SCIENTIFIC AMERICAN

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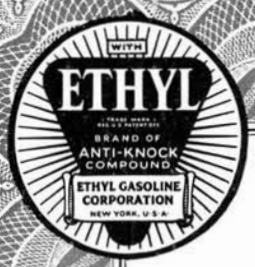

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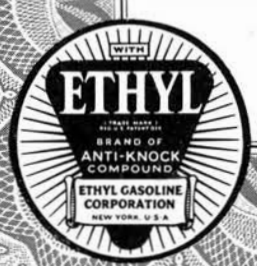

SCIENTIFIC AMERICAN

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EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor

CONTENTS · MAY · 1932

ACROSS THE EDITOR'S DESK

ON page 284 of this issue, one of our editors presents an unbiased survey of the present-day status of television as it pertains to home entertainment. We frequently receive inquiries regarding the advisability of investing in one or another of the many television companies that are offering stock for sale. The facts brought out in the article mentioned indicate the chaotic state of the television industry at the present time, and point definitely toward the speculative quality of any and all television stocks. A confirmed gambler might achieve some measure of success by purchasing television stocks today, but the conservative person who is looking for an investment with a fairly assured future will wait until such time as the industry is on a sound basis and practical television equipment is on the market. Then, too, many "wild-cat" television stocks are being promoted, the sole purpose of those who have issued them being to fleece the unwary. All in all, the question of investing in television is one which should be studied carefully before any decision is reached.

●

Professor G. W. Ritchey, the genius who designed and made the great reflecting telescopes at Mt. Wilson Observatory, has invented a new kind of reflecting telescope for which he makes large claims, stating that, size for size, it will be far more efficient than the types of telescopes at present in use by astronomers. Unfortunately, the methods by which this high degree of efficiency will be gained are not self-evident, for the Ritchey telescope looks superficially much like the orthodox type. A "Ritchey-Chrétien" telescope of this new type is being built by the inventor for the United States Naval Observatory at Washington, and in an article scheduled to appear next month will be explained the basic principles which make possible the great gains in efficiency which are claimed for this instrument.

●

When you drop into a convenient telegraph office, or call on the telephone and file a message for delivery in Europe, South America, Australia, or the Orient, you set in motion a vast and complicated system of machinery which has been built up around "record" communications. You take the delivery of your message for granted, but probably give little or no thought to the routine through which it goes before it reaches its destination. This interesting routine is the basis of an article which will appear soon, illustrated with an especially prepared series of photographs. The speed and accuracy with which messages are dispatched over vast distances points once more to the coordination between science and industry which brings to you a service of inestimable value.

●

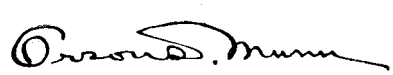
So much has been reported in various publications about "smashing" the atom, power from the atom, and transmutation of elements, that one often has to pause and wonder how far science has carried all these things. Just where does our knowledge of these phases of the atom stand? May atomic power or the transmutation of lead or mercury to gold be expected in the near future? We have obtained, from Professor William D. Harkins, of the University of Chicago, an article that discusses "Modern Alchemy" from the viewpoint of one who has delved deeply into the subject. We are highly enthusiastic about this particular article; we think it is one of the best that we have been privileged to present in many months. If you enjoy it as much as we did, we are sure you will find that it has cleared up for you many things that heretofore were hazy in your mind.

●

When an oil well comes in, everyone is happy and the field buzzes with activity. But when weeks have been spent in drilling, and a "gasser" blows in, potential disaster stares the whole field in the face. The dreaded scourge of fire threatens, and fire fighters and mechanics are mobilized to save as much property as possible. Every gasser presents a new problem and one that must be dealt with immediately. A gripping picture of what happens when a gasser blows in is given in an article which is scheduled to lead our June issue. It will be illustrated with a series of photographs that show vividly the destructive powers of gas when it is released from its earth-bound reservoir.

●

What limits the speed at which man can travel? His own physical powers to withstand acceleration, or the mechanical construction of his vehicle? The public has become so accustomed to constantly increasing speeds on the highway, on the water, and in the air, that there is always considerable interest as to future possibilities. Much has been learned about various phases of the problem of speed in the past decade, and an article soon to be published gives the facts that have been established thus far.



Queen of the Sciences

By E. T. BELL
Prof. Math.
Cal. Inst. Tech.

IN connection with The Century of Progress Exposition to be held in Chicago in 1933 a series of 20 books will be published of which this is the first. Each will be written by a foremost authority and all will attain a most comprehensive outline. This book is unusually clear and readable. It gives a new idea of mathematics and a new viewpoint of the process and art of thinking rigidly, a reasonable conception of which enables all men to see exactly what it is that each imagines he is talking about.—$1.15 postpaid.

Illustrated Magic

By OTTOKAR FISCHER

NOW at last we have someone who is not afraid to give away the secrets of the profession. There has been somewhat of a gentlemen's agreement among magicians not to allow even the mechanism of parlor magic to be disclosed. Here we have the whole works from the wand and table up to the classic illusions requiring big properties. All the tricks are illustrated photographically, which has never been done before except in a half-hearted way.—$5.25 postpaid.

The Fingerprint Instructor

By FREDERICK KUHNE

SCHOOLS of identification are increasing in number. Foreign nations are sending representatives to study our systems. Hospitals are adopting this method to prevent substitutions. There is a great opportunity in this line if one will but study it attentively. This book is the recognized authority.—$3.15 postpaid.

100 Paths to a Living

By EDWARD MOTT WOOLLEY

TRUE experiences of men and women who discovered new ways of getting a job, who got into vocations more congenial, who built up new abilities in lines they had never known before and stories of those who found means of obtaining financial and personal independence. Narratives of brains, ingenuity, strategy; brief biographies that suggest occupations and how to get into them.—$1.10 postpaid.

Making Farms Pay

By CORNELIUS J. CLAASSEN

AS the manager of a group farm organization busy with 703 farms running over a total of 252,000 acres, the author tells a way out for owner and tenant. It is not theory but gives the instances of how these farms are made to pay. Full of workable suggestions to every absentee owner of farm property, to tenants and farm operators, to bankers, life insurance companies and other financial institutions, and individuals with capital invested in farm lands. Congressional Farm Relief is not the solution but the helpful assistance of experienced farmers who are also good business men. A direct, informative, and provocative account of what actually has been accomplished.—$2.20 postpaid.

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

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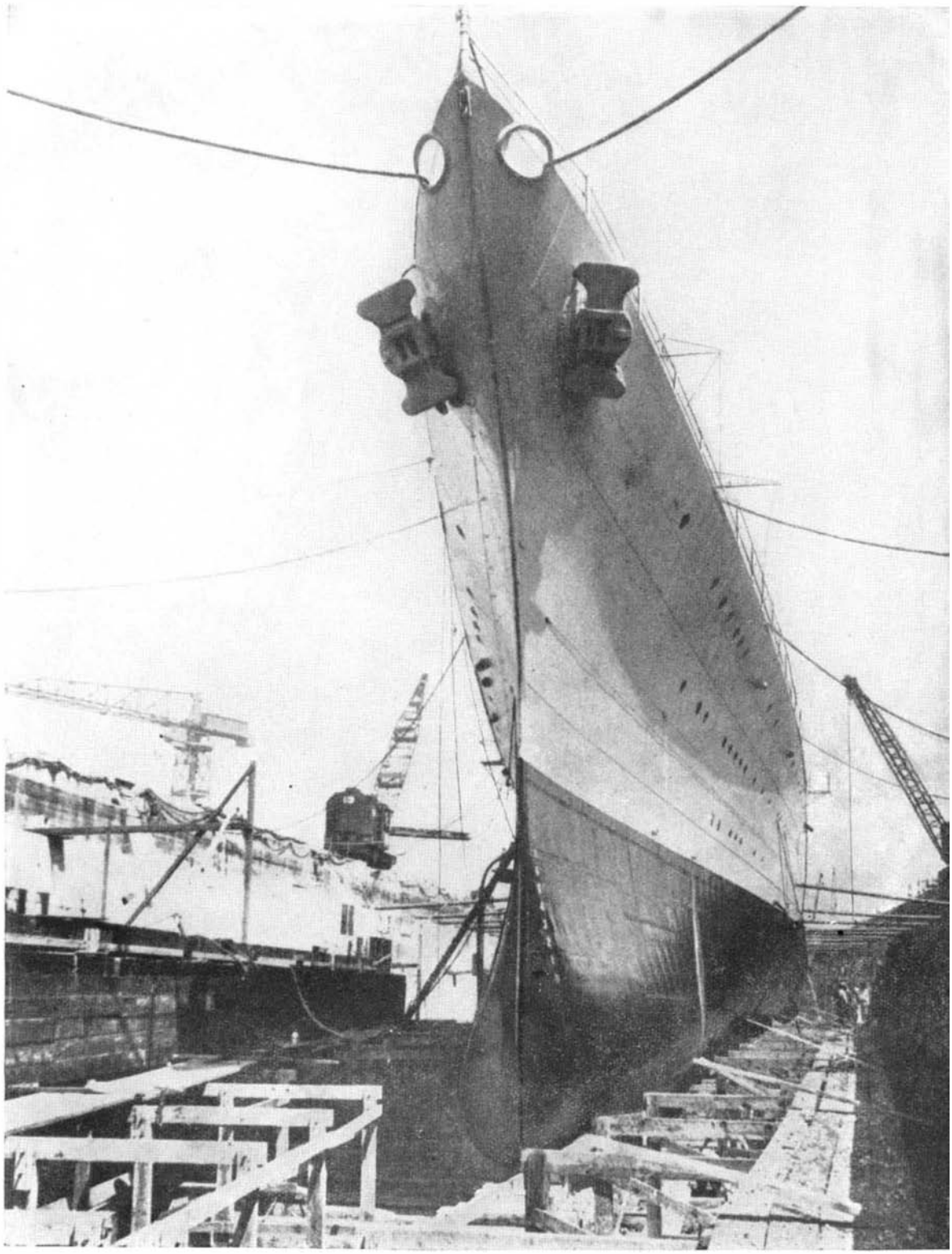
SIR JAMES JEANS

FEW who habitually follow the literature of science will need an introduction to Sir James Jeans, the noted English cosmologist; not so many may be familiar with his countenance. No other man of science at the present time has enjoyed so wide a public following as Jeans. His more popular books, "The Universe Around Us" and especially "The Mysterious Universe," have met with an acceptance that is phenomenal—unprecedented, in fact, for scientific books, the sales of these two works placing them almost among the best seller classes. This is a remarkable thing, considering that few scientific books, even today, reach more than a few thousand readers and many good ones reach less than a thousand. Doubtless it is due to the fortunate fact that Jeans not only has something to say but knows how to say it. His appeal is not merely to the student of science, as such, but to the philosopher—and we are all philosophers.

Sir James Jeans was born in '77. He was educated at Cambridge University, famous "capital of the scientific world," with which he has been associated almost ever since—though he taught in America, at Princeton, between 1905 and 1909 and incidentally married an American. He is a research associate of the Mt. Wilson Observatory and has many links with America and American science, coming here quite frequently to do research and to lecture in scientific circles. His lectures are as "smooth" as his books; he is a fluent, agreeable speaker. An article by Sir James, on cosmic evolution, appears on page 272.



THE PECULIAR SHIP'S BOW THAT SAVES FUEL

THE U. S. S. *Chicago*, in dry dock at Mare Island, California, shows off its bulbous bow. This form of bow lessens resistance and therefore saves fuel. While apparently a simple development, it represents many years of research at the model testing basin by Rear Admiral Taylor who is a leading world authority on ship design in relation to power and propulsion. This bow design symbolizes strikingly the Navy's contributions to civilian progress for, besides being used on all new naval vessels, it is being rapidly adopted for many new merchant ships

As commerce stabilizers, ships of our Navy visit far ports of the world. Here are shown American and Allied warships in the Bosphorous, off Constantinople. Mosque of St. Sophia at right

THE NAVY'S CONTRIBUTION TO INDUSTRY

By F. D. McHUGH

IDEALISTS would have us put away our arms entirely; more particularly, they demand the abolition of our Navy. They contend that civilization has reached that high peak of development, or evolution, where peace may be perpetuated by treaties alone. Perhaps they're right; it is not for us to say. Nevertheless, the world is seething with threats of wars; and treaties and popular opinion, volubly expressed in favor of peace—at any price almost—do not deter the war makers.

Remembering the ghastliness of the World War, we are inclined to forget that it is not the military forces that need arms—it is not the Navy that needs ships, but the nation that needs both the Navy and ships of war. When the idealists speak of the enormous expenditures of the people's money by the Navy, they either overlook or are ignorant of the fact that for every dollar this service expends, the nation's dividends in security and in industrial progress are enormous.

The Navy needs no war to justify its existence, for its activities are of far greater value to our commerce and industry in times of peace than during any period of hostilities. It is a fact that American naval progress and American industrial progress are so closely linked that, in many fields, the latter has actually been an outgrowth of the former.

We live in an industrial era. The unequal distribution of essential raw materials throughout the world has made all nations increasingly dependent upon one another and upon overseas trade and communication. World prosperity is as dependent upon the integrity of sea communications as national prosperity is dependent upon the transportation lines within a nation's frontiers. It is, therefore, to the mutual benefit of all nations to preserve peace and to co-operate in the business of international commerce.

> **"OUR American Navy has always been much more than an arm of war-time defense. All the money that has ever been spent on the Navy has been returned to the community several times over in direct stimulus to industrial development. We may be very sure that in the future, as in the past, the Navy's services to industry and the arts of peace and science will completely justify its maintenance in the highest efficiency." —Calvin Coolidge, October 19, 1924**

The United States Navy is a powerful agency in the execution of American foreign policies, and it is but natural that many of our well-established foreign policies are of immediate interest to the American business man. There is the fundamentally American policy of the "open door," for example, of which our Navy has been the chief instrument of perpetuation. Even more important, however, is the policy of our Government to protect, abroad and on the high seas, American citizens engaged in lawful enterprises.

PRACTICAL diplomatists have long appreciated the protective value to peaceful commerce of a mere demonstration of naval force. The unsettled state of the Near East and the war between Greece and Turkey shortly after the World War jeopardized American interests in oil, tobacco, flour, and other necessities of everyday life. Our warehouses in Greece and Turkey contained, for example, hundreds of thousands of dollars' worth of American-owned tobacco, the loss of which would have meant the loss of much American capital. To protect our property, we sent a number of destroyers to anchor off the principal centers of our business interests and see that fair play and jus-

We are indebted to "The United States Navy in Peace Time" for much of the material for this article.

