived back-to-the-land movement. Thousands of families from the cities have recently gone in for farming, not for profits but in order to have food and shelter. It has been shown that whole families can raise sufficient food for themselves on relatively small farms. Other thousands, originally from farms, have returned to them for the same fundamental reason: food and shelter. In a third class are those, often born and bred in the city, who have sufficient money for a small down payment on a farm. At a recent meeting of the National Land Use Planning Committee, it was reported that in one Ohio county "one out of every three farms that were visited was occupied within the past two years by persons formerly employed in cities." The Government is helping these people—all farmers, in fact—by lending them, through the Reconstruction Finance Corporation, many thousands of dollars for the purchase of seeds. In Idaho alone, for example, such loans already total 796,500 dollars.

Native thrift and ingenuity are in the saddle, the investigators reported also. One plowing outfit seen consisted of an old touring car minus tires, with sticks tied to the wheels to provide traction, pulling an aged plow.

There is no longer any question that the farmer withstands hard times better than the city man. He may lack cash for equipment, for fertilizer, for many things needed to keep a farm running, but he has in the soil and in his own labor the first essentials for living. To these two—the products of nature, both organic and inorganic, plus labor—is man indebted for his sustenance and even his wealth. The city man can supply the labor but he has not the earth from which to extract his living; and when he can not obtain employment in the city, he is simply up against an insurmountable obstacle.

Construction Wages

WHILE relief legislation looking toward increased employment through public construction is being considered by Congress, there are some who contest such plans with the argument that little of the construction dollar goes for wages. It is well to remind these people that practically every cent of the cost of any construction work goes into wages. Roughly 50 percent of the total goes directly to the worker on the job. The remainder goes for the purchase of materials, and since these never have any intrinsic value in the mine, in the forest, or on the farm, their cost is reckoned solely on labor and capital investment. The laborer and the white collar man thus get full return for their efforts, and no part of the cost of a project vanishes into thin air.

FLYING IN THE BEGINNING

By HUGH D. WISE
Colonel, Retired, United States Army

Colonel (then Lieutenant) Hugh D. Wise in 1896 at the time of the experiments described in this article

Foreword

By GENERAL WILLIAM MITCHELL
Former Assistant Chief of the Army Air Corps

THE Wise family of Virginia has from the beginning of our history been pioneers and originators in our civic, economic, and military development. Colonel Hugh D. Wise was outstanding in his conception of the application of aerial devices. He always had in the back of his head the idea that if a person could go over the hostile army and reach a vital point through the air, victory would be assured. In furtherance of this he began experimenting with kites in 1896. He developed these at first so they would lift a wire over the rivers bordering New York City. Over this wire a telephone could be operated. Next he lifted cameras so they could take photographs from on high of a position presumably occupied by an enemy, which would give decisive information to our own forces. Next, he developed man-lifting kites and actually went up himself, a pioneering accomplishment. Then he found that when the cord to the ground was no longer operating, he could glide against the wind from a higher to a lower place. This was the beginning of flight in our country as we know it today. All he needed was a motor to carry him on. Later, Professor Langley and the Wrights developed their motor-driven aircraft, which really were motor-driven gliders.

Hugh Wise has been so modest that the people of America little know what he did to develop the most decisive influence in present day military and economic development—the heavier-than-air flying machine, which we know as the airplane. Had Hugh Wise not been called to the Spanish War and the Philippine Insurrection from his experiments and diligent work to develop aerial locomotion, he might have gone down in history as the developer of the flying machine.

I have known Hugh Wise for many years. When I first saw him in the Philippines, he was the aide-de-camp of General Joseph Wheeler, one of the greatest cavalry commanders that the world has ever seen. Most of our expeditions into the Philippines were started at night. The dogs of the villagers, by barking, always gave the alarm. If we fired rifles at them to kill them, this only accentuated the trouble. But Hugh Wise had developed a corps of bow and arrow men who were so expert that they would hit the dogs at practically every shot. They made no noise, the dogs stopped their barking, and the expedition moved on.

When confronted with the problem of lifting antennae for radio high in the air during the beginning of our radio art in 1903, I used Hugh Wise's kites to lift my receiving apparatus miles above the earth and took messages from the longest distances that had then been received. This result was not due to us, but to Wise.

Hugh Wise has always been modest and conservative about what he has said concerning his accomplishments, but no one has done more to advance the art and science of aerial navigation than he has. The narrative which follows tells only a part, and a very small part, of what he has done. All of us who have followed in his footsteps appreciate not only the deep thought he put into his work but the initiative and the will-to-do, which entailed the exposure to danger of his own personal being, and the ability to rise above criticism and carping that is always present when an entirely new experiment is tried.

All of us "old-timers" take our hats off to Hugh D. Wise for his pioneering experiments that not only showed us the way to the development of flying but indicated to us how original thought could be applied to the development of the greatest military power the world has ever seen—military aeronautics.

WHAT little I may have contributed to the development of flying machines came from no initial attempt in that direction but as a result of efforts to utilize the kite as a means of support for signal apparatus. The idea of using the kite in our army, for that purpose, though usually accredited to me, was, in fact, not mine. Unquestionably it had its inception with Captain James Allen, Chief Signal Officer at Governors Island in 1896 and, later, Chief Signal Officer of the Army.

One day Captain Allen showed me in an engineering magazine an article by Lawrence Hargrave, an engineer in New South Wales, in which article Hargrave described a kite he had developed and with which he was experimenting. "It seems to me," said Captain Allen, "that we might use this kite in our Signal Corps," and he urged me to take up the subject. Though not in the Signal Corps, I was interested in the novelty of this investigation which promised amusement and excitement.

In those days, money was not easy to get from the government, especially for what might appear to conservatives as a "wild-cat" notion, but Captain Allen was able to get hold of a small sum with which to help me, so I started.

THERE was little information to be had about kites because, until then, they were regarded simply as playthings. The Chinese had developed them farthest but not along scientific lines; the legends of Icarus and Darius Green were not helpful; no accurate data were available as to the experiments of Leonardo da Vinci who seems to have tackled the problem in his usual scientific way.

At the time, Lilienthal, in Berlin, was experimenting with gliders but he was still at the very beginning and Langley had then had no success. Therefore, beyond this kite of Hargrave's, we had nothing with which to commence, and so it became our starting point.

The Hargrave kite is, I believe, the father of the modern cellular kite as also it was the first step toward the development of the glider and the airplane. It may therefore be deserving of some brief description.

Roughly, it consists of two rectangular parallelopipeds connected by a trussed central spine. There are four surfaces upon which the pressure of the wind acts as a lifting force and there are four others, vertical to these, along which the flow of the wind tends to hold the kite headed into it and, at the same time, keeps the kite on an even keel.

The point of attachment of the flying-cord, on the central spine, close to the forward cell, becomes the pivotal point for motions of the kite. The greater effect of gravity being aft of this point,

the rear cell is pulled down lower than the forward cell, thus presenting the lifting surfaces to the wind. The proper angle at which the kite stands is regulated by the placing of the flying-knot, and the balance so obtained between gravity and wind pressure will then be automatically maintained.

If for any reason one side of the kite receives more pressure than the other side, it will be forced back but then the vertical, or side, surfaces are rotated about the central spine into position more normal to the wind, thus increasing the pressure upon them and so equalizing pressure on the sides of the kite.

IT is to be observed that the useful component of the force which manifests itself by pull on the cord is the vertical "lift." Hence it is the experimenter's purpose to adjust the angle of incidence to the wind and the balance of the kite so as to obtain maximum lift with steadiness of flight.

I omit here, as I shall throughout this article, discussion of many forces, such as wind-friction, which, though of great importance for the experimenter to understand, are probably not essential in this story.

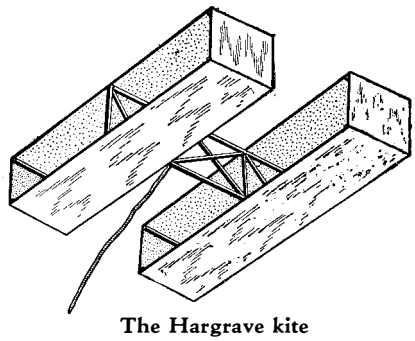
Having obtained two excellent soldier assistants, one a rigger and the other a carpenter, our work began with the construction of a small Hargrave kite, about five feet of beam with about 35 square feet of lifting surface. Then, to the entertainment of the children of the post and the amusement of officers and soldiers, we daily flew kites on the parade ground. At this time, I think I was generally regarded as a candidate for the Army Insane Asylum and, certainly, had I been playing marbles in the street with my assistants we should have received no more pitying glances from passers-by.

Our first kite was followed by others, modified in proportions and structure as we progressed in the understanding of their action.

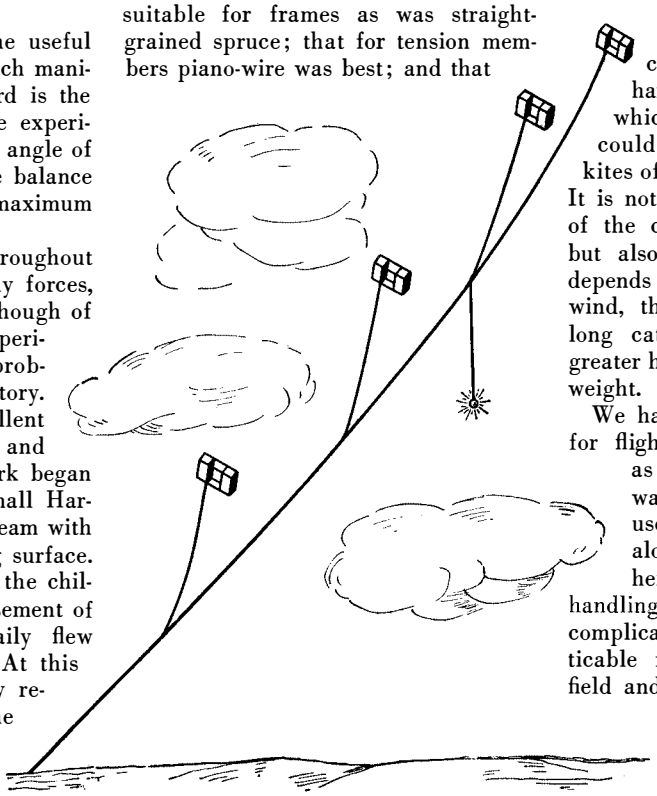
In the beginning I realized that our experiments were not a simple case of "cut and try" and that the action of a kite was in fact a determinable problem which could be accurately calculated mathematically. The data for the study of wind pressure on an inclined and moving surface were, however, at that time, exceedingly scarce, though Smeaton's "Tables of Wind Pressure," Duchemin's studies of the same subject, and Langley's "Aerodynamics" served as a basis for my own experiments and kept me busy while my assistants produced apparatus and kites.

Meantime, thorough tests of materials were made and from these we learned that no other material was so suitable for frames as was straight-grained spruce; that for tension members piano-wire was best; and that the covering could be nainsook, muslin, or heavy unbleached cotton, according to size of kite, closeness of weave being unimportant.

The flying-cord was a difficult as well as an important problem. Even the best of cotton cord, because of stretching and consequent weakening, was unsatisfactory, and the same fault was found with most other cords. We finally settled upon a hard-laid and sized blocking cord which is used by hatters. This could be had in weights suitable for kites of sizes from small to very large. It is not only the strength and weight of the cord that must be considered but also its diameter, for upon that depends the surface presented to the wind, the pressure of which on the long catenary of the line is a far greater handicap to the kites than is the weight.



The Hargrave kite



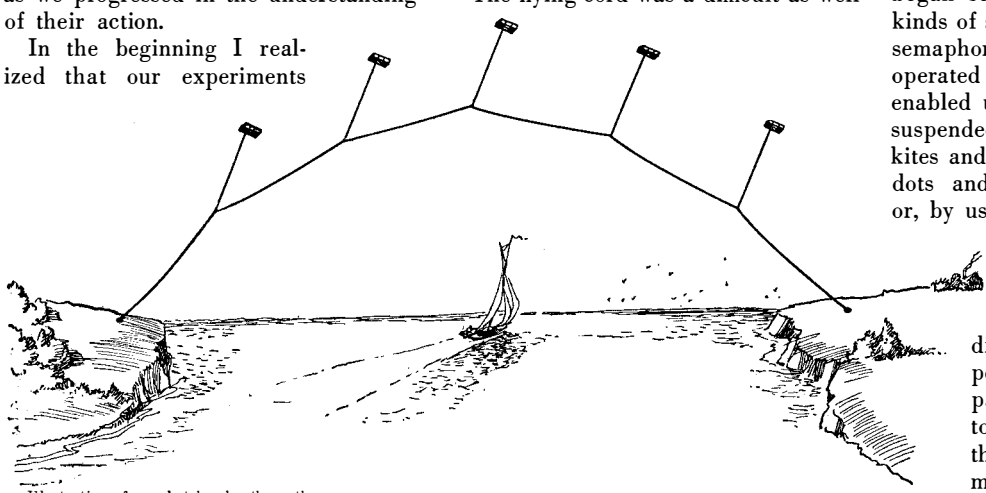
". . . flash the dots and dashes of telegraph codes . . ."

We had learned that the ideal cord for flights to great altitude, as well as for withstanding heavy strain, was steel piano-wire. Later, we used this when we were sending aloft the meteorograph to great heights but the difficulty of handling wire and the necessity of a complicated reel rendered it impracticable for Signal Corps use in the field and that was the purpose of our investigations. We therefore stuck to cord and to our comparatively simple wooden drum reel.

Having settled upon a type of kite, our modification of the Hargrave, we built a number of them of from four to six feet beam, from 20 to 50 square feet of lifting surface, and began sending aloft on them various kinds of signal apparatus such as flags, semaphores, lanterns, and flares which, operated from the ground by cords, enabled us to send messages. We next suspended electric bulbs from the kites and with these we could flash the dots and dashes of telegraph codes or, by using different colors, could use the Navy Ardoise system.

We had soon learned, however, that because of the swinging, darting and diving of a single kite, suspension from it of signal apparatus was quite unsatisfactory, so we had come to using the "tandem" in which two or more kites carried the load

(*Please turn to page* 186)



Illustrations from sketches by the author

". . . communication was opened while ships passed beneath the cable . . ."

The PEREGRINATIONS of a FREIGHT CAR

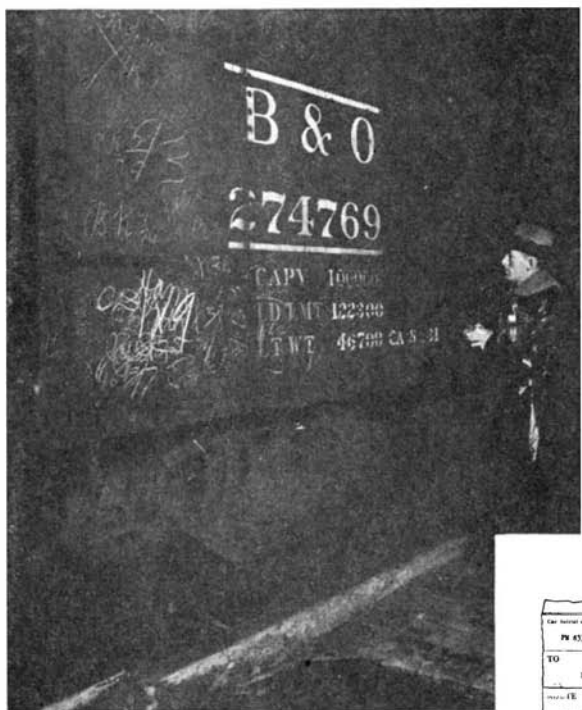
By FRANCIS X. MILHOLLAND*

WHO has not, as a boy, watched with fascination the long strings of freight cars on a railroad and the initials of their various owners, without wondering where each was destined, what the initials meant, and what the tightly closed box cars contained? And the next thought to pop into mind is; how can a railroad keep track of all of its cars, much less be able to account for every pound of freight moved in them? These and similar questions not only occur to the child, but adults, too, ponder occasionally upon their significance in these days of modern facility of transportation and highly developed competition.

One cannot watch the bustle around a freight yard, see the train-men signaling to the engineers to proceed or back as they shunt the cars back and forth through the maze of tracks, without beginning to grasp something of the significance of all the pushing and shoving. They are simply placing the cars ready for transport, although at a casual glance, it looks as if it were some kind of game played by giants.

AS soon as a freight car starts on its peregrinations, agents and agencies of the road begin to make records of its travels, so as to render proper charges for shipments. While the actual operation of a freight car in transit is important, equally so is the accuracy of the detailed records of its movement. Upon these records depends the main source of a railroad's life—the revenues which, through the treasury of the company, buy the cars, the motive power that hauls them, and quantities of supplies. Most important of all, these revenues provide the payrolls for the men who maintain the tracks, men who make records, men who watch over the freight in transit and protect it from robbery, men who are in the signal towers, men who truck the platform freight and those who work in the shops to repair locomotives and cars when a wheel has gone flat or some part broken, and other men and many women who form the big "railroad family."

Before freight is loaded, the transportation department has seen to it that the proper type of car is available and that it is in good physical condition. The car is examined as to its roof and sides, and to make sure that the doors fit snugly when closed, so that the contents will not be damaged by dampness or wet weather while on the road.



This man in a railroad yard is recording the number and coded classification and destination of a car, as it is to be transferred to another line and the owning line will receive compensation. The code is printed in book form

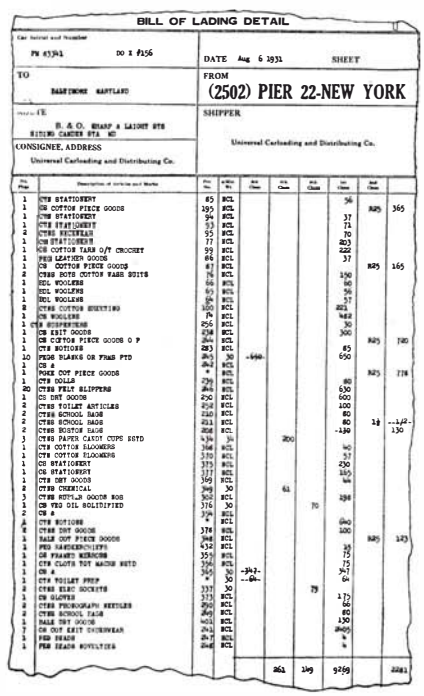
The car is then placed alongside the loading platform of the freight shed, is cleaned and made ready for its consignment of goods. After being weighed, freight is loaded into the car, particular care being taken to pack it so that it will not be tossed around in the car and that the available space is used as far as possible. The car is then closed and sealed.

For example, B. & O. box car No. 274769 is being loaded, say at Willimantic, Connecticut, with less than carload shipments. In this car there are a number of consignments for destinations west of Chicago; therefore the car is billed to Chicago where bulk will be broken.

The merchandise has been brought to the freight station by drays or trucks, each consignment being accompanied by an order from the shipper, and on this order should be given complete information as to the name of the consignee, destination, description of the shipment and whether the shipper wants to specify the railroads over which his shipment will move. At the freight station the orders are taken up and a receipt is given to the drayman for the shipper.

The shipping orders are sent to the freight office for making up the waybills, which show the name of consignee, destination, full routing, and so on. Should the shipper fail to specify the roads over which his shipment is to move after leaving the original line, the originating railroad will accept and forward to destination, in accordance with tariffs in effect at the time. The waybills accompany the shipments to their respective destinations.

The car is next pulled out from the loading-platform track and forms one unit of the freight train. At strategic


BILL OF LADING DETAIL

DATE Aug 6 1931 SHEET

FROM (2502) PIER 22-NEW YORK

SHIPPER Universal Carloading and Distributing Co.

TO BALTIMORE MARYLAND

CONSIGNEE, ADDRESS Universal Carloading and Distributing Co.

The bills of lading are all tabulated here, showing contents of a car

*Assistant to the Senior Vice-President, Baltimore and Ohio Railroad

points, "classification yards" help to simplify the making up of through trains in order to route them economically.

This car, unless something happens to it and it is set out for repairs, will continue in a solid freight train to Chicago. Should this car be unfortunate in developing a hot box, broken coupler, or other "ailment," it would be placed on the repair track, where it would be put in good condition again and sent forward by the next available fast train.

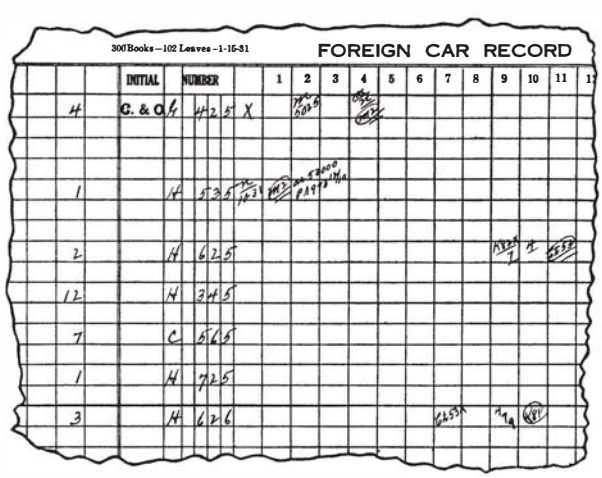
The train finds itself on its way to Chicago, passing over several operating divisions, and there are as many operating train crews as there are divisions. The waybills pertaining to our car are passed along from conductor to conductor, usually through the medium of the yardmaster at each divisional or terminal point.

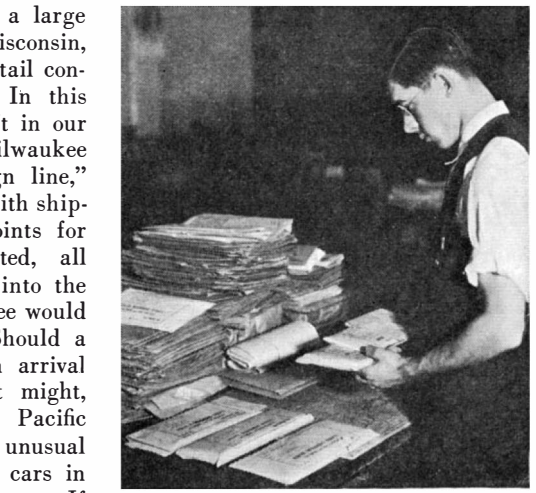
Slips cut from "wheel" reports are being classified according to roads; a step in accounting

When the train pulls into a receiving yard at Chicago, the road engine is taken off and a switch engine takes it place. Then the train is split up, the switch engine "drilling" out the cars, shoving those for the freight house on one track, those for track delivery on another, and those for industrial or private sidings on another. Through this process our car is spotted on the freight house delivery track. It is put in its proper place as soon as possible after arrival, generally by 7 A. M. The waybills are turned over to the agent, who prepares the notices of arrival, expense bills, and delivery receipts. Notices are sent the consignees who sign the delivery slips when they or their representatives send for their freight.

IN unloading our car, the freight for delivery in Chicago is taken out first and then the freight for other points is either transferred to another car or moved by drays to the connecting line serving as a medium through which the shipment is moving towards its destination. It might be, however, that there would be a large consignment for Milwaukee, Wisconsin, the transfer of which might entail considerable expense and time. In this event the freight would be left in our car which would go on to Milwaukee over another road, or "foreign line," filled up by the freight agent with shipments received from other points for Milwaukee. If room permitted, all freight that could be packed into the car for points beyond Milwaukee would also be stowed in this car. Should a similar condition prevail upon arrival of the car at Milwaukee, it might, eventually, be found on the Pacific Coast, for it is not unusual to see eastern road cars in all parts of the country. If the car was loaded with all Chicago consignments, it would have been emptied there and put in shape for re-loading.

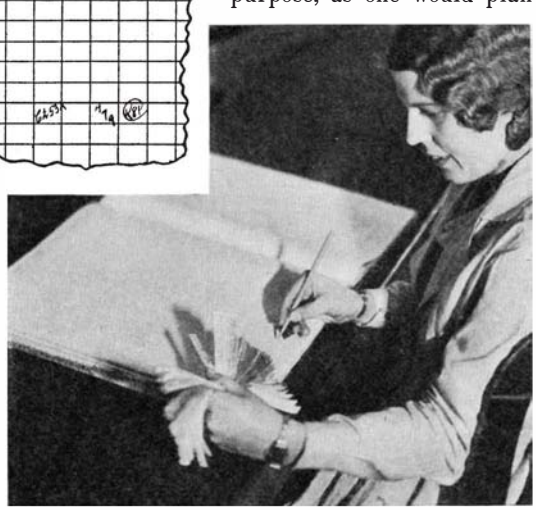
When our car arrived in the classification yard and was switched to the train for Chicago, the yard clerk proceeded to take a record of its number, initials and light weight, (the weight of the car itself without load). Upon his return to the yard office, he matched his record against the waybill. He then prepared his so-called "wheel" report. One of the principal reports kept by the car service department is this wheel report. This cryptic appellation for a railroad car record is very applicable since it implies the basic idea of movement. A wheel report is nothing more or less than a "consist" on which is the record of all cars handled in the various trains operated over the system, showing car initials and numbers, contents, if any, points of origin whence they were moved, final destination and weight gross, tare, and net, in tons. Wheel reports are filed by the conductor at the end of each run, together with his time slip, in the yard offices, from which they go to the division accountant. Other copies are forwarded by the first passenger train to the superintendent of the car service department.





Reports and waybills for freight auditor come by train and are sorted

The first clearing-house for the records, where the location of any car, on the line and off the line of road, belonging to the company or hired from another company, can be ascertained at any time, is the car service department. With the records of cars moving over all lines of the railroad, thousands of miles apart, or on sidings waiting for loading, the department serves the shipper by being informed where consignments are located. To be able to accomplish this service the department has the experience of years plus modern accounting devices, as well as a system of forms that were not just "blueprinted" in advance for the purpose, as one would plan



All photos courtesy Baltimore and Ohio Railroad

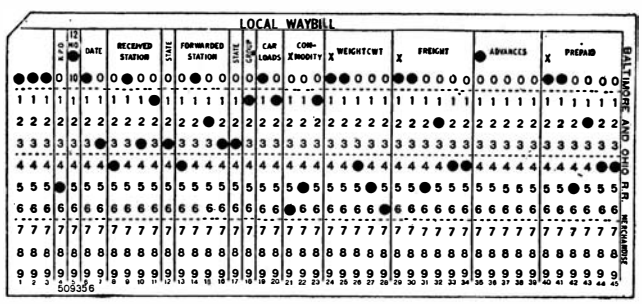
Upper Left: **Record book in car service department contains code entries.** ***Above:*** **Clerk entering car numbers from "wheel" reports**

a building, but are economical forms that have been made from practical study over a long period of time. To the layman a visit to the car service department is most bewildering and the sequence of operations can hardly be grasped in one visit. Some of the best minds in the railroad field have devoted their attention to the simplification of the systems employed.

The records are made from freight train reports and show the movement of cars not only over the "home" railroad, but the various lines over which cars belonging to the home railroad may be in transit, as well as foreign line cars moving over the home road.

IN vogue on most of the railroads in the United States is what is known as the standard "cut-up" system of wheel reports, which, in the case of freight trains, is compiled by conductor or yard clerk. To each of these reports is attached a narrow flap showing initials, car numbers, contents—if loaded or empty—where taken and left, and the date. These flaps are placed in quantity on a gage board and cut up into slips by a cutting machine, so that in a few minutes from 12,000 to 14,000 slips are ready for assortment by the nimble fingers and quick eyes of the clerks. A gage board is used for assembling the sheets so that none of the records on the cut-up slips will be mutilated, after the wheel reports have gone on the "operating table."

When cars of the home road leave it for, or come back to it from, a foreign railroad, the method of recording is by the simple system of using two different colored flaps attached by agents or yard clerk to the interchange reports when forwarding them to headquarters. The pink flap indicates delivery to a connecting road, while the yellow flap shows receipt from connecting road. Our car of less than carload freight was delivered to its own line, the B. & O., by the Reading Company near Philadelphia; it came on to the Reading line at Bound Brook, New Jersey, from the Central Railroad of New Jersey, which in turn received it at its Communipaw pier from the New York, New Haven and Hartford, on which road the freight originated. The transfers are checked at junction points or in the yards as illustrated. The cabalistic chalk marks on the cars have a meaning all their own. For example: the "93" and "BK7/14" on the freight car illustrated on page 142 indicate that this particular car was moved by train 93 and was classified on July 14th, destined for Youngstown, Ohio.



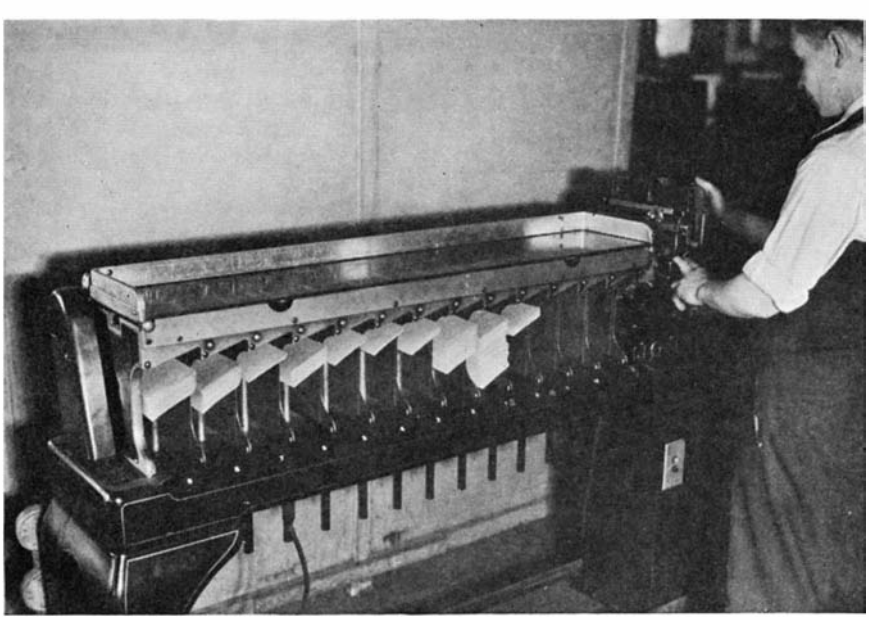
Reporting the car's arrival on its own tracks from the Reading, the yard clerk used a yellow flap; at Chicago, the clerk used a pink flap to indicate its delivery to the Chicago, Milwaukee and St. Paul. These colored flaps or records are known as interchange reports and likewise undergo transformation into slips on the "operating table" at headquarters, going through a process, similar to that already described, of assembling, gaging, cutting-up, and assorting.

Above: **Punching a card for freight traffic auditor.** *Below:* **Cards give much information**

After the slips are put in the respective assorting boxes, they are distributed frequently during the day to the various record clerks. Slips from interchange reports are arranged in alphabetical order of the names of foreign roads owning the cars and entry in the record books is by cipher code, various symbols being used to designate the interchange of cars to and from connections at interchange points, in and out of main yards or terminals on the line of the railroads. Slips representing cars of the home railroad are assorted by their numbers.

THE interchange slips showing delivery to connections, after records are made from them, are sent to the respective railroads owning the cars; this likewise is done with slips representing so-called private owners, such as packers, tank-car companies, and so on. This enables the owners to keep a check on their cars as to mileage covered on connecting lines, as well as where and when the cars were delivered to such and such a line, and whether the cars were loaded or empty. Should a "tracer" be received from a shipper or consignee at any time, the pertinent facts can be readily supplied by the car service department.

Quite a large number of tracers is received daily and prompt replies are made to inquiring shippers and consignees, informing them of the location of a car. If it be destined to an off-line



Card sorting machines assemble and sort the punched accounting cards automatically into twelve pockets for balancing purposes by freight accountants

Operator is perforating interline waybills to show station audit number and date of report.

point, the shipper or consignee is notified at once and the information is given as to what road has received the car, and date of delivery so that the inquirer may continue to follow the movement of the car on the connecting line until it reaches its destination.

In handling cars that are not their own, the railroads have agreed to certain regulations which are known as American Railway Association Car Service Rules, governing the movement of such cars on their lines. By this means, confusion is avoided. Under these rules a railroad must return cars of foreign lines to the respective railroads as promptly as possible.

A SYSTEM of checking the reports received in the car service department is used by comparing them with records kept also in the division accountants' offices, showing the operation of all trains over their respective divisions. Should a yard clerk or conductor fail to send in his wheel report, the records kept by the division accountants will furnish the necessary pertinent details.

What happens to the flaps attached to the wheel reports has already been described for shipments, and especially destination points, which information is useful when tracing shipments for claims and so on. These sheets also contain data from which car mileage statistics are compiled, including statements as to the average miles covered by each car a day. The sheets are bound and filed for three years in accordance with the regulations of the Interstate Commerce Commission.

Railroads do not have their cars on the lines of other railroads free of charge, but each road is paid for the retention of its cars on lines other than its own. Prior to 1902, settlements were made on a mileage basis, after which various arrangements were tried, until the present basis of agreement, the per diem settlement plan—whereby the owner of a car is paid one dollar a car a day for its presence on another railroad—became standard practice. Such charges are based on the date of receipt of a car till its delivery to the home railroad, or to a connection.

Private cars in the majority of cases move one way loaded and return empty. To assist in minimizing the excess empty mileage, there is a plan of equalization in which the car owners are required to equalize the excess empty car movement with loaded car movement, or pay for the mileage of the empty movement that exceeds the loaded movement of their cars.

Of equal importance and intricacy to all the foregoing is the accounting for the revenue from transporting the many different commodities in the various movements of the freight cars, hither and yon. While the handling and recording of car movements may be looked upon as a difficult, complicated business to master, the accounting for the revenues may indeed be considered a science.

Knowledge of what article is shipped, where and how, to what distance, the time spent in transit, what rate applies —all these must be mirrored in the accounting department of the railroad.

What the ticket is to the passenger, the waybill is to all freight shipments. The waybill, therefore, is the reason for the freight auditing department, which is divided into four main divisions. These are; the local settlement, which has to do mostly with recording the receipt and tabulating the freight manifests; the revision section, where principally the rates and charges shown on the waybills are carefully checked; the interline settlement, similar to the first-named sub-division, except that the work is more complicated; and the transcription branch where the millions of figures on tens of thousands of waybills are carefully copied by the quickest and most up-to-date methods known to auditing.