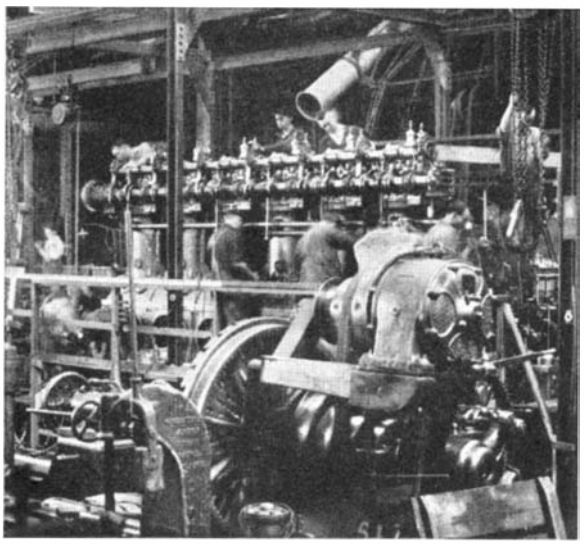
tice were accorded to all. Based on Constantinople (now Istanbul), they cruised the Aegean, Mediterranean, and Black Seas; in the event of a local disturbance, a destroyer would proceed to the port nearest the disturbance and anchor. Invariably its presence exerted a stabilizing influence and our foreign representatives continued their legitimate business transactions without interruption.

Largely because of our well-recognized commercial rights, we are entitled to and should have a Navy second to no other in the world; and since we are not an aggressor nation, most Americans are confident that our Navy's power will never be misused. Speaking of the peaceful use of naval power by Great Britain, an eminent American naval authority has said:

"Their doctrine of a supreme navy, not to make war, but to preserve peace; not to be predatory, but to shield the free development of commerce; not to unsettle the world but to stabilize it through the promotion of law and order, has been demonstrated as sound. Britain has given us outstanding proof of the fallacy that armaments are necessarily provocative of war. For virtually 100 years, while possessing much the strongest navy in the world, her government kept free from major wars and used her dominant naval power primarily as a commercial shield, in accordance with the doctrine of 'trade protection' so wisely propagated. On many critical occasions during this period, the mere strength of the royal navy was sufficient to deter other nations from making war on her."

HOWEVER great may be the value of such security given by our Navy to our trade, and however tangible or intangible that security may be, the Navy has another equally important peace-time economic function, the value of which may be reckoned almost in dollars and cents. Our Navy is a vast marine laboratory, stimulating research and fostering scientific progress and industrial achievement. Since the Navy must maintain the highest peak of efficiency and proficiency, it is continually seeking out the latest, most improved products of applied science. It keeps its standards of quality extremely high, of necessity, and its specifications for new equipment or materials are often counted by manufacturers as impossible of attainment. As a result manufacturers often must re-vamp entire plants or processes in order to meet Navy standards. The manufacturer gains knowledge and experience thereby and his business prospers accordingly.

In many cases, industrial products have shown a lack of, or very slow, improvement until, under the impetus of the Navy's demands, progress is made at a tremendous pace. But the Navy does not stop with a demand for superior products; it offers the manufacturer the fullest co-operation in the research or re-organization of facilities necessary to attain the higher standard. The Navy then will make tests of the product and if it does not come up to specifications, often suggests to the manufacturer the method by which errors may be rectified. It even goes so far as to take up promising inventions, methods, or processes, and develop them into products which will ultimately increase the Navy's efficiency.

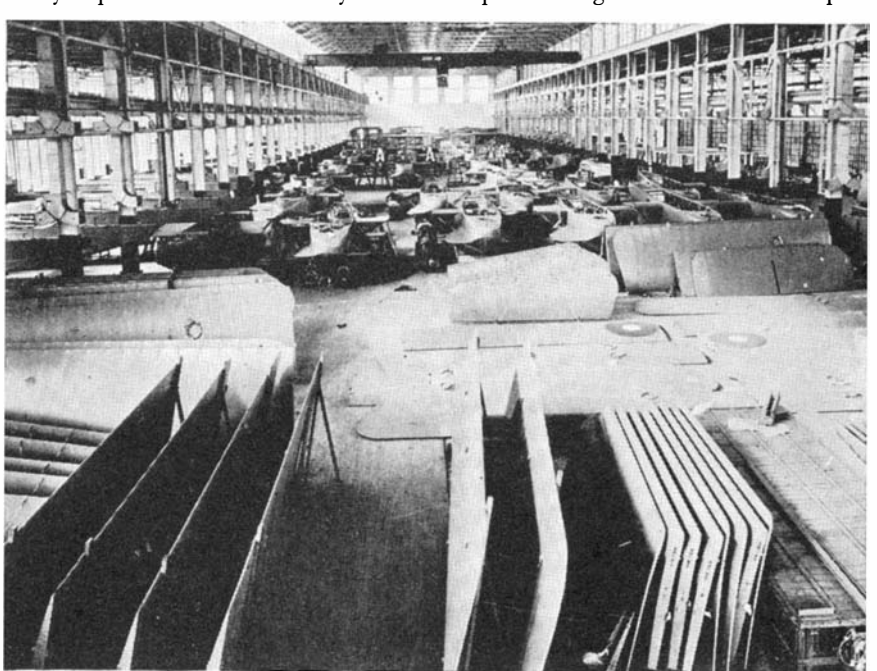


In building submarine engines, the Navy has contributed to the development of commercial engines

Aviation has been dependent upon Navy experimentation and Navy needs. This is shown by numerous cases such as that of a well-known builder of airplane engines who was paid something over 2,000,000 dollars for the first one of a new type of aircraft engine. Yet in its development the Navy's designers worked side by side with the company's engineers.

The air-cooled engine which became world-famous as the type with which Lindbergh, Chamberlin, and Byrd flew across the Atlantic, was evolved from an engine developed for the Navy. The development of this engine could not have taken place except for the assistance of the Navy Department since the cost rendered the engine prohibitive for commercial development and the Army was not in the market for these engines. In the development of the technical construction of airplanes, also, the progress until very recently has been due almost entirely to the studies and demands of the Army and Navy.

In its work on lighter-than-air craft, the Navy has been a pioneer. It built the first large dirigible in America, the *Shenandoah*, at the Naval Aircraft Factory at Philadelphia, but civilian industry profited by the fact that the materials were purchased from American firms. A civilian company has just completed for the Navy the *Akron*, largest airship in the world, and is now building a sister ship, the *Macon*. These orders are enabling manufacturers to obtain invaluable experience in building a type of craft which may yet find an important place in American transportation. The Navy also owns and is experimenting with the first airship in



All photographs are United States Navy Official

A naval assembly plant for flying boats. The Navy was the first to investigate fully the use of duralumin in the construction of pontoons for aircraft of this type

the world which has an all-metal "bag."

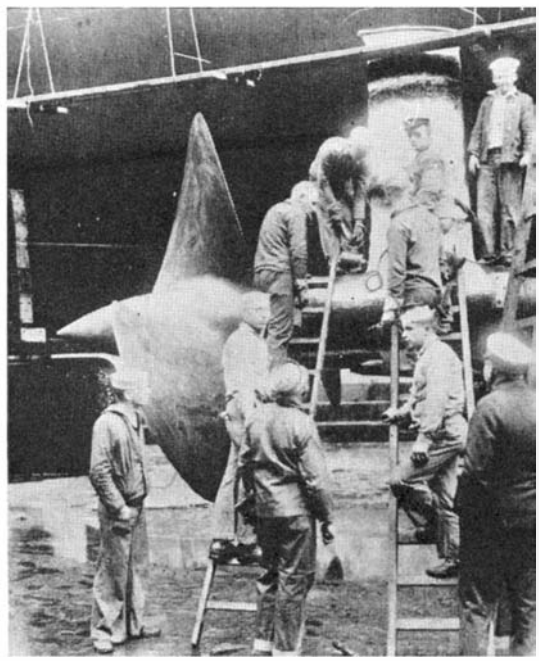
Every person in the country who owns a radio set is indebted to the Navy for its efficiency and low cost. The Navy was the first large organization to enter the radio telegraph field in America, yet its requirements alone were sufficient to cause the creation of several radio manufacturing concerns and to inspire a spirit of competition among these companies which led to many of the early discoveries in radio.

In the early days of radio, the only equipment that was available was crude and suitable for use only under laboratory conditions. Since the Navy required apparatus which would function under the trying conditions found aboard ship, it soon became obvious that intensive development work was necessary. To this end, and encouraged by the Navy's demand for instruments, several manufacturing companies were formed. With these the Navy adopted a policy of intimate co-operation in all matters of design and production, the result being rapid improvement in equipment produced.

EXAMPLES of the good effect of the Navy's work in radio development are to be found throughout the history of the art. Spark transmitters, admittedly inefficient and expensive, were brought to a high peak of efficiency and to such a low cost that they became available for many services which otherwise would have been deprived of the benefits of radio communication. The same results of Navy development work are to be found in the realm of the vacuum tube, the alternator, the radio compass, underwater signaling and sounding systems, and in many phases of electricity and mechanics which are closely allied with radio.

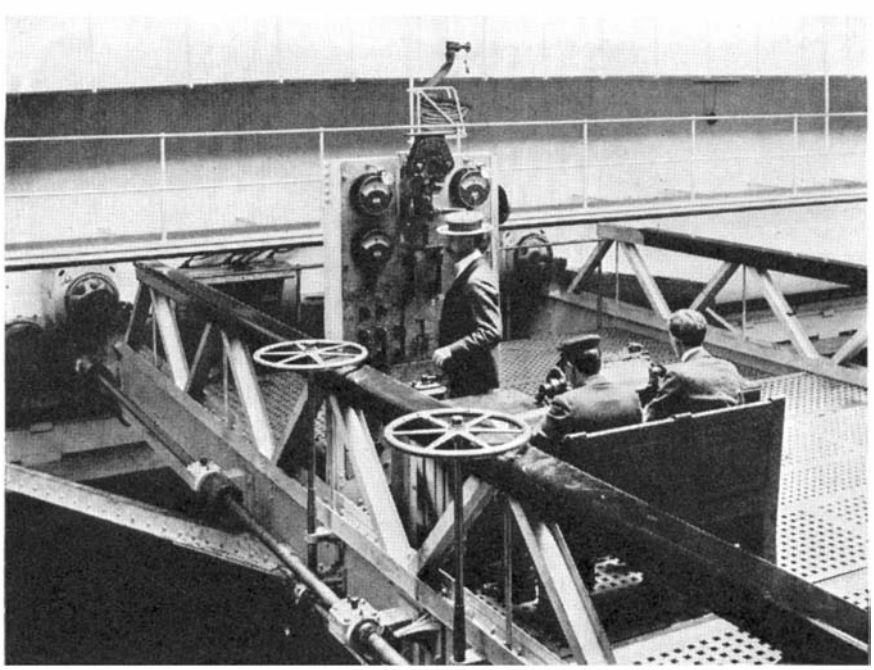
During the World War, the Navy took over all commercial radio stations except the high-power transocean stations of the Marconi Wireless Telegraph Company of America. After the war it was obviously impossible for the Navy to continue operation of commercial communications systems. In April 1919, therefore, officials of the Navy met with the directors of the General Electric Company, laid the facts before them, and steps were taken to form what eventually resulted in the Radio Corporation of America. This company soon established 100 percent American control of commercial radio stations in this country.

The Navy's demands, in 1881, for a higher quality of steel than was then manufactured may be said to mark the beginning not only of our modern Navy but also of the manufacture of steel as an industry in the United States—an industry, incidentally, in which we lead the world. A board appointed by the Secretary of the Navy at that time recommended that four new vessels be built of steel. At first no manufacturer was willing to accept the contract to deliver steel on the Navy's specifications, but contracts were finally made. The difficulties experienced in producing the steel were enormous; and, although great pressure was brought to bear on the Department to modify the requirements, all such efforts were successfully resisted. Finally steel was produced which met the specifications and, what was more important, taught manufacturers how to make good steel.



Members of the crew of the *Memphis* repair one of her great propellers at Kiel, Germany

The Navy also was one of the pioneers in the use of gas and electric welding and cutting as applied to ship repairs and construction. A seaplane derrick barge begun at Mare Island in 1919 was one of the earliest extensive applications of electric welding to a floating vessel. Since then, progress has been rapid, and especially so following the Washington Treaty for the Limitation of Armaments which placed a premium on weight saving. The Navy is now building a number of all-welded barges, tugs, and lighters. As a further evidence of the Navy's desire to develop the art of electric welding in ship construction, the forward 88 feet of the four light cruisers now under construction are to be practically all-welded construction.



The traveling instrument bridge of the model testing basin in Washington. While not new, the basin continually gives new knowledge to ship designers

THE Navy has become so thoroughly cognizant of questions of design of passenger and cargo ships that it is able to make many valuable contributions to the art of designing merchant vessels. One of the most important, perhaps, is electrical propulsion, a system which was first used by the Navy in warships during the World War. It is now employed in a considerable number of merchant ships. Its principal superiority over turbine propulsion lies in the fact that between the turbo-generator unit and the propeller, the driving motor acts as the most efficient speed reduction system yet found.

Because of the conditions under which they operate, propellers become less efficient as their speed and load increase. The efficiency of the steam turbine, however, increases with its

speed. Great losses result in increasing propeller speed or decreasing turbine speed beyond their economical points. Mechanical and hydraulic reduction gears, to solve this problem, have been developed and found satisfactory for some applications. The "electrical reduction gear," or electrical drive, however, has been found most satisfactory for the larger ships. This

From the highest commissioned officer to the enlisted man, the Navy-trained man is of great worth to industry. Here is shown a blacksmith shop aboard a battleship

system consists simply of high-speed, light-weight steam turbines, directly connected to alternating current generators which supply power, through flexible-control switchboards, to the propeller-driving motors.

BOILERS, condensers, pumps, water distilling plants, refrigerating plants, and a host of auxiliaries, information concerning which is of vital importance to our merchant marine, have come under the close scrutiny of the Navy, have been experimented with, and, without exception, have been improved by the Department's engineers. A further service rendered to civilian ship-builders is the Navy's supervision of new ships that are to be built on loans from the revolving fund created a few years ago by Congress.

Prior to the World War, there was no such thing as a satisfactory American Diesel engine. The work of the Navy, however, in tearing down and analyzing a German Diesel engine, obtained from England after the war, and building replicas which ran with high efficiency from the beginning, gave America the necessary knowledge and experience for the satisfactory growth of this industry. As a result, Diesel engines have now entirely replaced gasoline engines for submarine use, and Diesel engines for commercial use have been vastly improved in recent years.

One of the greatest advances in the science of naval architecture made during the last century was the method of determining, by means of model-basin tests, the power required to drive ships. This method of ship-design testing, first used in England, was begun in this country when Congress authorized, in 1896, construction of a model testing basin at the Navy Yard in Washington.

No naval architect would now think of designing a ship differing materially in size, speed, or other characteristics from former types without first determining its resistance by model basin experiment. A great deal of highly scientific research work has been done there by Rear Admiral Taylor in the past for determining the best form of underwater bodies for all kinds of ships, for the purpose of reducing resistance to a minimum. The results of these experiments have been made public and have proved of inestimable benefit to the ship-building industry. For his discovery of the resistance-decreasing bulbous bow, which is now used on practically all naval vessels and which received much publicity because of its use on the *Bremen* and *Europa*, Rear Admiral Taylor received the Fritz medal in 1931. (See our February 1932 issue.)

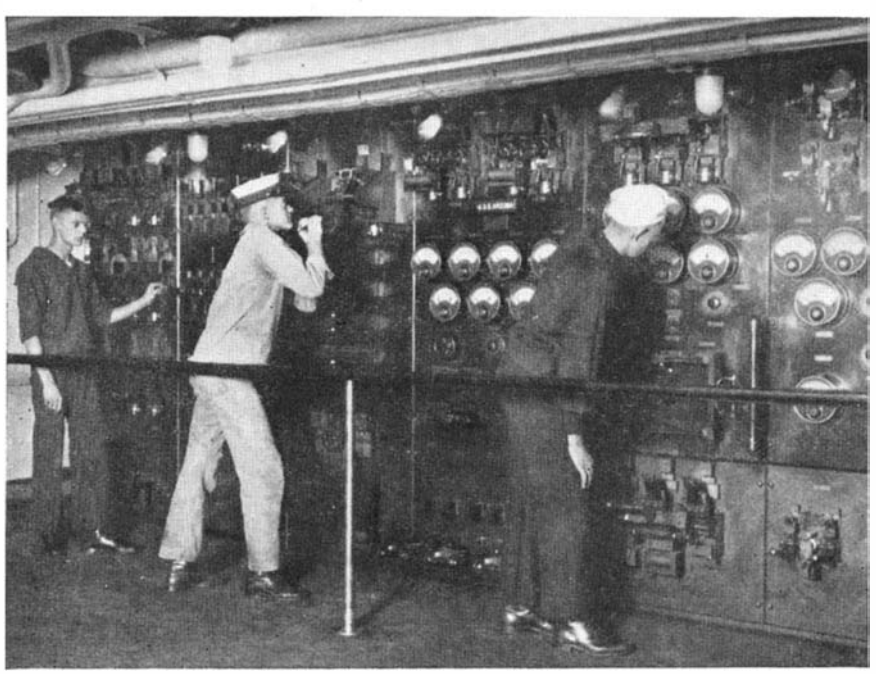
The present successful manufacture in this country of optical glass equal to the best imported kinds—for scientific instruments, telescopes, and the like—owes its being to World War needs and the efforts the Navy made to induce glass manufacturers to devote their attention to this important item.

The Navy, collaborating with the Edison Laboratories in 1913, built the first three high-speed movie cameras in the world. By this important development, "slow-motion" movies were born and since then have found a recognized place in educational and amusement activities and in scientific research.

The publications of the Hydrographic Office are a great boon to commercial navigation. Ships rely on radio bearings from naval shore stations. Ocean currents, storm tracks, and sailing routes are given on charts furnished by the Navy. Coast Guard patrols warn of the location of icebergs. In time of disaster, the Navy is the first on the scene. Bearing witness to this fact was the dash of the aircraft carrier *Lexington* to aid Managua at the time of the Nicaraguan earthquake. The Navy's relief work after the Japanese earthquake was admirable as was its intervention during the Russian famine after the war. Improvement of sanitary conditions and combating plague conditions in Guam, Haiti, Santo Domingo, Samoa, and Central America is another part of the fine record made by the Navy.

THERE is practically no end to the contributions the Navy has made to American industrial progress as the Department's activities reach out into practically every field of human endeavor. Need it be said, then, that Navy-trained designers, engineers, scientists, executives, and even enlisted men trained in Navy trades have been coveted by civilian industry? It is true that they have been and are; and it is true, further, that Navy men of all grades, retired from the service, have made their mark in American industry.

As has been aptly said: "The Navy's usefulness to science and industry justifies its maintenance in the highest efficiency even though it may never be called upon to fire a hostile shot."



The after distribution room of the *Arizona*. First employed by the United States Navy, electrical propulsion is now being applied widely to merchant vessels

OUR POINT OF VIEW

"Buy British"

FOR some months, the British people have been urged, coaxed, and almost commanded under threat of being made the object of scornful epithets regarding their patriotism, to "Buy British!" Editorials, advertisements, billboards, bulletins have demanded: "Buy British!" Politicians, lecturers, and the radio have made "Buy British" resound throughout the Empire.

Americans, long experts in the art of "cutting off their own noses," look upon this amateurish attempt of the British to isolate themselves with a superior sort of air. We are old hands at "protecting" our great industries, but our method is decidedly more effective. We learned two years ago the secret of killing the industries of other countries so that they could not buy from us and we could have the fun of selling to ourselves alone. At present, after almost two years of high tariff, we could give the British many pointers which should help them amazingly along the road to the sort of unique prosperity enjoyed in this country today. Perhaps, of course, they may not wish help of this kind but may prefer their own boycott-of-imported-goods method. If such is the case, we shall simply watch with interest to see what degree of success they have.

We hasten to add, however, that we sympathize with the people of the British Empire since their distress is much the same as our own. When they have proved that the Empire is "self-contained" they will, indeed, be our fellow sufferers. The isolation of the English-speaking world will be complete.

In the Grip of Crime

AS this is being written, the world still awaits in breathless suspense the denouement of one of the most dastardly and heartless crimes of our time: the kidnapping of 20-months-old Charles Augustus Lindbergh, Jr. Since there is now but little doubt that this crime was the work of professional crooks, it epitomizes the steady systematization of crime in this country that has made of it a big-money, safe business. For the time being it has aroused the public to a sense of its responsibility. Will the public actually do something now, or forget this crime shortly and allow other, perhaps more horrendous, deeds to be perpetrated?

Commenting on the kidnapping, a thoughtful British newspaper said: "If this cruel and miserable method of intimidation with a helpless child as its nearest victim is the work of racketeers and if the outcome of it is not a genuine and determined effort to end the whole deplorable business in all its ramifications, then the rot must have sunk deeply into American life."

Frankly, we think the above statements show admirable restraint. The rot *has* sunk deeply. A woman, writing to a New York newspaper recently, stated the case most aptly. She said: "My family—both sides—dates back 300 years in this country. There is now a strange feeling of not belonging. England still seems to be England; she still has her hand on her own bridle. *We* sit and take it and chatter like a lot of old hens and that is all that does happen."

We sit and chatter. Most of the time we simply sit while the octopus of crime gets its strangle hold more tightly on every phase of American life. Is it any wonder that some of us begin to feel that we don't belong? We can sit and chatter. We can blame crime in this country on prohibition, on the off-scourings of Europe that swarmed in at our doors for decades, or on any other such bête noire without avail. It will still be idle chatter.

It is high time we took a hand in this business. Since we all know that it has its roots in corrupt politics, law-making bodies, and the courts of the land, we must lay our hands on those roots and destroy the diseased ones. Are we going to do it?

George Eastman

LEAVING a note saying "My work is done. Why wait?" George Eastman, founder and chairman of the board of the Eastman Kodak Company, shot himself at his home in Rochester, New York, March 14. He had been in ill health for several years, and at the time of his death was in bed under the care of a physician. His age was 77.

Mr. Eastman was best known for his development of the complicated early camera into a low-priced commercial product, for his transformation of the highly difficult profession of photography into a popular pastime. His further improvements of cameras and films made possible the development of "still" and motion-picture cameras to their present high state of perfection. He was looked upon as the first American manufacturer to use large-scale production methods and therefore contributed largely to the modern industrial era's efficiency. A philanthropist with a most impressive list of gifts to charitable and educational institutions, he also gave freely of his private fortune to further invention and scientific research.

There can be no more noble tribute than that paid to him by an executive of his company: "George Eastman played the game to the last. By his own hand he lived his life, and by his own hand he ended it."

Wood Farming

REFORESTATION of large tracts of land has been discussed at great length in recent years but not much attention has been given to the small farm wood and timber lot. Recently, however, W. K. Williams, of the Department of Agriculture, compiled a farmer's bulletin (No. 1680-F) which cites almost a score of cases where farm timber cropping has yielded good returns.

One farmer in Indiana, for example, reported that he sold 700 dollars' worth of forest products, built five farm buildings, and supplied posts and cordwood from a 20-acre tract he had acquired in 1900 just after it had been cut over. By "farming" the woods, he had a good stand of timber left for which he was offered 3000 dollars. Another farmer supplied his farm with fuel for 17 years and produced 16,000 board feet of construction timber from a 2½-acre tract.

Of all the arguments that might be advanced in support of such planned cropping of the farm wood lot, perhaps the most cogent is the promise it holds out to the farmer of annual profits. The evidence gathered proves that profits can be made. By cropping his woods as he does corn; by cutting out the weed trees and the unhealthy and crippled ones so that the best trees have a chance to develop properly; and by cutting the good trees only when they are fully "ripe," the farmer may not only earn a cash dividend each year on loafing acres but may also enhance the value of his farm.

NEW LIGHT ON PLUTO

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 results of astronomical investigation are almost always easy enough to explain in popular language and it is usually possible, too, to make clear the way in which they were obtained. One branch of the science, however, is an exception to this latter rule. The calculation of the motions of the planets and especially of the perturbations which their attractions produce on one another is a very intricate affair. Only a few specialists have gone deeply enough into this to be able to add to the extensive store of knowledge accumulated by their predecessors and when they do, their methods

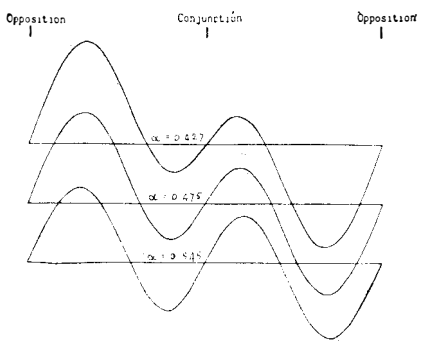


Figure 1: **Perturbations of an inner planet by an outer one. The horizontal coordinate represents time; the vertical, deviation of planet's longitude from undisturbed motion**

are usually so technical that the average astronomer whose work lies in other fields makes no attempt to understand the details.

A good example is afforded by the prediction of an unknown planet by means of the perturbations of one already known. Ever since Neptune was discovered the possibility of such a prediction has been known to millions; the way in which it was made has been understood perhaps by hundreds.

An exceptionally simple and lucid treatment of the problem has recently been published[1] by a Professor E. W. Brown of Yale, who speaks from a knowledge second to none, and upon his results the present article is based.

One thing, and an important one, the non-technical reader must still take on trust: Given the orbits of any two planets and their masses, it is possible to calculate just what modifications in the motion of either one will be produced by the attraction of the other.

An example is given in Figure 1, taken from Professor Brown's paper, which shows what happens to the longitude of an inner planet perturbed by an outer. After the opposition of the two planets the inner one runs ahead of the position it would occupy if unperturbed. Later it returns to normal and falls behind a little. After the conjunction of the two it gets a little ahead and then a good deal behind. The three curves correspond to the values α of the distances of the two planets which are matched in the figure. For the top one the period of the outer planet is 3.6 times that of the inner; for the bottom curve 2.5 times. The general effect is very similar in all three cases. The diagram applies to the case where the orbits are circular. For elliptic orbits the curves are more complicated and do not repeat themselves exactly after successive conjugations, but the general nature of the effect represented by a wavy curve is still the same. Over a single revolution or so of the disturbed planet, the effect of the perturbations can be very closely simulated by assuming that its period is a little different and that its orbit is slightly eccentric.

FIGURE 2 shows just how this happens. The downward trend of curve B represents a slight increase in period, and its wavy character a small eccentricity. For more than a whole revolution it agrees so closely with the perturbation curve A that the difference is not perceptible on the scale of the figure. It follows that if the planet were really perturbed and we had observed it only over this interval, we would not realize the fact but be content with the slightly erroneous values if the period and eccentricity corresponds to curve B. Observations during the next period would show a moderate discordance, and in the following period a large one.

It is evident that the wavy character of curve B—that is, the eccentricity of the orbit of the planet—is the main cause of the complication. If we could find some way of flattening out this wave so that curve B was reduced to a sloping straight line, things would be simpler. Professor Brown has done just this. He shows that if we take two points on B, separated horizontally by just one third the planet's period—that is, of the length of the wave—add the heights of the curve at these points, and subtract the height at the point half way between them and plot our results, the wave will be "ironed out," exactly as was to be desired.

If we apply the same artifice to curve A, we will flatten it down a good deal but not completely, and the shape of the transformed curve—which we may call "curve C"—can be calculated without difficulty. Two such curves worked out by Professor Brown are given in Figure 3. The first corresponds to an outer planet with period 3.05 times that of the one it perturbs, the second to a period 1.62 times as great. Within these wide limits the shape of the curve is nearly the same (as is shown by other calculations).[2]

Here is, at last, a simple and reliable method for testing whether the observations of a planet from its calculated orbit are due to the attraction of an unknown body. Take the deviations for any two dates separated by one third of the planet's period, add them, and subtract the deviation at the middle date. Plot the results and if perturbations are really present you will get a curve of the shape of C. This curve will rise to a high maximum before the conjunction of the known and unknown planet, and then descend sharply. In practice the curve may be raised at one end and lowered at the other (corresponding to a small curve in the assumed period of our planet) but this will not alter its general shape. When this process is applied to the observations of Uranus used by Adams and Leverrier in their memorable investi-

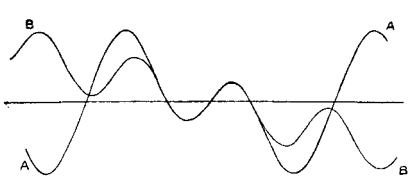


Figure 2: **Curve A represents the perturbations due to an outer planet. Curve B gives the effect produced by supposing that the inner planet, while unperturbed, has a slightly eccentric orbit and a little longer period. For a whole revolution of the inner planet the two curves are nearly indistinguishable**

[1] In *Monthly Notices,* Royal Astronomical Society, Nov. 1931, from which Figures 1, 3, 4, and 5 are reproduced.

[2] This corresponds to the very simple relation $\sin(x-60°) + \sin(x+60°) - \sin x = 0$.

gations, Figure 4 is obtained. The dots show the original observations, while the circles indicate the course of curve C. It is evident that real perturbations are present, and that the planets were approaching conjunction in 1830—as indeed they were.