AMONG those that should be mentioned, because of the rapidity of recording and the surety of action, are the machines that assemble and assort the accounting cards for balancing purposes. Equipped with magazines and 12 pockets, these modern-day genii work with more than human precision, indicating the figures in all 12 columns and by their aid the freight accountants may make known the total debit to all agents connected with their respective shipments, no matter where the commodities originated.

But this is quite another story in itself. While the outside of a railroad's general office building is quiet and serene, the inside is buzzing with fascinating activities. Of course, the life inside depends upon the loaded cars outside.

Thus, the peregrinations of any freight car, moving at any time, whether full or empty, can always be traced in the record kept at headquarters. The car may be on the Canadian Pacific or Canadian National bound for "home" with a load of dressed lumber; delivering coal to the Great Lakes; down in Florida being loaded with fruit; or in Kansas; but wherever it be its location is recorded. The cars are kept moving as promptly as possible but the business of their movement and the accounting thereof is difficult to master. Ask any railroad man!

Checking the items totaled by the tabulating machine against the card that has been punched for record purposes, saving much valuable time in auditing

NEW PLANETARY DISCOVERIES

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

THE discovery of minor planets has fairly been put on a basis of mass production.

In the old heroic days the observer, with great labor and pains, made himself a chart showing all the stars in some given region of the sky near the ecliptic; then he went over this region again and again comparing each star in his field of view with the chart. An interloper might be a variable star which had brightened up since the chart was made, or it might be a planet which had moved into the field. Only by later observations could it be told which of these discoveries had been made.

Now, of course, the discoverer works by photography. With a wide angle lens of large aperture—preferably a pair of them if he can afford the luxury—he makes an exposure of two or three hours, and obtains a plate which may show tens of thousands of stars. The average asteroid moves enough during such an interval to make its image a definite trail which can be picked out at once among thousands of point-images of stars. Defects on the plate, rare in any event, can be eliminated by means of a simultaneous exposure with the twin camera.

THIS method, as was once told in these columns, was invented by Prof. Max Wolf of Heidleburg and his observatory is still active above all others in this field. Dozens of new planetoids are found every year and those already known are picked up again at such a rate that, were all existing records destroyed, they could substantially all be rediscovered in a decade or two. Usually the newly found bodies are of no special interest—just one more bit of work for the observer who measures their positions and the computer who works out the orbit. But once in a while it still proves true that "there are as good fish in the sea as ever were caught."

On March 12 of the present year E. Delporte of the observatory of Uccle, in Belgium, found on one of his plates the trail of an object which attracted attention at once by its unusually rapid motion—nearly two degrees a day in a northeasterly direction. This suggested a comet, for most planets when in opposition to the sun, as this object nearly was, are moving eastward in space slower than the earth and so seem to drop back to the westward. Even with powerful telescopes, however, it presented the sharp starlike appearance of an asteroid and when a really reliable orbit could be calculated it turned out indeed to be one. Several computers have derived orbits which agree so well that there is no doubt left that the period is close to 2.7 years, the inclination 12 degrees, and the eccentricity of the orbit 0.44. The planet's greatest distance from the sun is 259,000,000 miles and the shortest distance 100,800,000 miles—only 8,000,000 miles greater than that of the earth. At this point—the point marked P in Figure 1—the planet's orbit is about 9,000,000 miles north of the plane of the earth's orbit. The closest approach of the two orbits comes nearly half way between the points N (the node) and P (perihelion), at a distance of 9,500,000 miles.

This was very nearly the situation of the two bodies ten days after the discovery. They were then almost in line with the sun—the asteroid about a degree ahead—and only 10,000,000 miles apart. The little planet moved fast in this part of its orbit—a little faster than the earth—so that the two *kept* almost in line with the sun as they moved around it, the planet gaining a little, as shown by its apparent motion. As it receded from the sun its motion slowed, and the earth caught up with it again on June 9. But by this time the two were 33,000,000 miles apart.

This interesting object should be observable for two or three months to come, though as it recedes it will become very faint, and before it is lost to sight there should be material for calculating a really reliable orbit. When next it comes into opposition in October 1933, it will be on the far side of its orbit, about 250,000,000 miles from the sun and 160,000,000 miles from the earth, and it will look only 1/1700 as bright as it did this spring. It was then of the 12th or 13th magnitude and next time will be of the 20th or 21st. This is less than 1/100 as bright as Pluto, and just at the limit of faintness which can be detected by long exposures with the greatest telescopes. It is therefore very improbable that the new asteroid will be observed again until another favorable opposition occurs and, by that time, it may be lost unless

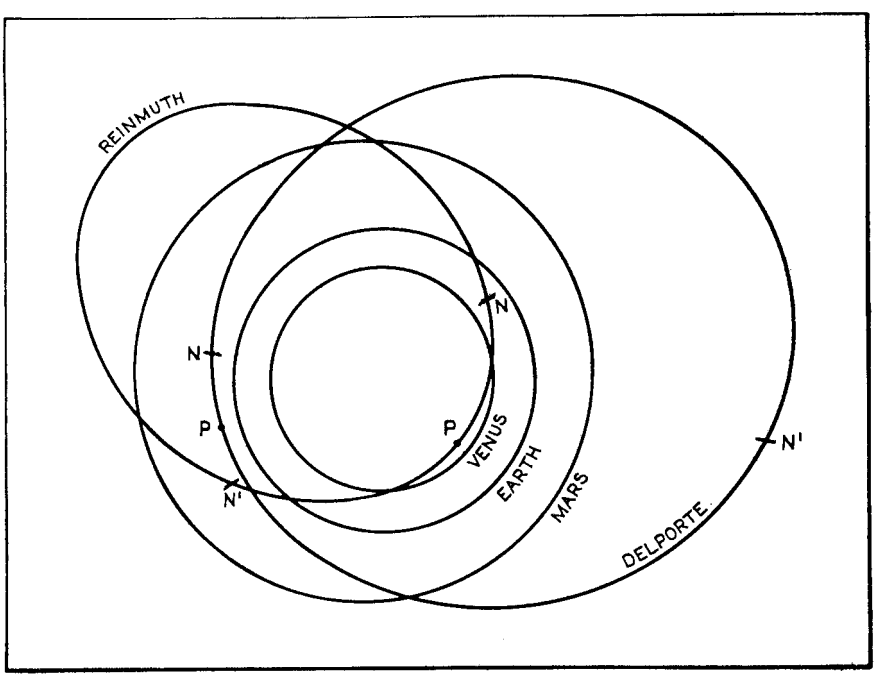


Figure 1: **Orbits of the earth, Venus, Mars, and the newly discovered asteroids. *P* marks the point on each of their orbits which is nearest the sun. *N* is the node, the point where the planet, moving in a direction opposite to that of a clock hand, comes up through the plane of the paper. *N'* is the other node, at which it descends again. The sun is supposed to be situated in the middle of the sketch**

unusually careful observations are made this summer.

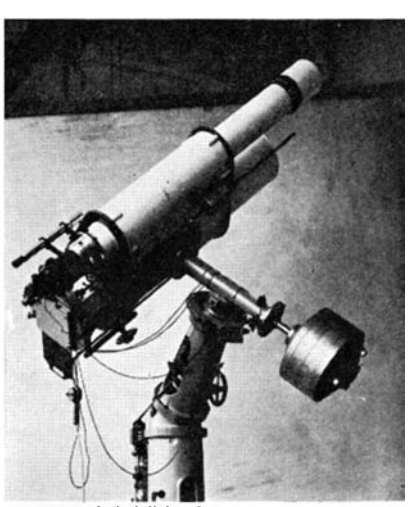
It is easy to understand why it was not picked up before, but it is a great pity that it was not, for it came nearer us this spring than any known planet ever was before. By a suitable campaign of observations from different parts of the earth its distance could have been determined with even a greater percentage of accuracy than that of Eros the year before, and the scale of the whole solar system still more precisely defined. We may have to wait many, many years before so favorable a chance happens again.

THE second object, discovered at Heidelberg by Reinmuth on April 24, is still more remarkable. It was moving westward in the heavens, but at the unusual rate of more than a degree a day, and was therefore carefully observed. The early orbits by different computers agree closely enough to make it clear that at perihelion this body comes far inside the orbit of the earth, and even within that of Venus. The period is about 1¾ years and the inclination of the orbit small—only six degrees. Like Delporte's asteroid it was very near the earth when discovered, and came a little closer soon after. It was in opposition on April 23rd, at a distance of 17,000,000 miles. On May 15 it reached its minimum distance—only 6,000,000 miles! On June 4 it was in conjunction with the sun and about 15 degrees south of it in the heavens!

This body is still more likely to be lost after the present apparition and it is to be hoped that observations will be continued as long as possible. Its appearance shows that it is a *planet*, not a comet.

These two new planets must be among the tiniest bodies known to astronomy. Our only way to guess at their size is by the amount of light which they reflect. If we assume the low reflecting power of the moon, Delporte's planet comes out rather less than one mile in diameter and Reinmuth's a little smaller. With the high albedo of the asteroid Vesta they come out only half as big. If such an object could be let down gently on the earth's surface it would be no bigger than a fair-sized mountain.

There must be enormous numbers of these small asteroids. At ordinary distances of a hundred million miles or more they stand no chance of being detected. Only those which happen to come very near the earth's orbit are discoverable, and then only when all circumstances conspire to produce an actual close approach to our planet. Yet two of them have been found in a single year! We may expect further discoveries of the same sort now and then for decades to come.



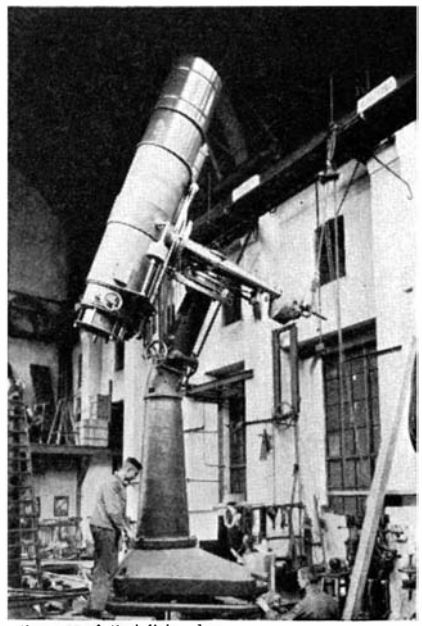
Courtesy of Carl Zeiss, Inc.

An 8-inch astrographic telescope at the Observatory of Torino, in Italy. Here a visual telescope is combined with a telescopic camera

THE present occasion may be appropriate to speak of quite another discovery relative to a planet which has received a good deal of publicity. Adams and Dunham, photographing the spectrum of Venus with the 10-inch telescope, the great coudé spectroscope (which is fixed in a constant temperature room and fed with light by an auxiliary mirror), and the new red-sensitive plates, have found a group of sharp absorption bands in the infrared which they announce as due to carbon dioxide. No such bands appear in light which has traversed the earth's atmosphere, even from the setting sun. But this is not surprising, for carbon dioxide is present in but small proportion on earth—less than 1/3000 of the whole atmosphere by volume. A layer 12 feet thick is equivalent of the whole amount between us and the zenith.

If some vast coal fire could rage on the earth's surface until all the oxygen of the air was exhausted, the amount of carbon dioxide in the atmosphere would be increased a thousandfold. The amount locked up in a chemical combination in the world's limestone is vastly greater. It may then require a mile long column of this gas, or even more, to bring out the bands strongly under laboratory conditions.

The identification of one more familiar substance in a neighbor planet is always of great interest, but in the present case some popular writers have interpreted the new discovery as indicating the possible presence of life on Venus. To the writer this appears very doubtful. The atmospheric essentials for life such as we know are oxygen and water vapor. No spectroscopic evidence of these has been previously found at Mount Wilson, nor do Adams and Dunham report it now. An atmosphere rich in carbon dioxide, and devoid of oxygen, seems far nearer what might be anticipated on a planet not generally different in composition from our own but on which life for one reason or another had never developed.



Courtesy of Carl Zeiss, Inc.

A double telescopic camera for the University of Stockholm, Sweden. The second "barrel" is hidden by the nearer one (16-inch objective)

FREE oxygen is an extraordinarily active substance to be found permanently in an atmosphere. We are so used to it that we tend to forget this. There are many processes on earth, such as the decay of organic matter and the weathering of rocks, which take oxygen out of the air, and only one process which restores it—the growth of green plants. There is strong reason to believe that in the sun, whence the planets were doubtless born, there is not nearly enough oxygen to combine with all the oxidizable elements. It appears probable therefore that the planets had initially no free oxygen in their atmospheres, though oxygen compounds such as H_2O and CO_2 may have been abundant, and that the oxygen now present on the earth and Mars has been liberated by the action of vegetation.

If carbon dioxide is present in great abundance on Venus this confirms rather than opposes the conclusion already drawn from the absence of lines of oxygen and water vapor. Our nearest neighbor among the planets bears every available evidence of being a lifeless globe.

It will be of great interest to learn whether these new bands appear also in the spectra of Jupiter and Saturn, which no one supposes to be the abode of life. If not, it may be that their surfaces are so cold as to freeze out all the carbon dioxide into Dry Ice. Further observational work may lead here to new discoveries.—*Princeton University Observatory, June* 24, 1932.

THE MUSCULAR POWER OF INSECTS

By S. F. AARON

THOSE myriad creatures that possess external skeletons, or rather, hardened integuments within which the active organs function, must necessarily depend very largely upon muscular power that acts differently from that of the creatures with internal frame-work, the vertebrates, as the so-called higher animals are termed.

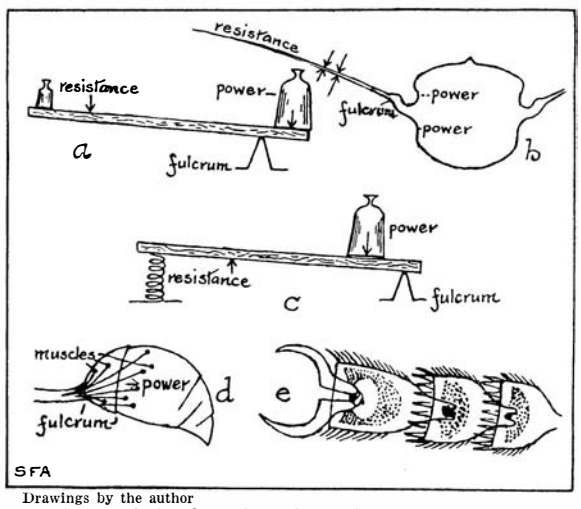
With very few exceptions the muscular attachments on the bones of fish, frogs, snakes, birds, and mammals are between the joint and the desired operation, thus being levers of the third class, the power being between the fulcrum and the resistance. The exceptions are generally partial, a divided power between levers of the third and first classes, as in the femur and the forearm of the elephant and the metatarsals of the ungulates and carnivores.

With the invertebrates there is a very exact combination of these two attachments and exertions of power, the muscles of course operating upon the inside and never the outside of the skeleton. Thus there are often in the same operated part levers of the first class working on one joint and levers of the third class on another and closely related joint, or in many cases the operation of one member requiring a great or special power is effected by both the principles acting together, as will be further explained.

IN all animal life there are no muscular levers of the second class.

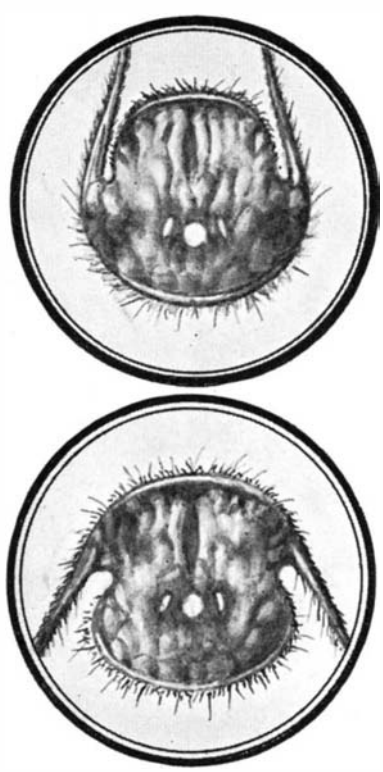
Singularly adapted to the external skeleton or "case" of the insects and their allies—the spiders, scorpions, centipedes and crustaceans—is the soft muscle that depends solely upon the power of resisting condensation between confining walls. The consistency of this mass is such as to permit no pull; it is about like that of dampened bread, or a ropy jelly, being bereft of fibers or any considerable adhesiveness and acting only by pressure. In the thorax of some species this mass of soft muscle is generally confined between the body wall and vertical tendons of considerable strength; in others the tendons are lacking. These muscles operate the wings only as levers of the first class.

Another kind of muscle with which the insects are endowed is the tendonous muscle made up of more or less strong fibers for the purpose of pulling and operating by either one or the other



Drawings by the author

***a,* lever of the first class. *b,* analogous cross-section of house fly's abdomen. *c,* lever of third class. *d,* abdomen of digger wasp, showing muscular attachments. *e,* terminal joints of the tarsus of a deerfly**



Microscopic cross-section of thorax of butterfly *Vanessa antiopa,* showing the action of soft muscles that raise and lower the wings by means of pressure exerted on integument

lever principle. These tendonous muscles are composed of non-striated and transversely striated fibers or cords, the latter being uniform, smooth, and much stronger than the uneven, often longitudinally striated muscles.

IN the legs of the grasshoppers, crickets and so on, the tendonous muscles are employed throughout all the joints, even operating the femur from the thorax, working upon or sometimes through the basal joint of the leg. The powerful leaping femur and tibia of the posterior pair of legs are admirably endowed with muscles attached to the inner walls of the broadened femur and by their length being capable of a very great extension. The leverage is of the first class; it is remarkably "in reverse;" that is, it gains strength through the relative distances from the power, fulcrum, and resistance, but makes this up by the tension of the ligaments. The construction of the joint between femur and tibia, not of the ball and socket type and yet singularly adapted to a pivotal resistance to wobbling, is such as to demand the admiration of a machine designer. Among all the leaping insects of various orders this principle is commonly developed.

With the legs of beetles the tendonous method is employed, working as levers of both the first and third classes, the latter with the attachment to the body, the joint between femur and tibia as with the grasshoppers. Both joints are relatively powerful in the terrestrial species, which are noted for their strength principally as diggers. The bodies of these beetles, as also those of the elaters (snapping beetles, click beetles), are necessarily powerfully muscled, the elater possessing both tendonous and soft muscles that operate each side of and through the joint between the front and middle sections of the body.

Most interesting are the muscular developments governing the wings of the rapid-flying insects. The comparatively weak-winged species, such as the grasshoppers, most beetles, the true bugs, some of the large-winged true bugs, and the ants, possess chiefly tendonous control, but the hornets,

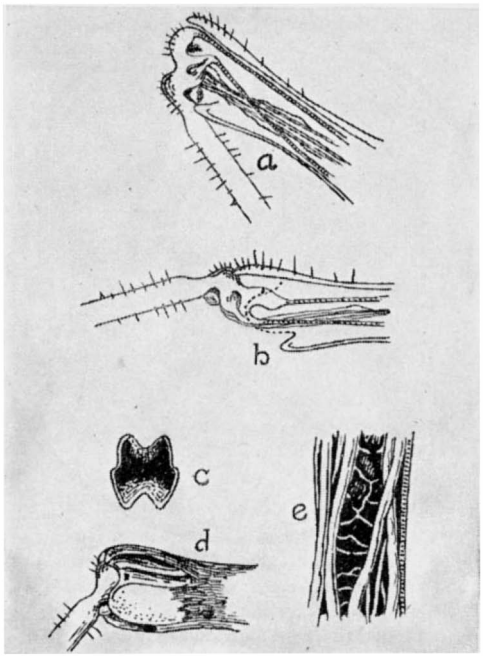
bees, stout-bodied flies (Diptera) and the moths and butterflies, all have the soft muscle control, the mass well-nigh filling the thorax transversely and longitudinally, thus permitting great power and, by reason of the pliability, extreme rapidity of change from contraction to expansion, as shown by the stout-bodied Diptera and the small digging bees.

Certain instruments high-pitched to the tuning-fork yield correct interpretation of the velocity of wing motion; by this method it is ascertained, however difficult of belief, that the wings of bee-flies or Andrenid bees commonly attain many hundred strokes per second. And these are downward strokes, for by the method of wing action the unresisting posterior portion compels the upward lift to be edgewise and cannot add to the humming sound.

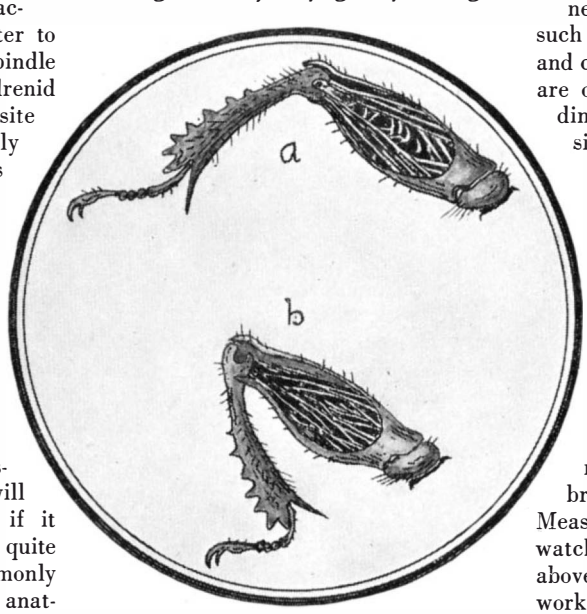
There has been a tendency to doubt the evidence of the vibratory pitch of sound as indicative of the speed of a fly's wing motion; it seems incredible that muscular action could be so rapid. The better to indicate this the writer made a spindle exactly the diameter of an Andrenid bee's body, fastened on its opposite sides two small metal disks exactly the size and shape of the wings and, by means of a series of cord-driven, solid pulleys from a central, timed, hand-powered mandrel and pulley, drove the wing-equipped spindle at the rate of about 600 revolutions per second. The sound given off was very near in pitch to that of the bee in flight.

THE action of these soft muscles, so soft that a pin point will pick the mass apart almost as if it were nothing but firm jelly, is quite different from that which is commonly described in the books on insect anatomy; there has, indeed, been very little reference made to their operation. The writer, in SCIENTIFIC AMERICAN for October, 1904, touched lightly upon this with reference to the comparative flight of certain insect species. The influence upon the wing of the pliable integument immediately above and below the wing attachment to the body has not been accorded the attention on the part of comparative anatomists that it deserves as a little understood and possibly a deservedly understood principle with regard to invention.

This soft muscle is sufficiently firm and of a nature mechanically to resist compression; acted upon by the voluntary nerves it expands and contracts relatively in different places to effect a pressure upon the pliable tegument (external case, cover or shell) and to



Hind leg of grasshopper, *a*, with joint reflexed, *b*, extended. *c*, end of femur. *d*, external view of joint. *e*, character of the leg muscles, very greatly enlarged



Fore leg of beetle: *a*, extended, showing ball-and-socket joint and slight muscular leverage. *b*, reflexed, showing fibrous muscle attachment

relieve the pressure on another part. Thus the enfolding body wall above the wing is forced outward and the firmly attached wing is thereby forced to take a downward inclination, the muscle moving away to permit the tegument below the wing to fold or bend inward. Thereupon, to lift the wing, the expansion and relative contraction again shift or change places; the tegument below the wing is forced out, that above gives way for the in-fold and the wing is forced upward.

With the butterflies and moths and the dragonflies this seems to be the only and sufficient means of obtaining powerful wing strokes; with the large-bodied biting flies, house flies, parasitic two-winged flies, and bee flies there seems to be an auxiliary tendonous action on the wings, the muscles of these being attached close to the sides of the thorax and acting in unison with the soft muscle. But these tendons are very weak and it is suggested that they serve principally to hold the wing base in place.

In no case that I have observed does the base of the wing extend within the body wall, as has been described in diagrams; rather the lobular attachments are supported by extensions of the integument, forming very effective fulcrums for the great stress upon them.

THE muscular power of the legs and bodies of insects compares in development with that of the wings; it reaches in nearly all species an adequate need in accord with the special development of parts. The leapers, the diggers, the runners are all endowed by nature with such powerfully or rapidly expanding and contracting muscles that the results are often astonishing when the law of diminishing proportions is not considered.

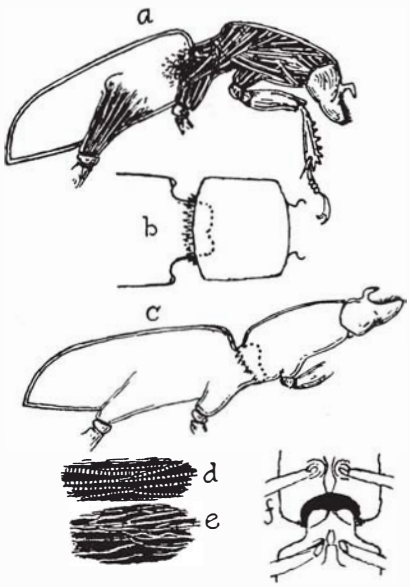
When studying the habits of the common black carpenter ant, *Camponotus pennsylvanicus*, which is found all over eastern North America and which offers superior opportunity for observation, I could not help noticing the remarkable speed attained in climbing from its hunting-ground over a wide area of grass and weeds to its colony nest near the top of an old and broken tree trunk ten feet high. Measurements and timing with a stop watch were easily obtained and marks above and below where the busy little workers passed were made.

An ant traveling with a dead spider in its jaws, the victim weighing more than its captor, ascended vertically two feet in a small fraction under two seconds. It measured one fourth of an inch in length. A racing automobile going at the rate of 200 miles per hour travels about 24 times its length in a second, but the loaded ant went vertically 48 times its length in the same time. Testing the speed of these ants over horizontal surfaces showed no appreciable gain.

But ants are not the swiftest of the insect athletes. After wide observation we may consider the funnel web spider, *Agelæna nevia*, upon noting its dashes from and into its tube-like lair. Probably nothing of its kind can move faster, though no doubt some of its eight legs are more of a hindrance to

speed than a help; they aid in capturing its prey. Timing one of these half-grown fellows across my study table I found that it ran more than a hundred times its length in a second. Figure what speed a car could make at a proportionate rate! A locomotive would cover 4000 feet per second and run from New York to Los Angeles in about an hour!

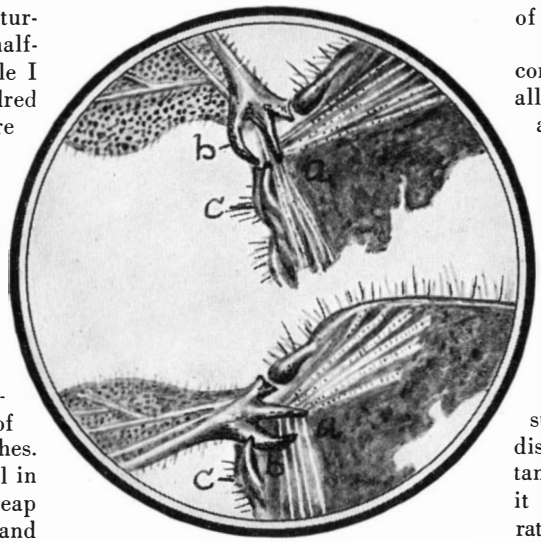
Leaping is somewhat akin to running, in the matter of rapid motion; it is the speed of the kick that carries far. A pupa of the common red locust, *Melanoplus femur-rubrum*, measuring three fourths of an inch in length, leaped 40 inches. An old man kangaroo, doing as well in proportion to its length, could leap over 200 feet! But it is the flea and those tiny members of the Collembola with an abdominal spring-piece, *Sminthurus*, that are the champion high and distance jumpers. The flea cannot be handily measured; the others leap from lowly leaf to grass stalk with such tremendous power that one covers a distance of over 500 times its length; in other words, though not more than 1/50th of an inch long, it leaped over 10 inches. If Mark Twain's Calavaras



The thoracic muscles of a beetle. *a*, with the prothorax bent down. *b*, socket joint of pro- and meso-thorax. *c*, prothorax bent up. *d*, striations in tendons. *e*, longitudinal fibrous tendons. *f*, socket joint of the pro- and mesothorax pulled apart

frog could do as well in proportion it could have leaped 100 feet and a man of ordinary height, measuring his body and head in a stooping position, could in one standing jump cover nearly a fourth of a mile and go to the top of the Empire State Building without difficulty!

Folsom, in his "Entomology," makes the declaration that there has been



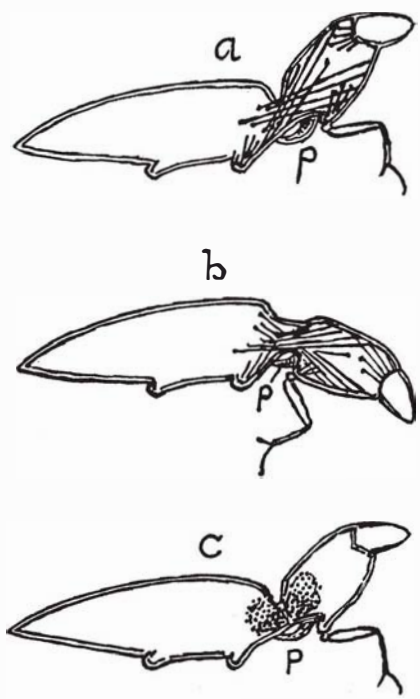
Microscopic view of wing attachment of a beetle, showing tendonous muscular control. *a*, muscles attached to slight spur. *b*, curved spur guided by forked projection, *c*. The weak wings have limited action. When folded, *b* slips from *c*

some exaggeration regarding the strength of insects. There can hardly be that, nor the need of it. He borrows again the very simple formula of the weight increasing by the cube but the strength only by the square to account for the relatively greater strength of a small creature over a larger one. Citing the muscular power of insects as marvelously greater in proportion to larger animals he compares their pulling strength which, because of varying surface friction, is inadequate. A better way is to test actual weight-lifting strength and for this purpose the writer prepared small bags of fine shot weighing from 1/8th of an ounce up. After testing many species—the lifting power of the down stroke of a cecropia moth, the upward heave of an elater beetle which hardly has a superior, and the leg power of several digging beetles of the Scarabidae—that busy fellow, bee-like in flight, the *Euphoria inda*, acquitted himself most remarkably, though it was later fully equaled by the long, shiny black Lucanid that is over an inch in length and very common—*Passalus cornutus*. Very likely any one of the so-called tumble bugs is equally powerful.

PILING bags of lead on these fellows was a real joy; the subjects were not hurt. They did their best to crawl off with the weights. Merely crawling out from under the bags was not counted.

The Scarabid weighed only 4 3/10 grains; it lifted 8¼ ounces, over 850 times its own weight. The Lucanid weighed 6 grains and lifted 11½ ounces. An elephant lifting as much in proportion to its weight could, if it weighed 3 tons, walk off with a load of 2500 tons, the weight of a ship! And there we have the subject of comparative weight and strength with all its illusions shed, if there really are any. Though liars will figure, the facts are too plain and too easily proved to admit exaggeration. But one more comparison remains, touching relative weight and muscular power in proportion to gravity, and it can best be illustrated by experience.

A man falls 20 feet and is injured—muscles strained, bones broken, ligaments torn, contusions suffered. A mouse falling the same distance runs away, unhurt. The distance is 3½ times the height of a man; it is over 60 times that of a mouse. A rat falls 50 feet, 100 times its length, and is killed or maimed, a cat likewise, from a height 40 times its length. Drop a beetle, a caterpillar, a pupal grasshopper (no wings), or an assassin bug 100 feet and it is not the least harmed, though the height is fully 1600 times that of the insect length. A flea or Sminthurus might fall from the height of the Empire State Building and consider it a jolly experience. Of course, atmospheric resistance gives the bulk of the answer; also the height of the organism is not the true criterion in physics.



Elater beetle or click beetle, in which the muscular action of the pro- and mesothoracic joint is very powerful and rapid. *a*, the upward bend, is to toss the insect in the air when on its back or to jar it from the bill of a bird. *b*, the downward bend, is not so powerful. *c* is the auxiliary soft muscle. *p* is the prosternal projection to guide the body bend, preventing the beetle from "clicking" sidewise, as it were

A MASTERPIECE OF MUSEUM-CRAFT

Right: The largest existing monument of Greek sculpture is the Pergamon altar from the Hellenistic city of Pergamon in Asia Minor, re-erected in a specially built museum in Berlin. It is 124 feet long. The altar, dedicated to Zeus, dates from about 180 B. C.

Below: A great achievement is the reconstruction of the Ishtar Gate at Babylon and of the procession-way leading up to it. The tiles, in polychrome, add to the reconstruction. It has been restored in the Near East Museum in Berlin adjacent to the Pergamon Museum

Two immense columns from Baalbek, the ancient Heliopolis in Asia Minor, in the Roman Hall of the Pergamon Museum at Berlin. On the floor in the foreground is a mosaic from a Roman house at Miletus

THE Pergamon Museum in Berlin, Germany, has taught an object lesson in museum technique which is an outstanding achievement in museum-craft. Here at last is a thoroughly honest attempt to reconstruct ancient masterpieces of architecture and to exhibit them without irrelevant distractions. The lighting is admirable, the walls are bare, the floors are of marble of appropriate color, and the labels are unobtrusive. The visitor is put in direct contact with the past without interference from externals. This new and scientific spirit is best evinced in the Pergamon altar room which contains the great frieze which formed the artistic decoration of a huge marble altar to Zeus (and perhaps Athena) on the Acropolis of Pergamon, a Hellenistic city of Asia Minor. It represents a contest between the gods and giants, and was probably erected by King Eumenes II, about the year 180 B.C., in honor of his decisive victory over the Gauls in Asia Minor. The altar has been reconstructed so as to exhibit the sculptures in their original position. It is perhaps the largest existing monument of Greek sculpture and rivals in importance the Parthenon sculptures in the British Museum. It forms a rectangular platform 30 feet in height and 124 feet in length. A flight of steps 65 feet wide leads up to the top.