Professor Brown shows that eccentricity in the orbits, whether of the disturbed or disturbing planet, alters the shape of curve C much less than of curve A, so that the former affords a good test in all reasonable cases. From a study of this curve alone the longitude of Neptune in 1846, the year of its discovery, could have been predicted within a few degrees. When the same process is applied to the observations of Uranus since its discovery in 1780, Figure 5 is obtained. The ragged character

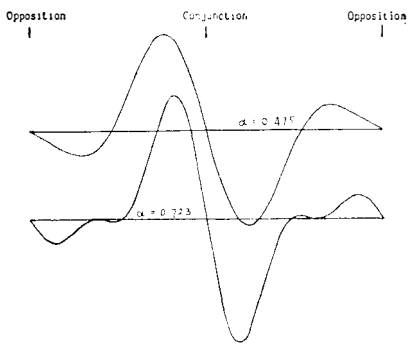


Figure 3: **Transformed perturbation curves as ironed out by Brown**

of the diagram is due to the very open scale on which it is plotted. Disregarding the sharp "chasms and crags" which obviously arise from errors of observation, there remains a very wavy tendency in the curve, but the interval from one crest to the next is only about 40 years—half the period of Uranus and about one third of the interval to be expected between its conjugations with the trans-Neptunian planet. No such rapid oscillations occur in the upper curve of Figure 3 (which is the one applicable to such case) and it is evident without further calculation that the "deviations" for Uranus, which are small anyway, cannot be due to the attraction of a single trans-Neptunian planet. Brown thinks it probable that they arise from some small error in the calculated perturbations of Uranus by Neptune. Neptune itself has not traversed a long enough arc of its orbit since its discovery to make a similar test practicable.

The conclusion, that the observed deviations of Uranus are not produced by the attraction of Pluto, is confirmed by other evidence. Direct calculations of the perturbations of Uranus and Neptune by Pluto show that the former at least could be detected if the new planet's mass were greater than the earth's. Moreover, the faintness of the planet, and the failure of experienced observers to see any perceptible disk with the greatest telescopes, indicate that Pluto must be smaller than the earth, and probably no bigger than Mars; in which case its mass is doubtless correspondingly small. Unless Pluto has a satellite bright enough to be photographed with the great reflectors, it may be a long time before we have any accurate knowledge of its mass. Why, then, did Lowell's calculations give an orbit so remarkably similar to that of the actual planet?

LET it be first remarked that his mathematical methods, on Professor Brown's excellent authority, were entirely sound. The trouble lay not in his analysis but in the fact that in order to get definite results he was obliged to use the ancient position of Uranus made before its discovery, when it was observed casually, supposing it to be a star. These observations are of very low precision and errors in them, made a century and a half before Lowell's work, are doubtless responsible for his conclusion that the unknown planet was several times as massive as the earth. If these primitive observers had made equal errors in the opposite direction Lowell's calculations would presumably have given a *negative* mass for the suppositious planet and the whole matter might have been dropped. It is most fortunate that this was not the case, for then the observational search which led to so happy an issue might have been discouraged.

The question still remains: If Lowell's calculations were upset by these bad old observations, *why* is there really a planet, though a small one, pursuing an orbit which is so uncannily like the predicted one? In view of Brown's investigations the only possible answer seems to be that it is a coincidence—

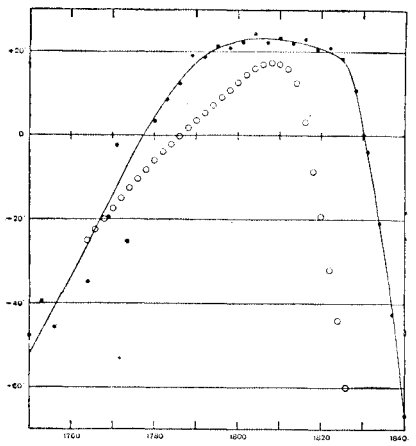


Figure 4

a mere accident. This is of course exceedingly unlikely to happen—so improbable that the present writer, among others, expressed strong opinions that the similarity was not a matter of chance. But improbable things sometimes occur; for example, in the famous case when a cablegram announcing the discovery of a comet in Europe contained an error which resulted, when it was decoded, in an entirely erroneous position in the sky. An observer at the Lick Observatory looked in this erroneous place and found another comet close by!

In conclusion, it should be emphasized that these mathematical developments in no way detract from the credit due to Percival Lowell in the discovery of Pluto. His analysis was sound; the observational errors which affected his result were made a century or so before he was born; and it was his intense interest in the problem, persisting long after he had been laid in his tomb, that led to the search for the planet and its detection at the observatory which he founded and endowed.—*Princeton, March 7, 1932.*

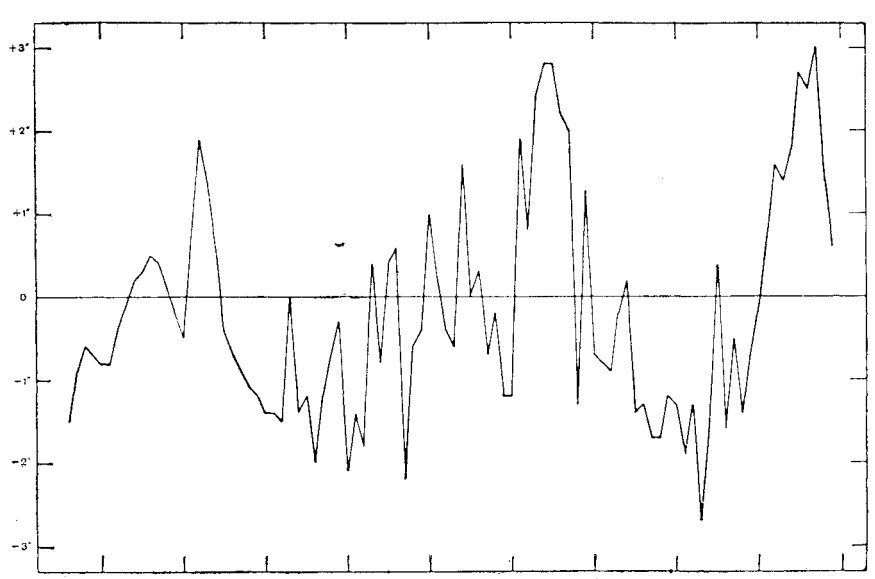
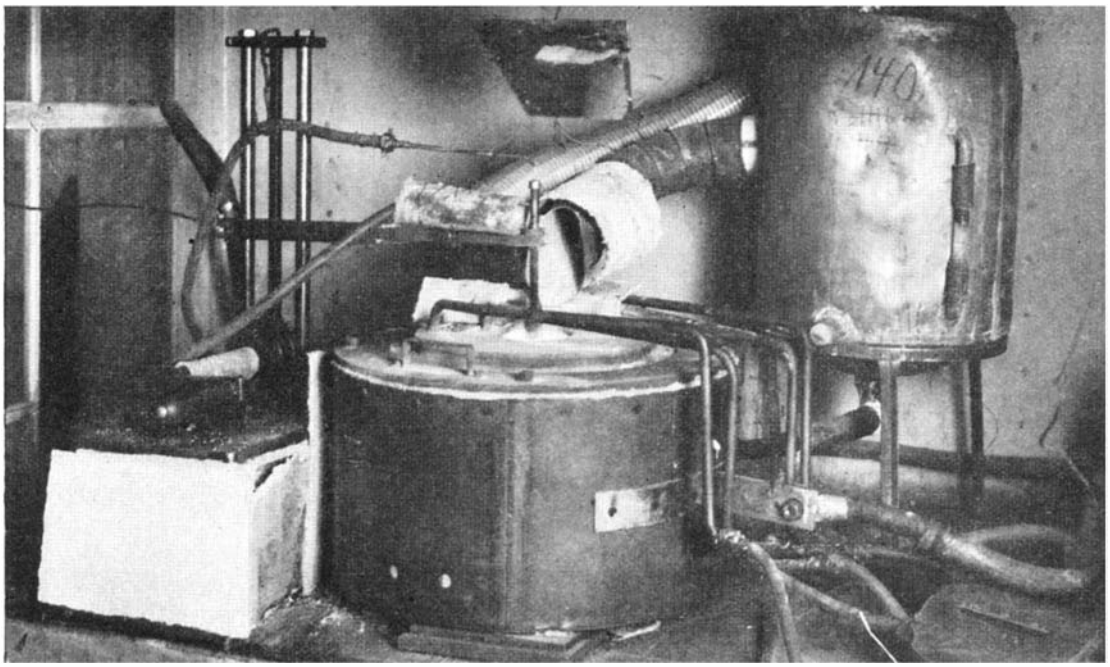


Figure 5: **The numerals on the left refer to angular residuals, a "residual" being the outstanding discordance between calculation and the observation**



The first furnace which produced beryllium in quantity by the melted electrolyte process described below, It turned out bars of the metal weighing over two pounds and consumed 24 kilowatts of power

BERYLLIUM . . . The Production of Beryllium on a Commercial Scale Presages Wide Use of its Alloys in Industry

By K. G. FRANK

METALLURGICAL research and investigation has succeeded in definitely putting beryllium on the list of metals for commercial use, and it is particularly in connection with the use of beryllium for alloying copper that it has shown its usefulness. During the last year, here as well as in Germany, the pioneer work of the metallurgists of Siemens and Halske A. G., Berlin, has been extended to beryllium alloys and it has been found possible to produce beryllium-copper alloys and beryllium-nickel alloys having exceedingly valuable properties.

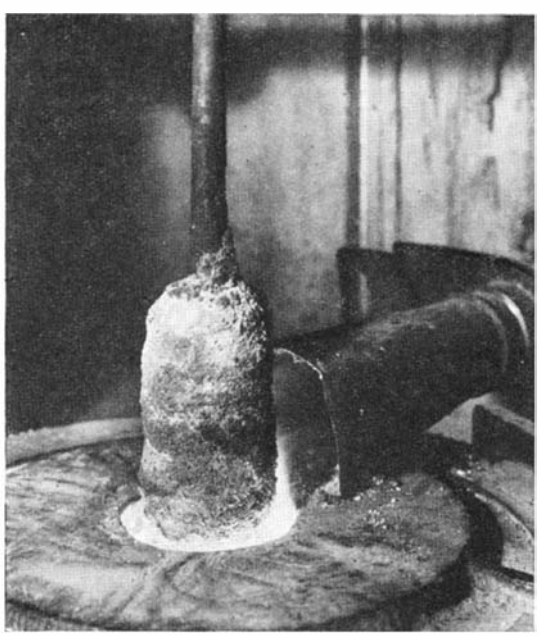
Inasmuch as the addition of only 1 to 2½ percent of beryllium to copper will bring about improvements such as an increase in hardness and toughness, as well as in resistance against fatigue, there is every indication that in spite of the high price of the pure beryllium the use of alloys will be quite extensive for those parts of apparatus and machinery which are subject to vibration, heavy stresses and strains, and chemical action under high temperatures.

Another valuable feature has been found greatly to increase the usefulness of these beryllium alloys—the possibility of an increase in mechanical properties through heat treatment. Very marked improvement was shown by copper-beryllium alloys containing 1.5 to 4 percent beryllium after having been subjected to temperatures of from 750 to 800 degrees, Centigrade, and after artificial aging at 250 to 400 degrees, Centigrade. Under these conditions, the hardness of these alloys rises to 400 Brinell! Likewise, rolling and drawing of copper-beryllium alloys at certain temperatures has the well-known effect of improving their mechanical qualities; to a much higher degree, however, than in the case of pure copper or other copper alloys.

WE are indebted to Dr. Masing and his collaborators in the Siemens laboratories for the explanation of the behavior of these copper-beryllium alloys; Dr. Masing ascribes the effect of the aging and heat treatment of copper-beryllium alloys to certain complex crystallization phenomena. Roentgenometric investigations showed the presence of these crystals very plainly, so-called α, β, and γ crystals and their combinations being formed.

Beryllium is produced in an electric furnace in which the graphite crucible forms the anode, a water-cooled iron tube is the cathode, while the electrolyte consists of fused barium fluoride and beryllium oxyfluoride. The temperature of the bath is kept at about 1400 degrees, Centigrade, which has given the best result.

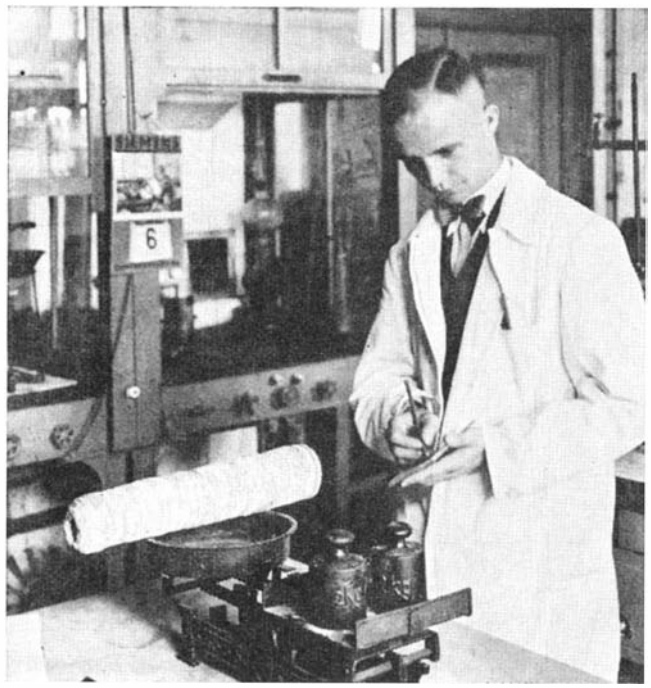
This method of producing beryllium was first used and developed by Stock and Goldschmidts, two German scien-



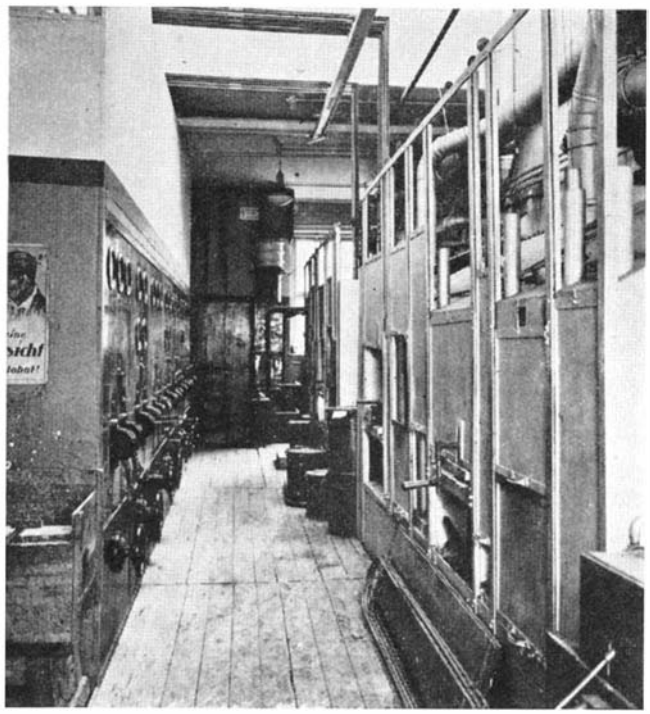
A beryllium-covered cathode emerging from the electrolytic furnace illustrated above

tists, who recognized that for producing metallic beryllium the temperature of the electrolytic bath must exceed the melting temperature of beryllium, which is about 1285 degrees, Centigrade. For the successful commercial production of beryllium it is necessary, of course, to provide for continuous uninterrupted operation.

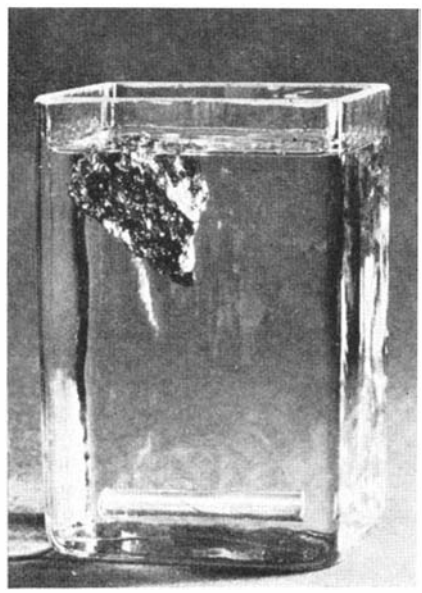
The proper proportioning of the two salts used—barium fluoride and beryllium oxyfluoride—in order to obtain the best results, has been the subject of very careful investigation, because the efficiency of the method largely depends upon the composition of the electrolyte. For starting the operation, a mixture of beryllium oxyfluoride and sodium fluoride is used because of the comparatively low temperature of the melting point of this mixture. The temperature of the bath is about 1350 degrees, Centigrade, in the beginning and is gradually raised to and maintained at 1400 degrees. The water-cooled iron tube, acting as a cathode, is slowly raised and withdrawn from the bath, together with the deposited beryllium. Solid cathodes of tungsten have also been used with good success. Care is taken that a layer of liquid slag of sodium barium fluoride and of barium fluoride covers the bath completely during the process, and that it is kept hot enough to permit a proper deposition of the beryllium on the cathode. Unless this is done and a high fluidity of slag and electrolyte is maintained, beryllium would be redistributed in the electrolyte surrounding the cathode.



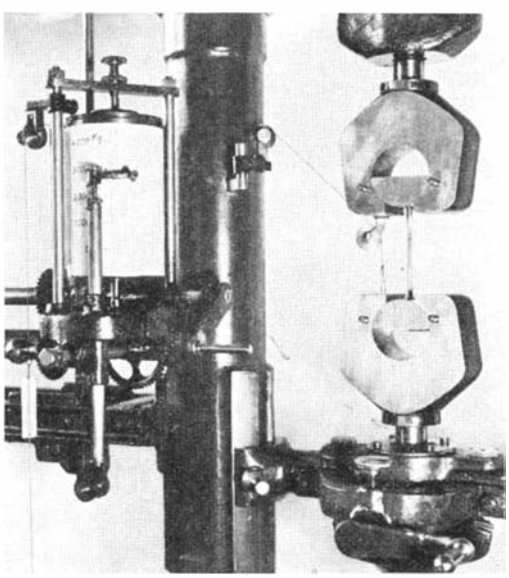
Right: **A bar of metallic beryllium weighing about nine pounds, produced in the commercial furnace illustrated below**



Left: **A modern electrolytic plant for the production of beryllium. The furnaces are covered with hoods to remove the poisonous vapors that are normally produced**



Beryllium is lighter than aluminum. A lump of beryllium floats in a solution of bromo-carbon-tetrachloride while aluminum sinks



Left: **Testing the tensile strength of a bar of copper-beryllium alloy containing 2½ percent of beryllium. Such an alloy has a tensile strength virtually five times that of annealed copper. A 3 percent alloy tests about 95 to 96 tons per square inch, while annealed copper is rated at from 15 to 20 tons per square inch. In the illustration, the rod, one fifth of an inch in diameter, resisted a pull of 2500 kilograms (5510 pounds) before it started to stretch**

One of the most valuable properties of beryllium in the metallurgical field is its ability to de-oxidize copper and other metals, which again accounts for the high qualities of beryllium-copper alloys. [The present cost of beryllium is in the neighborhood of 80 dollars a pound—a substantial reduction from the cost of 225 dollars a pound mentioned in the March, 1930 issue of SCIENTIFIC AMERICAN.—*Editor.*]

WATCHING THE CREATION OF THE STARS

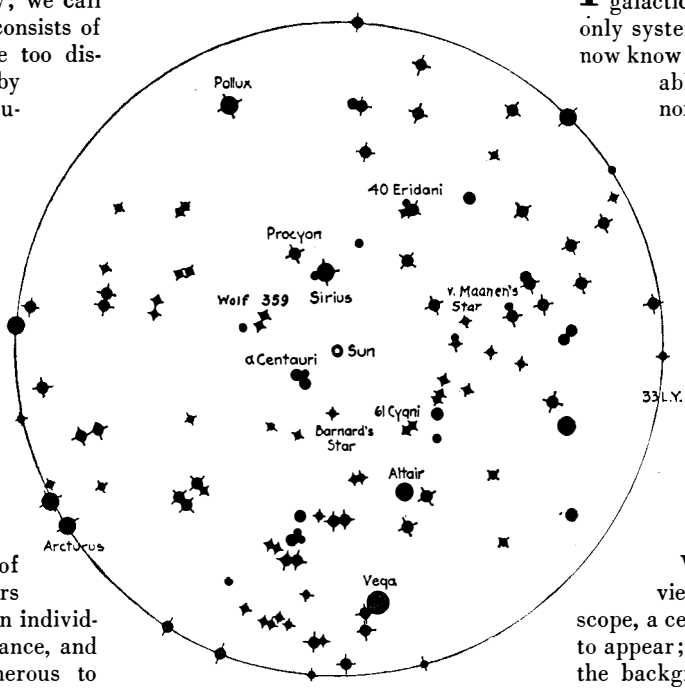
By SIR JAMES JEANS*
Former Secretary of the Royal Society
Research Associate, Carnegie Institution of Washington

WHEN we look upward in a clear night, we see a sky spangled with stars; we can see between 2000 and 3000 with our unaided eyes. Some appear very bright and some very faint; astronomical investigation shows that this results in large part from their being at very different distances. The stars which look brightest are so near that their light takes only a few years to reach us, but the faintest we can see are, for the most part, at distances of about 3000 light-years.

Besides this collection of individual stars, we also see a band of faint pearly light encircling the whole sky; we call it the Milky Way. This also consists of stars, but of stars which are too distant to be seen as individuals by our unaided eyes, although numerous enough to appear as a continuous cloud. Thus the sky which our unaided eyes discloses to us consists of two distinct parts—a foreground, consisting of separate stars, and a background, formed by a continuous cloud of distant stars. No middle distance can be seen by the unaided eye.

Yet telescopic observation at once discloses that a middle distance exists. Like the foreground and the background, it consists of stars—in this case of stars which are too distant to be seen individually without telescopic assistance, and yet are not sufficiently numerous to form a continuous cloud; for it is only in the direction of the Milky Way that the distant stars lie close enough together to affect our eyes. The telescope shows that this middle distance of stars connects the foreground of individual stars with the background which we can see only as a band of light, and it becomes possible to study the system of stars as a continuous whole.

SUCH studies have shown that the system of stars is shaped like a disk or a coin or a cart wheel. Perhaps the last of these three comparisons is the best, because it has now been found that the system of stars is in a state of rotation. Early investigators, Sir William Herschel in particular, imagined that the sun must be somewhere near the hub of this wheel; we now know that it is at a great distance away. It is so far away that even the brightest stars near the hub are too faint to be seen by the unaided eye. The farthest stars our unaided eyes can see are only about 3000 light-years away from us, while the hub of this great wheel of stars is probably something like 40,000 light-years away. We still do not know the diameter of the wheel with any approach to accuracy, but it is probably something like 200,000 light-years. Still less do we know the total number of stars which constitute the wheel. It is almost certainly greater than a hundred thousand million and may quite well be two, three, four, or even five times this number.



Most of the stars we see with the unaided eye are relatively close neighbors. Diagram showing all the stars within 33 light-years of us

Thus we shall get the best picture which modern science can give us of our system of stars if we think of it as shaped like a cart wheel, with the sun perhaps a third or a half way along one of the spokes, and rotating like a cart wheel. The Milky Way is formed of all the stars which are at great distances from the sun, including of course the great number which are near the rim of the wheel.

The wheel is held together by the gravitational attractions of the different stars of which it is composed. As a consequence, the outermost stars move with the slowest speeds, and take longest to perform a complete revolution—just as in the solar system the outermost planets move most slowly and take the longest time to describe their orbits round the sun. So far as is at present known, the sun moves at about 200 miles per second, and requires something over 200 million years to complete a revolution.

IN the early days of astronomy, our galactic system was thought to be the only system of stars in the sky, but we now know that it is only one of innumerable systems. If you look to the north of the star Beta in the constellation of Andromeda, you will, if your eyesight is good, see a faint hazy patch. This is the object known as the Great Nebula in Andromeda. It looks at first like diffused starlight, as though a bit of the Milky Way had broken away—the astronomer Marius described it as looking like candle-light seen through a horn, while Herschel described it and similar objects as "shining fluid."

When this patch of light is viewed through a powerful telescope, a certain amount of detail begins to appear; we can see dark lanes across the background of light and notice a certain regularity in the form and structure of the object. But to study it properly we must photograph it with an exposure of many hours. Endless new detail now appears. The nebula is found to be far larger than can be seen either by the unaided eye or by direct vision through a telescope; it is found to cover about 20 times as much sky as the full moon. The only part we can see with the unaided eye is a comparatively bright central mass, which is fuzzy in appearance and ill-defined in outline. Around this is a detailed structure which lies hidden until it is photographed with a very long exposure.

Just as Galileo's telescope broke up the Milky Way into separate points of light which he at once identified as stars, so the modern high-powered tele-

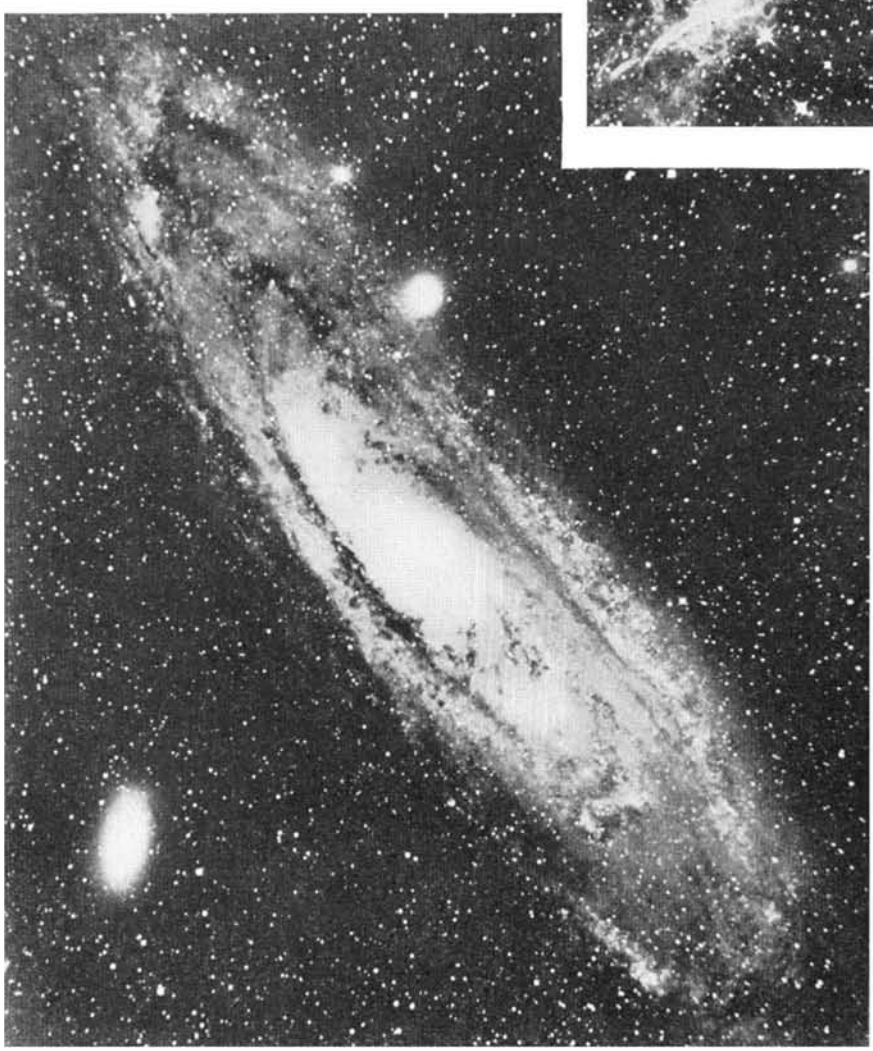
*See page 261

scope breaks up the outermost regions of this nebula into separate points of light. We know that these too are stars. Many of them do not shine with a steady light, but fluctuate in a very characteristic and quite unmistakable way with which we are familiar, because many stars of our own system do precisely the same. Indeed stars of this type are so peculiar, so uniform in their behavior, and so similar to one another, that we can estimate the distance of the nebula from the apparent faintness of these stars. Dr. Hubble of the Carnegie Institution Observatory at Mt. Wilson has found it to be at such a distance that its light takes about 800,000 years to reach us.

There is no longer any room for reasonable doubt that, in its outer parts at least, this great nebula in Andromeda is formed of a system of stars which is similar in its essential nature to our own system. It is not the only such system in the sky; millions of others can be observed.

Although these are of varied shapes and constitutions it is found that the greater number of them can be arranged in a sequence (page 274). At one end of the sequence are nebulae consisting solely of round fuzzy masses, in which no stars are visible even with the most powerful telescope, while at the other extreme we have clouds of stars such as our own system. Half way along the sequence are nebulae, such as the great nebula in Andromeda, which consist of a central fuzzy mass surrounded by stars, in which both the fuzzy mass and the stars are present, the former occupying the central, and the latter the outer regions.