In the adjacent Roman Hall there are two columns from the magnificent temple of Baalbek and a mosaic from a Roman house at Miletus. In the Near East Museum, connected with the Pergamon Museum, is to be seen another great achievement—the reconstruction of the Ishtar Gate at Babylon and of the procession-way leading to it. As the tiles are polychrome they add greatly to the imposing effect. A well-lighted model and a plan enables one to grasp immediately the place and functions of the originals in Babylon itself.

RADIO IN THE FOREST SERVICE

New Transmitter-Receivers, One Weighing Only Ten Pounds, Are to be Thoroughly Tested This Year

By A. GAEL SIMSON*

ONE of the most important factors —one of the most necessary weapons—in fighting forest fires, as in modern warfare, is communication. Battles have been lost both on the firing and on the fire line through lack of adequate communication.

Present-day communication in forest fire work is largely carried on through radio or telephone facilities. The Forest Service maintains an extensive network of telephone lines, totaling approximately 40,000 miles and this mileage is being increased every year. This is not a complete system, but is made up of thousands of short lines which tie in with commercial lines serving National Forest areas. Until the last few years, however, almost nothing had been done with radio—not because its potential advantages were not recognized, but because radio apparatus in the proper form to meet the requirements of Forest Service use had not yet been developed.

Radio, in order to be a practical tool for the forester, must be extremely portable; for, unlike military organizations, forest protection forces are made up of small units—often one man, sometimes two or three and occasionally as many as 25 or 30.

When these units are stationed at fixed points, as in the case of guards and lookouts, they are probably best served by telephone but it becomes both difficult and expensive to maintain telephonic communication with mobile units such as patrolmen, smokechasers, and road and trail crews. It is in connection with the mobile units that radio offers interesting possibilities. But in order that it be usable by, for example, a smokechaser or patrolman, the apparatus must be light enough for him to carry in addition to his fire fighting tools, food, and other equipment. It must be so simple to operate that a man with no knowledge of radio can use it. It must furnish reliable communication over distances of at least 10 miles, the cost must be within reasonable limits, and it must be so rugged that packing over the roughest trails or hauling over the roughest of roads will not damage it or its component parts.

Unfortunately radio equipment of this sort could not be found. An exhaustive search of the commercial and non-commercial radio field yielded negative results. Radio apparatus capable of fulfilling the rigid requirements of Forest Service work was non-existant.

MOREOVER, opinion was pretty well divided among radio experts as to whether or not it would be possible to "get out even a mile" in dense forest with radio apparatus of even pack-horse portability; as for using apparatus light enough for one man to carry—pish, and likewise tush!

Regardless of these opinions, the potential advantages of radio communication in fire control work were so manifold and so obvious that the Forest Service decided to take a chance, and a forest officer was asked to assemble a radio transmitter-receiver for foresters. The result was a 79-pound combined transmitter-receiver.[1] Field tests of this set demonstrated that when it was set up even under a dense forest canopy, signals were transmitted tens, and on occasion, hundreds of miles. Seven of the sets were in service during the 1930 fire season with gratifying results.

One of the semi-portable radiophone transmitter-receivers set up in the field under actual operating conditions. The aerial is strung between near-by trees

Close-up view of the front panel of the new semi-portable radiophone

*In charge of the study of the application of radio to forest-fire control in the National Forests.

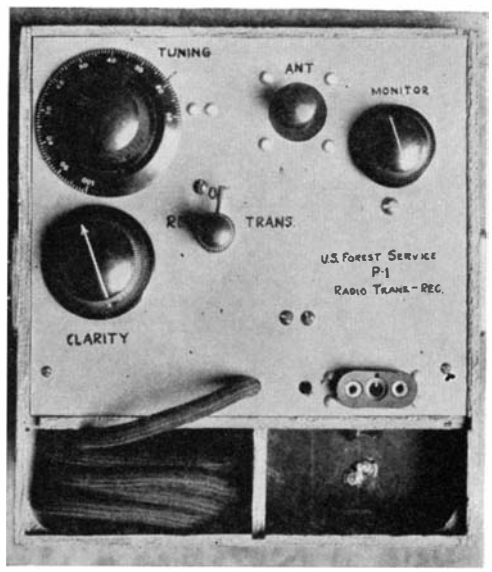
[1] *Scientific American*, Feb. 1932, "Radio and Forest Fires," by Chas. E. Randall.

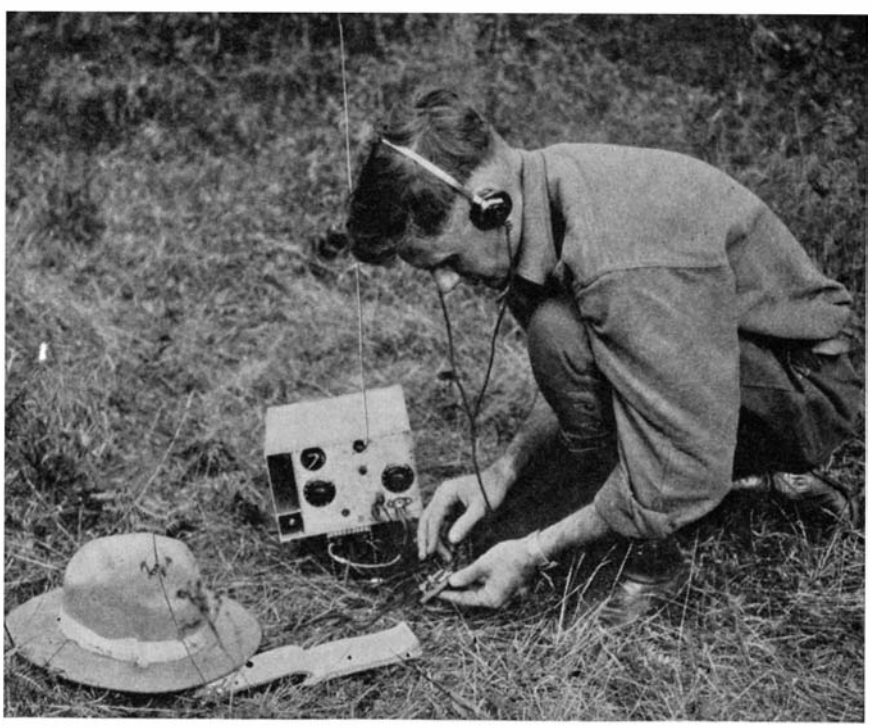
It is significant that, though these sets transmit code only, they were operated without difficulty by men who had no knowledge of radio. It is true that communication was necessarily slow until the men had memorized the Continental Morse code, but nevertheless they were able to get their messages across from the beginning.

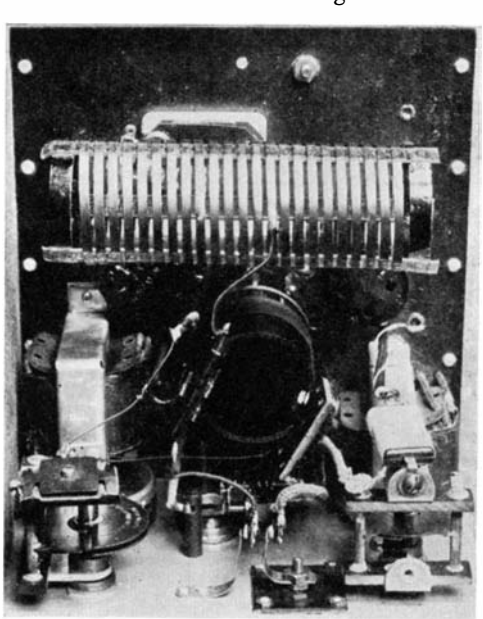
The 1930 tests were highly encouraging. They demonstrated that signals from portable apparatus could be sent over reasonable distances in mountainous, heavily forested regions; that inexperienced operators could use the apparatus and could communicate by means of code signals; that apparatus having the requisite ruggedness could be built.

THE results of the 1930 tests also showed the need for two special types of transmitter-receivers for two altogether different types of service. These were: (1) A general purpose transmitter-receiver capable of transmitting voice or code over a distance of at least 10 miles to be used for communication on large fires, communication with mobile units, such as patrolmen and smokechasers, communication with emergency lookouts, road crews, and so on, and where, for one reason or another, telephone service was not available. (2) A code transmitter-receiver of the utmost compactness, weighing approximately 10 pounds, with a minimum reliable transmitting range of 10 miles, to be used by smokechasers in reporting on the condition of fires to which they are sent and to be used by scouts on large fires in reporting to their respective fire chiefs.

Accordingly, apparatus to meet these requirements has been built. The larger of the two—the general purpose radiophone—in its final form weighs, complete, 59 pounds. (The weight may be increased or decreased according to the size of batteries used). It is housed in two small boxes; one contains the set proper, the other contains the dry batteries (dry batteries only are used in both types of apparatus), headphones, and antenna. Putting the set in operation is the essence of simplicity. It involves three operations, the first of which is to hang up the antenna and plug it into the set. The antenna is a single wire about 70 feet long and is usually tied to bushes or trees at any convenient height. Second, plug headphones into set. Third, plug in battery cable. The set is now ready for operation. There is no tuning of the transmitter, and the change-over from "transmit" to "receive" is done with a single switch. This set has a reliable transmitting range of 10 miles with voice and 25 miles with code.







Upper right: **Panel of the ten-pound combination code transmitter-receiver, with space for phones and filament battery.** *Above:* **Ten-pound set in use.** *Left:* **Top view of set, case removed, showing compact layout**

The small code transmitter-receiver is also contained in two packages—a box which houses the set itself, the headphones, and filament battery; and a small canvas bag in which the plate battery and antenna are carried. Total weight of the set is about 10¾ pounds. Putting this set "on the air" is even simpler than is the case with the larger radiophone.

Though this transmitter has, in many instances, been heard over distances of several hundred miles, the maximum reliable working range is rated at 20 miles.

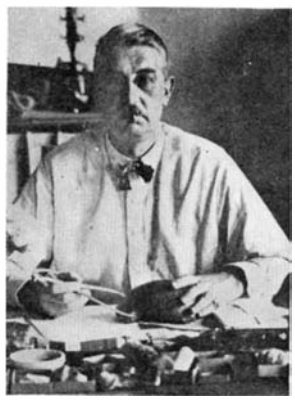
By an ingenious circuit arrangement the transmitting tubes are also used for receiving, which has made it possible to incorporate in the set a "three tube" receiver with a degree of sensitivity that is unusual in so compact an outfit. Fundamentally, the circuits used in both sets are conventional.

Arrangements have been made to install 26 radiophone units and 93 code units on National Forests of the Northwest this year. If results are satisfactory it will mean another step towards modernizing fire fighting, another reduction in forest protection costs, another advance toward the ultimate goal of making timber-growing profitable.

SOLO MAN—
A NEW FOSSIL SKULL

By WILLIAM F. F. OPPENOORTH, E.M., M.R.I.E., F.G.S.
Superintendent of the Geological Survey of Java

TWENTY-FIVE years have past since the author came to the island of Java as a member of the Selenka Expedition which, with the financial aid of the Academy of Berlin, had planned to carry on extensive excavations at the famous Trinil site on the banks of the Solo River. This was the same place where Dubois in 1891-92 had found fragments of a hominid, called by him *Pithecanthropus erectus*, the "erect-walking ape-man." Though we collected quite a number of vertebrate remains, no more parts of the famous "ape-man of Java" were encountered.



The author in his study

AFTER this expedition interest in the bone deposits flagged. The Geological Survey of Java, which service the author in the meantime had entered, was at least willing to continue the excavations, but technical and scientific research work in the other islands of the archipelago demanded all the available scientific men and time, and left no opportunity for concentration on vertebrate paleontology.

A few years ago, however, the Geological Survey of Java formed a party to make a survey of the island, in order to modernize the existing reconnaissance map, and this new survey first of all had to make a study of the extensive Tertiary Period deposits of the island. One of the difficulties met with was to distinguish the sediments of Tertiary Period from those of the Quarternary Period.

Several excavations were started, chiefly in the neighborhood of the Solo River, and these yielded many thousands of fossil bones. One of the oldest bone beds is that of Trinil where *Pithecanthropus* was found 40 years ago. Much more recent is another, also situated on the banks of the Solo River, but farther downstream near the little native village of Ngandong. This bed, discovered by Mr. C. ter Haar, the local geologist, is the remainder of a terrace of the Solo River laid down during the Pleistocene Epoch. It lies about 65 feet above the modern stream bed and has proved to be extraordinarily rich in bones. Within a few months a rather big collection has been unearthed, among which are several splendidly preserved skulls of mammals. Only a part of this collection has been prepared, the greater part of the bones being embedded in a hard mass of calcified sand and gravel that has to be chiseled away.

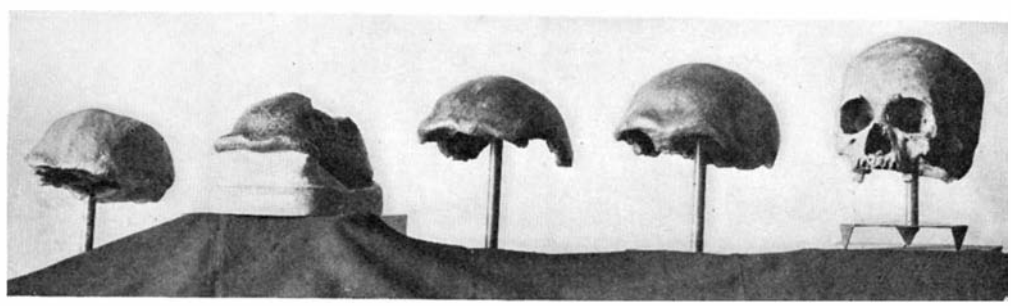
As far as can be determined at the present moment, the find is that of a typical Pleistocene fauna: tortoise, crocodile, tiger, rhinoceros, pig, hippopotamus, deer, cattle, buffalo, stegodon, and man. As Osborn explained so clearly some years ago ("Men of the Old Stone Age"), the Pleistocene age of the river terrace, which rests unconformably on marls deposited in the previous epoch, the Pliocene, may be deduced from its height above the present bed of the river. According to Osborn's deductions the Solo terrace should date back to the Riss-Würm interglacial stage if it is not a little older.[1]

Further investigations into the age of river terraces in Java will be carried on with the hope that it may soon be possible to get an accurate correlation with known Pleistocene sediments of the northern hemisphere.

Among the many bones were discovered some fragments and a nearly complete skull of man. The latter afforded a research on this new Java man, of which a preliminary description was recently published in the *Wetenschappelijke Mededeelingen van den Dienst van den Mijnbouw*, Scientific papers of the Mining and Geological Survey of the D. E. Indies, No. 20, (written in Dutch, with an English summary).

STILL more recently a second skull and a fine fragment of the frontal part of a third have been found.

The interior of the first skull has not yet been prepared, making it impossible to give accurate measurements, but some preliminary remarks may give an idea of the great significance of this discovery. The fully fossilised skull is clearly not that of modern man, but of a much more primitive type. The skull is long, like all prehistoric crania. The vault is low, the forehead flattened, with a heavy ridge over the eyes. The back part is broadened out, and has a sharp ridge on the occipital bone. In back view the skull[2] shows resemblance to the Rhodesian skull of Broken Hill in South Africa, also with that of the Australian race.



A comparison of different skulls. ***Left to right: Pithecanthropus*** **(cast),** ***Sinanthropus*** **(cast),** ***Homo soloensis*** **(Ngandong IV),** ***Homo neandertalensis*** **(cast), and recent man (Javan native)**

[1] On the system accepted by the majority of geologists there were four separate advances of the ice during the Pleistocene glacial epoch, with three warm intervals between them. The Riss-Würm interglacial stage was the one between the third and fourth ice advances. Though it is variously dated by different authorities, 100,000 or 150,000 years ago is perhaps a median figure.—*Ed.*

[2] The maximum length is 195.5 mm.; maximum width about 141 mm., so the cephalic index will be between 72 and 73; height to glabello-inion line 85 mm., which gives a calvaria index as used by Schwalbe of 44.5; width at supra-orbital ridge about 115 mm.; width at constriction behind supra-orbital ridge about 102 mm.; bregma angle 45°.5.

It has not yet been possible to measure the cranial capacity, but a calculation based on the method of Lee-Pearson gives a capacity of about 1300 cubic centimeters. However, I think this is too high.

From the pictures and measurements it is evident that *Homo (javanthropus) soloensis*, as I have named this man, may represent a stage of human development equivalent to that of the Neandertal race.[3]

The occurrence of *Javanthropus* in Pleistocene sediments of the tropics is a fact of great significance in its bearing upon the problem of human origin and dispersal on earth. It is the first neandertaloid skull outside Europe whose age can be determined with exactness. From this find we know that in Pleistocene times there were at least two parallel development series of human life. One was in western Europe with Heidelberg man and Neandertal man, and the other in eastern Asia, probably in the late Pliocene Epoch, with *Pithecanthropus erectus*, *Sinanthropus pekinensis* (Peking man), and *Homo soloensis*. Therefore a common ancestor of these two groups, if there is one, must be sought in still older deposits. In future there should be a greatly enhanced attention devoted to bone deposits of Pliocene age.

Excavation No. 1, in the Solo River terrace at Ngandong. Here the fossil skulls of *Homo soloensis*, the Solo man of Java, were discovered

WHENCE man evolved is a question still to be solved. The first as well as the majority of known finds of human remains have been made in Europe, but Europe is not supposed to have been the locality of the origin of mankind. Osborn has brought up the probability that Asia, especially the dryer plains and plateau regions of central Asia, should be the birthplace of mankind. These regions, the Desert of Gobi, have been explored by the American Museum's Asiatic Expeditions. Osborn's idea was supported by Matthew and recently also by Black. After the discovery of *Sinanthropus* the latter pointed out that from eastern Asia all along latitude 45° there is a strip of territory, extending between the Yellow River and the Caspian Basin, which is free from major mountain barriers, and accessible to western Europe along the northern Black Sea littoral and through the Danube and Rhine valleys. Along this route, the only practical open way, a relatively rapid east and west dispersal of land animals from a common center of origin must have been possible.

The accuracy of this theory might have been established by the above-mentioned American expeditions had they been allowed by the Chinese to continue their work in Asia. Alas, before they were stopped, they discovered no fossil human remains in central Asia. If this had happened it would have been of very great interest, for the following reason: The oldest and most primitive hominid, *Pithecanthropus*, was found on the island of Java, in the tropics. Now we know that in the Pleistocene there existed at several different times a land connection between the Dutch East Indies and Asia, and therefore it is not at all impossible that a dispersion of human life started from the tropics, where the climate has always been a favorable one for man.

From this we infer that there is still another possibility, which an examination of the several skulls reproduced in these pages will corroborate. This is the possibility that the offspring of *Sinanthropus* emigrated to Europe and gave rise to the Neandertal race, while *Pithecanthropus* evolved in the tropics into *Homo soloensis*, *Homo wadjakensis* (Wadjak man, a skull found 60 miles east of Trinil in 1889), and the Australian race. In this second category we include the Rhodesian man from Africa.

However, the very scarcity of finds of early human remains always makes such suppositions very hypothetical, and we shall require many more facts before we can have any certainty about the exact manner of spreading of man on earth. With regard to the origin of man we now know that only the deposits of the Tertiary Period can be expected to give light on this problem. There are indications that we should look for that light in Asia and especially, perhaps, in the tropics. For this reason it will be of much interest to continue the researches in Java.

[3]Neandertal man was also contemporary in Europe with the times (Riss-Würm) cited by the author.—*Ed.*

Three views of the skull of Solo man. *Left to right:* Frontal view, right lateral view, and back view. The lateral view reveals the heavy supra-orbital ridge, the flattened forehead, and the odd sharp ridge on the occipital bone at rear of skull

NEW NOTES ON ANCIENT MAN

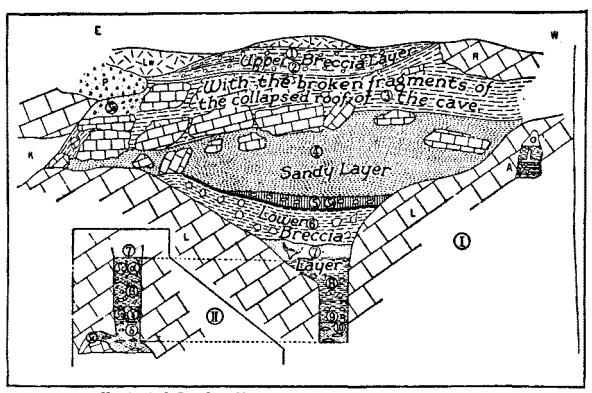
By ALBERT G. INGALLS

SIR ARTHUR KEITH, noted Scottish anatomist-anthropologist of London, in commenting on the *Homo soloensis* discovery described in the two previous pages, states that he regards *Homo soloensis* as an ancestor of the modern Australian aborigine and a descendent of *Pithecanthropus*—a half way stage in the evolution of the one from the other. This, he points out, tends to show that our living races each have a long independent history. *Homo soloensis* had a much larger brain—higher skull—than *Pithecanthropus* but was far short of the most primitive modern race in this respect.

New light has recently been shed on the already famous *Sinanthropus* discovery. Flaked implements and evidences that the Peking man used fire have been found. Readers will recall that, in 1926 and 1927, in a cave 37 miles from Peking (Peiping), China, three human fossil teeth were discovered. In 1928 parts of some jaws and skulls came to light. In December, 1929, the almost complete skull of *Sinanthropus* was discovered in the same cave. The find proved to be of major importance, comparable to that of *Pithecanthropus*, Piltdown man, Heidelberg man, and Rhodesian man, according to Sir Arthur Keith, and "the most impressive and significant discovery in the whole of human paleontology, according to another noted anthropologist, Professor G. Elliot Smith of the University of London.

THESE discoveries were described by Professor Smith in the SCIENTIFIC AMERICAN—June, September, and November, 1930. Sir Arthur Keith places *Sinanthropus* on a branch of the human tree springing from the main human stem at the opening of the Pliocene Epoch, earlier than the Piltdown man and the neandertaloids, though later than *Pithecanthropus;* not, however as our own direct ancestor, which remains to be found. This does not, of course, mean that the specimens found in China are of that age (7,000,000 years) but only that their own ancestors were probably the same as ours at that time. The *Sinanthropus* specimens are probably about 500,000 years old, possibly 1,000,000.

In the latest of the three SCIENTIFIC AMERICAN articles cited above, that of November 1930, Professor G. Elliot Smith said; "So far no worked tools have been found in the cave." More recently such evidences—worked tools and remains of hearth fires—have actually been discovered and specialized publications[1] now describe them. The



Courtesy *Illustrated London News*

Cross-section of the cave near Peiping. The skull pieces were found at SB (top, left). Note Layer 4

layer marked "Sandy Layer 4," in the center of the diagram, which is reproduced from the SCIENTIFIC AMERICAN article published in September 1930, has been found to contain an abundance of disintegrated charcoal from wood fires—old hearths like those so familiar to students of cave-dwelling man in Europe. The layer is 25 feet thick and we must therefore imagine perhaps hundreds of generations of primitive human beings, one after another inhabiting this cave, maintaining a more or less steady hearth fire and living adjacent to it, very gradually building up this deep layer of charcoal interspersed with sand accidentally brought in on their feet and otherwise. The layer beneath Layer 4, the one at 5 SA, is heavily impregnated with hearth fire cinders and is as black as ink. In the same layers the antlers of deer were found. These had been cut into lengths and used for flint tool handles and as picks. Fragments of cups made of skulls (still a custom among primitive races) were found, and further finds are anticipated as the painstaking task of excavating this cave slowly proceeds.

The result of this discovery has been to accelerate the growth of an opinion previously held by some students of man's ancestry—that "the beginning of human arts," as Professor A. Smith Woodward, another noted British anthropologist, states it in *Nature*, "dates back to immense antiquity, before man had acquired his present form." It doubtless will tend to support another growing suspicion—that the half million or million years commonly assigned to man's antiquity during the past decade or two will prove to be too short. The proof that man made rough tools half a million years ago implies a much longer background for the slow cultural acquisition of even this degree of skill.

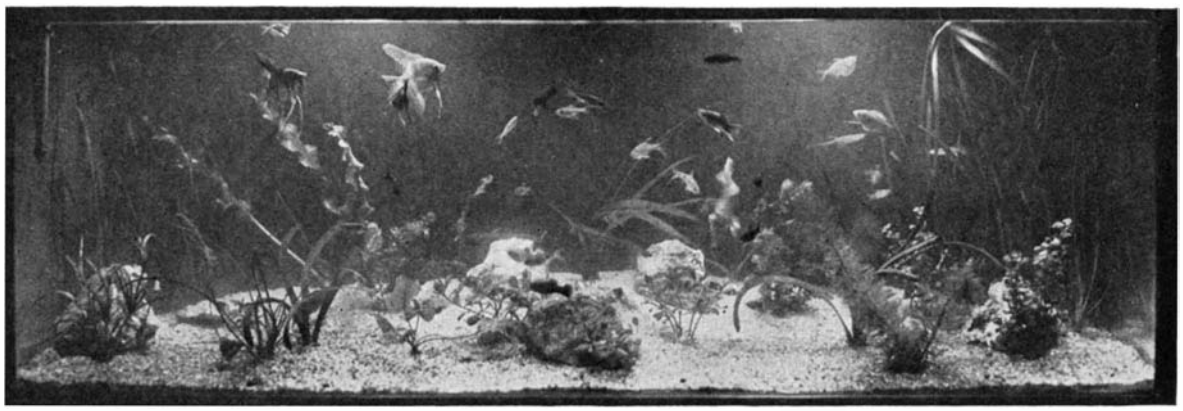
Another find of major importance has been made in Palestine. Eight skeletons of what were supposedly Neandertal men were found in the Cave of the Kids near Haifa, by the Joint Expedition of the American School of Prehistoric Research and the British School of Archeology. The former is under the direction of Professor George Grant MacCurdy of Yale, author of "Human Origins." This is not to be confused with the discovery in 1925 of the Galilee skull, nor with fragmentary evidences of a Neandertal culture found in Judea in 1928, or at Mount Carmel in 1929, 1930, and 1931.

A year ago the first of the eight skeletons was found by Mr. Theodore D. McGown, field representative of the American School of Prehistoric Research. It proved to be a child's skeleton bedded in hard travertine.

EARLY in the present summer seven more skeletons were discovered and these enabled anthropologists to determine that they were not Neandertal man but were indeed, as had been suspected, those of a new race of fossil men, which Sir Arthur Keith has named *Paleoanthropus Palestinus*, or "ancient man of Palestine." While the skulls and bodies are primitive types, having heavy supra-orbital ridges and curved femurs which suggest the Neandertal slouch gait, other features are quite different. The skull is higher, and a well-marked chin replaces the Andy Gump chin of the Neandertal species, though the mouth parts protrude in ape-like fashion as in the case of Neandertal man. The leg bones are longer than those of Neandertal man. At the time these notes go to press no illustrations are available.

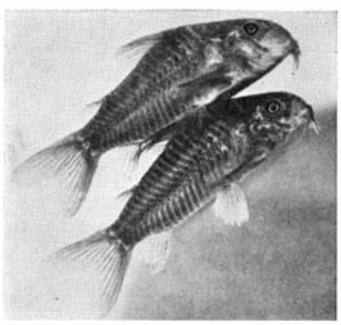
Most of the other animals occur or have at different periods occurred in numerous species and genera, and man is proving to be no exception. Still, why should he be?

[1] Bulletin of the Geological Society of China, Vol. 2, pages 107-108; 109-147; 147-154. *L'Anthropologie*, 1932, pages 1-17.

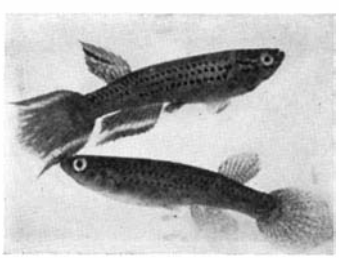


An amateur's aquarium filled with beautiful tropical fish

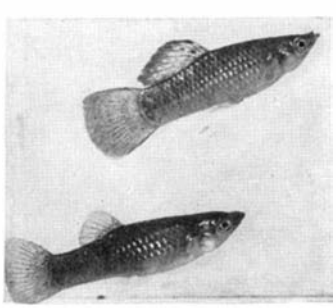
TROPICAL FISH AS PETS



Scavenger Catfish



Lyre Tail

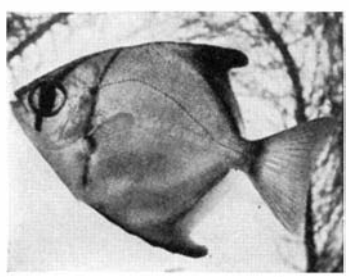


Sail Fin

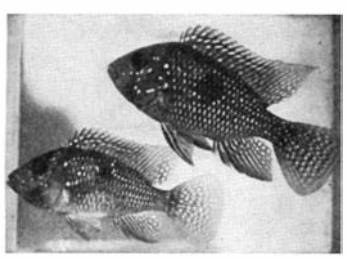
THE hobby of keeping and breeding tropical fish is giving pleasure and recreation to thousands. These fish are ideally suited to domestic quarters of small size. The study of these finned pets has introduced many to the subject of biology and has aided in self-education. There is also a scientific angle, because tropical aquarium fish are now being used in biological and medical laboratories. The commercial propagation of these fish is an industry of no mean proportions and is constantly growing. One metropolitan newspaper carries, every Saturday, half a column of ads of hatcheries and importers. We find whole stores devoted to the sale of tropical fish. Only the other day in passing through the basement of a great department store in New York we came across a pet shop where about 50 species were on sale. The prices run from 50 cents or less to 50 dollars or more per pair, depending on rarity. On at least one transatlantic ship a special room is given up to the transport of tropical fish from Germany.

The New York Aquarium has yielded to the popular interest in small fish and has installed tiny aquariums where some 200 species of little tropical fish are kept.

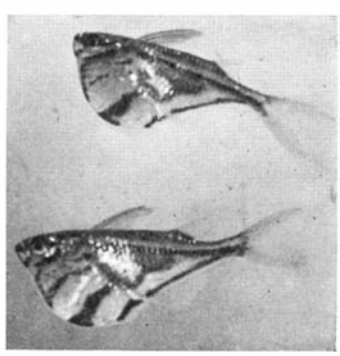
Many of the tropical fish are desirable for outdoor pools but they should be removed before the temperature falls below 60 degrees. They will thrive in a room with a temperature of 70 degrees. An electric aquarium heater is available when emergency heating is necessary. The well-balanced aquarium has plant life to provide oxygen and the water is never or rarely changed. Snails, tadpoles, clams, and other scavengers serve to keep the aquarium clean. For our picture of a balanced aquarium we are indebted to Mr. J. Lingg, an aquarist of Yonkers, N. Y., and for the pictures of fish, we must thank Mr. W. T. Innes of Philadelphia, editor of a new publication, *The Aquarium*, and the author of several books on the aquarium.



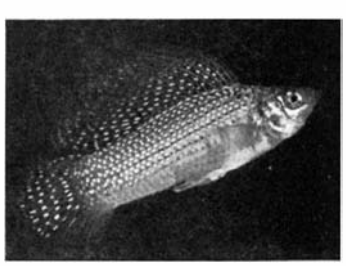
Silver Dollar Fish



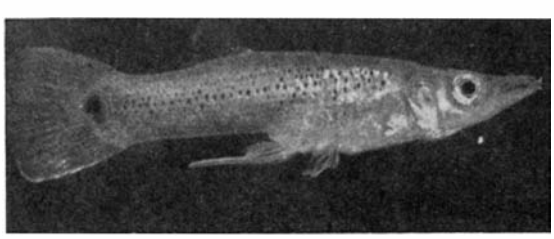
Braziliensis



Striped Hatchet Fish



Yucatan Sail Fin



Live-Bearing Piklet

Rasbora

FOOD FOR A FLOATING HOTEL

The Supplies for an Ocean Liner's Next Trip Are Ordered While 1000 Miles at Sea

By ALBERT A. HOPKINS

THE revictualing of a liner was simple in the old days when a ship laid at her pier for days, but as vessels became larger, faster, and exceedingly costly, quick turn-arounds became imperative and a stay of only 14½ hours in port is possible. The revictualing really begins at sea, two days before land or lighthouse is sighted. We do not mean that tugs or tenders come alongside and make fast to the speeding liner, but the net result is the same.

When the vessel is about midway across the Atlantic, a wireless is received which states that, for example, there will be in the neighborhood of 1800 passengers on the eastward voyage. The chief steward —that man of many parts—consults the chief cook, who never cooks anything himself but whose advice is good, as to the supplies on hand and what food will be required to be put on board at New York. The purser, as the "treasurer" of the ship, verifies the figures and gives the headache-producing sheet to the assistant purser in charge of stores. That individual disappears and presently comes back with a carefully coded wireless of interminable length which reads something like this: "Nordlloyd New York 33432, 51318, 44271 . . ." and so on. The last two numbers specify the quantity, the others the items. On receipt of the wireless it is decoded and the land commissary department gets busy telephoning orders to the wholesale butchers, grocers, and fruit merchants. The food must be delivered at a certain specified hour.

In our August issue we mentioned going through a square port in the side of the *Bremen*. It is through similar ports on the same "D" deck that the provisions are put on board with the aid of belt conveyors. Purser's men on the dock check the quantities and the chief cook looks after the quality.

It might be supposed that the various passenger classes are served different grades of food but this is not the case. There is no difference in quality but there is in choice. The first cabin passenger has 80 items on his dinner menu, the second cabin passenger has 50 items, the tourist class traveler 20 items, and the third-class sea-goer ought to be content with only ten, for he gets a good four-course meal with no limit as to quantity except his individual capacity.

On the "D" deck is the Main Street of the ship—for the crew. The food is taken to the routing room on this deck and is then sent to the "E," "F," and "G" decks below the water line, by electric elevators. Space that could be occupied by 200 staterooms is given over to the storage of provisions. About 12,000 dollars worth of food is usually put on board the *Bremen* and her sister ship, the *Europa,* at New York, and of course more at their home port of Bremen.

The passengers and crew must like milk and cream; they consume 3500 quarts each voyage

With a proper introduction to the chief steward we are assigned one of the commissary clerks as a guide. First, we pay our respects to the chief storekeeper, for he must know for what purpose the rooms are being opened. He has a tell-tale board where a miniature lamp lights up when any door is opened. Only seven men have the keys to these Aladdin food caves. Some of the smaller stores are kept in the storekeeper's own room.