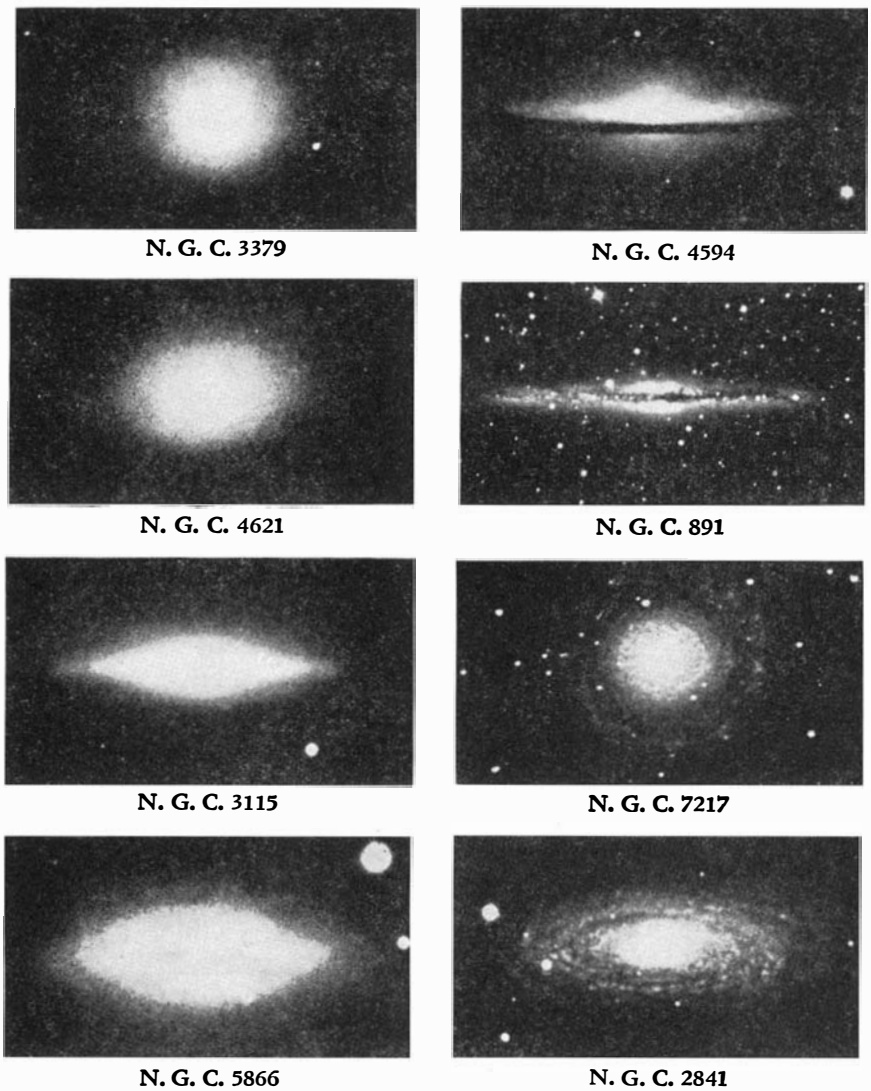
The Veil Nebula in Cygnus, one of the diffuse types which consist of dust and luminous gas. These are within our own universe or galaxy, though probably in others as well



Great Nebula in Andromeda, not a diffuse nebula but a whole galaxy. It is unfortunate that the same word designates two entities so diverse in nature

Like our own system of stars, these nebulae are generally flat in shape. The comparison of the cart wheel remains quite a good one—partly because many of these nebulae are known to be rotating and all are believed to be so; partly also because they often are found to have a thick central projection, corresponding to the hub of the wheel, while the rest of their structure is flat. The Great Nebula in Andromeda is of this cart wheel shape, but it is rather disguised because we are neither looking at it full on nor edgewise on. If we could look at it full on, it would appear nearly circular in shape; if we could look at it edgewise on, it would appear rather more than a bright line of light; indeed it would probably look very much like the nebula N.G.C. 891 which is seen edge on. From the angle at which we actually view it, it appears elliptical in shape.

We know all this because the various nebulae in the sky are of course seen at different angles, so that we can study their structure as three-dimensional solids. When we do this, we find that



A sequence into which the majority of extra-galactic nebulae can be arranged. It begins with the globular fuzzy mass of gas having little or no rotation, and ends with the flat cart wheel type which rotates more rapidly. It is believed that this sequence represents stages in the mechanical evolution of the universe. The last three are similar types, but turned at different angles to our point of view

the sequence I have already described starts with perfectly globular nebulae and ends up with quite flat nebulae. The sequence is one of nebulae arranged in order of flatness.

It is easy to obtain a theoretical interpretation of this sequence. We know how an increase in the speed of rotation of a body is accompanied by a flattening of its shape. Our own earth, which is rotating slowly, is only slightly flattened, so that we describe it as orange-shaped. Jupiter rotates much more rapidly, (once every ten hours) and as a result is much flatter in shape. Finally, astronomical bodies which are rotating very rapidly may be almost completely flat.

It is natural then to interpret our sequence of nebulae as one of bodies which are rotating at different speeds. And as we know that the speed of rotation of a body increases as it shrinks, we may reasonably conjecture that this sequence of nebulae corresponds to different stages of development. At the one end we have the globular fuzzy mass of gas with little or no rotation; at the other end we have the flat cartwheel shape in which rotation predominates and governs the structure of the whole mass. A satisfactory confirmation of this is to be found in the fact that a number of these flat nebulae have been observed to be in a state of rapid rotation.

Now before Dr. Hubble had arranged the nebulae in sequence in the way I have described, I had tried to work out, as a problem of abstract mathematics, the sequence of configurations which a mass of rotating gas would assume as it cooled and shrank and as a consequence increased its speed of rotation. I arrived at a sequence of shapes which agreed almost exactly with that which Dr. Hubble subsequently found when he arranged the observed nebulae in sequence, guided solely by the facts of observation, and deliberately putting theoretical considerations out of his mind. This leaves little room for doubt that the nebulae we see in the sky are members of this theoretical sequence, that they began as rotating masses of gas, and that we see them in various stages of development.

If a rotating mass consists of water or some entirely incompressible substance, an increase in the speed of its rotation merely increases its flatness. But compressibility of substance, such as comes into play with a gaseous nebula, introduces new features in addition to flattening.

At first the spinning mass simply flattens and assumes the shape of an orange. After a time a new feature appears—a pronounced bulge all round its equator. Finally this becomes so marked that the equator is merely a sharp edge; the rotating mass has assumed the shape of a double-convex lens as in N.G.C. 3115.

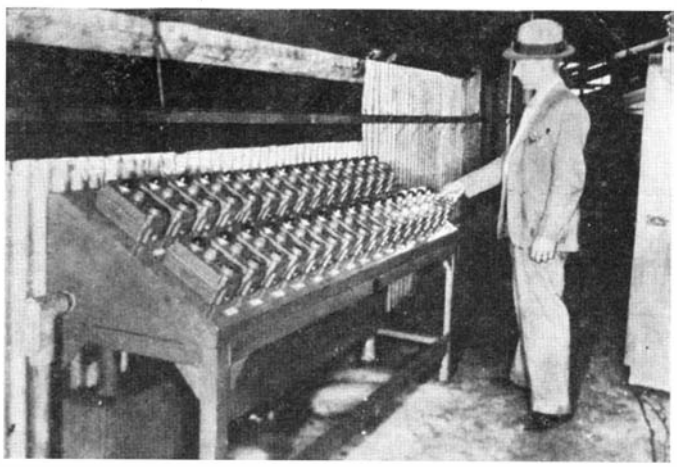
This configuration forms a noteworthy landmark in the evolutionary path of a nebula. Until it is reached, the effects of shrinkage can be adjusted, and are adjusted, by a mere change of shape—in spite of its reduced size, the rotating mass carries the same angular momentum as before by the simple expedient of rotating more rapidly and bulging out its equator. But we find that this is no longer possible when once this landmark has been passed.

Three interesting spiral nebulae in Pegasus, discovered by Ritchey. The distortion of the arms seems to indicate mutual attraction between these galaxies. Probably they are somewhat closely related, at least

FURTHER shrinkage now involves an actual break-up of the nebula. This can no longer carry all its angular momentum as a single body; it is in the state of a fly-wheel which is rotating too fast for safety, and it relieves the situation by the ejection of matter from its equator. This brings us to the type of configuration shown in N.G.C. 5866, 4594, and 891.

(To be concluded)

FACTORY METHODS IN COAL MINING



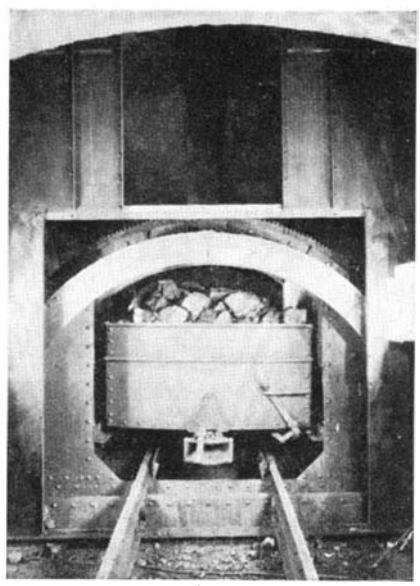
Below: **Signal lamps on each button of the air-cleaning motor control board show which motors are in use**

THE writer recently visited Wildwood, the new mine of the Butler Consolidated Coal Company, in Allegheny County, Pennsylvania, to see how electricity has converted an unprofitable coal investment into a profitable enterprise.

Wildwood is the first coal mine in America to be 100 percent mechanically operated. It was determined that manufacturing methods applied to coal mining was a remedy for a sick business, and in this new installation a reduction in production costs is accomplished by mechanical loading, multiple-shift operations, and intensive preparation of the coal.

The mine is located in a new field and is new from the bottom up; there was no old plant to modernize. The electrically operated coal-mining machinery is of the latest type. The coal is brought by steel mine cars over narrow-gage rails to a rotary dumper in the mine, where the coal is spilled into hoppers and bins from which it is transported to the tipple at the surface by a 54-inch, 12-ply rubber belt 900 feet long between centers. The capacity is 1000 tons per hour.

The coal is then crushed and all coal of four inches or over is hand-picked in the tipple, while minus 4-inch coal and all crushed impure coal goes to an air-cleaning plant for treatment. The coal shipped for any particular purpose is uniform, for when the buyer decides on the coal he wants, cleaning will be so controlled that every shipment will be the same. The idea is like that of the Champion plant of the Pittsburgh Coal Company where coal is cleaned by washing as described in our December 1931 issue.

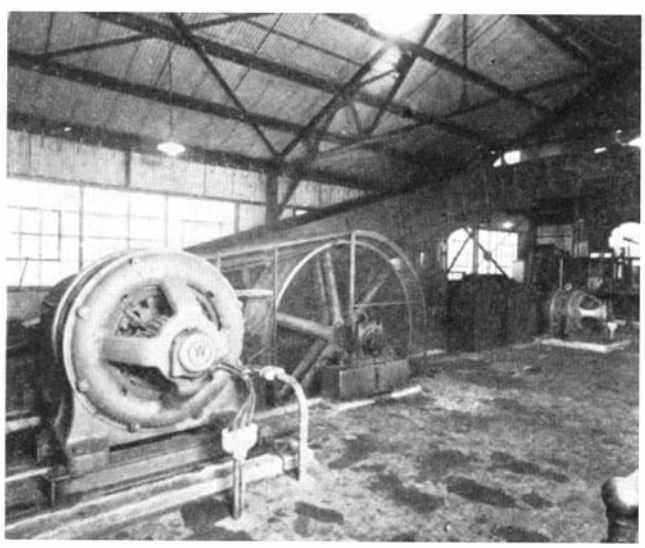


A rotary car dump empties cars before coal is loaded on the belt

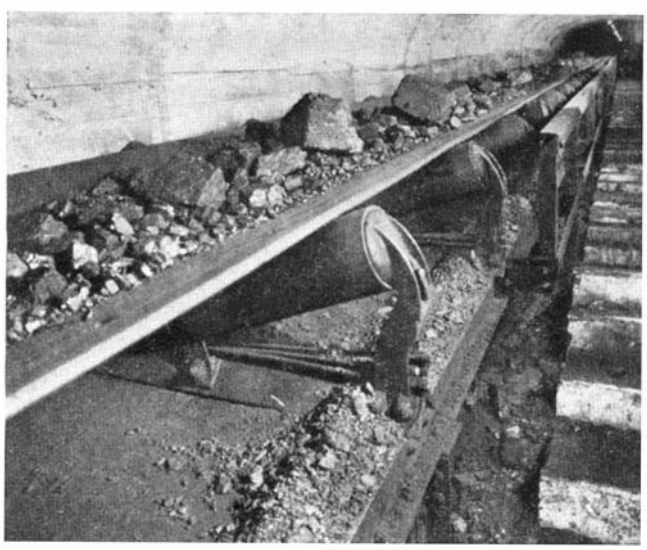
A SHAFT is used at Wildwood only for lowering equipment; workers and others enter the mine by walking down the steps shown next to the belt.

One of our illustrations shows the motors which drive the conveyor belt. The larger motor is of 250 horsepower and the smaller of 75 horsepower. The driving is done by two pulleys of equal diameter which engage the return run of the belt. Because the belt stretches under load, the motors operate at slightly different speeds, acting as an electric differential. This arrangement represents a saving in first cost over a mechanical differential which might be used to accomplish the same purpose.

The pulley driven by the smaller motor also acts as an idler to which a small torque is applied to minimize slipping at the other pulley; the idler also enforces a large arc of contact with the first pulley. We are indebted to Westinghouse Electric and Manufacturing Company and to *Coal Age* for the photographs which we reproduce.



The large and small motors that operate the conveyor belt. A small driving torque is applied to an idler pulley



The 12-ply, 54-inch wide conveyor belt, 900 feet long between pulleys, has a capacity of 1000 tons per hour

VISCOUNT GREY AND LORD HALDANE

A Biographical Contrast of Two Loyal British Colleagues

By W. D. PULESTON*
Captain, United States Navy

THE "science of government" quickly changes in representative government to the "art of government" in which the characteristics and previous training of the leaders become the dominant factors. Comparative biography thus becomes a necessary study if we are to understand the complex situations that confront governments.

It is a frequent observation that statesmen responsible to a Congress or a Parliament are often handicapped in their negotiations with the representatives of autocratic states. This article describes the measures employed by two able British statesmen to meet the foreign problems that pressed upon Great Britain before and during the World War. Our statesmen labor under similar disadvantages in the domain of foreign affairs, and we believe this narrative will enable our readers to understand better the complexities of our own foreign problems.

—The Editor.

DURING the decade prior to 1914 it became increasingly plain to experienced observers that in the event of a European war, Great Britain could not stand aloof. During this critical period, the British government was in the hands of the Liberal Party in alliance with the Irish members; the dominant ideas of this coalition were free trade, home rule for Ireland, retrenchment of expenses for the military, and increased expenditures on social legislation. The government was more interested in domestic than foreign affairs and the essence of its foreign policy was to prevent a European war if possible, but to be ready to guard Britain's interests with her Navy and Army if war came.

When Campbell-Bannerman succeeded Balfour as Prime Minister in 1905, he selected Sir Edward Grey for his Foreign Minister and Richard B. Haldane as his Minister for War; and, as events developed, upon these two gentlemen fell the joint responsibilities of preserving the peace as long as possible and of being ready for war when it came.

Grey and Haldane entered Parliament together in 1885, but there the similarity ends. Grey obtained his seat almost by inheritance in a liberal constituency (Berwick), his family having been prominently associated with the Liberal Party for almost a century. Haldane earned his seat by defeating a Conservative member in a district usually Conservative.

Edward Grey comes from old English stock long established in Northumberland County. The baronetcy that he inherited on the death of his grandfather in 1882 carried with it the family seat at Fallodon and an income sufficient to support him in a public career.

Grey went from Winchester School where his real interest was in fishing, to Balliol College, Oxford, in 1880 when the formidable Jowett was master and at the height of his fame. Though stern and reserved, Jowett set his students a fine example of industry, public spirit, and disinterestedness; and around his dinner table brought them in contact with such men as Browning, Matthew Arnold, Ruskin, and Huxley. Among Grey's student contemporaries were Lang, afterwards Archbishop of York; Curzon, destined to be a Viceroy of India; Louis Mallet, who, as British Ambassador, vainly attempted to keep Turkey neutral; Cecil Spring-Rice, British Ambassador to the United States during the war; Rennell Rodd, Ambassador to Rome at the same time; and J. A. Spender, for years Editor of the *Pall Mall Gazette.*

AT Oxford, Grey's interest in fishing increased; he became prominent in athletics, particularly in tennis; and he frequently indulged in the horseplay characteristic of undergraduates the world over. He took the law, concentrating on its philosophy and historical development, not intending to practice in the courts. He did not distinguish himself in his studies, and Jowett, who frequently forecast the future of his pupils, failed to prophesy fame for Grey. Among some of his classmates, however, he acquired the reputation of being able to do anything if he would apply himself.

Haldane's mother came from Northumberland—the same county as Grey—but his father was a Scotch solicitor, and it was a stern Scotch environment that formed the youthful Haldane. His father's family were devoted Calvinists and there was a pronounced spiritual strain in the Haldane blood. Haldane attended Edinburgh Academy and Edinburgh University and then was sent to Göttingen University in Germany, where this young Scotsman, surrounded by frolicking, beer drinking classmates whose language he was just learning, wrestled with his spiritual doubts under the sympathetic and understanding guidance of Professor Lotze.

GREY'S young mind seems to have been untroubled by any metaphysical reflections; in fact throughout his life he showed little intellectual curiosity, although he was fond of literature. He early revealed an unaffected love of nature and a high sense of duty, but life had treated Grey too generously to expect him to be censorious of a society that unfolded itself so agreeably to his young manhood.

At Göttingen, Haldane learned to apply himself diligently after the modern German method, made his first acquaintance with Kant and Hegel, solved his spiritual doubts, and began to acquire that philosophy which sustained him during his stormy public life. He returned to England with an affection for Germany's educational system and a respect for the German ability to apply scientific discoveries to practical uses.

Grey married his first wife soon after leaving Oxford and is courageous enough to admit that throughout their very happy married life he never failed to consult her on all important questions. The young Greys were attractive and were in demand socially but they were devoted to the country and, while not unsociable, preferred the tranquil life of Fallodon with its trees, gardens, and birds to the more active life of London society and English week-end parties.

Haldane, less fortunate than Grey in his courtship, remained a bachelor, was gregarious by disposition, and was very fond of London. As he prospered, he passed easily from one London set to

*The opinions and facts in this article are the personal ones of the writer. They are not to be construed as official or reflecting the views of the Navy or the Navy Department.

another and soon became as much at home with the Jockey Club crowd as with the more literary "Souls." He became an intimate of the Rothschilds and a friend of King Edward, yet still maintained his friendly association with his German professors. Haldane early decided upon a public career, but it was first necessary for him to earn a competence at the bar. His first three years at law were not remunerative but his diligence and some friendly influence caused him to be made a "Junior" for Horace Davey, one of the leaders of the London bar. Opportunity now came to Haldane and by his skilful handling of an important case during the absence of his senior, he attracted the attention of several old established law firms. Briefs came his way, and within five years of being called to the bar, his income enabled him to consider a parliamentary career.

In 1882 Haldane met another young barrister, H. H. Asquith, with a similar love for the law and an even greater desire for a public career. These two became fast friends, dined together regularly, visited each other's homes, and traveled abroad in company. Another traveling companion of Haldane's was Professor Hume Brown of Edinburgh University; these two visited some German university annually, and it was during these visits to Germany that Haldane became convinced that because of the rapidity with which the German industrialists were applying scientific methods to business, German goods would soon capture British markets.

Wilhelm II (below) made annual European tours to improve Germany's foreign position, but he was too impulsive and erratic

Edward VII, of England, likewise actively worked for his country's good. Urbane and discreet, he was a more successful envoy

ONCE convinced of this danger, Haldane endeavored to combat it by founding more civic universities in England, and under them he proposed to place scientific and technical colleges, for he was further convinced that technical schools should not be separated from the universities, as in Germany. He enlisted the support of Prime Minister Balfour, helped to rehabilitate London University, and sponsored the legislation that made possible civic universities at Liverpool, Birmingham, and Bristol. His work for the Imperial College of Science and Technology gained him the friendship of King Edward, who was then Prince of Wales, and he continued to enjoy the confidence of his Sovereign until the latter's death. His interest in education also brought him in contact with the Sidney Webbs and other members of the Fabian Society who furnished a large measure of the leadership of the Socialist Party then in its infancy.

Whatever preparation Grey got for his position as Foreign Secretary, he obtained as Under Secretary of State for Lord Rosebery from 1892 to 1895; he was extremely loyal and devoted to his chief, and he imbibed many of Rosebery's ideas. When Rosebery first became Foreign Secretary under Gladstone, he was strong enough to stipulate terms that secured some coherence in foreign affairs, and he generally followed the policies taken by Lord Salisbury under Disraeli. In Rosebery's second term, beginning in 1892, Gladstone was older, and Rosebery was able to take a still more independent position; and although Gladstone, when in opposition, had declared for the evacuation of Egypt, Rosebery insisted that his pledge be ignored and that there be substantial continuity in the handling of foreign affairs, regardless of the party in power.

Rosebery selected Edward Grey, then 30 years of age, as his under secretary, and in an environment of almost complete independence of the Prime Minister and complete aloofness from the rest of the Cabinet, young Grey obtained his first impressions of the Foreign Office. Not since Waterloo has the British Foreign Office been an uninteresting place, and when Grey joined its staff, England and France were disputing over their rights in Egypt, China, and Newfoundland. England and Russia were rivals in the Near East and Far East. In consequence of their common hostility to France and Russia, the relations of England and the Triple Alliance were usually friendly.

ENGLAND, however, soon discovered that if she expected Germany's support in her penetration of Egypt, she must extend her support to Germany's plans for a sphere of influence in Turkish Asia Minor. This England reluctantly did, and Grey has recorded how helpless he felt under German pressure that couldn't be resisted. A dispute arose with France over the boundary between French Indo-China and Siam that almost caused a war, and France was advancing claims in West Africa that conflicted with British claims, so Grey left office in 1895, already half convinced that the period of splendid isolation was over as far as England was concerned.

Grey resigned office almost gladly for he preferred to live as a country squire; and when he was in opposition, his leisurely life is in striking contrast to that of the industrious Haldane. Grey was elected to the Board of the North Eastern Railway in 1897 and became its chairman in 1904; in 1897, he served on a Royal Commission to investigate the trade depression in the West Indies. Aside from these two activities, Grey gave himself up to the joy of living the life he loved with his wife, his birds, his books, and his fishing rod.

The South African War broke in upon Grey's quiet life and without hesitation he joined Asquith and Haldane under Rosebery's banner to form the Liberal Imperialists, a group that supported the Government in its conduct of the War, while Lloyd-George, Campbell-Bannerman, Morley, and Harcourt attacked the government. These three young Liberals demonstrated their political courage when they forsook the party's policy of peace and retrenchment to follow the patriotic lead of Lord Rosebery.

During the Boer War, the Unionists held the so-called "Khaki election"

(*Please turn to page* 314)

THE NEW X-RAY 'MICROSCOPE'

By GAYLORD JOHNSON

WHEN your newspaper recently gave you Dr. R. A. Millikan's announcement of an "X-ray microscope" built by two of his scientific associates, which actually reveals electrons in motion within the atom, what sort of picture rose up before the eyes of your mind? How did your imagination visualize the apparatus?

Unless you are thoroughly familiar with the properties of X rays, you probably imagined an instrument more or less like the usual microscope —with a tube containing lenses, a stage for the object under examination, and a mirror below it.

That is what I imagined—a regular laboratory microscope, but modified in some unexplained way for use with X rays. And through it I should have expected to see a "movie" view of one of the many models of the atom which have been published—a pea-like proton stationary in the center, with bird-shot-like electrons flying at enormous speeds in circular or elliptical orbits about the proton.

I CONCEIVED the new invention in this way, just as you and other laymen might, in spite of knowing that the calculated sizes of protons and electrons are far below the theoretical limit of any optical microscope, and in defiance of learning that X rays cannot be brought to a focus by lenses of optical glass. The word "microscope" forced me to think of the device as I knew it. So must we always imagine the unknown in terms of the known.

In this chaotic state was my concept of what I expected to see in Dr. Jesse W. M. DuMond's laboratory at the California Institute of Technology. My only outline of a more accurate mental picture was given by the scientific name of the new device—the "multicrystal spectrograph." From this I fancied that the instrument might use several small prisms of glass to concentrate the faint spectrum from a cloud of moving electrons upon a photographic film—somewhat as the spectrograph attached to a great telescope records the spectrum of a cloud-like nebula hundreds of light years distant.

If an astronomer can decide from the photographed spectrum of an almost infinitely distant spiral nebula whether the nebula is traveling toward or away from the observer, and how rapidly, might not Professors DuMond and Kirkpatrick read in the spectra of electrons equally remarkable facts about their motions?

With these speculations in mind, I asked Dr. DuMond whether the new instrument contained a combination, a whole group of spectroscope prisms, which condensed many pencils of faint X radiation to a common focus upon the photographic film.

"You have a glimmering of the method," said Dr. DuMond, "but you are thinking of the ordinary spectroscope prism used to refract sunlight or starlight into a colored spectrum. That would not work at all in this case, for X rays are only very slightly bent or refracted by a prism. The word you should use to describe what takes place in the multicrystal spectrograph is diffraction. It resembles reflection by a mirror, but differs from it in one all-important property which will be easier to make plain after you understand the mechanical construction of the instrument itself.

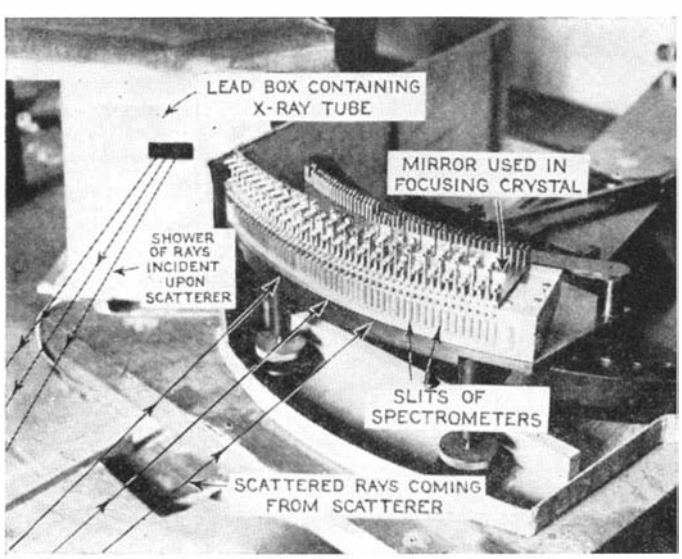
Dr. DuMond (left) and Dr. Harry Kirkpatrick starting a 1000-hour X-ray exposure

"LEND me your pencil; let us start with a clear map of the country we are exploring. First, let us see how this so-called 'X-ray microscope' built by Dr. Kirkpatrick and myself differs from an ordinary optical microscope, and then we will clear up your ideas of X-ray 'diffraction,' the phenomenon which makes our growing knowledge of X rays possible at all. Last of all, I will show you the photographic results which prove that the electrons really do travel around in the atom with high velocities."

Dr. DuMond sketched a double diagram (Figure 1) and explained it with the pencil for a pointer.

"Since the newspaper accounts of the 'multicrystal spectrograph' have *called* it an 'X-ray microscope,' a comparison of it with an optical microscope may be illuminating.

"The regular microscope, when adapted for photomicrography, has the following elements: *A*, a source of light; *B*, a mirror to direct its rays through



A close-up view of the "X-ray microscope" (multicrystal spectrograph), showing the bank of crystals of calcite used

the instrument; *C*, the magnifying lens system; and *D*, the photographic film upon which the magnified image is formed and recorded. The object, usually translucent, is introduced between *B* and *C*.

"Now how do the parts of the 'multicrystal spectrograph' correspond? *A*, the source of light, is plainly the X-ray tube. Is *B*, which I have labeled 'scattering body', equivalent to *B*, the microscope mirror? Not exactly, but let it pass as roughly equivalent for the moment; at least it changes the direction of the rays coming from *A*, which is what the concave microscope mirror does, but since no true reflection occurs at the surface of the scattering body its likeness to a mirror is superficial. We will look into its functions more thoroughly later.

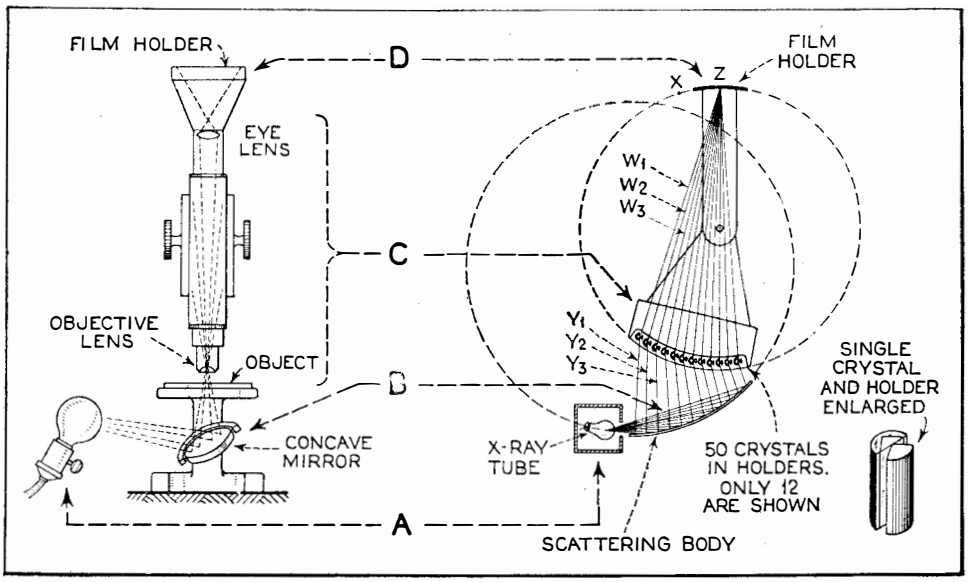


Figure 1: **The multicrystal spectrograph compared with a microscope**

"AND now what shall we compare to the lens system *C* of the optical microscope? As you probably know, there is no such thing as a lens to bring X rays to a focus, but the bank of 50 little crystals (at the right end of the line marked *C*) performs a similar function through the phenomenon called diffraction, which I mentioned a few moments ago. This bank of crystals is therefore roughly equivalent in results to a lens system. There remains only *D*, the photographic film, upon which the image is received and fixed in both cases."

"Splendid!" said I. "But where, if I might ask, are the objects to be examined—the electrons which are to be shown in motion?"