The offerings look very tempting but we doubt if the captain himself would dare to abstract as much as an olive from a jar, for all the accounts are kept with true German precision and no bank vault is better guarded than are the stores. Of course, not all the rooms are of equal interest, for the potato and vegetable rooms are prosaic compared with the cheese room and the sausage room. The fruit room smells like a tropical jungle. This would be about the right place to introduce a table of quantities of food but we will resist our statistical urge and only mention a few items selected at random. Forty-two thousand pounds of meat are consumed on a round trip by the 3600 passengers and 975 members of the crew. Ninety thousand pounds of vegetables, 40,000 pounds of fruit, 60,000 eggs and 25,000 pounds of fish are among some of the items.

THE cold-storage rooms are perhaps the most interesting. Here the perishables are kept in solitary confinement with the sentence expressed in degrees Centigrade on the door. Every time a door is opened a light flashes on the board of the refrigerating engineer in the engine room and if the door is kept open too long and the temperature rises he sends up more brine through the cooling system. The range of temperatures varies from 42 to 46 degrees, Fahrenheit, for potatoes to 23 degrees for fish and 21 degrees for ice cream. Most of the vegetables are kept around 35 degrees.

People eat at sea and likewise do they drink; but in the latter case no supplies are brought aboard at New York! The wine stores are constantly being replaced on the other side; 15,000 bottles of wine are consumed each round trip. We cannot say that the steamship company puts any hindrance in the way of passengers consuming wines or liquors for they issue a wine list of 40 pages. All tastes and all purses can be accommodated. "Zeltinger of 1898" can be bought for 63 cents a bottle but if you have 37 dollars to spend you can get a bottle of Hatterheimer Nusbrunnen Trockenbeeren Auslese. This is certainly the high-water mark for the wine connoisseur.

If you want to go in for quantity

there is the "jereboam" or double magnum of champagne which should furnish the makings of a good party at 20 dollars. If your taste runs to liquors you can imbibe 100-year old brandy at 75 cents the *petit verre*. Six thousand six hundred gallons of beer are carried and consumed on each round trip. Of course, the supply comes from the other side. Without Münchner and Pilsener a German ship might as well open the sea cocks and sink. Mineral waters are provided in abundance. Those who care for a sundae or an ice cream soda can always be served at an up-to-date fountain.

The bottles are all secured so that there is no breakage. Some of the red wines are divorced from their brothers and sent aloft to enjoy a proper temperature in a "cellar" between the stacks. The wicked daughter of malt and hops is kept cold in kegs. Cigars are kept in humidors and the passengers smoke 15,000 on a round trip; 120,000 cigarettes is about right.

On taking leave of the chief steward he offered to show us, or rather have us shown, the kitchens.

There are seven kitchens—one for each class, one for the restaurant and one for the crew. The first cabin kitchen has 17 sub-kitchens such as "special diets," "vegetable kitchen," "cold dish kitchen," as well as others that are just as obvious. Those who desire Kosher food can have it prepared under the direction of a Rabbi.

A luxurious restaurant is provided on the top deck with its own special kitchen and highly trained stewards. About 25 percent of the first cabin passengers prefer to eat here à la carte. To these voyagers the line allows a 25 dollar rebate on the sum total of the checks in lieu of furnishing regular meals in the dining saloon. If you are a bad sailor you might win out, but the odds would be against you even then.

None of the chefs or the table stewards is employed in this restaurant unless he has had an apprenticeship at one of the great hotels of one of the capitals of Europe, such as Paris or Berlin, for a period of at least five years, and the stewards know all the art and niceties of serving a meal in the "grand manner." Live turtles and brook trout from an aquarium are among the delicacies provided.

We may say that the chief steward is probably the busiest man on the ship. He is the social head of the ship and it is his duty to see that the passengers have a good time. He runs the shops in "Peacock Alley," the bars, the soda fountains, the flower shop, the laundry. He distributes some 18,000 letters and 2000 packages. He also must collect about 12,000 dollars from the passengers at the end of the voyage, for there comes a day all too soon when the piper must be paid.

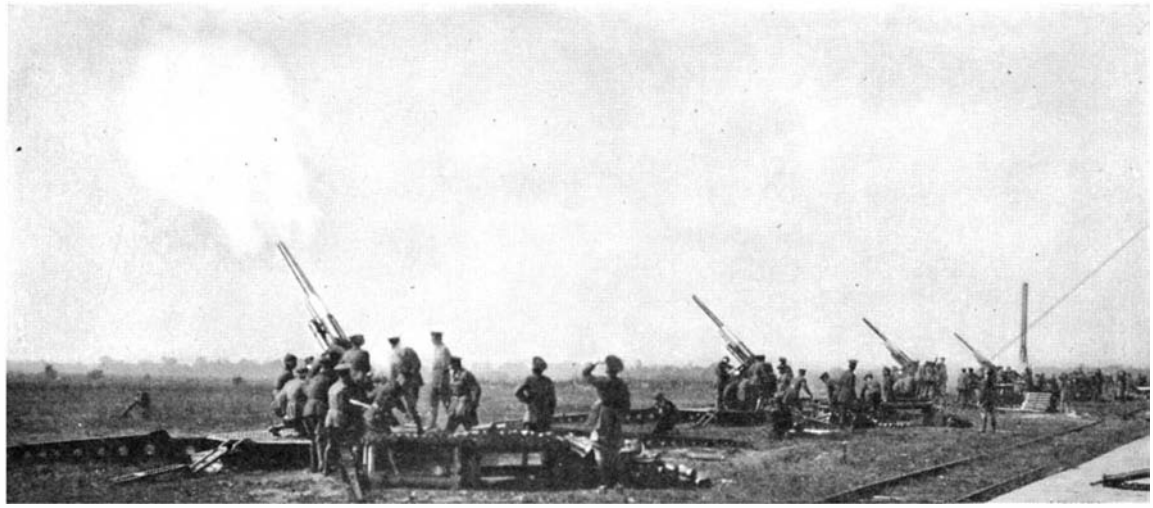
When we surrender our landing permit at the bottom of the gangplank we are struck with the immensity of the great ship we have just left which is really a great mobile "Grand Hotel" where individual taste is catered to as is rarely done on land.

All photos courtesy North German Lloyd

The chief storekeeper in his lair doles out some of the smaller packages and oversees all. Whenever a storeroom door is opened he knows—ask him how

***Left:* A choice of 150 vintages may appeal to you. Passengers consume 15,000 bottles each round trip. *Right:* Yes, it is the real thing, light or dark—6600 gallons in kegs**

Do you like such tasty things as hams, sausages, liverwurst and pork? Well, here they are in the flesh and in cans and glass jars in a most attractive storeroom



The type of gun being made centrifugally, the largest so far attempted: Three-inch anti-aircraft guns

WHIRLING MOLTEN STEEL TO MAKE GUN CASTINGS

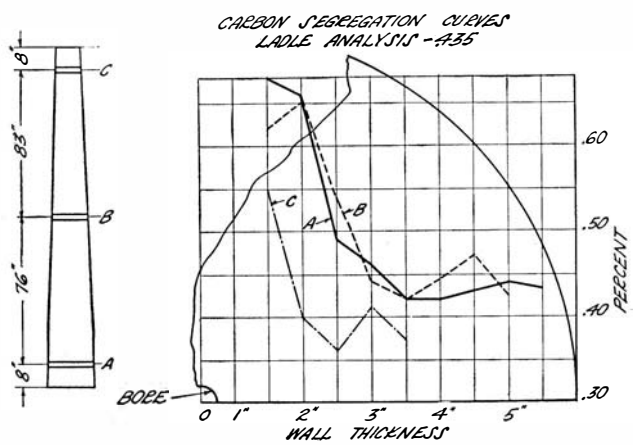
By STEVEN L. CONNER
First Lieutenant, Ordnance Department, U. S. Army

THE advantages of the centrifugal casting of iron and steel for particular purposes has long been recognized. Centrifugally cast iron pipes were made nearly a century ago and described in the December 1, 1849, issue of *Scientific American*. In our January, 1931, issue, we described a centrifugal process of casting steel ingots that was superior to old practice. Now the process has been applied to the manufacture of steel cannon, as explained in the accompanying article. In this application, centrifugal casting assumes a place of no little importance in the scheme of national defense—*The Editor*.

AFTER years of research, the manufacture of cannon from cast steel is now an accomplished fact. Molten steel is poured into a rapidly revolving mold where centrifugal force shapes it to the form of the mold. The result is a piece of ordnance superior in many ways to anything heretofore produced.

The earliest successful cannon were bronze castings. As the need for greater strength became apparent, wrought iron was used, frequently in the form of hoops or jackets shrunk into place. The first cannon for which sound engineering design was used was the famous Rodman gun. Cast iron had been used more or less successfully for a hundred years or so when Rodman cast his cannon. He used the internal powder pressure curve for his external shape—hence the fat-breech guns of a few decades ago—and cooled the metal at the bore with water during solidification of the casting. This was approximately contemporaneous with the Civil War. As the science of artillery progressed, the power of guns increased and their weight decreased until finally the forged steel gun came into being. By 1890 steel forged to shape was the accepted ordnance material. Attempts to make cannon by casting steel were made, but were uniformly failures.

A gun is a tube, closed at one end. Within this tube high pressures are developed to propel the projectile. The metal near the center is subjected to high circumferential stresses by this pressure, while the metal near the outside has but little work to do. Guns must be movable, so weight enters as an extremely important factor. Rodman put the metal at the center under a compressive stress by his method of cooling. The result was that a higher explosive pressure could be used, or a lighter gun could be made. By wrapping steel tubes with wire under tension, or by shrinking jackets and hoops into place, guns of forged steel may be made which are light in weight and yet can withstand the highest chamber pressure the artillery man calls for.



Chemical analysis graph for three-inch gun casting

There are many reasons why the centrifugal casting process is a notable advance in the art of gun manufacture. Improvements are constantly being made in all forms of cannon, and types now made immeasurably surpass anything used in the World War. In the event of a major national emergency in the future, vast quantities of new artillery will be needed very rapidly. From a metallurgical point of view, forgings for cannon must be of exceptional quality. Their production is a long process, requiring great skill and experience. Equipment and personnel capable of the operations are extremely limited. Under the stress of war conditions, the inevitable result is a sacrifice of quality to quantity. Since steel must be cast into ingots for forging, about one half of the total metal is wasted. Due to the drawing nature of the forging operations, the finished forging is much stronger in the longitudinal direction than it is in the transverse direc-

tion. For guns under five inches in bore diameter, forgings must be made solid, necessitating a difficult machining operation involving additional waste.

Let us make a comparison of the two methods of production. Starting with molten steel, in the one we produce an ingot. For a day this ingot is cooling; for another day it is heating; and for still another day it is soaking at heat. Four days are consumed before the rough forging has been produced, and at least 35 percent of the original molten steel has been discarded. This forging is stronger longitudinally than transversely; it is roughly round; and it is solid.

In centrifugal casting practice, we produce from the molten steel a round, straight tube with a hole, accurately round and truly centered, already in it. Within 20 minutes of pouring, this casting is ready to proceed to the heat-

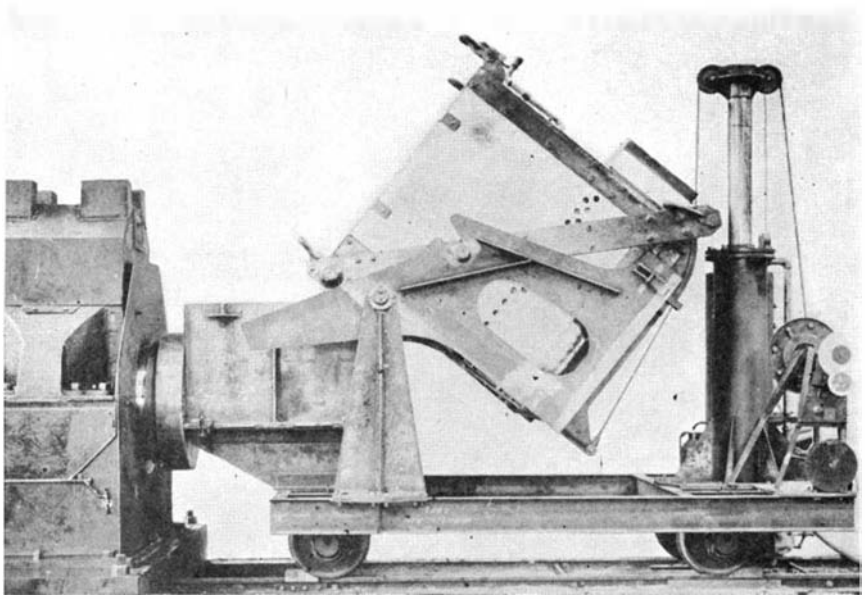


Figure 1: **High frequency induction furnace being used as a lip-pour ladle**

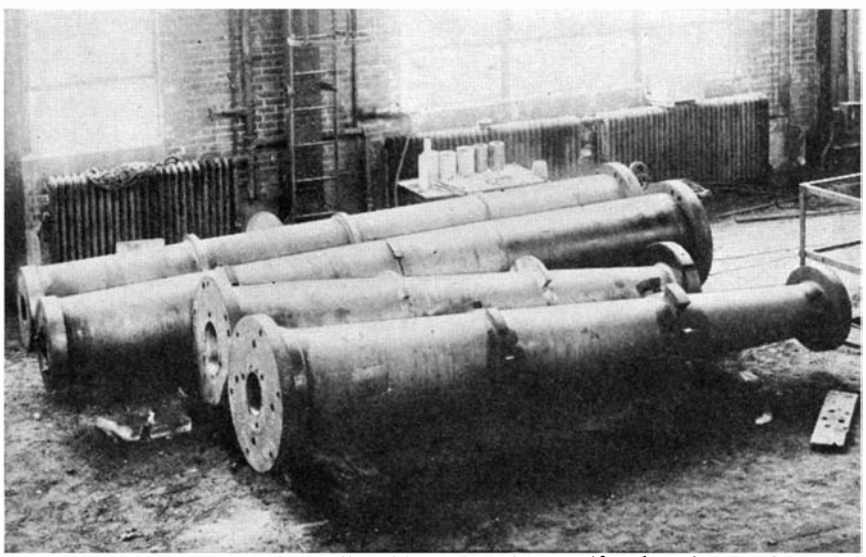


Figure 2: **A group of the chill molds used in the centrifugal casting machine**

high grade molten alloy steel. This may be conveniently produced in high frequency induction furnaces in amounts nicely adjusted to the requirements. Figure 1 shows such a furnace being used as a lip-pour ladle on a special pouring car used for pouring into rotating molds. Chill molds of exceptionally high chill ratio have produced the best results. Figure 2 shows a group of these molds. They are made of cast iron in a single piece; the largest in the illustration is 16 feet and three feet in diameter at the large end. This mold is designed to make a heavy three-inch gun. The molds are bored internally to the size of casting it is desired to make and, of course, a separate chill mold is needed for each size of cannon. A suitable machine, such as shown in Figure 3, is needed to support the mold and

treating operations. The total discard necessary is under 5 percent of the gross weight of the molten steel. This casting is in every way the equal of the forging produced, and there are three ways in which it shows a marked superiority. It is as round as though it had been turned on a lathe, and a hole exists throughout its length. It has no directional characteristics: that is, its physical properties are the same in all directions, transverse as well as longitudinal. Due to the fact that the casting has cooled in shape under the action of centrifugal force, a considerable segregation of the constituents of the steel occurs. This is exceptionally marked in the case of carbon, the strength-giving element. The graph indicates the results obtained by chemical analysis of material at various positions in a two-ton casting for a three-inch gun. We have our strongest material at the center where the stresses to be handled are the greatest.

Satisfactory cast steel cannon require

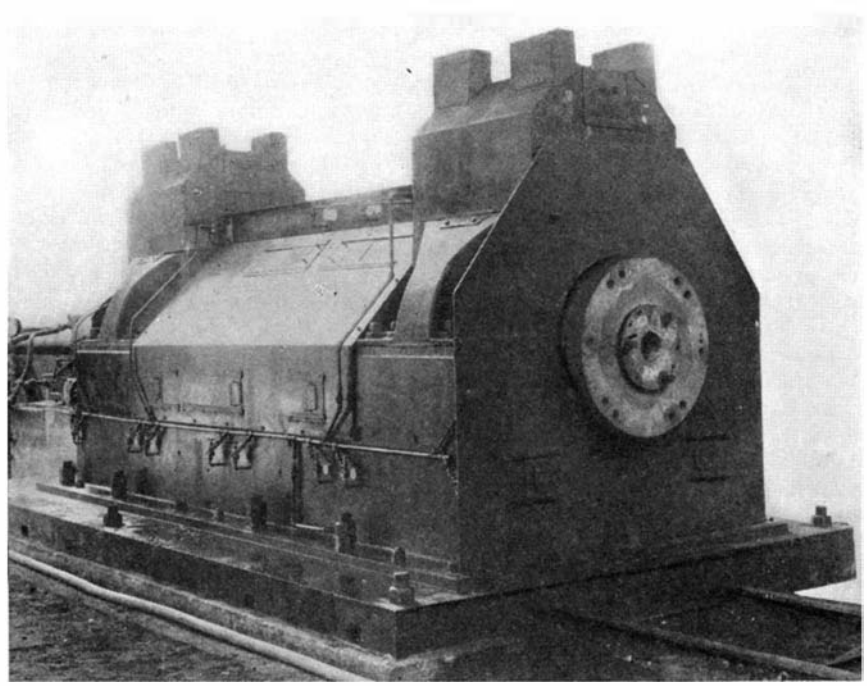


Figure 3: **The machine used to support the mold and rotate it at proper speed**

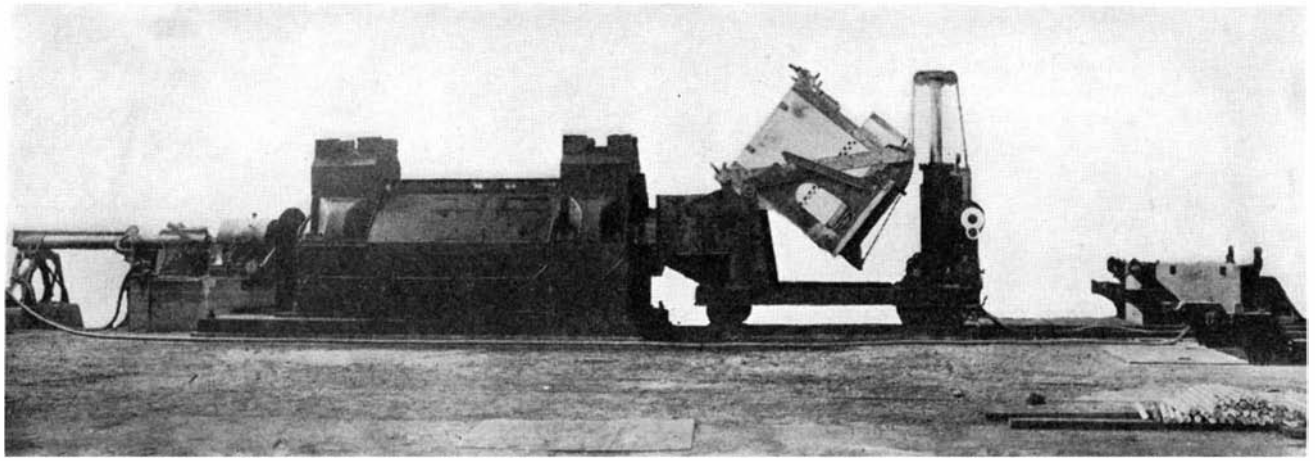


Figure 4: **Medium centrifugal casting machine with furnace in pouring position. Driving motor and push-out ram at left**

rotate it on a horizontal axis. It consists of a steel cylinder, motor driven at the non-pouring end, mounted on rollers. The inside of this cylinder is bored to fit the external bearing surfaces of the chill molds. The molds may be slipped in and are held in place by studs through the exterior flange at the pouring end. The holes for these studs are shown in Figure 3. Corresponding holes are drilled and tapped in the end of the steel cylinder. Molds are easily changed by removing holding studs and sliding the mold out.

To produce a cast steel gun, the proper mold is inserted in the machine and preheated. The desired quantity of steel is melted in the furnace. A runner box, shown on the forward end of the car in Figure 1, is prepared. This is a built-up firebrick funnel contained in the steel box and terminating in a horizontal sprue of suitable size. The mold is closed by a venting plug in the non-pouring end and a bushing at the pouring end to receive the sprue. This bushing is shown wedged in place in Figure 3.

When the steel is ready, the machine is started and brought up to the desired speed: 500 to 1500 revolutions per minute depending upon the size of casting being made. The runner box and furnace are placed on the pouring car, the sprue is fitted to the bushing, and the steel is poured into the mold. Figure 4 shows a general view of the equipment during the pour. The driving motor and the push-out ram may be seen at the non-pouring end of the machine.

When pouring is completed, the furnace is removed and the machine allowed to spin until solidification is complete. This time varies from 10 to 20 minutes depending upon the size of the casting. A two-ton casting is ready to strip in about 19 minutes. The pouring car is removed and the machine brought to a stop. A roller frame is set before the mold and the casting pushed out. Figure 5 shows a casting as received onto the roller. The handling ring at the large end is in place on the roller to receive the casting. The surface temperature of such a casting is normally about 1000 degrees, Centigrade. It is immediately hung vertically in a soaking pit and cooled very slowly to room temperature. Figure 6 shows a 3000-pound casting after cooling and cutting. A discard of about three inches has been taken from each end, disclosing the small cast hole that is formed.

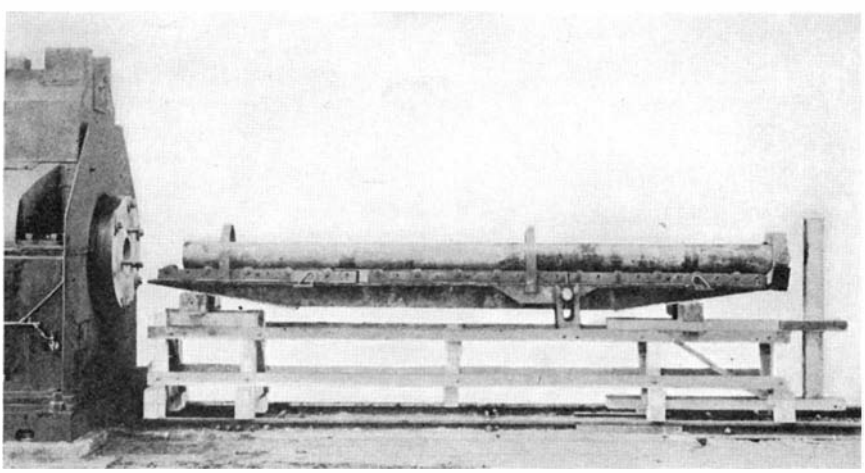


Figure 5: **A three-inch gun casting pushed out of machine after casting**

THE advantages of the cast gun may be briefly reviewed. Simplicity of manufacture and economy stand out. The product is ideally suited for its intended purpose: in fact no other method of manufacture can produce a comparable result. And most important of all, from the military point of view, the rapid production and uniform high quality combined offer an excellent solution to the knotty problem of supplying modern artillery to the nation in the event of a major national emergency.

The process and equipment for the production of centrifugally cast cannon have been developed during the past few years at the Watertown Arsenal, a manufacturing plant of the Ordnance Department of the United States Army, by Colonel T. C. Dickson of the Ordnance Department.

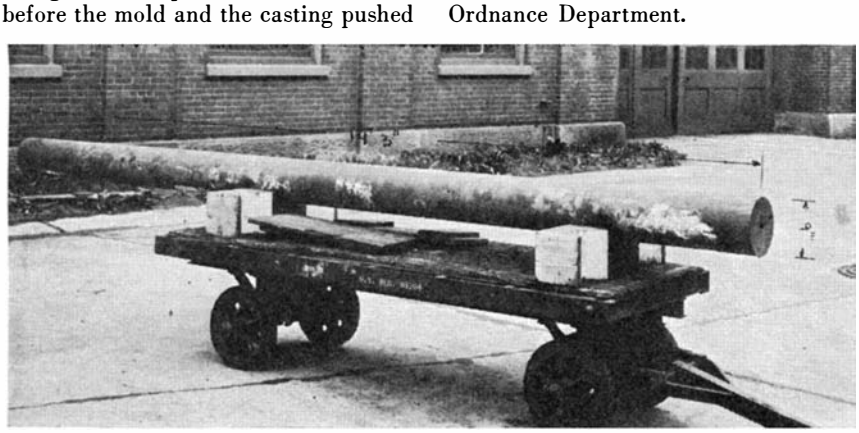


Figure 6: **A 3000-pound casting after cooling and cutting. Note hole in end**

TREASURE TROVE IN LOWLY 'SWEEPS'

SCRAP piles and dust heaps are not generally productive of wealth but in the case of the jewelry trade they are the basis of a thriving industry. In the past most of the wealth in the waste from such sources was lost because of the unscientific methods of refining the waste. The waste products include the sweepings from floors where gold and silver are worked, and even the water used in washing down the walls, discarded woodwork, and the workers' clothing, including shoes. All is grist to the refiner, who must be "on the level" if he wishes to remain in business, for competition renders him immune to ordinary temptation even if he were inclined toward it.

The waste material is first reduced to powdered form and is then divided and redivided. One part is assayed by the smelter, another by the seller, a third goes to an umpire (in case of a difference), and a fourth is held in reserve. Here indeed we have "check and double check."

THE waste materials seldom bear even a remote resemblance to the refined product later to be obtained. The material is first sorted with the aid of shovels into convenient piles. It is next burned at high temperature until it becomes thoroughly disintegrated. Later it is ground until it is reduced to a fine dry powder. A pile of a few bushels of this dust may prove to be worth 100,000 dollars or more, and the assaying of a sample must be carried out with extreme accuracy. The entire consignment of sweepings is paid for according to the percentage of precious metal found to be in the sample.

"Sweeps" and other fine materials are charged into a pug mill in which they are mixed with water before being transferred to a blast furnace. The highest grade of sweeps, concentrates and similar materials, and also rich copper bullions, are smelted directly in a cupel or test furnace. The lower grade bullions are charged directly into a converter.

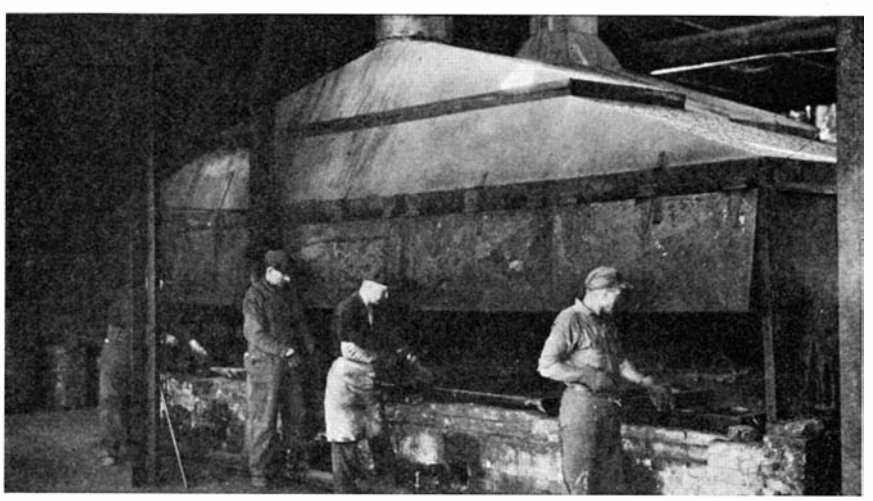
Sweeps of medium grade and other materials adapted to blast furnace treatment are usually smelted with lead as a carrier, which is supplied by including litharge (lead oxide) in the charge. Lead pigs or lead bullion from the blast furnaces are charged into oil-fired cupels or test furnaces, where they are subjected to melting and air oxidation. Litharge is formed as a liquid floating upon the molten lead, and is allowed to overflow into pots or molds. This litharge, being lean in precious metals, is returned to the blast furnaces to be used again. The silver bullion, with its gold and platinum content, remains behind in the hearth of the test furnace and is ladled out into molds.

If the silver bullion is low in gold and platinum, the metal is cast in anode molds and the resulting anodes are sent to the electrolytic silver department. If, however, there is a large quantity of gold and platinum metals, the bullion is cast into thin slabs which are treated with concentrated sulphuric acid in iron kettles. Silver goes into solution and gold and platinum are held back as residues. The silver solution is kept in lead lined tanks and is precipitated with copper. The residues containing gold and platinum are treated electrolytically.

The test furnaces also handle certain original materials, such as high grade bullions and concentrates, and rich slimes from other departments, hence much of the values contained in them enter the silver bullion and are subject to prompt recovery.

We are indebted to John Drake, Executive-Secretary of a national jewelers association for our material.

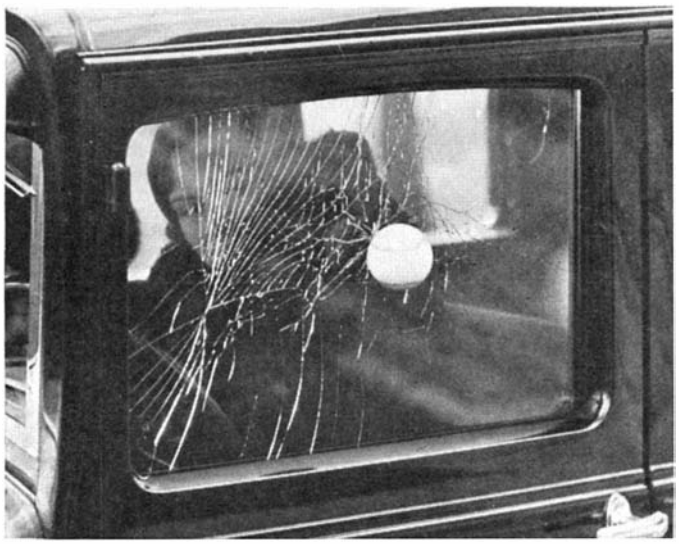
A 5000-dollar barrel of "sweeps" as it is received by the refiner, before crushing



Large furnaces dry the "sweeps" as they come to the refinery from various sources. This is the first stage in refining. Reduction to powder is the next step

After reduction to powder the mass is divided into four parts for assay by interested parties

BUILDING SAFETY INTO AUTOMOBILE GLASS



When the safety glass in the door of a car is struck, it will crack badly but will be held together by its sealed-in celluloid center

By BYRON C. FOY
President, De Soto Motor Corporation

SAFETY glass is one of the truly great discoveries of our generation. Every year it prevents thousands of accidents from causing grievous bodily injury. It is enabling millions of men, women, and children to travel in greater safety than ever before. And like so many other "indispensables," its discovery was itself an accident.

It happened in the laboratory of a French scientist named Benedictus, 28 years ago. He had been using a bottle of collodion or some similar cellulose nitrate in solution. By some chance the solvent evaporated, leaving a skin of cellulose nitrate on the walls of the bottle. Then, in rearranging his equipment, Benedictus happened to dislodge this bottle from its shelf and it fell to the floor with a crash. It shattered, but to the scientist's astonishment it retained its shape. None of the particles was scattered.

Now it is probable that Benedictus would have completely forgotten this incident had he not read in his newspaper, a few days later, of an automobile accident in which a young woman had been seriously cut by flying glass. The two events connected themselves in Benedictus' mind, and laminated safety glass was the outcome. That was in 1904.

The modern type of safety glass that the wise motorist specifies for his new car, differs very materially from that which was in common use a few years ago. Formerly, laminated glass was made from window glass or sheet glass. Naturally, it had all the characteristics of that product and it must be admitted that it gave rise to many misconceptions, both among the general public and among automotive engineers. They believed, rather naturally perhaps, that the defects of the product were due to the laminating process rather than to the glass itself.

Inspecting pyroxylin for defects, and cutting sheets of it to the outline of a glass pattern

Sheet glass is never a *flat* product in the strict sense of the word. It always presents a wavy surface which tends to distort objects that are viewed through it or reflected from it. This same characteristic remains when sheet glass is laminated into safety glass.

It is very different with plate glass. This starts out as a rather rough sheet which is subjected to extremely careful and exacting processing to produce surfaces which are very nearly optical planes and almost perfectly parallel to each other. The result of this grinding and polishing is to produce a piece of glass that does not distort objects which are viewed through single or laminated sheets of it. Besides plate glass, there is another raw product used in the manufacture of the finished safety plate glass and that is pyroxylin, or as it is frequently called, celluloid. It, too, has been immeasurably improved during the past few years. Defects in the pyroxylin which were not apparent under ordinary sheet glass, became glaringly noticeable when plate glass was used, and had to be eliminated. Another source of worry—haze—proved to be a defect in bonding and this, too, was overcome.

THERE are several laminated safety plate glasses produced in the United States. The method of making one of the better known is essentially as follows:

Two plates of 7/64-inch glass are required for each finished piece of Duplate. These are given an intensive examination before they are laminated, cut to size, and matched up exactly.

From the inspection and cutting room, the glass enters the head of the assembly line, where it is once again thoroughly scrubbed with water and pumice to insure absolutely clean surfaces. The pumice is removed by brushes under a suction hood and the glass continues on its way, next encountering a small compartment in which a large swinging spray deposits a uniform coating of a gelatinous adhesive over the plates. Just beyond this point the pyroxylin enters the line.

In the meantime, the pyroxylin has run a gauntlet of inspections. The rough sheets, just as they were cut from the huge blocks of raw pyroxylin, are first tested for

the content of volatile matter. Then follows a close scrutiny under the all-revealing light of Cooper-Hewitt lamps, first against a black background and then against a white. All defects are marked and eliminated in one way or another, usually by cutting a pattern to avoid them. After this examination, the pyroxylin sheets are cut to match exactly their companion plates of glass and then cleaned. No adhesive is applied to them.

Now we are back in the assembly line. As the glass leaves the spray room it passes through a drier which removes the excess moisture from the adhesive. Then comes the filling of the "sandwich." The pyroxylin sheet enters the assembly line—an operator places it upon a sheet of glass, then places the companion plate on top.

Scrupulous care must be exercised to exclude all dust and foreign matter from the assembly line enclosure. The air is filtered and the operators wear dust-free clothing. Nevertheless, the assembled glass and pyroxylin is again examined to make certain that it is flawless.

Up to this point we have been dealing with three separate and distinct parts of a whole, but from here on, one individual unit is handled. The assembly is placed between the faces of a platen press, under considerable heat and pressure, for a few minutes in order to bond the edges thoroughly before the next step in the process. From the platen presses, the laminated plates are stacked on racks, usually on edge, preparatory to being subjected to the rather high pressures of the autoclave.

THIS autoclave is an immense vertical steel cylinder, capable of receiving a plate 48 inches wide and 84 inches long. It is equipped with a system of pumps for circulating the liquid within and for building up the pressure; with a pressure-tight cover which can be securely locked in place; and with a steam coil heating system for raising the temperature.

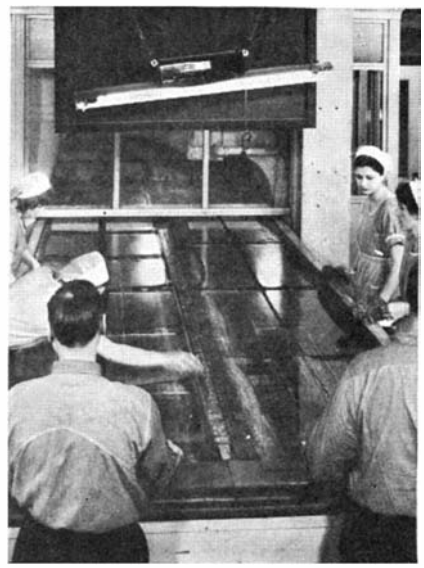
When the laminated glass comes out of the autoclave, its optical characteristics remain unchanged. It has been subjected to the compacting hydrostatic pressure of 125 pounds per square inch, and the unifying temperature of 240 degrees, Fahrenheit. Since the pressure is uniform all about the plate, edges as well as face, there is no tendency for the edges to be pinched together as was formerly the case, and the pyroxylin is just as thick at the edges as it is in the center of the plate.

Pressing in the autoclave is the last essential step in the manufacture of laminated safety plate glass. The rest of the process is one of finishing the edges. Excess pyroxylin is scived off and the plates are then immersed in warm, concentrated sulfuric acid. The acid penetrates the edges of the plate and eats or etches out the pyroxylin to the depth of about one eighth of an inch. This is called grooving. The grooved plates next go to the edge-sealing wheels.

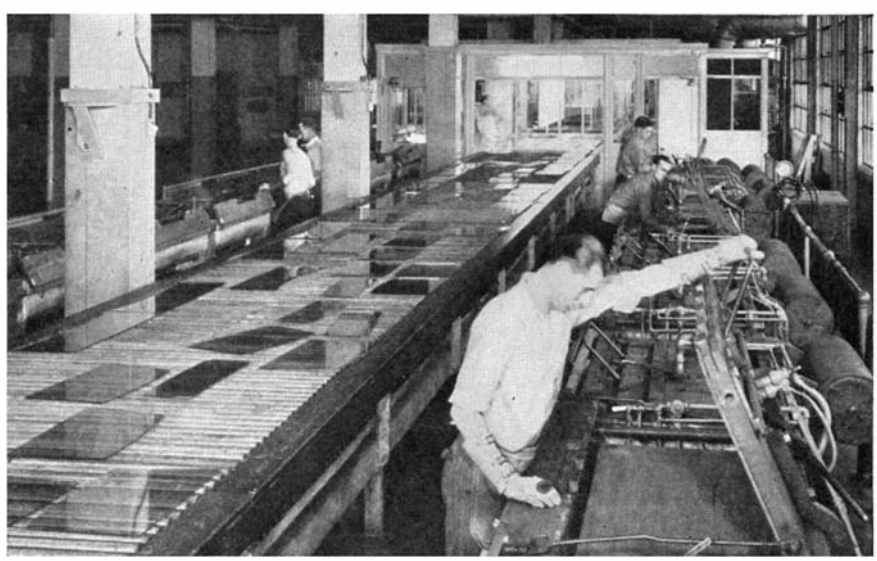
Edge sealing is accomplished by forcing a cold resinous cement into the grooves left by the acid treatment. Such sealing is important, if not essential, where the edges are to be held in fixed channels in which moisture may gather, but seems to be entirely unnecessary on open edges. The object of sealing or calking the edges is, of course, to prevent the absorption of moisture by the pyroxylin. The separation so often noticed in former windshields was partly caused by moisture penetration, partly by pinched or strained edges, and partly by the evaporation of solvents.

The final step in the production process is grinding and polishing the edges, where this is required. It is done by edging machines and abrasive wheels, and considerable skill is required to produce smooth, rounded edges. The laminated safety plate glass is then ready to be packed and shipped. At every step during the manufacture of this new product, it is carefully inspected to insure perfection.

Another interesting development is Multiplate, a bullet-proof glass intended for use in banks, cashier's cages, and the like. It is made up of a plate of 7/64-inch plate glass, a sheet of pyroxylin, a plate of ¾-inch heavy polished plate glass, a sheet of pyroxylin and a plate of 7/64-inch plate glass. It will actually stop a .45 Colt automatic bullet. It is the thickest safety plate glass made. At the other extreme is Aerolite—made of the thinnest photo glass and designed for use where weight is the controlling factor, as in airplanes and airships.



Start of the assembly line under the rays of a mercury vapor lamp



A battery of pressing machines which complete the first step in the welding-together process. The conveyor brings the glass sandwich from assembly room

Racks of preliminary pressed Duplate being lowered into autoclave

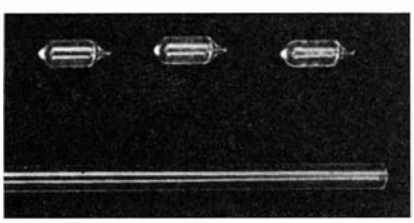
QUARTZ TAKES UP FIRE FIGHTING

By GRACE LOCKHART

PERHAPS there is no cry which strikes greater terror to the heart of mankind than the cry of "Fire!"

To outwit fire, to control fire has been a vital, constant problem. For countless years men have listened fearfully, intently for the crackle of blazing brush in the forest; for the soft, licking noise of flame in their wheatfields; for the muffled roar of the marauder in their homes. Concentration of population in large cities increased the hazard, and with the advancement of science, extraordinary skill and ingenuity were applied to the invention of fire-fighting apparatus.

First and last, however, water has been man's most powerful ally against



Transparent quartz tubing and sprinkler bulbs formed from it

fire. But the difficulty lies in getting the water to the fire and on the fire quickly enough. The invention in 1875 of the automatic sprinkler system (successor to a more or less elaborate perforated pipe system) provided an answer to this problem. Developed by engineers after long, patient experimentation, the sprinkler system revolutionized fire fighting. Heat from the blaze melts the fusible solder of the sprinkler head at a predetermined temperature, a flexible diaphragm bends upward, a valve opens, and a drenching downpour of water is released. Thus the column of heat rises to its undoing.

In spite of everything that skill and ingenuity, caution and precaution achieved, however, the nation's fire bill last year reached a staggering total of 500,000,000 dollars.

No major triumph having been scored in automatic fire protection since the invention in 1890 of the link and lever type solder sprinklers, the recent announcement of a quartz bulb sprinkler head by the Grinnell Company, of Providence, Rhode Island, created widespread interest. For fire protection the problem is not to create a device that will withstand wear, but one that will remain inactive over long periods and then operate effectively in an emergency. Certain physical elements inherent in the solder type strut, such as high fusing point, the fact that solder is vulnerable to corrosion, and the effects of loading or dust coating on the reliability of solder head action left the door open for scientific skill to walk in. It did, with quartz in its hands.

THE 2,000,000-dollar fire which recently destroyed the famous Cunard piers in New York sharply emphasized the urgent need for sprinkler protection of our largest port, and directed attention to the recent automatic sprinkler installation in New Orleans which provides protection for 26 miles of waterfront property and more than a billion dollars worth of merchandise annually.—*The Editor.*

The use of quartz introduced an entirely new principle of sprinkler head operation. Fusible alloys as the controlling feature are discarded. The operating element of the new head is a hermetically sealed quartz bulb which contains a measured amount of liquid that expands and bursts the bulb at a predetermined temperature. This temperature may be set wherever desired. After extensive investigation of temperature ranges, 135 degrees, Fahrenheit, was selected as the lowest practical operating temperature. As there is no progressive weakening of the quartz bulb sprinkler, the environmental temperature may approach the opening point without affecting the bulb.

The cycle of operation causes sharp fragmentation of the bulb with force sufficient to break coatings of cement dust or other factory dusts that would be fatal to a solder type sprinkler. Laboratory tests and actual fire tests have established the fact that the quartz bulb sprinkler operates in one half the time of the solder type. A fire of sufficient intensity to open a solder type sprinkler in five minutes opens the quartz bulb sprinkler in two and one-half minutes. The opening cycle may be briefly described as follows:

THE bulb is nearly filled with a liquid, the remaining space being largely a bubble. The liquid used is chosen because of its low freezing point —40 degrees below zero, Fahrenheit— its large coefficient of expansion, slight compressibility, low specific heat, and the reluctance with which it retains air in solution. Quartz bulb sprinklers have been immersed in liquid oxygen at a temperature of 295 degrees below zero without injury.

When the head is exposed to rising temperature, the liquid expands and the bubble gradually decreases in size, the air being forced into solution because of the increasing pressure. When the air is dissolved and the bulb filled entirely with the expanding liquid, an almost irresistible force is brought to bear on the walls of the bulb. At the instant of rupture, the pressure is suddenly decreased and the air held in solution is free to escape with an explosive action sufficient to shatter the bulb regardless of loadings.

Each head is subjected to an internal water pressure of 1000 pounds per square inch, and thoroughly checked in order to insure uniformity and dependability under service conditions.

Microscopic examination of bulbs after they are filled and sealed

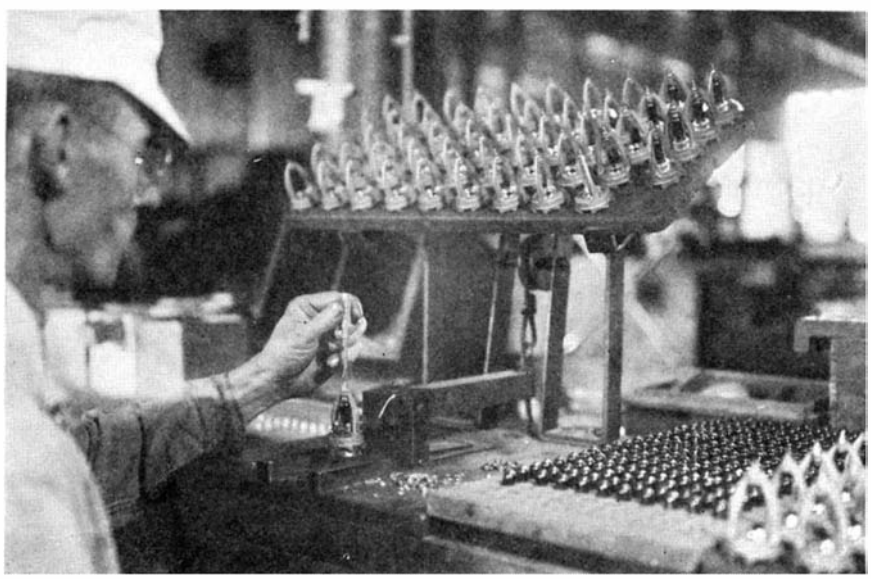
The opening point, once fixed at 135, 175, 250, or 325 degrees, remains fixed indefinitely. The sensitiveness, promptness, and effectiveness of the quartz bulb in action, and its immunity to corrosion renders the head particularly valuable for waterfront property.

Quartz, like gold or platinum is not affected by time. It is a compound of silicon and oxygen, and occurs in a

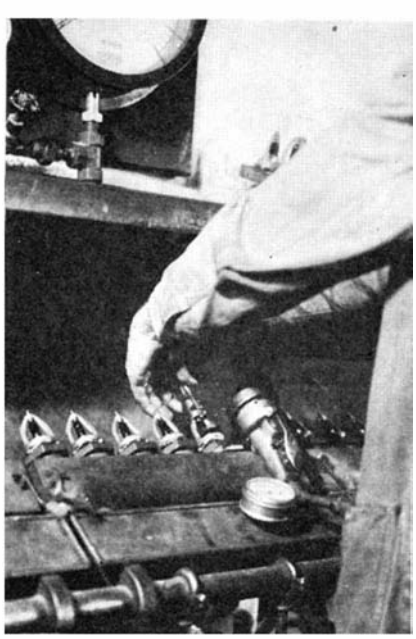
wide variety of crystalline forms, ranging from minute grains of sand to single crystals weighing half a ton. As it is an exceedingly hard material, it loses its crystalline form only when subjected to intense temperature (about 3000 degrees, Fahrenheit.) The resultant transparent, glass-like substance has unusual ability to resist sudden changes of temperature due to its low coefficient of expansion—about 1/14 that of glass.

Until recently, the use of non-crystalline quartz was confined to scientific apparatus because of its costliness. Such apparatus was made by fusing a bit of crystal in an oxy-hydrogen flame and then joining to that bit another fused globule, thus laboriously building up the desired shape. A natural phenomenon eventually pointed the way to production for commercial use. It was observed that lightning bolts striking certain parts of the earth's surface composed largely of quartz sand, notably areas in South Africa, formed rough pipes of fused quartz.

Where more than 100,000 quartz bulb sprinklers have been installed in the docks on the right hand side of the Mississippi River in the city of New Orleans



The process of setting quartz bulbs into their frames is very exacting. Note stock of bulbs at operator's right, and frames on rack with and without bulbs



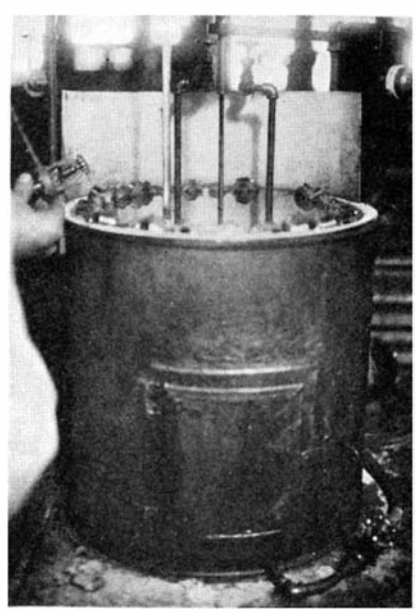
Pressure testing and adjusting bulb to insure proper tightness of seat

Duplicating this trick was simple. A graphite rod and an electric current were substituted for the lightning bolt. As quartz does not assume a liquid form, but becomes plastic and passes directly from that state to vapor, the sand particles enclosed countless air cells in process of fusing which weakened the quartz and gave to the mass an appearance of silvery translucency.

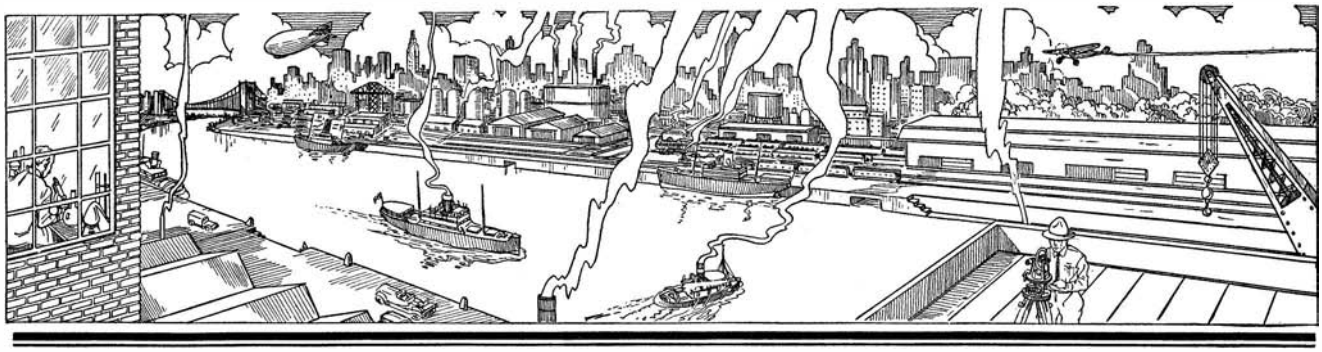
Changes were therefore made in the process. Selected crystals of considerable size were employed instead of sand, and a vacuum of high degree produced before fusion. Air bubbles were thus obviated, and transparent fused quartz having all the properties of non-crystalline quartz was finally made available for commercial use.

The largest automatic sprinkler installation in the world was completed recently in New Orleans where 26 miles of waterfront property and 27 dock units, which annually accommodate more than a billion dollars in merchandise, are now protected by the quartz bulb sprinkler.

This sprinkler installation involved an investment by the state of Louisiana of 1,500,000 dollars, and it included special precautions to prevent dock fires from spreading either above or below the floors of the wharves. The project includes 118,000 quartz bulb sprinklers, 250 separate sprinkler systems, 250 alarm valves, and 2000 open sprinklers, controlled by deluge valves capable of releasing a Niagara of 2,000,000 gallons of water per minute. Water distribution is assured to every point of the docks by 1,500,000 feet of pipe, varying in size from three quarters of an inch to eight inches and supported by 150,000 hangers.



The finished heads are tested in hot water almost to breaking point



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

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

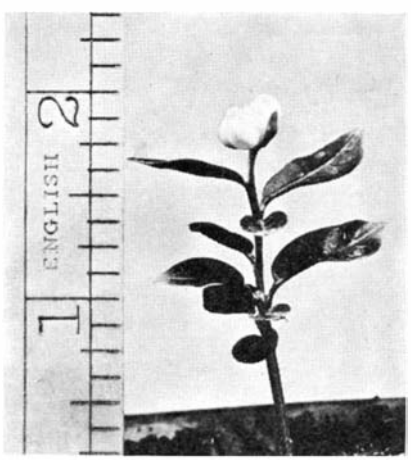
A. E. BUCHANAN, Jr.

Lehigh University

Youthful Maturity

STILL seedlings, upwards of a month in age, but already in flower—such has been the experience of two grapefruit plants in the electric hothouse atop the roof of the General Electric research laboratory at Schenectady. Under normal conditions grapefruit plants are at least five years old, and more usually ten, and at least a few feet high before they flower; but these plants are less than two inches high, have had their heads above ground only a matter of days, and are still wearing their "baby" leaves. Their flowers are dwarfed, but otherwise normal in appearance.

The early flowers are the result of X-ray treatment of the seeds, in the belief



The seed of this grape fruit was X rayed. It flowered when it was five weeks old and two inches high

of C. N. Moore and C. P. Haskins, who are studying the effect of X rays on plant life. One seed, exposed to 200,000-volt, 30-milliampere X radiation for two minutes, produced a plant with normal leaf and flower coloration but with leaves somewhat elongate and diminutive and with a deficient root system. The other seed, subjected to the rays for eight minutes, produced a plant lacking in chlorophyll or green coloring matter (which effect frequently is encountered in citrus seedlings), but with the stamens of the flower of the proper golden color.

The seeds were part of a quantity supplied to the laboratory by the College of Agriculture of the University of California, from stock ordinarily yielding most uniform plants. On March 8 they were rayed, after having been soaked in distilled water and dried; and on March 16 they were planted in seed flats within the electrically-heated roof garden. Snow and winter were still in evidence, but within the structure the temperature was uniformly warm. On April 14 the plants began to sprout. Before the end of May the two flowers were in evidence, and on June 6 were in full bloom.

Whether the tiny plants would have had full-size, or even dwarfed, fruit will never be known. The experiments called for the removal of the pollen for use in additional experiments.

"It is hardly thought, however," said Mr. Haskins, "that the flowers could have matured into fruit. And neither should it be concluded that early flowering plants can be produced regularly by X-ray treatment. Other rayed seeds produced such abnormalities as twisted stems, double leaves, and blotches of white; and still others produced apparently normal seedlings. So far it has been a matter of chance as to how the chromosomes and genes—those tiny but controlling factors of heredity—might be affected by the X-ray treatment of the seeds. Promising leads of many kinds have been obtained in the work that is being done with seeds, bulbs, and plants of many species, but it is too early to make definite statements regarding the results obtained."

Operates to Relieve Protruding Eyes

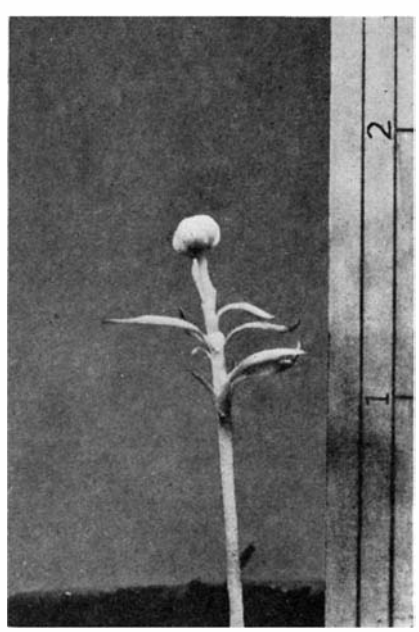
PROTRUDING eyes caused by goiter, which sometimes persist after the goiter has been removed, may themselves be corrected by a surgical operation, Dr. Howard C. Naffziger, of San Francisco, reported to the American Medical Association. He reported gratifying results on six patients who had the operation on both eyes. Their eyes have receded to the normal position, their vision has been restored, and there has been no recurrence thus far.

In this condition, the muscles around the eyeball are swollen from three to eight times their normal size, causing abnormal pressure within the eye socket, and forcing the eyes to bulge out. In the operation, a bit of bone is removed, giving more room for the eyeball and releasing the pressure on the optic nerve by enlarging the passage through which it and the artery supplying the eye with blood enter the eye socket.—*Science Service.*

Study Poison Auto Exhaust in Tunnel

A COMMITTEE composed of representatives of the United States Bureau of Mines, Mellon Institute of Industrial Research, the University of Pittsburgh, the United States Weather Bureau, and the Departments of Health and Safety of Pittsburgh, Pennsylvania, has just completed a study to determine concentration of carbon monoxide at busy traffic points in Pittsburgh. The study was carried out in the Liberty Tubes and continued for more than six weeks under varying conditions of traffic, temperature, and weather, according to *Chemical and Metallurgical Engineering.*

The survey developed that the concentration of carbon monoxide often exceeded a desirable maximum. As a result of the survey several recommendations are offered.



Another flowering grape fruit at five weeks. It lacks chlorophyll

One of these states that there should be a carbon monoxide indicator for each side of each tube. The attendants in the fan house could regulate the speeds of the appropriate fans to maintain the carbon monoxide below a certain level of concentration. It also would be possible to have the fans increase speed automatically when a certain predetermined concentration is reached.—*A. E. B.*

Colored Newspapers in Siam

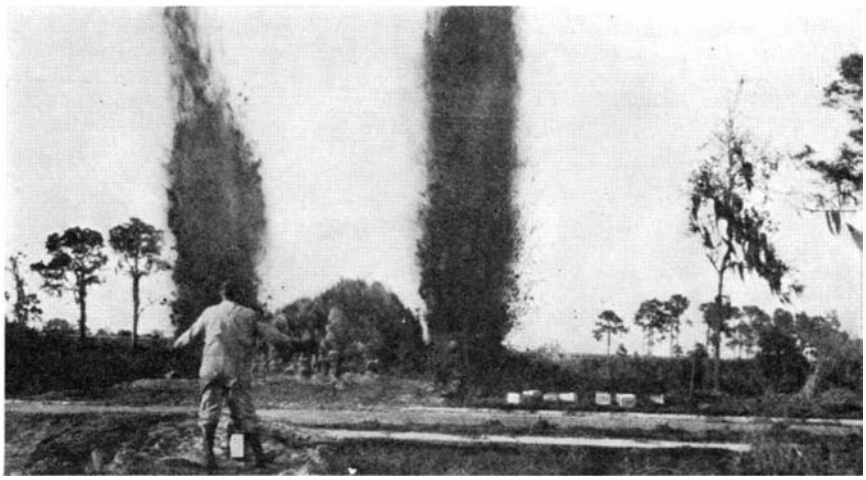
PINK and green newspapers are not exactly novelties in the United States, but according to Assistant Trade Commissioner Walstrom, located in Bangkok, Siam can teach us new tricks in the matter of colored dailies. To the Siamese each day of the week stands for a different color, and many of them match their "panung" (the native costume) with the color of the day. The newspapers endeavor to follow this custom to a certain extent; on Monday their editions are printed on yellow paper; on Thursdays on green paper; Sundays on pink paper; and the rest of the days of the week on white paper.

Practically no paper is manufactured in Siam. The Siamese government at present has a small paper-making plant, and there is also a small native industry manufacturing paper from the bark of a tree. Production from these sources is negligible, however, and the market depends upon imports for its requirements.—*A. E. B.*

Explosives for Settling Highway Fills

JUST one year ago we published an explanation of the newly developed science of blasting road fills across marshy land and through muck in order to settle them immediately and thus obviate the costly delay attendant upon natural settling. Through the courtesy of the duPont company we publish an illustration which depicts the extraordinary results of such a blast, and another which shows relief trench blasting.

In the first, a dirt fill has been laid across muck, or soft ground, into which the fill material would not ordinarily settle for months, thus holding up completion of the highway. A blast beneath this fill, however, has blown the muck to one side so that the fill material, which has been lifted by the blast only slightly, may settle back into the deeper hole thus made. The settlement in this particular case amounts to about seven feet.



In relief trench blasting, the muck is thrown high into the air

In the second photograph, muck is being thrown high into the air by a blast in two trenches beside the future right-of-way of a highway. After these two trenches are blasted, another down the center will throw the remaining ridge of material into the two side ditches and the result will be a trench into which fill material can be placed with the assurance that it will not be necessary to wait for a natural settlement to take place.

By the use of these two methods, road building can be expedited and costs of labor reduced.

Nudism Not Needed to Get Ultra-Violet

NUDIST cultists and others who preach extreme exposure of the human body can not justify their fads on the grounds that they are necessary to prevent rickets. Keep your hands and face uncovered in the moderate sunshine such as occurs at the latitude of middle New York state, Professor Arthur Knudson, of the Albany Medical College, told the American Association for the Advancement of Science, and there need be no fear of being afflicted with rickets, the disease of the bones that arises from the lack of ultra-violet light or vitamin D.

Experiments with rats showed Professor Knudson that if one-eightieth of the surface area of the skin were shaved and bared to the sun's radiation, greater healing of rickets was produced than if the whole animal were exposed. Although through three to four months of winter the sunshine does not contain curative rays, the body builds up sufficient reserves in summer to prevent rickets during the winter. Ungloved hands and exposed faces of children or adults will give sufficient chance for the sun to do its protective work and nude sun-baths for normal persons would not seem necessary in the light of Professor Knudson's experiments.—*Science Service.*

Chemical Compound Lowers Humidity

MARK TWAIN once said "Everybody talks about the weather, but nobody does anything about it." Of recent years, however, a great deal has been done about it, until now it is no novelty to go into a theater or factory where the temperature and humidity are maintained at the ideal points for maximum comfort. Many engineers believe the time is just ahead when practically every building designed for human occupancy will be supplied with artificial weather. The recent discovery of a new chemical compound which has the property of absorbing moisture from air may hasten this universal adoption of air conditioning.

The new compound is the result of 18 months of research conducted by the metallurgical laboratory of The Peoples Gas Light and Coke Company, under the direction of Robert G. Guthrie, chief metallurgist, and Dr. Oscar J. Wilbor, research chemist. It has been christened "lamisilite" by its discoverers, because of its laminated structure and siliceous nature.

Lamisilite, it was explained by Mr. Guthrie, has the property of removing moisture from the air much more rapidly and thoroughly than other compounds now available for this purpose. It can be produced at low cost and a smaller amount of it, which will make possible a reduction in size of air conditioning installations, will do the same work as much larger quantities of the materials now in use.

Extraordinary results of a blast to settle a highway fill across a marsh

"The old expression, 'It's not the heat, it's the humidity' is founded on fact," said Mr. Guthrie in announcing the discovery. "The most successful and healthful air cooling and conditioning devices in use today are those which remove excess moisture from the air in addition to lowering the temperature. Warm, moist air, laden with dust and obnoxious odors, is drawn through a fine spray of water, where it is washed and cooled, and then passed over a bed of lamisilite, which delivers it cooled, dry, and odorless. The lamisilite is easily dried out, after it has absorbed moisture, with an automatically controlled gas flame.

"Another important feature of the discovery of lamisilite is that it makes very valuable certain types of large deposits of a very common ore, which until now have not been worth digging out of the ground," Mr. Guthrie added.—*A. E. B.*

Brazil Experiments With "Coffee-Gas"

THE use of low-grade coffee for making gas and by-products is proving a commercial success at the gas-works at Nictheroy and Santos, Brazil, government officials agree. Coffee in Brazil is just now cheaper than coal, for 3,000,000 sacks of it have been burned in the open air or dumped at sea in recent months. The discovery that burning coffee can be used for gas-making, therefore, brings a clear gain. The coffee as used in making gas was ground and made into bricks with a tar binding. After the experiments got under way, the tar used was a by-product of the coffee itself.

The gas operating companies in Brazil will experiment to see the effects on meters. —*A. E. B.*

Iron Rod Flushes Game

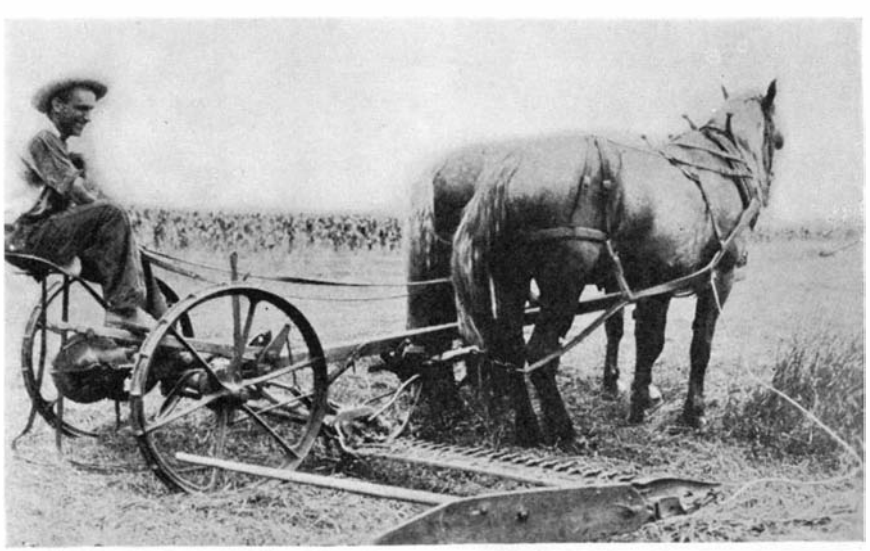
BY inexpensive co-operation, farmers every year can save thousands of game and song birds and small game animals from certain death, according to Paul D. Kelleter, of Wisconsin, conservation director, in explaining the use of the Wisconsin flushing rod.

This rod is a simple device invented by Conservation Warden A. J. Peterson of Racine, Wisconsin, for use on a mower in harvesting. It may be attached very simply to the harness and the mower. The rod ahead of the mower flushes a bird from the nest in time for the driver to lift the knife and avoid cutting into the nest.

The ideal rod is made of steel three eighths of an inch in diameter and 12 feet long, bent as indicated in the picture. It hooks on to the short tug or hame, and is fastened to the far edge of the bar of the mower. The rod may be made from heavy wire as well as from steel.

The conservation department is conducting an intensive test of these rods in southeastern Wisconsin in the country in which the Hungarian partridge is plentiful. The rod, however, will be effective in protecting other game birds as well as Hungarian partridge.

All farmers interested in protecting birds and small animals are appealed to for co-operation in the use of the rod.



Courtesy Wisconsin Conservation Department

The rod that flushes game so that the knife of a mower may be lifted before it can destroy the bird's nest: a thin steel rod at right flushes the mother bird

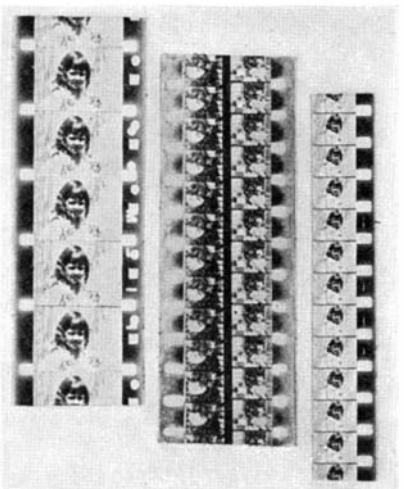
"Metal Mike"

IN the article entitled "On the Captain's Bridge," in our August issue, an automatic steering device on the *Bremen* was inadvertently referred to as Metal Mike. We have been informed by the Sperry Gyroscope Company that Metal Mike is a registered trade name applicable only to the Sperry Gyro Pilot manufactured by them, and that the automatic steering mechanism on the *Bremen* is of German manufacture and so cannot be termed Metal Mike. They also advise that the statements relative to the operating limitations of the mechanism on the *Bremen* do not pertain when the Gyro Pilot is used.

We are glad to take this opportunity to correct any mistaken impression regarding the Gyro Pilot that may have been formed by our article.

Selenium Protects Alloys

PROTECTING magnesium alloys used in aircraft construction against atmospheric corrosion and particularly against the action of salt water spray was the object of British research that has now produced a novel preservative process. In the new process the metal to be protected is immersed for a few minutes in a bath containing 10 percent of selenious acid in water. The film which forms has the property of self-healing to a limited extent, especially when immersed in stagnant sea-water. The film is only a few thousandths of a millimeter thick; its production does not cause any appreciable dimensional change in the alloys treated; it forms a satisfactory base for certain types of paint.



At the left is shown a section of the standard amateur movie film; in the center is a piece of film made with the new camera, before splitting; at right, the split film

It is understood that experiments are being continued in order to develop the best means of protection for aluminum alloys, and in this connection it is of interest to record that progress is now also being made with the "Panalumin" process of Protective Coatings, Ltd., which also is an immersion process not requiring the use of electric current. The "Panalumin" solutions are applicable also to magnesium, but probably are not so effective as the new selenium method; on the other hand, they have proved their value on aluminum and its alloys and particularly as a primer coating for paint and lacquer. In addition, very effective colored and iridescent effects are obtained by these solutions, which fact may aid in extending the use of aluminum for decorative and architectural work.—*A. E. B.*

Four Images Per Frame With New Movie Camera

AN amateur movie camera that quadruples the number of images recorded on a given length of 16-millimeter film, and thereby makes every foot of film go four times as far, was introduced recently by the Eastman Kodak Company.

Small enough to fit in a coat pocket, the newly designed Ciné-Kodak Eight holds 25 feet of 16-millimeter film but takes enough pictures on that length to run four minutes on the screen—equal to the projection of 100 feet exposed in other cameras using 16-millimeter film.

The new camera will save movie makers who use it nearly two thirds of film cost. The camera itself will cost only $29.50, and a complete outfit of camera and projector can be bought for 52 dollars.

The camera, equipped with a Kodak anastigmat *f*.3.5 lens, is the lightest, smallest home movie camera with a film capacity for four minutes of projection.

An entirely new method of distributing

A new movie camera takes four pictures in the space of a 16-millimeter frame, and fits the pocket

on the film the sixteen photographic images taken per second is embodied in the Ciné-Kodak Eight. It loads with a 25-foot roll of special 16-millimeter film, but it exposes only half the width of the film at a time, recording a series of complete images on each half. When the 25 feet have run through once, the spool containing the film is removed and placed on the supply spindle. The other half of the film is then exposed. The width of each image being thus reduced by half, the height is similarly reduced and the number of images down the length of the film is doubled in consequence. Each exposed half of the 25-foot roll contains, therefore, as many pictures as a 50-foot roll exposed in other cameras using 16-millimeter film, and the whole 25-foot roll contains as many pictures as 100 feet from the larger home movie cameras.

When the exposed film reaches a processing station, it is processed, slit down the middle, spliced end-to-end, and then returned to the movie maker as a 50-foot reel of 8-millimeter film with perforations down one side. Perforations on the special film for the Ciné-Kodak Eight are spaced half as far apart as on other 16-millimeter film.

The special 25-foot rolls of 16-millimeter film that are used have an extremely fine-grained panchromatic emulsion that assures a clear, sparkling screen image in spite of great magnification. A black coating on the back of the film reduces the possibility of halation. The price will be $2.25 for a roll of film that makes six dollars worth of motion pictures on the basis of other cameras using 16-millimeter film. The film rolls are small enough so that several may be carried conveniently in a pocket.

Chances for Tuberculosis Cure

REPORTS from tuberculosis sanitariums in the state of Illinois show that as high as 70 percent of the patients discharged by some of these institutions are fully recovered from a practical standpoint. From other places no more than 30 percent have improved sufficiently to resume former occupations.

The difference depends upon the condition of patients at the time of admission. Only a third of far-advanced patients can hope to recover, while of those with the disease in the beginning stage, fully three fourths may look forward to complete recovery.

If the sanitariums did nothing more than teach patients how to keep from being a menace to others the expenditure of funds for that purpose would be eminently justified. That they send back to healthful life nearly one half of the patients who enter enhances enormously their value.

It is estimated that the campaign against tuberculosis has prevented the disease in fully 50,000 people who would now be infected to an incapacitating degree if the control project had not been undertaken. —Dr. Andy Hall, *Director, Department of Public Health, State of Illinois,* in the *United States Daily.*

Cavitation Studies

THE behavior of certain destructive little bubbles that form in swiftly moving water and collapse with such tremendous force as to bend, pock, and melt the metal in ships' propellers, hydraulic turbine blades, and pumps, is being studied at the Massachusetts Institute of Technology.

This research seeks a way to overcome the deadly erosive effects of a strange mechanical disease known to engineers as cavitation, one of the most acute problems in the operation of high speed hydraulic machinery. The bubbles, many of which are no larger than the head of a pin, are often compressed to the tremendously high pressure of 15,000 pounds per square inch. They form by the escape of air, gas, or vapor in areas of low pressure in the water rushing through turbines, propellers, and pumps. Caught in the currents and transported into regions of higher pressure, the bubbles are immediately compressed. It is their collapse, or implosion, under high pressure which causes destructive water-hammer blows.

The effects of cavitation have become increasingly serious with the development of high speed hydraulic machinery. The studies now being made at the Institute under the direction of Professor W. Spannhake, distinguished authority on hydraulic engineering, include investigation of the physical, chemical, mechanical, and hydraulic conditions of this baffling mechanical disease. They are being undertaken for the Safe Harbor Water Power Corporation in connection with the huge hydraulic power development on the Susquehanna River described in our August issue.

Cavitation in ships' propellers is caused by the formation of bubbles in the swirling eddies of the wake, or in the violent agitation of the water and vortices between adjacent propellers. The erosive action is increased on a propeller working in the wake of another. The design of the stern frame of a ship or propeller brackets may also produce a wake which encourages cavitation.

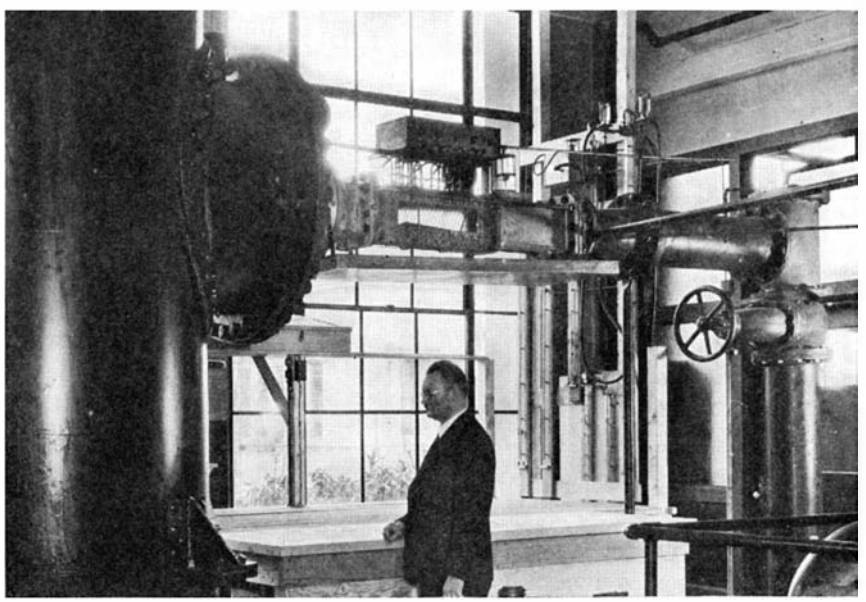
With more complete knowledge of the nature and effects of cavitation, the research workers at Technology hope to be able to suggest changes in design of machinery to overcome or control the destructive action. The research apparatus set up at the Institute for these studies consists of two 60-horsepower pumps and a closed circuit containing a large tank for quieting the flow of water. The action of the bubbles will be studied at the smallest section of a simple Venturi canal in the region of highest velocity. Glass plates will make it possible to observe and photograph the phenomenon. Various instruments will register pressures and temperatures.

Alcoholic Mental Disease Since Prohibition

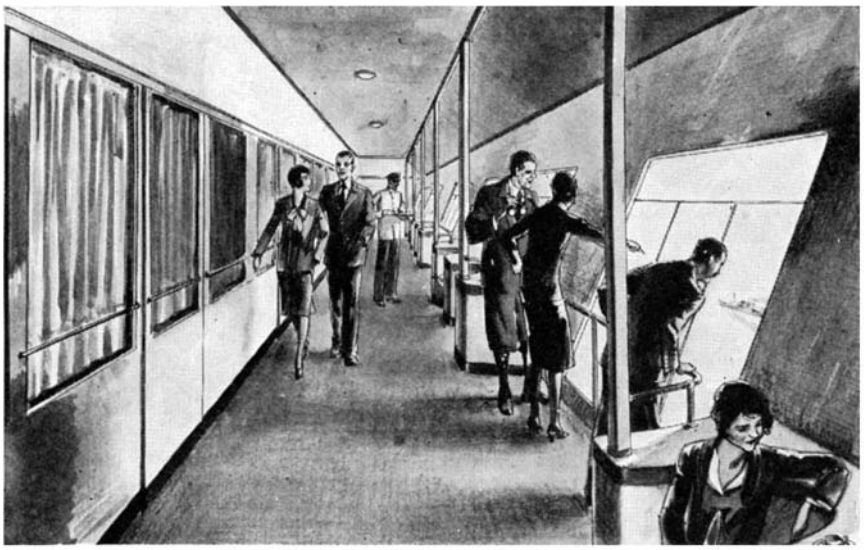
A DEFINITE increase, especially among very young people, of cases of alcoholic mental disease and the development of a new type of this condition have taken place since 1920, Frederick W. Brown, director of the department of statistics of the National Committee for Mental Hygiene, reports in the *Mental Hygiene Bulletin.*

Mr. Brown has analyzed figures from the Census Bureau and from the Statistical Bureau of the New York State Department of Mental Hygiene and reports from superintendents of state hospitals for mental disease.

"An examination of certain trends among alcoholics before and after the enactment of prohibitive legislation indicates that the



Professor W. Spannhake is shown standing beneath the open window in the pipe in the set-up with which he will study the destructive effects of cavitation



A glimpse into the future: A promenade on a future transatlantic airship

problem is increasing in magnitude and consequently in seriousness," Mr. Brown said.

"During 1919 and 1920 the sale and use of intoxicating liquor was restricted to a degree that brought about a marked reduction in alcoholic mental disease," he found. "Since then, however, there has been a definite increase, the rates per 100,000 general population showing a jump from 1.9 in 1923 to 2.6 in 1930 for alcoholic mental disease, and from 0.4 in 1926 to 1.5 in 1930 for alcoholism without mental disease."

A new type of mental disease which did not exist before prohibition is observed by some hospital superintendents. In this the alcoholic state is accompanied by a poisoning, often with destruction of nervous and organic tissue. Extreme cases of this type suffer from violent mental disturbances and die within a short time without regaining a normal mental state.

More young patients are admitted than formerly, one hospital reporting during the past year an unusually large group of patients of high school age.—*Science Service.*

Airplane Hook-on for the "Akron"

ONE of our photographs shows a Vought observation airplane suspended from the *Akron* in position for taking off.

From the airship is lowered a latticework structure which carries a single cross bar at its free end. The bar is pivoted to rotate fore and aft against friction, and the supporting structure itself, by means of wire cables, has a restricted fore-and-aft movement. This limited freedom permits absorption of energy and lessening of shock when the plane strikes the bar at a speed slightly above that of the airship.

An engaging hook is fixed to the upper wing of the plane. The frame-work which carries the hook extends forward and forms a partial guard which prevents the propeller from striking the cross bar. The hook itself is located at the after end of this tube and is fitted with an automatic locking device so that after engagement with the bar, unintentional release is impossible. The pilot can trip this locking device when he wishes.

In approaching for a hook-on the pilot comes in from astern in a steep climb and lines up the bar and the hook during the approach. In rough air both the approach and the engagement become somewhat erratic; in smooth air they are comparatively simple. After lining up, the plane is flown directly onto the cross bar. Upon engagement, the throttle is retarded, the controls are put in neutral, the motor is idled, and the plane rides smoothly from a single point of attachment.

When it is desired to release the plane from the bar, the pilot trips the hook and, keeping the motor at idling speed, falls clear of the airship in a dive.—*A. K.*

Is a Transatlantic Airship Service Financially Possible?

THE most important provision of the Merchant Airship Bill, now receiving so much attention, is the placing of the airship on the same footing as ocean-going steamers as far as compensation for carrying mail is concerned.

An airship capable of a speed of 24 knots, of flying 2000 sea miles without refueling, and of carrying over 10,000 pounds of mail would be termed a Class I airship, and if engaged in regular trans-oceanic service would receive on any outgoing trip (from New York to Paris for example) compensation of at least 12 dollars per nautical mile. For every knot above the minimum of 24 it would receive an extra 50 cents per knot.

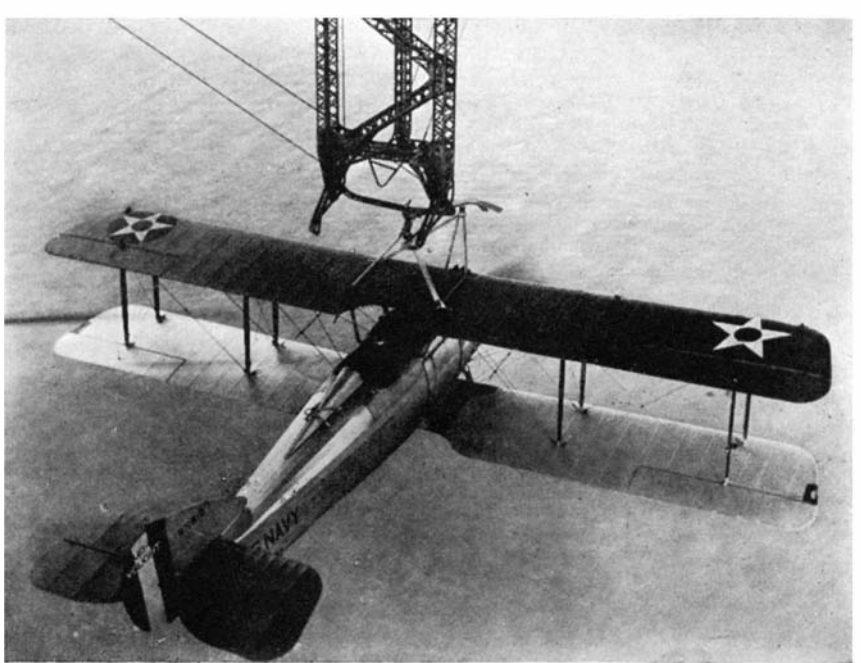
Thus if the plans of Goodyear-Zeppelin and of the International Zeppelin Corporation materialize, and 70 knot ships are built, they would receive 12 dollars base pay, plus 50 cents for the excess speed of 46 knots. That is to say 35 dollars in all, or an average of $17.50 per mile over the round trip.

If our readers are confused by this arithmetic, they are in good company, because the examining Committee seemed to have a good deal of difficulty in grasping the situation. At any rate, for the trip of 3600 miles between New York and Paris, the airship would receive 63,000 dollars, and the same amount for the trip back.

Of course the Post Office Department would lose on such an arrangement. Even with a 10 cent surcharge and 10,000 pounds of mail, the Post Office would receive only some 40,000 dollars in exchange for its 63,000 dollars.

Nevertheless, the arrangement would not be such an unfair one as might at first appear. To begin with, the Post Office always loses on first-class mail, but such losses are more than balanced by the immense benefit to American commerce. Secondly, as the airship line survived its pioneer efforts, and put more and more ships in operation, its costs would run less, and the mail compensation would be diminished. Again, the provisions of the Merchant Airship Bill are such that the airships have to be designed according to specifications of the Secretary of the Navy, and be convertible into naval auxiliaries at short notice and at small expense.

The Bill has been very well received. It carries no mention of heavier-than-air craft, and its backers claim that seaplanes are not at present capable of giving transatlantic service. Some of the airplane people think, however, that a heavier-than-air transatlantic service is also possible, and that the Bill might reasonably be extended to cover the operations of transatlantic seaplanes.



U. S. Navy official photograph

An airplane hooks onto a frame beneath a large airship

The plans of the International Zeppelin Corporation call for placing four airships in service, two American and two German, and the construction of one complete terminal in the United States and one complete terminal in Europe.

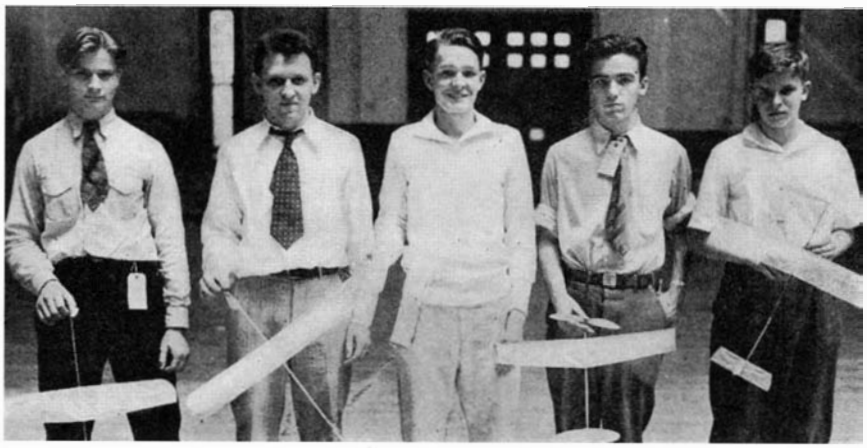
By complete terminal is meant a terminal capable of mooring, docking, over-hauling, and repairing an airship—in other words, an elaborate station similar to that maintained at Lakehurst, New Jersey, by the Navy. Such a terminal would, for meteorological reasons, be placed somewhere between Philadelphia and Richmond, Virginia, and would be inland, behind the mountains, sheltered from ocean winds and storms. In addition, mooring masts would be erected at, say, New York and Paris.

The airships designed for this service would have about 7,500,000 cubic feet gas capacity, or more than a million cubic feet above that of the *Akron*. They would be 858.8 feet long, or some 75 feet longer than the *Akron*. The maximum diameter would be 132.9 feet, and the horsepower of eight engines would total 4800. The maximum speed would be 72.5 knots which means, in non-nautical language, 83.5 miles per hour. There would be accommodation for 80 passengers with an exercising corridor of 400 feet, where there would be open windows on both sides, a central dining room, smoking room, lounge room, observation car, and so forth. A crew of 54 would be provided. There would be 24 tons of mail and express. The eastbound schedules of a bi-weekly service would be 58 hours in summer and 64 hours in winter. Westbound, the schedules would be 70 hours in summer and 80 hours in winter.

The operating cost per trip on the American vessels would be 68,400 dollars. Granted 40,000 dollars of Post Office compensation, 2000 dollars of express revenue, and some 27 passengers at 750 dollars per passenger (which is not exaggerated in view of the prices passengers are willing to pay for really first class and high-speed travel) the operating costs would be covered.

The capital requirements would be some 16,000,000 dollars for American ships and terminal, and nearly 9,000,000 dollars for the German ships and terminal.

An immense amount of investigation and research has been carried out, and the project is a highly plausible one, though every trip would be an exercise in applied meteorology. It certainly has immense possibilities from a national point of view.—*A. K.*



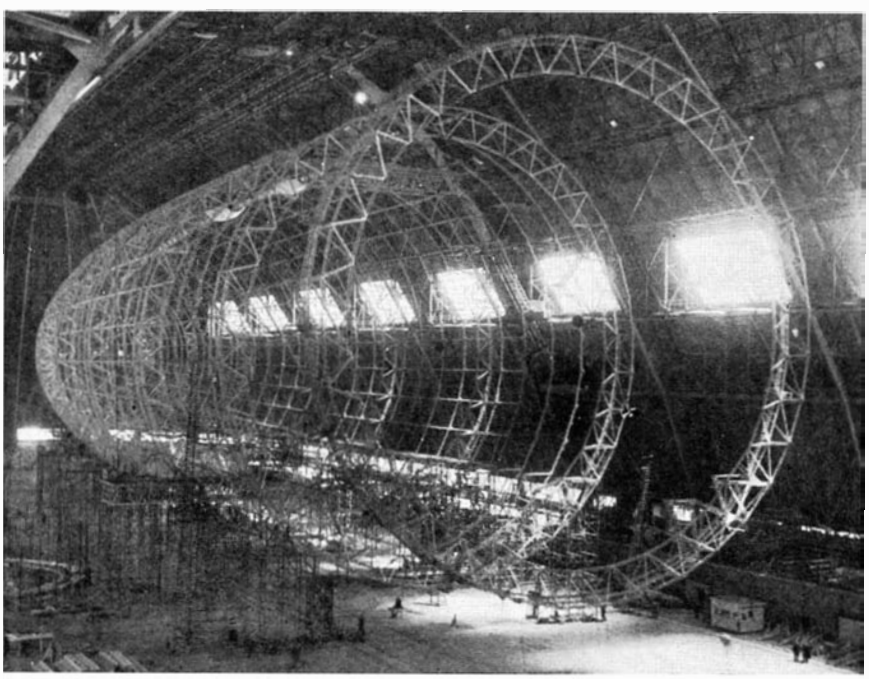
The winners of prizes in the model airplane meet held recently in Hartford, Connecticut, by the Hartford Aero Model Club and the Connecticut Model Airplane Association. Robert Knudsen, of Hartford, at right, won a year's subscription to *Scientific American* by placing fifth in the hand-launched duration contest. His "flying stick" flew for 5 minutes, 5⅘ seconds

Rapid Construction of the "Macon"

WITH the experience gained on the *Akron*, the construction of her sister ship, *Macon*, is proceeding far more rapidly. Although no specified time has been set for the completion of the ship, indications are that it will be ready for trial flight about January 1, 1933.

With the passing of the Merchant Airship Bill through the House of Representatives (even though the bill carried no specific appropriations with it) the possibility of a transatlantic airship service becomes far greater. Mr. P. W. Litchfield, President of the Goodyear Tire and Rubber Company, predicts that such a service will be established within the next three years.

Our photograph shows the frame of the *Macon* with 460 feet of its total length of 785 feet in position.—*A. K.*



Work progresses on the *Macon*, sister ship of the airship *Akron*

Synchronizing Motors on Airliners

THE first practical device for the synchronization of engines on multi-motored airliners, to remove the irregular "beats" so disturbing to passengers and caused by the motors being "out of tune" beyond the ability of the instruments to detect, has been perfected in the experimental laboratory of the Pan American Airways System, at Brownsville, Texas. The new "synchronizer," discovered by George Kraigher, Chief Pilot of the Western Division of Pan American Airways and perfected in the company's shops, employs the shadows of the whirling propellers, reflected through convex mirrors to the pilot's eye, and has stood exhaustive tests on the line's equipment for several months.

Up to the present, airline pilots have had to "tune" the motors on the big airplanes by ear in order to eliminate the "beats" which occur if there is a difference of even ten revolutions per minute in the speed of the different propellers. Previous tests had shown that, unless a pilot possessed a good "ear for music" he could not properly synchronize his engines. The task was further complicated by other vibration "beats" in the airplane. Aeronautical engineers have been searching for years for a positive means for synchronizing engines. Pilot Kraigher, who carried on a series of independent studies of this problem, was standing on the ground watching the engines on a tri-motor being "tuned" when he discovered that by looking through one of the outboard propellers to the propeller of the center engine, a definite, unvarying line was visible when both propellers were turning at the same speed. When one propeller turned faster than the other, the line would move upward and when slower, would travel in the opposite direction. The phenomenon was found to be caused by the whirling blades of the propeller nearest the eye acting as the shutter of a motion picture camera or "stroboscope".

The problem then was to make this stroboscopic effect visible in the cockpit.

This was accomplished by mounting a convex mirror on the cowling of each outboard motor so that the pilot could look through the outboard propellers to the center blade.

Pilots Must Fly Blind

ONE of the real pioneers of blind flying instruction, Major William C. Ocker, United States Army Air Corps, is shown in one of our photographs, holding a hooded pigeon. He writes to us of certain

Major William C. Ocker experimenting with hooded pigeons in his study of blind flight theory

of his experiments as follows: "Hoodwink a mule and he will stand fast until the blind is removed. Hoodwink pigeons and release them from an airplane, and their attempts to fly without sight are about the same as those of an airplane pilot on his first ride under the hood. The pigeons will start a turn of a spin, then climb at a steep angle, flutter 'round, and finally set their wings at a safe gliding angle and land unharmed."

This experiment with pigeons only confirms previous conclusions on the subject. No pilot can fly blind by sense of feel. He must have instruments. If he has the mentality to prefer the instrument indications to his own vague feelings, he will soon learn to fly blind.

The Aeronautics Branch of the Department of Commerce certainly thinks so, as their latest regulations for the licensing of transport pilots clearly indicate. Besides 1200 hours of flying in the last eight years, 75 hours of night flying, the passing of a theoretical examination, and so on, the fully qualified transport pilot must satisfy the following tests:

Practical flight tests in a hooded cockpit, under the conditions of instrument flying, performing the following maneuvers with recovery to a predetermined heading. A, straight level flight. B, moderate banks making 180 degree and 360 degree turns in both directions. C, minimum glides and maximum climbs and approaches to stalled attitudes of flight. D, climbing turns. E, recovery from stalls, skids, slips, spirals, and banks in excess of 45 degrees.

Anyone who has ever flown "hooded" will realize what a stiff test this is.

Sometime ago, the saying was that the airplane pilot would soon be nothing but an aerial chauffeur. This view has proved quite wrong. The knowledge required of pilots is constantly growing. They will never be comparable with chauffeurs, but will have the duties and rating of officers in the merchant marine. Pilots employed by Pan American Airways on their routes to South America, not only fly and navigate, but clear cargoes, meet port officials, and otherwise act as the Captains of merchant vessels. Some of them are even now termed Master Pilots. Perhaps Captain would be a better name. The sooner this professional status is acquired, the better for commercial flying.—*A. K.*

The Langley Field Conference

THE Seventh Annual Aircraft Engineering Research Conference of the National Advisory Committee for Aeronautics was held recently at Langley Field, Virginia. The conference, as always, was attended by distinguished representatives of the Government air services and of the aeronautical industry.

In the group shown in our photograph were such well known men as Orville Wright; Dr. J. J. Ames, Chairman of the National Advisory Committee for Aeronautics; H. F. Pitcairn of Autogiro fame; Charles L. Lawrance, the designer of the famous Whirlwind motor; Dr. Karl Arnstein, the designer of the *Akron;* Glenn L. Martin, and many others just as distinguished. The purposes of the Conference are to allow the National Advisory Committee for Aeronautics to present the most important results of its research work during the year (which is most comprehensive and fundamental, although it does not deal with proprietary and specific devices), and to allow the industry to make suggestions for further researches of all kinds.

Perhaps our readers will be interested in some of the striking suggestions put forth by the gathering.

One suggestion was that the tail-less airplane should be carefully studied for stability and control to determine its suitability as a privately owned machine. The absence of a fuselage simplifies this type and makes it interesting in the low-priced machine class.

Another suggestion was that steam power-plants for aircraft should be studied. It is most interesting to see how the steam power-plant for aircraft is now meeting with a revival of interest.

Further investigation of slots, flaps, and other lift increasing devices was urged.

Still another inquiry received by the Committee urged the further investigation of boundary layer control on wings. By proper application of suction to the surface of the wing, it is possible to delay the stalling of a wing and to increase the lift very considerably. So far, efforts in boundary layer control have been limited to the laboratory. Perhaps someone will have the courage to complete the laboratory investigations and try the method in full flight.

On the structural side, it was suggested

The student in the front cockpit is ready for a test blind flight

that electric spot welding in stainless steel structures should be studied.

Another correspondent to the Conference thought that air-cooled engines might be mounted in the wing with cooling air taken in through the leading edge of the wing.

A noted engine designer thought that the two-cycle engine was of interest and that the basic problem was to determine the design of valve or piston arrangement

The gathering of notables at the recent Langley Field, Virginia, conference on aviation

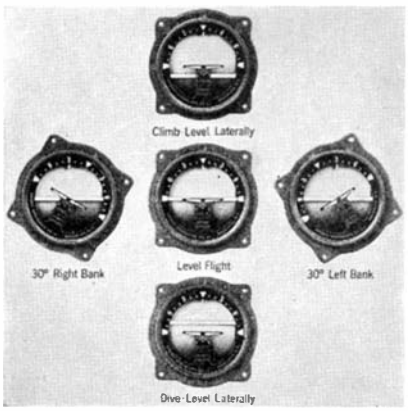
for scavenging the cycle with the least loss of fuel.

In the automobile field, the two-stroke-cycle engine is in some cases giving remarkable power for a given cylinder displacement. It seems reasonable to believe that this principle should be equally useful in aircraft work.

The gathering was as interesting and stimulating as usual.—*A. K.*

An Improved Artificial Horizon

WE have had occasion to refer to the Sperry Artificial Horizon and describe it in the past. A gyroscope is driven by a stream of air, and, in conjunction with a pendulum, maintains a truly vertical



The improved artificial horizon with its helpful calibrated scale

position in space. When the airplane pitches or rolls, the indicator attached to the gyroscope shows the character of the displacement. With the addition of a scale, the magnitude of the roll in degrees is also indicated to the pilot. The illustration shows the working of the instrument better than any verbal explanation.—*A. K.*

Observations of an Early Flight

THE records of observations of early flights are all too few and the observations of today do not have the flavor and pleasurable thrill that early witnesses experienced. We will be permitted to quote, therefore, from a letter which Chancellor Elmer E. Brown, of New York University, wrote to Mrs. Brown on September 12, 1908 after observing one of the pioneer flights of the Wright airplane:

"At the end of the afternoon today I ran away. That is, I took a green trolley car, and went to Fort Myer, and there I actually saw the great little Wright travel through the air in his flying machine. He broke his own record again today, too, keeping up in the air continuously for an hour and a quarter, lacking only the fraction of a minute. The most of the time he was circling round the outer edge of the parade ground at a height of from 50 to 200 feet. Each time around must have been something more than half a mile, and he made it in almost exactly one minute each time. He seemed to have the machine perfectly under his control, and the curves which it described, and particularly the graceful tilting at the turns, were beautiful to look at. I don't wonder in the least that some of the weighty scientists here at the Club say they can't get it out of their minds. The large crowd on the parade ground today watched it through the hour and a quarter with comparatively little stir or coming and going. When he passed the longest time that he had previously remained in the air, all the automobiles present sent up a great honk-honking like enthusiastic donkeys, and the crowd shouted and waved their hats."—*A. K.*

Nitrocellulose Lacquers in Japan

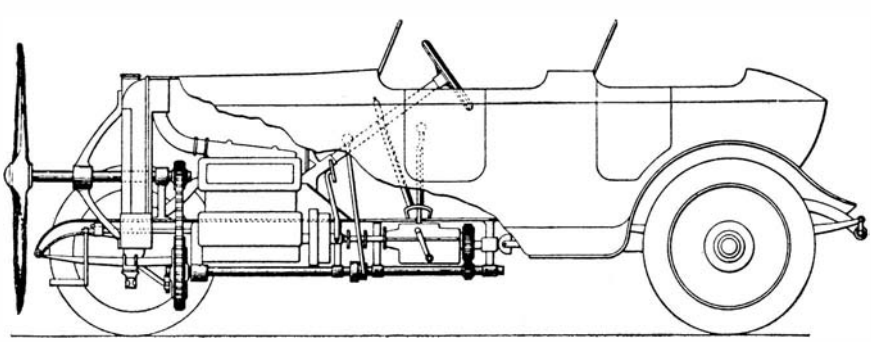
THE demand for industrial lacquer in Japan is increasing rapidly with the industrial development of the country. In the past, the principal source of demand for industrial lacquer has been the automobile. There are approximately 96,000 automobiles in Japan, of which, owing to the high duty, operating costs, and difficulties of securing licenses, only 6 percent are privately owned, the remainder being either commercial machines or vehicles for hire.

The great majority of automobiles used in Japan are American. The automobile lacquer industry is, however, an exceedingly undependable source of demand, since the majority of Japanese owners of taxis and commercial vehicles do not seem interested in maintaining the appearance of their automobiles.

Recently the lacquer industry has been endeavoring to open up new and more satisfactory fields of demand. It is estimated that in the future the greatest source of demand will arise in furniture and building construction, although in this field industrial types of lacquer will encounter competition with the ancient forms of Japanese lacquer. Approximately 70 percent of the nitrocellulose lacquers consumed in Japan is imported from abroad, importations coming almost entirely from the United States. The remaining 30 percent is manufactured domestically by some 10 different plants.—*A. E. B.*

A Debatable Streamlining Suggestion

THE streamlining of all vehicles of transportation is very much to the fore today; automobiles, inter-urban street cars, even locomotives and trains are being studied. Therefore, the suggestion which M. Constantin, a distinguished French inventor, sends us is at least interesting. He proposes that a windmill should be placed ahead of the motor car to absorb energy from the relative wind of motion, which energy would be converted into driving power. The presence of the windmill would decrease the air resistance of the automobile itself since it would be in a region of retarded air. This is not perpetual motion, but simply a method of reducing the air resistance of the entire vehicle. We believe that it is both simpler and more efficacious to streamline the automobile. But it would be fun to find out what such a windmill would do with an ordinary car! —*A. K.*



A French suggestion for increasing the speed of automobiles. Will it work?

Helium Reported in Trinidad

REPORTS from Port-of-Spain state that investigations started last September have resulted in the discovery of helium in Trinidad. The United States has, in the past, had a practical monopoly in the production of this valuable gas; it occurs in the natural gas and oil fields of Texas. The reports cited the possibility of developing an important source of supply, but offered no estimate on the extent of the deposit. The search started when oil-well drillers came upon a pocket of this gas, and plans were laid to trace its source.—*A. E. B.*

Amateurs in Science

WORKING in the laboratories of the Rockefeller Institute for Medical Research, Colonel Charles A. Lindbergh sets an example and provides inspiration that equals his lone flight to Paris. He is a reminder that the day of the serious amateur in science is not past.

Before the dawn of our era of science much of the important progress in invention and discovery was made by those who earned their bread and butter in other work. Benjamin Franklin was printer and publisher by vocation and scientist by avocation. Joseph Priestley, discoverer of oxygen, was a clergyman, and Sir William Herschel, one of the greatest of astronomers, was a music teacher.

Today the radio industry is largely manned by amateur "hams" who pounded spark sets before the war. Thousands of members of the American Radio Relay League, mature men as well as youths, are now pioneering the short waves and talking across oceans.

In Tuxedo Park outside New York City there is a laboratory of physics created by Alfred L. Loomis, New York investment banker, who delights in working on advanced problems too unpromising to be attacked by university or industrial laboratories. Mr. Loomis has had leading scientists as his collaborators and while retaining his amateur standing has won a recognized position in science.

Astronomy has peculiar fascination as a serious hobby. Masani Nagata, by day melon patch foreman in California, by night an observer of the heavens with a

small telescope, discovered last year a new comet that astronomers are still watching. An ex-governor of Vermont, James Hartness, is president of a machine tool company, enthusiastic amateur astronomer and designer of a new type of telescope. Russel W. Porter, who is designing the new 200-inch telescope for Mt. Wilson, started out as an architect. Hundreds of amateur astronomers have made their own telescopes. Some amateurs regularly watch the variable stars, a useful service to astronomy sponsored by the American Association of Variable Star Observers.

A Joliet, Illinois, factory executive, George Langford, has made important contributions to our knowledge of prehistoric Indians, excavating hundreds of skeletons, and doing it in such a way as to win the admiration of professional archeologists.

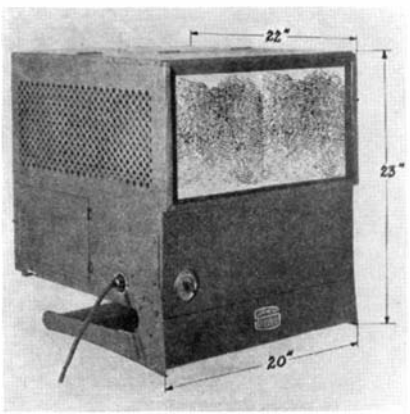
The day of the genius in the garret may be past, but opportunities in science still exist for the amateur who desires a serious hobby.—(All rights reserved by *Science Service*, Washington, D. C.)

Fingerprint Identification Devices

ACCORDING to record, the first prepared work in fingerprints was done in 1823. Since then much has been written on the subject and the science of fingerprint "reading," has so developed that it has become one of the most important branches of criminal investigation.

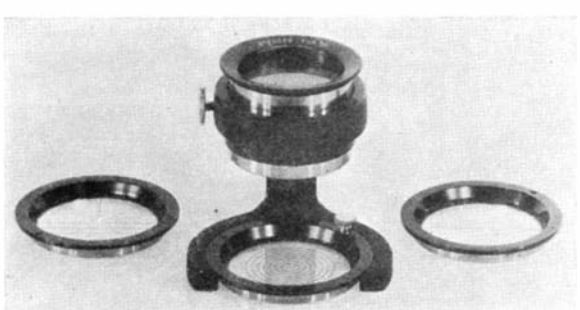
Following the fingerprint work done in England by Sir William Herschel and Sir Francis Galton, about thirty years ago, the work was spreading into such universal use that a goodly number of men began to improve on its use and many books were written, the most important of which was by Sir E. R. Henry. It was he, too, that first appreciated not only the necessity of fingerprints for local registration, but also the distant identification of suspected criminals, and for such he instituted the Henry coding system. By this system, the ridges were classified as to shape and the formations they made with their neighbors. These lines, deltas, arches, whorls, loops, and so forth, were assigned letters, and thus the principal characteristics of the pattern of a fingerprint could be dispatched by either correspondence or wire without sending the actual fingerprints.

From this time on more operators developed different coding systems, each with their own points of advantage. There are now such coding systems as the Henry, Jorgensen, Battley, Collins, Born, Bonnevie, and others, the first four of which, we believe, are the most universally used. The Federal Bureau of Identification at Washington, D. C., developed what is known as the Reno Extension, which is used in connection with the Henry System. This method reduces the files so that an operator can locate a set of prints in about one third the time that would ordinarily be needed with the Henry System. With these coding systems accepted, it was necessary to develop such instruments as would quickly enable the Identification Department to "read" the fingerprints. The solution was definitely solved by the Spencer Universal Dactyloscopic Outfit, (fingerprint magnifier), in which any one of all the coding systems can be used in the base. One of our illustrations shows the magnifier proper with the Battley dispositive (a Battley coding pattern on a separate glass) in position in its base. To the right is the Jorgensen dispositive with the Henry dispositive on the left.



A fingerprint comparator on which prints may be shown to juries

Experienced identification operators, due to their constant application, almost immediately recognize the prints as seen through the magnifiers. However, in case of controversy during court trial, it is exceedingly difficult to portray to the court or jurors the characteristics that are to be stressed in the fingerprint in question, due to the jurors' unfamiliarity with instruments of this kind. To overcome this handicap, the Spencer Fingerprint Comparator, shown in a second illustration, has been developed. Here the fingerprints in question can be placed side by side and projected much enlarged on the screen in the front of the machine. With these enlargements, the operator can readily point out either the similarity or the dissimilarity of the characteristics of the prints.



A magnifier for studying fingerprints, in which any coding patterns may be employed

600-Year-Old Paper Still Good

NOTICE, sometime, how a newspaper begins to turn yellow after it is a few weeks old and marvel at the keeping qual-

ities exhibited by some of the paper made centuries ago, long before modern paper-making machinery was invented. Several old Chinese and Japanese papers composed of paper-making fibers peculiar to the Orient were recently examined at the United States Bureau of Standards and found to be in an excellent state of preservation. These papers are said to date from the 14th Century.

Three of the papers were composed of paper mulberry, two of mitsumata, and one of bamboo fibers. The use of these fibers dates back to the origin of paper making in China during the first century. The mulberry and mitsumata, which are derived from the inner bark of shrubs, are still used extensively in the Orient for production of tissues characterized by great strength combined with softness. The mulberry papers examined possessed these characteristics, two being tissues and one a very heavy paper. The mitsumata papers were thin, hard papers of high strength. The bamboo paper was thin and soft, but was weak, as would be expected because bamboo fibers are very similar to those of straw.

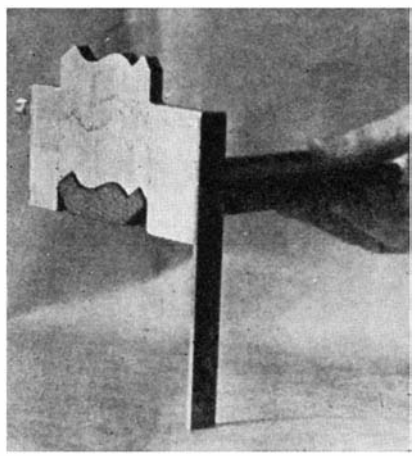
The colors of the papers ranged from a cream white to a dark brown. The only sizing material found was starch, which was present in four of the papers. All of the papers had good formation and had strength characteristics similar to those found in newly made papers of these types.—*A. E. B.*

Device Takes Off Profiles

GAGES that have a myriad of uses for getting the exact profile of odd-shaped pieces of materials have been developed by the Stockton Profile Gauge Company, of Salem, Massachusetts. Of many sizes, these gages are used in the shoe trade to determine the outline and curvature of heels, toes, side walls, arches, et cetera; by railroads to check wear on rails, flanges of wheels, and gears; by furniture manufacturers for determining accuracy of saddle seats, backs, curves of arms; and by many others who may wish to take off the exact curves and angles of molding and the like for the purpose of making drawings or cutting some material like linoleum to fit irregular shapes.

The Stockton gage has a relatively heavy steel plate base at right angles to which a strong steel bar several inches long is mounted. On this bar are a large number of laminations slotted to slide lengthwise on the bar. A nut on the end of the bar is used to tighten the laminations into position after a particular profile has been obtained.

In use, the irregular object of which the shape is desired is pressed against the



A new profile gage in use

ends of the laminations. These latter are thus pushed forward on the bar until their opposite projecting ends form a pattern identical with that of the object. When the nut is locked, the gage may be laid flat on paper, linoleum, or any other material and the projecting pattern used to trace the profile of the object.

New Principle Improves Oil Burning Efficiency

BY smashing a tiny globule of fuel oil into 100,000,000 particles, a new oil burning furnace, developed by the General Electric Company, attains an efficiency in the combustion of liquid fuel that leaves little to be desired. The oil, under pressure, is brought into direct head-on impact with air under approximately the same pressure, causing superfine atomization and facilitating easy conversion of the small particles into a gaseous hydro-carbon by heat. This allows almost the entire energy of the fuel to be converted into heat without loss of carbon in soot or smoke, and without excessive combustion air. This new principle is described as "progressive impact combustion" and laboratory application indicates a much more economical employment of oil as a fuel for heating purposes.

Delegated five years ago to study the electrical control of oil combustion, engineers of the General Electric Company have made hundreds of experiments in combustion, ending with the so-called laboratory battle between oil and air, under pressure, which resulted in the new development.

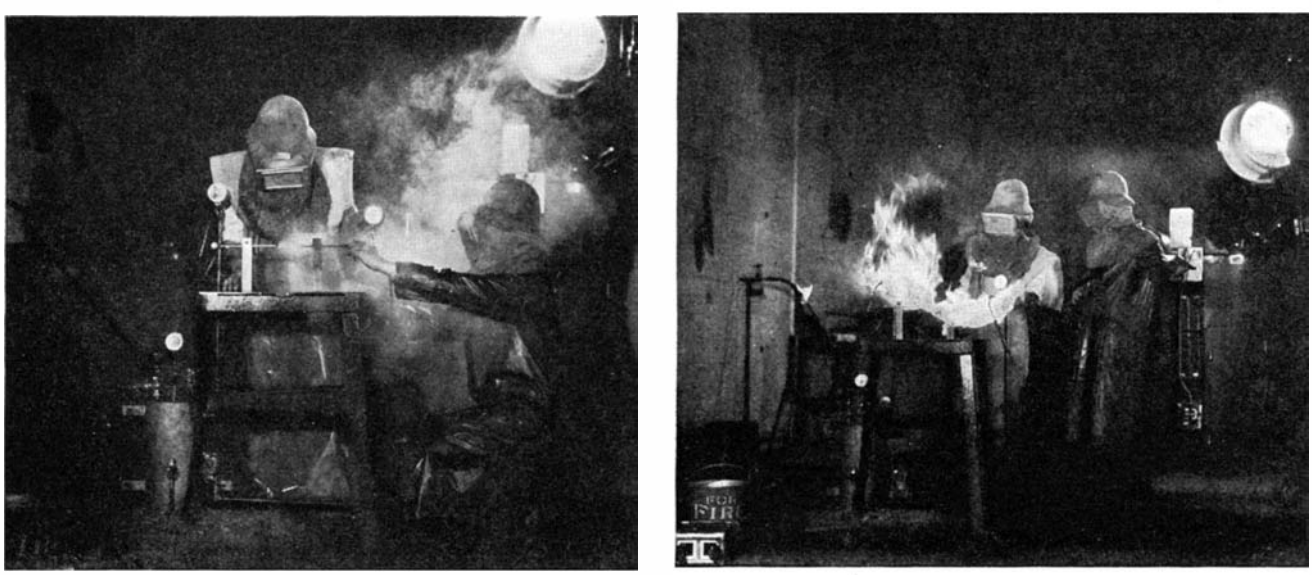
In the application of this principle the complete combustion of oil occurs progressively in three stages. The first, the head-on collision of oil and air under pressure, breaks up each drop of oil into millions of particles. Then follows the application of heat which further breaks down the oil particles into gaseous hydro-carbon. The third and last stage is the collision of the gaseous hydro-carbon with the air for combustion to produce the proper and complete air-oil mixture for effective combustion.

Engineers feel that there are many applications for this new principle of atomization, and the company plans to use it in a new oil furnace that has been developed in its laboratories.—*A. E. B.*

Children Grow On Pasteurized Milk

HEATING milk in the process of pasteurizing, to make it free from germs, does not affect its nutritive qualities for children of from two to six years, Leslie C. Frank, sanitary engineer in charge of milk investigations of the United States Public Health Service, reported to the Conference of State and Territorial Health Officers with the United States Public Health Service.

Mr. Frank made a house-to-house survey of over 3000 children of this age group in 41 cities, getting information as to whether the children had been given raw or heated milk, and what their ages, weight, and heights were. These children were from middle class American families, and their supplementary diet was that of the average American child. The children who had had



Smashing globules of fuel oil, and demonstrating the complete combustion that may then be obtained

raw milk for more than the latter half of their lives were no taller and just three-tenths of a pound lighter in weight, on the average, than the children who had had heated or pasteurized milk. The study will be continued during the coming year to include children under two years of age.

The problem is of particular importance because recently advocates of raw, unpasteurized milk have been claiming that heated milk lacked some of the growth-promoting properties present in raw milk. The raw milk, however, is frowned upon by health officials and most physicians because it is likely to carry disease germs. The children in Mr. Frank's survey who received predominantly raw milk had more diphtheria, scarlet fever, intestinal disturbances, and rickets than the children getting predominantly heated milk, according to their parents' reports.—*Science Service.*

Explosive Gas Hazard Tester

A NEW combustible gas indicator for practical use in detecting flammable gases and vapors which are recognized hazards in many industries, has been developed by the Mine Safety Appliance Company. It is direct-reading, light in weight, and easily operated. It may be carried from the shoulders by a harness as illustrated on this page.

This indicator may be used advantageously for testing gasoline and oil storage tanks,

Explosive gas tester in use

oil tankers, manholes, flammable liquid storage tanks, and in general any location where there is danger of explosions from vapors and gases.

By squeezing an aspirator bulb, a sample from any desired location is drawn rapidly through the flexible metal tubing to the instrument. Up to 60 feet of sampling line can be used with the instrument for sampling from inaccessible places. There is no lag in the indicator reading except the time required to draw the sample through the length of sampling line used.

The instrument has two platinum wire filaments which are heated to a relatively low temperature by current from two dry cells, one of the filaments being exposed

(*Please turn to page* 183)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS month, observatories.

"I dropped amateur telescope making temporarily a while ago and took up amateur carpentry, with the result shown in the photograph."

"The result" is the square structure, capped with a silo top, shown below, and its maker, owner, user, and the writer of the above comment, is E. N. Ryder, D.D.S., of Brewster, New York. Dr. Ryder further

The famous Ryder Coffee Mill

observes in his letter that, "this edifice has been spoken of, I understand, as 'The Coffee Mill with the crank on the inside'."

AN observatory constructed partly with the help of the well-known "Scanlon Specifications", and partly by the Morrisville Foundry Company, is that of W. D. Jones, 18 Summer Street, Morrisville, Vermont. The dome, Mr. Jones says, is 12 feet in diameter inside, and is rotated by rack and pinion. The brick walls are seven feet high and the four-inch telescope is mounted level with the base of the dome, so that it may be used down to a low angle.

The Scanlon Specifications are—or formerly were and probably still are—available from Leo J. Scanlon, Secretary-treas-

Mr. Jones' observatory

urer of the Astronomical Section of the Academy of Science and Art of Pittsburgh, 1405 East Street, N. S., Pittsburgh, Pennsylvania. This is the observatory whose prototype, roofed with sheet aluminum, was described in a special article in the July, 1931 number.

LACONIC is Charles A. McPherson, contractor and home builder, of Edgar, Montana, who writes:

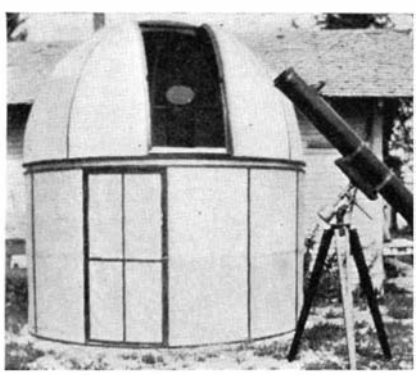
"Sir: Enclosing photo showing results of reading 'A.T.M.' Observatory eight feet diameter. Too small for eight-inch telescope —hard to move around without bumping tube. Concrete floor with six-inch diameter pipe set in concrete, carrying German type equatorial. Have two eight-inch mirrors. Either one can be used for the same tube. Telescope used for variable stars."

"CONGDON ORCHARDS" is the name on the letterhead of Fred L. Farmer, manager, Yakima, Washington, surprinted over pictures of two big luscious red "Chekola Brand" apples—from which we gather that amateur astronomer Farmer is also a professional apple farmer. Mr. Farmer sends several progress photographs of his job.

"In the construction of this observatory," Mr. Farmer writes, "the sill and plate of the side walls, as well as the rafters and sill of the dome are all made of two thicknesses of one-by-three, cut on a ten foot circle, except the upper member of the plate, which was made of one-by-four. I had this material cut at the mill. The studs for the side walls are six feet long. The shutter opening is 30 inches wide and extends well beyond the center. The dome is supported by eight roller-skate wheels and has eight roller-skate wheels on brackets for thrust bearings which ride under the top member and on the lower member of the plate. The frame of the shutter is made of ½-inch angle iron on which wooden strips are fastened to support the slats. Both the shutter and the dome move very easily. The dome is covered with heavy canvas and the side walls with Beaver Board.

"The cost of material was 60 dollars.

"In building this observatory, I followed very closely the instructions of Chas. D. Higgs of Fortana, Wisconsin, as published in *Popular Astronomy*, August-September, 1928. I find that this makes a very satisfactory housing for my six-inch reflector

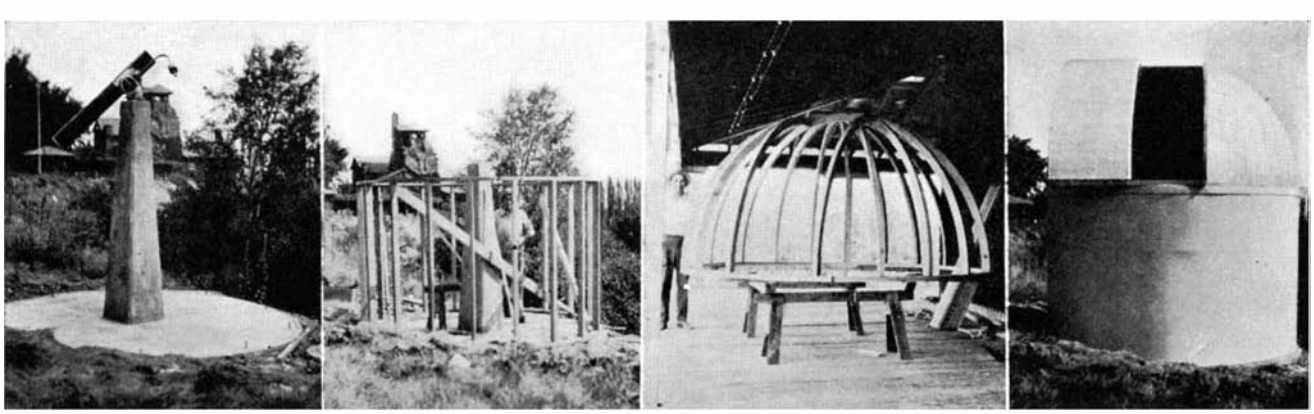


The McPherson observatory

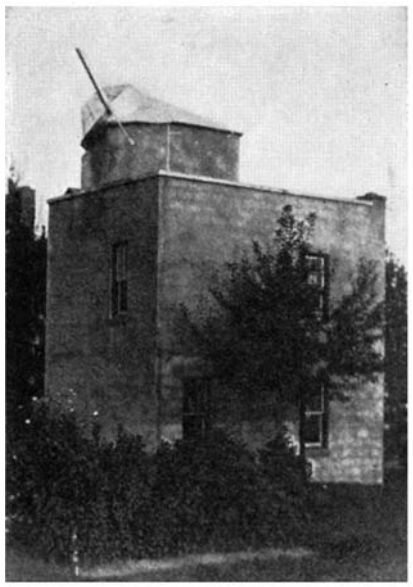
and greatly increases the pleasure of using my telescope."

BONNEVUE OBSERVATORY is at 222 Evans Avenue, Wyomissing (near Reading), Pennsylvania, and is the creation of J. Milo Webster, wholesale optician.

"The building contains a small shop on the first floor," Mr. Webster writes. "The second floor is given over to an assembly



Mr. Farmer and his interesting job, from start to finish. The pictures tell their own story



Bonnevue observatory

room which will more or less become 'hobby headquarters.'

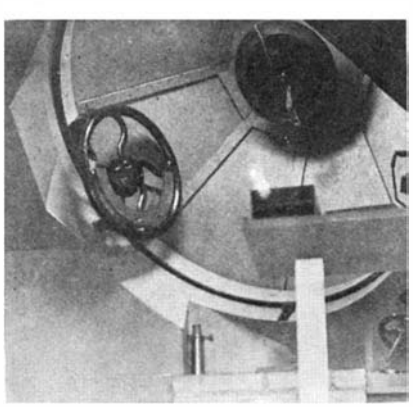
"The main point of interest is the turret house supported on I-beams resting on the masonry walls of the building. It is approximately eight feet square, affording standing room for several persons.

"The refracting telescope at present mounted carries a five-inch lens, but this will later be replaced with a larger one. A second telescope can be mounted on the opposite side of the turret.

"Six two-inch grooved wheels carry the turret, four being located at the top and one either side. The driving mechanism consists of a gear of 24-pitch and 1508 teeth on the outer edge of the large steel ring, into which a 21-tooth pinion meshes. The speed of the shaft carrying the 21-tooth pinion when following a star is three revolutions an hour.

"A synchronous motor of 1800 r.p.m. is followed by a 400 to 1 reducing gear, which in turn will turn a worm gear with 90 teeth, attached to the pinion shaft. The synchronous motor operates on standard time but the number of teeth on the large steel ring corrects for sidereal time in the revolving of turret, with an accuracy quite satisfactory, the error being but five and one third seconds in 24 hours.

"For the general idea of a turret type refracting telescope, the owner is indebted to ex-Governor Hartness of Springfield, Vermont, who has the first, and until recently had the only, turret type refracting telescope."



Inside the turret—Bonnevue

CURRENT BULLETIN BRIEFS

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

SAFETY CODES FOR THE PREVENTION OF DUST EXPLOSIONS (Bulletin of the United States Bureau of Labor Statistics No. 562) is a valuable monograph on a very real danger. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

ONE HUNDRED AND SEVENTY-SEVEN BOAT BUILDERS AND WHAT THEY BUILD is the most complete directory of the small boat industry that has been compiled. It lists 619 models in addition to boat plans, novelty boats, and water sport accessories. *Outboard Motor Corporation, Milwaukee, Wis.—Gratis.*

ELEMENTARY AND SECONDARY SCHOOLS (Bulletin 1932, No. 1, Office of Education, Department of the Interior) gives a list of the principal state, county, city, and other public as well as parochial schools. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING. The Twenty-sixth Annual Report deals with such subjects as retiring allowances and pensions, schools of the U. S., improvement of legal education, and the study of American college athletics. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

SCIENCE IN ACTION (Reprint from the Western Society of Engineers, Vol. XXXVII, No. 1. February, 1932) by E. R. Weidlein gives a picture of the developments that are of interest principally to engineers. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

CONTROL OF RESEARCH EXPENSE (Reprint from *Industrial and Engineering Chemistry*, Vol. 24, April 1932), by William A. Hamor and George D. Beal, deals with a peculiar subject which has to be reckoned with in modern research. The authors are both Assistant Directors of the Mellon Institute. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

TRICHLORETHYLENE. ITS PROPERTIES AND USES. This booklet contains in concise form reliable information on the properties, uses, and industrial applications of this solvent. *The Roessler & Hasslacher Chemical Co. Inc., Niagara Falls, N. Y.—Gratis.*

WEATHERING RESISTANCE OF CONCRETE (Engineering and Science Series No. 36), by E. J. Kilcawley, gives a comprehensive account of the latest experiments on the subject. *Rensselaer Polytechnic Institute, Troy, N. Y.—Gratis.*

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.*

NATURAL RESOURCES OF SYRACUSE AND VICINITY, by William Miller Booth, deals with local problems and successes. *Industrial Bureau, Syracuse Chamber of Commerce, Syracuse, N. Y.—Gratis.*

PRESENT PROBLEMS OF THE ORIENT (International Conciliation, June, 1932. No. 281) gives addresses by Jerome D. Greene and Wallace M. Alexander together with the text of the nine-power treaty. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—5 cents.*

THE AUTOGIRO. This book is an authoritative presentation of the autogiro; what it is, what it does, and how it does it, together with a résumé of its history, development, achievement, progress, and acceptance by the public. *Autogiro Company of America, Land Title Building, Philadelphia, Pa.—Gratis.*

RUBBER SHEATHED TRAILING CABLES (Bulletin No. 358, Bureau of Mines) describes the cables which are used in mining and which extend back from the machines to the permanent wiring; they are, therefore, called "trailing cables." *Superintendent of Documents, Washington, D. C. —25 cents, money order or coin.*

HIGH TEMPERATURE BEARING SERVICE LUBRICATION REQUIREMENTS (*Lubrication*, Volume 18, No. 6, June 1932) deals with the utilization of steam heat for drying purposes in various industries such as paper and rubber from the viewpoint of lubrication. *The Texas Company, 135 East 42nd Street, New York City.—Gratis.*

TESTS OF ROCK-DUST BARRIERS IN THE EXPERIMENTAL MINE (Bulletin No. 353, Bureau of Mines) describes rock-dust barriers which are not a substitute for general rock dusting but are a supplementary or secondary defense where rock dusting has not been done recently or is temporarily deficient. *Superintendent of Documents, Washington, D. C.—10 cents, coin.*

THE FOREST RESOURCES AND LUMBER INDUSTRY OF SOVIET RUSSIA (Trade Information Bulletin No. 798, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce). The greater part of the forests of the Union of Soviet Republics are at the present time inaccessible for commercial exploitation. Production does not keep pace with the mounting domestic demand. This pamphlet gives the latest available facts. *Superintendent of Documents, Washington, D. C.—10 cents, coin.*

NITRATE DEPOSITS OF THE UNITED STATES (Geological Survey Bulletin 838, Department of the Interior), by G. R. Mansfield and Leona Boardman, contains bad news for those who have been optimistic concerning an American nitrate industry and gives a survey of the whole subject. *Superintendent of Documents, Washington, D. C.—40 cents, money order.*

SAFETY IN THE HOUSEHOLD (Circular of the Bureau of Standards No. 397) is one of the best treatises on home safety ever written. It suggests practical means of removing causes of harm and advocates everything which will promote safety. It is well illustrated. *Superintendent of Documents, Washington, D. C.—15 cents, coin or money order.*

A PROGRAM FOR TEACHING SCIENCE (National Society for the Study of Education—Thirty-first Yearbook, Part 1) is a 370-page book dealing primarily with the course of study in science in the public schools. *Public School Publishing Company, Bloomington, Illinois. Paper $1.75; cloth $2.50.*

TRAILSIDE FAMILY. THE NATURE TRAILS AND TRAILSIDE MUSEUM AT BEAR MOUNTAIN, N. Y. (School Service Series Number Seven, Department of Public Education), by William H. Carr, describes an unusual enterprise in the field of natural history. It is attractively illustrated. *American Museum of Natural History, 77th Street and Central Park West, New York City.—15 cents.*

COMBUSTION (Industrial Gas Series, Third Edition) is an exceedingly valuable reference book on theory and practice. Labeled "Third Edition," it is entirely rewritten to keep pace with the progress of the industry. Though written with gas fuel as a background, much of the data are of general interest. The work is sold at the cost of production or less, as it is the policy of the American Gas Association to distribute technical information without attempting to make a profit on the publication. The purchaser pays the postage, shipping weight 2½ pounds.—*American Gas Association, 420 Lexington Avenue, New York City.—$2.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 179)

to the action of the gas sample. Combustible gas in the sample is oxidized or burned catalytically on this platinum wire and any increase in temperature from this combustion increases the electrical resistance of the wire. This increase in resistance is proportional to the amount of flammable vapors in the sample and is measured by a milli-ammeter, the scale of which is calibrated to give direct readings in percentage of lower explosive limit concentration. It will also indicate whether the vapor concentration is within the explosive range and in addition, by dilution with air, whether the vapor concentration is above the upper explosive limit.

"If" For Chemists

THE chemist's life is not all romance, as Mrs. J. C. Lamb, of Lexington, Kentucky, points out in the following parody of Rudyard Kipling's poem, "If", reprinted from *Industrial and Engineering Chemistry:*

If you can make the vilest stinks invented
And work in them from morn till late at night,
Or with your lot be perfectly contented
When you are asked to fool with dynamite;
If you can still remain quite calm and placid
When plant officials effervesce and fret,
Or being told to test a fuming acid
Can suck it through a 1-cc. pipet;

If you don't get just what the boss expected
Yet have the pluck the true results to state,
And from the truth refuse to be deflected
And never stoop to adding in the date;
If you can read a bunch of sample numbers
When all the labels have been soaked in crude,
And can, when wakened from your slumbers
At 2 A.M., respond in cheerful mood;

If you can drop the fruit of your exertion
Before you've weighed it, on the concrete floor,
And feeling not a symptom of aversion
Can start again as blithely as before;
If you can take a broken desiccator
And from it improvise a Liebig still,
Or gage the rainfall by the dehydrator
And give three hours a week to first-aid drill;

If you can subjugate all thoughts of pleasure
And still retain a meed of self-esteem;
If you can give your few short hours of leisure
To keeping up with every modern theme;
If you donate your every waking minute
And seek your sole reward in duty done,
Yours is the Lab. and everything that's in it,
And what is more, you're welcome to it, Son.

Rubber Paint

SNOW-WHITE, transparent, non-flammable chlorinated rubber is on the market in Germany where it is finding use particularly for painting iron, concrete, and wood. Such a coating is no more expensive than that obtained with the usual good paints, and it has better adhesive qualities. The Mannesmannwerke now produces about 20,000 pounds per month of a similar product known as "Tornesit" used for painting gas and water piping. Tornesit, containing 30 percent rubber, can be used for all articles hitherto made of ebonite or Bakelite and may be obtained in all colors desired.

Decomposition of chlorinated rubber begins at 150 degrees, Centigrade; therefore it is suitable for impregnating fabrics, wood, and so on. It is resistant to acids and alkalies, insulates against electricity, and gives special hardness to films. It has a specific gravity of 1.5, is soluble in benzol, esters, and chlorin-hydrocarbons as well

as in tetraline. It is insoluble in alcohols, benzine, and mineral oils. Highly concentrated solutions readily absorb colors and therefore have good covering power. Plastic masses, artificial leather, and the like can be produced from chlorinated rubber. The products are cheap because the basic materials, rubber and chlorine, are at present low in price and available in practically unlimited quantity; production is comparatively simple and inexpensive.—*A. E. B.*

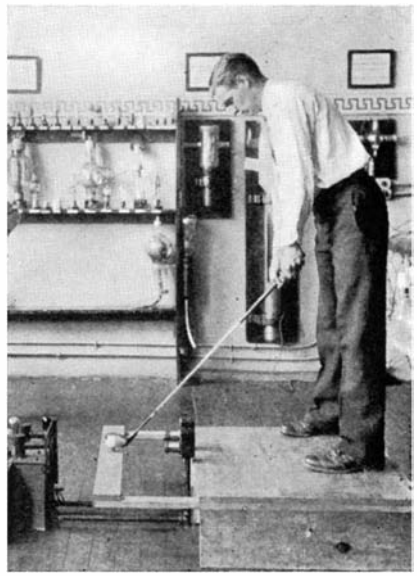
Why Golf Balls Go Far

THAT the measured speed of a driver when it connects with a golf ball is from 70 to 125 miles per hour was shown in the research laboratory of the General Electric Company when a series of tests was conducted by means of a device utilizing the phototube. Jim Reynolds, of Schenectady, winner of the national driving championship at Chicago in 1930, made the mark of 125 in his second attempt. The device used in the laboratory to measure the speed of the club was developed by H. W. Lord, vacuum tube engineer. It employs two photo-electric cells and can be used to measure speeds which have never before been measurable because of the nature of their force.

Reynolds, who has a reputation for obtaining remarkable distance in driving, in his first attempt registered a speed of 106. His second swing was 125, the high mark of the afternoon, while other attempts ran from a low of 72 to 102 miles per hour, varying with the length of club used.

Alex McIntyre, professional of the Edison Country Club, Schenectady, also swung a driver several times from the platform. His speed when connecting with the practice ball ranged from a low of 70 to a high of 97 miles per hour. The tests demonstrated that lightness, rather than weight in the head of the club, and length of shaft contributed to the higher rates of speed.

The apparatus developed by Lord for making the measurements includes two phototubes and light sources which project two beams of light about six inches apart. These beams run at right angles to the path of the club, which is swung from a platform. The driver cuts the first beam a split second before it strikes the ball on its tee and almost immediately afterwards cuts the second beam. Both phototubes operate Thyraton tubes, the first one causing a condenser to begin charging and the



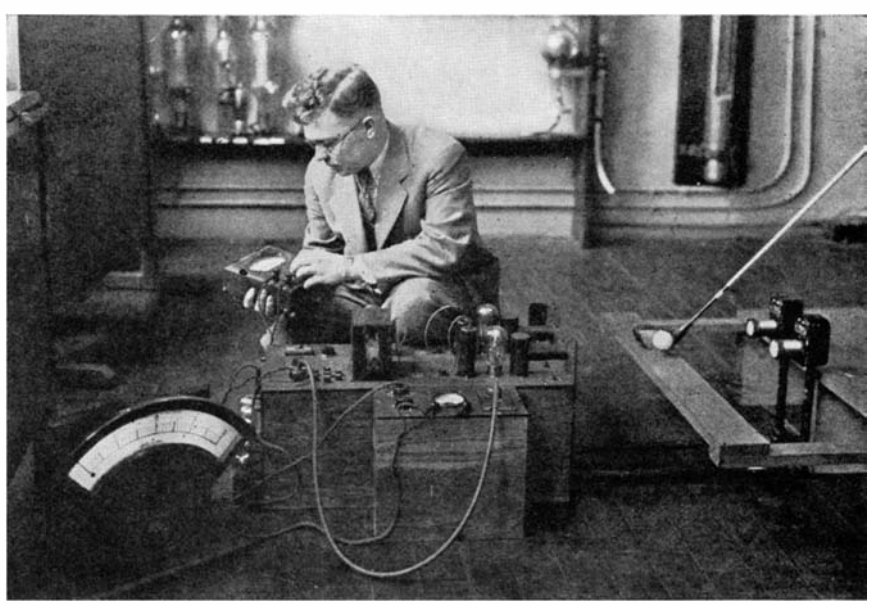
Laboratory set-up for measuring speed of the head of a golf club

second one stopping it. The resulting voltage charge across the condenser is measured by a meter, which is calibrated in terms of miles per hour. The calibration can be altered to measure much slower or much faster speeds, and it is possible to measure speeds up to about a thousand miles per hour with the device.

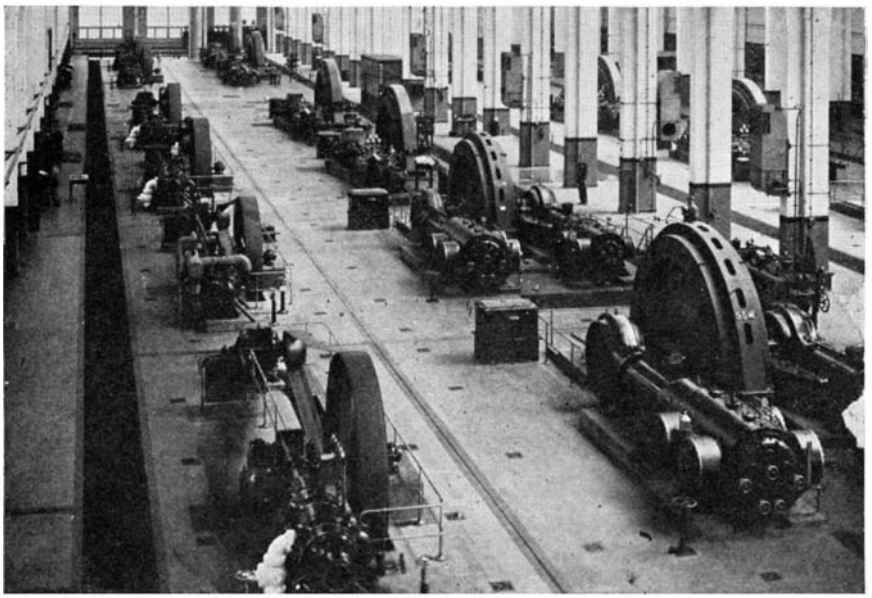
Headaches Caused By Food Sensitiveness

HEADACHES may be caused by hypersensitiveness to certain foods, it appears from a report of Drs. Ray M. Balyeat and Herbert J. Rinkel of Oklahoma City to the American Medical Association. These physicians studied the various types of headaches due to this cause. They found that women have longer, less frequent attacks, while men have frequent attacks of shorter duration.

The symptoms vary in different persons



The instruments used in determining why golf balls go so far (or not so far)



Motors and compressors in new Dutch synthetic ammonia plant

and in different attacks in the same person. Several members of a family may have them. The only way to determine that the headaches are caused by food sensitiveness is by the trial method; avoiding the offending food will give relief. This is also the best method of treating, or preventing, the headaches.

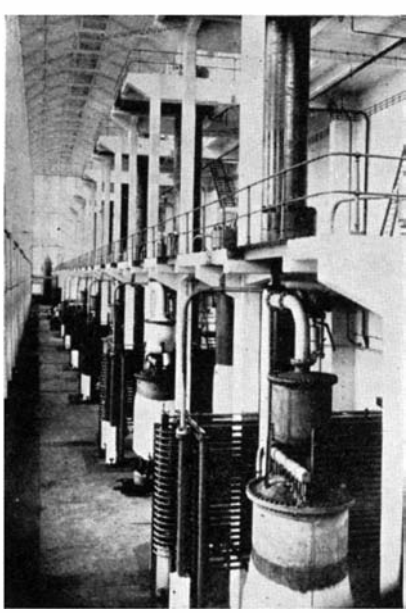
Many persons have headaches caused by inflammation of the nasal sinuses. In these cases the food sensitiveness is often a predisposing factor, Dr. Balyeat said. This occurs especially in hay fever victims.—*Science Service.*

New Dutch Plant for Synthetic Ammonia

THE largest plant in the world for the manufacture of synthetic ammonia was put into operation recently in Sluiskil, Holland. Here hydrogen and nitrogen are united to form ammonia at the rate of 200 tons of product per day. This splendid plant, the last word in chemical engineering achievement, is described in a recent issue of *Chemical and Metallurgical Engineering.*

Hydrogen for the process is obtained as a by-product from coke-ovens. It is separated from the coke-oven gas by compression and refrigeration. The union of hydrogen and nitrogen is accomplished by passing the mixture at high pressure through converters filled with activated iron oxide. When the plant is first started, it is necessary to heat the converters by electric heating units, but as soon as the reaction gets under way it supplies its own heat and the electricity can be shut off.

The synthesis plant comprises five compressors handling 6000 cubic meters per hour; two compressors handling 2500 cubic meters; six reaction towers, each producing 35 to 40 tons of ammonia a day; and two preliminary converters. Every synthesis unit consists essentially of the reaction chamber proper, a water cooler, a column for condensation and separation of liquid ammonia, an ammonia evaporator, and a circulating pump. Very little manual labor is required; only one man is needed to perform all operations on two synthesis units.—*A. E. B.*



The converters where nitrogen and hydrogen form ammonia

Rubberized Paper

A NEW development in paper manufacture, involving the use of rubber latex in making coated papers for the printing and lithographing trades, has been announced by the United States Rubber Company.

The name given to the special latex formula is lexene. The following claims of special interest to printers are made for coated papers containing the new ingredients:

Because rubber is waterproof, the water content of the paper is more stable and the tendency of the sheet to curl, shrink, or expand is largely overcome, eliminating many pressroom difficulties.

Because rubber is non-absorbent, a lexene-coated sheet uses less ink and the ink "lays" better. Solid blacks, for example, are beautifully soft and even in texture, and experiment has demonstrated that the ink dries more rapidly and offset is greatly reduced.

Because rubber is continuously flexible,

it binds the harsher coating ingredients in a soft, pliable coating and greatly increases the folding strength.

The use of the new ingredient has passed the experimental stage, several of the large paper manufacturers having been engaged in making and marketing the paper for nearly a year to test its qualities and acceptability among printers.

A Permanent Synthetic Blackboard

A GLASS blackboard combining the virtues of slate with original and exclusive properties of its own has recently been developed by the New York Silicate Book Slate Company, New York City. The board, known as Seloc antiseptic glass blackboard, is a deep black and will not fade or become glazed. It has a velvety surface, free from imperfections. The board is patented and consists of black plate glass with a suspended abrasive uniformly dispersed throughout the glass while molten. Experimental tests equivalent to 100 years' wear have left the sample in as good condition as when new. The thickness and weight of the board are the same as with natural slate, and the cost is but slightly higher.—*A. E. B.*

Thunder Does Not Sour Milk

CONTRARY to popular belief, thunder does not have anything to do with the souring of milk, says the United States Department of Agriculture. Just before a thunderstorm the atmosphere is unusually warm or even uncomfortably hot. This warm condition is ideal for bacteria to work, and the sour milk is a result. The heat and bacteria do the trick, not the thunder. More attention to cooling the milk is suggested to prevent souring at these times.

New Anesthetic Deadens Pain for Longer Period

A NEW anesthetic, which continues to kill pain after an operation but has no habit-forming power, was reported at a recent meeting of the American Chemical Society in a paper by Dr. T. H. Rider and E. W. Scott of the William S. Merrell Company of Cincinnati. The new anesthetic, called diothane, is local and is said to outdo both cocaine and novocaine. The drug is closely related to a number of similar organic anesthetics which are not particularly effective. A few slight changes in positions of atoms account for its potency.

"This compound," said Dr. Rider, "is the only one at present available which is not only stronger than either cocaine or novocaine but can be used satisfactorily in any surgical operation that can be done under local anesthetic. At the same time it is not habit-forming and is less toxic than either cocaine or novocaine.

"Clinical studies have been made with diothane which have shown that its use in actual practice leads to more favorable results than the use of previously known anesthetics.

"Among the outstanding effects is the slowness with which the anesthesia disappears. Because of this the patient is more comfortable after operation than is usually the case."—*A. E. B.*

FLYING IN THE BEGINNING

(*Continued from page* 141)

while others, below, supported and steadied the cord and kept up its sag.

With tandems of kites supporting the wire at intervals we were able to send field telegraph lines out for long distances and across ground assumed to be swept by hostile fire.

Not the least interesting of this class of test was the sending of a small cable to Brooklyn. The end, secured to a float, when received there was attached to a telephone by which communication was opened while ships passed beneath the cable held arched over Buttermilk Channel.

This stunt attracted much publicity and a civil engineer in Mexico, having read of it in the papers, wrote to me that he was confronted with the problem of putting a cable across a wide, deep cañon in the bottom of which there was a raging torrent. He wanted to know whether kites might not be used to carry across a rope by which the cable might be hauled over. He sent me a map and sketches of the place and I replied, sending him directions for the building and operation of kites he would need. A month or so later, an enthusiastic letter from him told of the complete success of the undertaking.

BY this time my mail was full of kite correspondence. Many of the letters were from serious scientific men, including Baden-Powell, in England; Lilienthal, in Germany; Hargrave, in New South Wales; Langley and others in our country. Many were from cranks with all sorts of fool ideas and suggestions. Numerous express parcels came too, frequently "express charges collect," with models which were usually absurd, and often the senders requested the return of these after trial.

Also I was now coming into rather unpleasant notoriety with people who regarded my kite experiments as utter nonsense and I regret to say that some of these were officers of the Army who regarded my work as a reflection upon official intelligence. My comrades at the post understood the purpose of my experiments but, nevertheless, they could not resist the temptation to twit me about my "flying-machines" and they took to calling me "Darius." I resented this because they knew as well as I that I was at that time considering no flying-machine.

We next branched off into attempts to gain high altitudes and, though it was of no particular military importance, we were sending aloft a box which contained thermometer, barometer, psychrometer, anemometer, and other meteorological instruments for readings in the upper air.

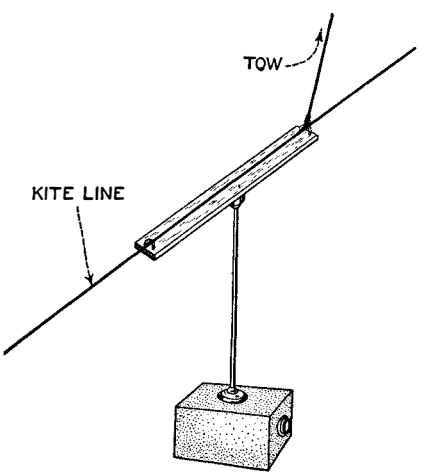
When the Weather Bureau recognized the value of this phase of kite work, it took it up and, under the direction of Professor Marvin, it accomplished surprising results at the Blue Hills Observatory and other stations. Meantime, Professor Alexander Graham Bell had become interested and he had developed a new type of cellular kite for high altitude flights. I therefore began to feel that if I was sent to the lunatic asylum I should at least be in good company.

One of the most noteworthy instances of the use of kites came some years after this when radio was in its infancy. Captain William Mitchell, of the United States Signal Corps, in 1904, using a tandem of modified Hargrave kites, raised the antenna of a radio two miles in the air and received a message from the S.S. *Navarisk*, 1900 miles away, the distance record at that time.

By the winter of 1896 we were having considerable success with aerial photography and were trying to perfect an apparatus by which a hostile position might be photographed from behind our lines.

At first, the camera was carried on a light platform suspended from the kite-cord and adjusted for pointing by means of the suspension cords. The shutter was operated by mechanism from an alarm-clock which sat beside the camera.

With this crude device some really remarkable results were obtained, fully justifying further experimenting. The final development was a specially constructed camera box equipped with long-focus lens



Camera set-up used by the author for aerial photography with kites

and holder for plates or film roll. The box contained a clock-work shutter mechanism which could be set to operate at a given time.

Attached to the top of the camera-box by a ball and socket joint was a slender rod which hung from a light wooden "rider" on the kite-cord. This rod attached to the rider by means of a disk-and-pintle so it could swing in a vertical plane but could not twist horizontally. A guy back to the rider prevented the rod from swinging forward past vertical with the wind (not shown in the drawing above).

The kite-cord passed through eyes at each end of the rider so it could slide along the line, and to the forward end of the rider was attached the cord of a towing kite to take it up.

The place on the kite-line to which the camera was to go having been decided upon, calculations were made of the angles for pointing to the object to be photographed, the camera was pointed and sent up. At the fixed time the shutter mechanism operated.

We succeeded in getting excellent photographs of lower New York while the operators were safely concealed behind the fort on Governors Island, more than a mile away. The kites and apparatus were, of course, in view but they offered a relatively small target and were much less vulnerable than balloons which, until then, had to be relied upon for such work.

There remained the serious disadvantage, however, that the Hargrave type kites we were using did offer a target and also they were bulky and hard to pack. We therefore commenced experimenting for a less conspicuous and a more portable kind. This we finally developed from a kite invented by Mr. Eddy of Bayonne, New Jersey.

The frame consisted of a central vertical backbone and a cross-piece perpendicular to it. The cross-piece, about 12 percent longer than the upright, crossed it at about 18 percent of its length from the top and the cross-piece was bent back into a shallow bow. The cover, somewhat wider than the length of the cross-piece, was gathered in a wedge-shaped pleat along the backbone which thus became a central keel on both sides of which the cover, bellying back, formed stabilizing pockets. The edges of the cover were hemmed around steel piano-wire so that there could be no stretching and the corners were fitted with small rings which engaged in snap-hooks on the ends of the sticks. The piano-wire bowstring was also quickly detachable; less than a minute was required to assemble or to dismantle the kite. When dismounted the sticks were rolled up in the cover and the kite was ready for shipping.

This kite lacked the power of the cellular kite but it flew at a very steep angle and proved to be excellent for our purpose.

Four six-foot kites of the Eddy type served to carry the camera to any desired height and, when rolled, could be comfortably carried on the shoulder. The reel-box, with rope handles, was fitted to take the camera and the developing paraphernalia, so the entire equipment was easily carried by two men.

IN the spring of 1898, soon after our entry into the Spanish War, it was necessary for us to know the whereabouts of Cervera's fleet which might be a menace to transports going to Cuba. It had been lost track of but was supposed to have gone into the harbor of Santiago de Cuba.

In the mobilization camp at Tampa I had my aerial photographic equipment, the Regimental Commander having directed me to take it with us. General Shafter sent for me and asked whether the harbor of Santiago could be photographed over the hills at its entrance.

As a test, he then sent me out on a ship to try to photograph the harbor of Tampa from outside. This was satisfactorily done and I delivered him photographs showing the details beyond obstructions.

He then ordered me to be prepared to go to Santiago to do the same thing. Naturally, I was enthused and was confident of being able to settle the question as to whether or not Cervera was there but before I was started Cervera's presence was discovered. General Shafter then ordered me to take the apparatus on the expedition to Cuba but the campaign there never necessitated its use.

(To be concluded)

In the concluding part of this article, Colonel Wise tells of his progress from the kites described above to man-carrying kites and then to his first successful glider which was launched on a hill-side from a bicycle.—The Editor.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY
Member of the New York Bar

Advertising as a Curb on Product Design Pirates*

Unfair Competition Involving Intentional Imitation Cannot Always Be Restrained by Courts

By JOHN C. PEMBERTON
New York Bar

WITHOUT fear of interference, any would-be competitor, indifferent to the ethics of the matter, may make or sell an exact, a Chinese copy of your product, your machine, your design—unless it is patented, copyrighted, or blessed with a "secondary meaning."

This is a hardship. No one denies it. The remedy, however, lies with the legislature alone, or so the courts say.

It is established that when an action is based upon the imitation of the form and appearance of another's products or goods, the complaint should allege (1) "not merely the imitation, but (2) that the particular form imitated had come to be known to the purchasing public as an indication of the origin of the plaintiff's goods or wares, and (3) that confusion has resulted or is apt to result, in the public mind by reason of the imitation." (Nims, 3rd Ed. page 822.)

In Rice v. Redlich (202 Fed. 155, 158) the court said:

"It is apparent (there is no evidence to the contrary) that no one who purchased the defendant's miniature telephone cared anything for the origin of its manufacture, much less does it appear that anyone was induced to buy, by the belief that he was buying an article made by the complainants." An injunction was here denied.

In Hudson v. Apco (288 Fed. 871, 876) the District Judge, in the same vein, asserted:

"To maintain the charge of unfair competition by imitation of goods or products it is necessary for the plaintiff to show that the appearance of his wares has in fact come to mean that some particular person —the plaintiff may not be individually known—makes them, and that the public cares who does make them, and not merely for their appearance and structure. In order to be deceived or led into mistake, the purchaser must have associated the article with a particular producer, or suppose that he is getting what he already knows about as a desirable article."

In the case of Crescent v. Kilborn (247 Fed. 299) the plaintiff was the manufacturer of an adjustable wrench and had widely advertised the same. The wrench, on account of its appearance and new and original shape, pleased the public. No adjustable wrench of precisely the same character had ever appeared upon the market. Defendant was engaged in manufacturing substantially a direct facsimile of the plaintiff's wrench. The Court said:

"It is an absolute condition to any relief whatever, that the plaintiff show that the public cares who makes these wrenches, and not merely for their appearance and structure. *It will not be enough only* to show how pleasing they are, because all the features of beauty or utility which commend them to the public are already in the public domain.

"The critical question of fact at the outset, always, is whether the public is moved in any degree to buy the article because of its source and what are the features by which it distinguishes that source. *Unless the plaintiff can answer this question he can take no step forward: no degree of imitation of details is actionable in its absence.*

"The defendant, on the other hand, may copy the plaintiff's goods slavishly down to the minutest detail, but he may not represent himself as the plaintiff in their sale."

In the preceding case it was held that the right to appeal to the public *even in the minutest* details of the plaintiff's design was open to all so long as the details had acquired no *secondary meaning.*

In Shredded Wheat Co. v. Cornell (250 Fed. 960) Judge L. Hand explained in this wise: *"If the public has come to associate the article with a single maker, he is, we think, entitled to some protection, as much when the association be through mere appearances, as when it be wrapped up in a name.* I think that since the plaintiff has shown that the appearance of its biscuit (Shredded Wheat) has acquired a secondary meaning, that the defendant should be compelled to put some distinguishing mark upon each biscuit sold to any final purchaser."

In unhappy contrast is the case of Upjohn v. Merrill (269 Fed. 209) involving imitation of shape and coloring of Phenolax wafers. Judge Denison here said:

"Defendant must have copied plaintiff's complete combination because it expected to get commercial benefit from the copying. This is not enough. Defendant thus began its competition before there was time for plaintiff to get the indicative effect of its trade dress *or form* sufficiently established in the mind of the purchasing public. *This makes the diligent thief immune, while the one who might hesitate and delay must give up his plunder.*"

Some years earlier, in Eisenstadt v. Fisher (232 Fed. 957) Judge Brown remarked:

"There are a number of cases in which the Court apparently has been of the opinion that the copying, in view of the association of the article copied with a particular manufacturer, was a means of palming off goods as those of another, and of trading upon another's reputation.

"Upon the facts of this case (imitation of bracelet links) I am of the opinion that the origin of the goods, the authorship of the design, or the reputation of the manufacturer, have not been shown to be a matter of such interest to the public as to afford an inducement to the public to buy the plaintiff's goods rather than the goods of other manufacturers. Whether the links are made by Bullard Bros., or by Bates, or possibly by other manufacturers, would seem to be a matter of indifference to the public. *Whether a particular make of goods is exclusively associated in the mind of the public with a particular manufacturer is a matter of fact.*"

A more recent opinion of the same tenor was rendered by Circuit Judge Mack in Maatschappij v. Kosloff (45 Fed. (2) 94), as follows:

"It is attempted to sustain the cause of unfair competition on the ground that the defendant's fruit juice extractors closely resembled those of the complainant and that by many sales and much advertising the form of the article had acquired a 'secondary meaning.' But there is no proof of palming off, nor is there anything to show that fruit juice extractors of the design in question have been bought because they originated with the complainant rather than because they were useful articles of a neat appearance. *It is to be remembered that the defendants would have the right to copy the Gilbert design slavishly* so long as they did not represent that their articles sold, were those of the complainant. Accordingly, we hold that the cause of action for unfair competition has not been established."

Finally, the United States Supreme Court declined in 1929 to review the lower court's denial of protection to plaintiff's dress patterns (neither copyrighted nor patented) since the patterns had not been in use long enough so that they had come to be identified as creations of the plaintiff. The Circuit Court of Appeals had said in this case:

"The plaintiff's claim that whenever anyone has contrived processes, machines, designs, and so forth, others may be forbidden to copy them. That is not the law. A man's property is limited to the chattels which embody his invention. Others may imitate these at their pleasure *unless in so doing there is imputed to the copies the same authorship as the originals.*"

*Reprinted from *Printer's Ink.*

Cheney Bros. v. Doris Silk Corp. (35 Fed. 2nd, 279).

To secure protection against imitation of the make-up, appearance or design of your particular wares, packages or containers, it is therefore obligatory to have (1) a patent or (2) a copyright or (3) a secondary meaning.

The first two are relatively cheap but not always available. The latter "is but a species of advertising, its purpose being to fix the identity of the object or container and the name of the producer in the minds of the people who see it. All advertising is an appeal to human interests and instincts, and its value has become well known."

Experience seems not only to justify, but to demand large expenditures for this purpose where the manufacturer has no patent or copyright to fall back upon for his product.

Patent Assignment Rights Defined

A PARTY having an agreement with a patentee for the assignment of a patent upon the exercise of certain options by the purchaser is not entitled to maintain a counterclaim in an infringement suit alleging the infringement of the patent covered by the agreement, according to a ruling of the District Court of the United States for the District of Delaware.

Since the owner of the legal title to the patent in the counterclaim was not a party to the suit, District Judge Nields ordered the dismissal of the counterclaim asserted in the case of Rhodes-Hochriem Mfg. Co. versus International Ticket Scale Corporation.

"While a sole and exclusive license to use, manufacture, and vend a patented structure may be held the equivalent of an assignment of the patent where the document granting the license is consistent with a present transfer of the patent, yet where the document granting the license negatives a present transfer of the patent, the license can not be held the equivalent of an assignment of the patent," Judge Nields states in his opinion.

In the agreement in question, it was noted, the sellers promised to assign to the purchaser title to the patents described, including the patent in the counterclaim, upon receipt of the payments therein provided under options set forth, and thereupon, on demand, to deliver a proper assignment of the patents to the purchaser.

The document fails to meet the requirements of an assignment of title to a patent, it was held, it being no more than an agreement to sell, expressing conditions upon which title shall vest in the purchaser.

IN another case, jurisdiction of the Division of Corporations over the sale of assignments involving undivided interests in patent rights, has been upheld by Attorney-General U. S. Webb.

The Attorney-General, in an opinion to Edwin M. Dougherty, Commissioner of Corporations, states such assignments constitute a certificate of interest which would entitle the holder to participate in the proceeds of a contract awarded for profit and would therefore constitute a security under the Corporate Securities Act.

In the case in question it was proposed to assign an undivided interest in certain letters patent for improvements on steam boilers. The assignment provided that the assignee would not attempt in any way to manufacture, sell, or license others to manufacture or sell the device described in the patent.

It also contained a provision that the assignment would be made subject to an exclusive right to a license granted to a manufacturing corporation under a contract licensing the corporation to contract for, manufacture, erect, design, and sell in any part of the United States steam boilers embodying the invention.

Machine Unpatentable Apart from Process

THE obvious mechanical or electrical device by which a new or useful process for accomplishing a given result would be practiced is not patentable apart from the process, the Circuit Court of Appeals for the Sixth Circuit has ruled.

This decision was handed down in holding invalid the Suter patent No. 1266879, for electrical heating apparatus for permanently waving hair. The patentee, after discovering that since the hair is coarser and more abundant near the roots that portion requires heating for a longer period of time than near the tips, practiced this process by duplicating the electrical stoves and heaters in common use, the court explained in its opinion. By the device of the patent in suit, the lower of two heaters could be connected electrically without using the upper or outer heater.

The method employed by the patent was first to connect the heater next to the head, and, after that heater had been in operation for a given period of time, to connect the upper or outer heater.

Considering the utility of applying heat for a longer period to the hair near the roots in order to procure a better and more permanent wave, the court held that the only advance in the art lies in the discovery of the advantages of that method. Having made this discovery, it was stated, the patentee designed the obvious electrical device to effect this purpose.

A machine patent which does not meet all the tests of patentability applicable to machine patents, it was ruled, may be held invalid notwithstanding the patentee may have discovered a clearly patentable process for the use of the machine.

"Where the entire utility of such machine depends on the method of its use in following the successive steps of a prescribed process, the situation is analogous to that presented by an aggregation," according to the opinion of Judge Hickenlooper. "The ultimate improvement in product or service is not determinative of the question of invention, but of utility only. The ultimate unity of operative result is to be disregarded and must yield, as a criterion, to the fact that separate operations are independently performed by the several units and the court must determine whether, with the performance of these several operations in view, an exercise of the inventive faculty was required to organize the machine." This principle was said to apply to the patent in suit since, apart from the processes disclosed, the device of the patent lacks patentable utility.

"Having discovered a new and useful method, which we assume was patentable as such, the patentee applied for a machine patent which was issued upon an unpatentable device." The court concludes in finding that this was an error in judgment and administration for which the courts can not and should not afford a remedy.

The decision was handed down in the case of The Nestle-LeMur Company versus Eugène, Ltd.

Oiling Patent Valid and Infringed

TEN patents owned by the Auto Research Corporation, covering devices sold by the Bijur Lubricating Corporation, relating to the art of lubricating the chassis bearings from a central source on an automobile, have been held to be valid by the District Court of the United States for the Eastern District of New York and to be infringed by the continuous central chassis lubricating equipment manufactured and sold by the Alemite Corporation.

"Prior to Bijur," Judge Moscowitz stated in his opinion, "there was no continuous central chassis lubricating equipment. The problem confronting Bijur was the lubrication of various bearings of the chassis of an automobile from a single source of supply on the car.

"The problem of a central source of distribution of lubrication of various bearings of the chassis of an automobile which Bijur solved was a very difficult one. Not only was it necessary to lubricate every chassis bearing, as the bearings were not alike—some required a greater, some a lesser amount of oil—but it was necessary to feed the oil from a common source to many widely distributed bearings in minute quantities which were proportionate to the different needs of the different bearings, having in mind that different bearings are at different distances from the source, at different levels with respect to the source and with respect to each other, and that some bearings are tighter than others. Weather conditions also played an important part. It was likewise important that oil reach the bearings as promptly as required, and that there be no unnecessary flow of oil to the bearings when the car was not being used."

The Bijur system is described by the court briefly as providing "for a simple pump delivering the amount of oil required to the various chassis bearings with a pipe system fed from the pump and having branches leading to these bearings with drip plugs or resistance units in the outlet ends of the branches, mounted at the various bearing structures."

After reviewing in detail in its opinion the patents involved and the prior patents and publication claimed to anticipate the patents, the court holds that "none of the prior patents and publications introduced in evidence by the defendant anticipate the claims of the patents in suit."

Relative to infringement, the court stated that the defendant's system is like the plaintiffs' system in principle of construction, in mode of operation, and accomplishes the same result. "The Alemite Corporation has made use of all of the features of the Bijur system, and has infringed each of the 10 patents in suit," it was ruled.

Books SELECTED BY THE EDITORS

OUTLINE OF THE UNIVERSE

By J. G. Crowther

THE whole universe, from electrons to stars, including life, is the scope of this book, which was written by the author of several rather recent articles in the SCIENTIFIC AMERICAN. There have been a number of books treating everything in the universe, so to speak, but we place this one on the top of the pile. One way in which it differs from many is that the author was entitled to write it. He has a broad scientific training and is in close touch with the personnel of science in Great Britain, being the liaison between the famous Cavendish Laboratory at Cambridge and the press, also scientific correspondent (in America we should say science editor) of Great Britain's "best" newspaper, the *Manchester Guardian*, and is rapidly becoming known as a leading popularizer of sound science, not as a journalist invading science but as a scientist invading journalism. This book conveys the true atmosphere of science. Not only does it cover inorganic science—modern cosmology and astrophysics and atomic physics—but the organic world as well, from the submicroscopic viruses to apes and psychology. And it is all pleasant reading, not dull, but bright and constantly interesting.—$3.65 postpaid.—*A. G. I.*

THE OPEN WORLD

By Dr. Herman Weyl, Prof. Math., Univ. Gottingen

THIS book contains in its 87 pages three lectures recently delivered at Yale University by a world-famous mathematician and philosopher. The subject is the metaphysical implications of science and the titles of the lectures are "God and the Universe," "Causality," "Infinity." Such a book as this is manifestly not addressed to readers of the tabloid press, but rather more to thinkers. It is replete with references and inferences, understanding of which demands a broad liberal education. Also its author is a German and the book, though in English, bears the typical earmarks of the Teutonic way of thinking. Perhaps these cautioning comments are unduly colored by the fact that the reviewing was done in that hot week last July. A winter-weight book in July is perhaps no worse than red flannels in the same month, but it is as bad.—$1.65 postpaid.—*A. G. I.*

ELECTRONS AND WAVES

By H. Stanley Allen, F. R. S. M., Prof. Natural Philosophy, University St. Andrews

THIS is an introduction to atomic physics and is neither altogether popular nor altogether technical; it falls between these limits—where the average SCIENTIFIC AMERICAN reader generally likes books to fall. Within the compass of 316 pages it covers atomic physics in a more rounded manner, touching on more things, than any book we have seen for several years. It contains some mathematics but not very much. Even this, as the author states in his preface, may be skipped without loss by the reader. This reviewer had done the skipping even before that permission was discovered, but still found it a good book, chock full of information. A large sale is predicted for it. The format is just right for the pocket—5 x 7½ x ¾ inches—and the volume should be a good cool weather companion to nibble at without a headache. From it one may reasonably expect to "surround" modern atomic physics (down to a sensible depth) and thus keep up with science. —$2.65 postpaid.—*A. G. I.*

PHYSICS OF THE EARTH—I, VOLCANOLOGY

By Day, Sapper, Friedlanger and Jaggar. National Research Council, Washington, D. C.

TO give to the reader, presumably a scientist but not a specialist in the subject, an idea of its present status, together with a forward-looking summary of its outstanding problems, was the aim of the National Research Council (which is in a sense the National Academy of Sciences) when that body organized a committee to prepare a series of authoritative books. This is the first of four separate treatises. It deals with volcanology, a corner of science which is as yet but partially organized. Those who are interested in the activity and causes of volcanoes, their mechanism, and the science of volcanology in general, will find this 71-page book a landmark where there are practically no others. The authors are the world's ablest authorities on the specialized science of volcanology.—$1.15 postpaid.—*A. G. I.*

PHYSICS OF THE EARTH—II, THE FIGURE OF THE EARTH

By Marmer, Bowie, Lambert, Brown, and others. National Research Council

THE second volume of the National Research Council's group of books, any of which may be purchased separately or the set for $10.00, contains 78 pages on the tides, ocean, and earth, by leading authorities on tidal theory in the United States Coast and Geodetic Survey, the Liverpool Observatory and Tidal Institute. The subjects are tidal theory, tidal predictions, tides in the solid earth, tidal friction. The next 118 pages are on the theory of isostasy, shape and size of the earth, determination of the intensity of gravity, determination of elevations and geographic positions by refined methods. The final 34 pages are on the slight but mysterious variations of latitude due to some unknown cause.—$3.65 postpaid.—*A. G. I.*

PHYSICS OF THE EARTH—III, METEOROLOGY

By Kimball, Humphreys, Henry, and others. National Research Council

AN important volume of 273 pages, more technical than the others; the reader who does not already know at least elementary meteorology will hardly be likely to get more than a little out of it. The subjects are the origin and composition of the atmosphere, solar radiation, dynamic meteorology, physical basis of weather forecasting. The authors are leaders in this science.—$3.65 postpaid.—*A. G. I.*

PHYSICS OF THE EARTH—IV, THE AGE OF THE EARTH

By Knopf, Schuchert, Kovarik, Holmes, and Brown. National Research Council

THIS fourth volume of what might be called the symposium-of-the-ablest-scientists-series contains 466 pages and covers the age of the earth as deduced on the basis of sediments and life, the age of the ocean, the age of minerals as calculated from radioactivity, and geologic time. The latter subject is covered in the utmost detail by the foremost of those of the world's scientific men who have specialized in this ever intriguing problem, and this book is the last word concerning it. The average reader who understands geology will be able to follow almost the entire

argument. None of these four books is strictly popular but there are thousands of well-read amateur scientists who will experience little or no trouble following them.—$5.20 postpaid.—*A. G. I.*

If the above set of four volumes are wanted together they should be ordered direct from the National Research Council, Washington, D. C.—price $10.00.

AIRCRAFT ENGINE MECHANICS MANUAL

By C. J. Moors, U. S. A. Air Corps Tech. School

COVERS the same ground as the course given the enlisted mechanics of the Army Air Corps at their special technical school with the addition of much data on types of engines that are common in commercial aircraft, but not adapted to the requirements of military service. So clearly is it written and so profuse are the illustrations even the beginner who has to study by himself without the aid of an instructor will have no difficulty in grasping its complete but simple explanations. 536 pages—189 illustrations.—$4.70 postpaid.

SEVENTY YEARS IN ARCHAEOLOGY

By Sir Flinders Petrie

AS a record of the life work of the world's foremost archeologist, this book is of prime importance whether or not some of the conclusions, stressed with such uncompromising vigor, are upheld by a majority of his fellow archeologists. At least it is an honest statement of opinion of finds, feuds, and the astonishing incompetence and petty spite of some museum authorities, supposed scientists, and government officials. It is the extremely interesting expression of a strong, vigorous, dominating personality, besides being an absorbing account of adventures and discoveries.—$4.20 postpaid.

THE FUN OF IT

By Amelia Earhart

IN a most entertaining way the reader is given the facts and incidents of a life already filled with experiences which would seem to be unusual even for one much older than the author. In aviation one realizes with surprise that Mrs. Putnam was among the first women who took an active interest in the early days. Without undue stress, the part taken by women is brought out continuously and this part, with their viewpoint of it all, gives particular élan to the whole story. It is bound to be widely read because of her recent flight. —$2.50 postpaid.

SHORT SELLING

By R. Whitney and W. R. Perkins

BOTH sides of the argument for and against are detailed by the President of the New York Stock Exchange and an eminent New York attorney. Both are calm, dispassionate discussions by two pleaders who probably are as well qualified as any that could be chosen. Regardless of how one believes in this matter, a question of fairness and broad-mindedness compels one to read each side. It is most illuminating.—$1.40 postpaid.

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