Dr. DuMond pointed to the curved "scattering body" *B* which he had provisionally called equivalent to the microscope mirror, and replied, "The electrons to be shown in motion are in the atoms of this thin curved plate of graphite or carbon, so that *B* in this diagram is a combination, in a sense, of both mirror and object. When the X rays generated by the tube at *A* fall upon the carbon atoms at and under the surface of the scattering body *B*, an effect is produced which we will now roughly illustrate."

Dr. DuMond quickly sketched the essentials of this diagram and handed it to me. (Figure 2)

"Regard this as a very arbitrary picture of the activities taking place in a section cut through an atom of carbon situated at the surface of the scattering body—the curved graphite (carbon) plate just mentioned. The section is made at right angles to the surface, that is, it is a horizontal section through a curved vertical surface. At the center of the atom is the carbon nucleus, surrounded by certain electrons which are so closely associated with it that they are seldom dislodged. More about them later. Around them and the proton move the electrons which our theory-to-be-proved regards as in ceaseless motion. For convenience in visualizing, let us suppose that their orbits are circular about the proton in this single plane—and counter-clockwise (see small arrows). In reality it is a much more complicated affair, with the electrons moving in every conceivable direction.

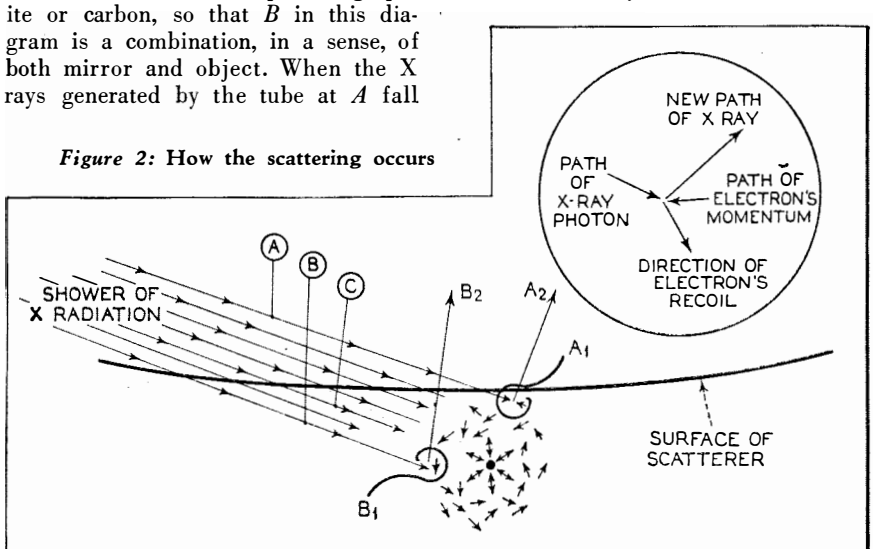


Figure 2: **How the scattering occurs**

"Now from the left comes the shower of X radiation which is being emitted from the target of the generating tube. It consists of a given wavelength, and therefore has a given constant momentum, for physicists have shown experimentally that each of the splashes of radiant energy, called photons, which constitute a beam of light or X rays, has a definite quantity of momentum which is rigidly related to its wavelength.

"NOW let us mentally pick out from the shower of X radiation arriving at the surface of the carbon scatterer the path of a single X ray (marked *A* in our diagram) and see what happens to it. Along its straight road advances a series of these splashes of energy which we have called photons. The arrow points will help you to imagine their successive arrival and regular wavelength.

"Let us therefore suppose that a photon of ray *A*, traveling with a definite momentum proportional to its wavelength, meets a moving electron in the carbon atom which we have mentally isolated for observation. We may suppose that some sort of collision takes place such as that symbolized at A_1 in the diagram, with results which are illustrated roughly in the detailed sketch within the circle at the right. A part of the photon's momentum is imparted to the electron, which recoils, while the remaining energy of the photon is reflected back along a new path. Having given up a part of its momentum in causing the electron's recoil, the splash of energy (or photon) now travels its new path, the arrow-line A_2, with a new wavelength.

"Another photon of X rays, such as one of the arrowheads traveling along ray *B*, may collide with an electron having a different initial momentum than

the first—and consequently the change in wavelength which it undergoes will be slightly different from that suffered by the photon of ray *A*. Its differing momentum and direction may be represented by the arrow-line B_2."

"Then," I said, "the beam of rays which is reflected from the scatterer of graphite consists of a number of wavelengths, all differing from the original incident wavelength?"

"Yes," said Dr. DuMond, "but that is not the whole story. We must also consider the effect produced upon a portion of the beam of X rays by the 'bound' electrons which are so tightly retained in the carbon nucleus that, although in their energetic motions they are straining terrifically against the proton's restraint, they are incapable of suffering any recoil under the impact of the photons. When a photon strikes one of these electrons it is reflected, without any change of wavelength, energy or momentum. We must remember this.

"I WILL now give an analogy (Figure 3) which will make perfectly clear the reflection of X-ray photons by moving electrons—causing the changes in wavelength of the X radiation.

"Let us first consider for a moment what happens when visible light is reflected from a moving mirror. Suppose, in the upper part of Figure 3, a beam of light to be traveling along path *A*, with a wavelength of *L;* that is, with a distance *L* between successive crests of the waves. If the beam now strikes the surface of a mirror moving rapidly *away* from the light source, the distance *L* between the wave crests of the incident beam will be increased to L_1 after the beam has been reflected. This lengthening of wave occurs because the mirror is running away from the advancing waves, and each wave must therefore travel slightly farther in order to be reflected than it would if the mirror were stationary.

"If we imagine the mirror as traveling rapidly toward the source of the incident beam, as in the lower part of the same figure, the effect is to shorten the wavelength of the reflected light, since each arriving wave crest is reflected before it can travel through its original wavelength. This change of incident wavelengths to longer or shorter ones when radiation is reflected from a moving body is called the Doppler effect.

"We can now apply this principle to the moving electron of the carbon atom as it meets an X-ray photon of wavelength *L*, emitted by the X-ray tube of our apparatus. For convenience in applying the analogy we will regard the electrons of our carbon atom in the scatterer as mirrors of infinitesimal size. These mirror-electrons will then be of three kinds: *First*, those which are so closely bound by the proton that they cannot be made to recoil and thus absorb a part of the momentum of the colliding X-ray photons. These correspond to a stationary mirror which reflects a beam of incident visible light with wavelength unchanged.

"*Second*, those electrons which can be regarded as relatively free to recoil, but which have practically no initial momentum. If one of these mirror-electrons, of zero momentum, is struck by an X-ray photon, it takes on a slight recoil momentum (which is constant for all electrons, since they are all identical in all the elements) and the reflected photon suffers a corresponding loss of momentum and change of wavelength. This change of wavelength due to the recoil of the scattering electrons was theoretically predicted and experimentally demonstrated by Dr. Arthur Compton of the University of Chicago in 1923.

"The *third* kind of electrons are those which our theory regards as in constant motion or as having initial velocities within the atom. These correspond to the mirror in Figure 3 which approaches or recedes from the source of light. Now can you tell what happens when an incident X-ray photon collides with one of these infinitesimal and rapidly moving mirrors?"

"I THINK so," said I. "The photon will suffer a modification of momentum and wavelength corresponding to the initial velocity of the electron with which it collides."

"Quite right," agreed Dr. DuMond, "and furthermore, since the initial velocity of our electron-mirrors may be quite random in direction, any beam of X rays reflected by them will possess, not a sharply defined wavelength, but a broadened band of wavelengths corresponding to all possible momenta and directions of the electrons. The extreme cases of shortening and lengthening of wavelengths will occur when the electron directly approaches the incident and reflected light beams, and when it recedes straight away from them.

"If we should therefore scatter the X rays coming from a certain type of X-ray tube—let us say one with a target of molybdenum—and should pass the reflected, or scattered, rays through an X-ray spectrograph upon a photographic film, we should expect to find in the resulting spectrogram not only the clearly defined lines of the characteristic spectrum of molybdenum, (due to the tightly bound electrons which cannot recoil) but, *in addition*, certain shifted and broadened bands, which are caused by the alteration of the wavelengths of all the spectral lines of molybdenum through the action of both the second and third kinds of electrons which we described a moment ago. A small number of the free electrons have nearly zero velocity and produce through their constant recoil a constant deflection of the original

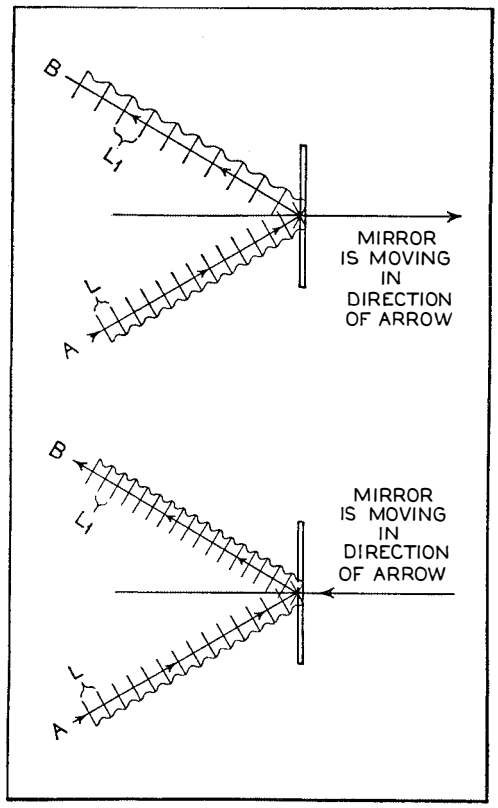


Figure 3: **The Doppler effect on a beam of light. It is analogous to the same effect as observed by passengers on a train when it moves rapidly past a stationary whistle**

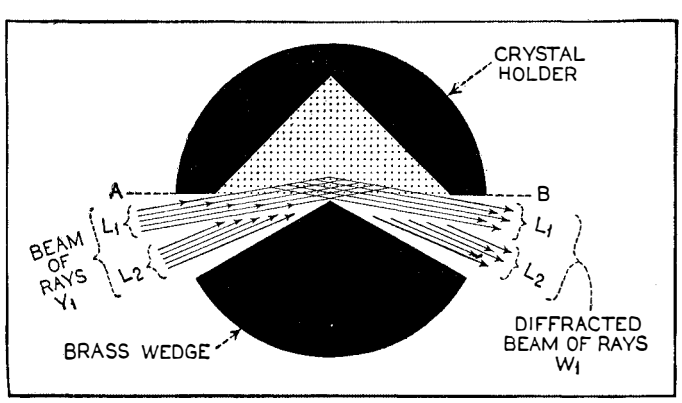


Figure 4: **A close-up of a single crystal and holder**

lines. But this is covered up and masked by the broad band of wavelengths caused by the randomly directed momenta of the electrons having initial velocity of their own. It is the presence of these *both broadened and shifted* lines in the spectrograms taken with the multicrystal spectrograph which proves that electrons are not static, as was once believed, but are constantly in dynamic motion within matter. This proof is especially convincing because the amount of broadening obeys laws in accord with the 'Doppler' explanation of the moving mirror's effect upon light. Do you see that?"

"Yes," said I, "but how can you ever find out whether this broadening of the lines occurs? How is it ever possible to detect these infinitesimal changes in wavelength caused by the velocities of such small bodies as the electron?"

"That is where our so-called X-ray microscope enters in," said Dr. DuMond. "Let us, however, call it from this time on by its true name, 'multicrystal spectrograph,' for it is to spectrometry that we must look for the answer to your question."

"Now," said I, "I am going to find out how that flock of 50 little spectroscope prisms works, am I not?"

"YES," said Dr. DuMond, "but don't call them prisms. As I explained before, X rays are not refracted to any extent through prisms. They can, however, be diffracted by diffraction gratings, and each of these little crystals contains a great many layers or planes —the totality of which is a perfect 'space diffraction grating,' made up of layer upon layer of atoms ranged in regular strata. And here is the essential property of a crystal which makes it so useful in carrying on research with X rays. It possesses the remarkable ability, in virtue of its layer-like structure, of separating a beam of X rays thrown upon it into the various wavelengths included in the beam, and of reflecting them in regular order as a spectrum. This property is called selective reflection. We cannot use prisms of glass to cast an X-ray spectrum upon a photographic film, but we can use a crystal lattice, as we call the layers of atoms in regular rows which make up a crystal of, let us say, calcite, which is the material we use in our instrument."

The pencil was flying over the pad again, and in a few moments Dr. DuMond had indicated the essentials of this diagram (Figure 4).

"This indicates," said he, "a horizontal section through one of our calcite crystals and the brass parts surrounding it. The crystal itself, shown in section by the white triangle, dotted to represent atoms, is fixed in a V-shaped groove in its rounded brass holder. Below, the edge of an obtuse brass wedge almost touches its center.

"If you will refer a moment to the first diagram I drew (Figure 1) you will see how the 50 crystals and their holders are set into the so-called microscope. All of their free planes or cleavage faces (represented by line *AB* in this sketch, Figure 4) are set so that if extended they would meet in a line passing through point *X* in Figure 1. Note that the photo-film is curved to correspond with a portion of the same circle in which all the crystal planes meet in point *X*.

"The tiny spaces left between the cleavage faces of the crystals and the edges of their brass wedges therefore furnish 50 small slits through which X rays thrown off from the carbon scatterer (See lines Y_1, Y_2, Y_3, etc., in Figure 1) can pass and be reflected by the planes of atoms which make up the crystals. When thus reflected, or more correctly, diffracted, the X radiation from the scatterer is brought to a focus upon the curved photofilm at the point Z, after traveling along the lines W_1, W_2, W_3, and so on.

"Now let us see how the diffraction gratings in a single one of these crystals separate and transmit to the photo-film (in the form of a spectrum) the various wavelengths contained in the radiation scattered by the atoms of carbon. We will make a close-up, as the movie people say, and trace the path of the minute beam of X rays we have labeled Y_1 in Figure 1. As it arrives from the carbon scatterer, it is made up of many wavelengths which we will call in this close-up sketch L_1, L_2, and so on. (See also Figure 4.)

"A ray of wavelength L_1, let us say, strikes the crystal. If it enters at the correct angle to the atom planes it finds successive planes of atoms separated by a distance which bears a certain mathematical relation to the ray's wavelength and the angle at which the ray strikes these planes. When this condition is satisfied the ray L_1 is reflected in accordance with the simple law of reflection at a plane mirror and leaves the crystal in the direction shown by the arrow L_1. Rays of wavelength L, which do *not* strike the crystal atom planes at the selective angle for reflection of wavelength L, are not reflected by the crystal, but are chiefly lost by absorption in it. There is, however, a plentiful supply of directions from which the various wavelengths can come to the crystal, because the scatterer which is furnishing the scattered radiation is many times larger than is necessary for this purpose. Again, rays of wavelength L_2, L_3, and so on are diffracted and since each wavelength is reflected selectively at a slightly different angle to the atom planes of the crystal (as indicated in Figure 4) each wavelength is reflected to a slightly different point upon the photo-film."

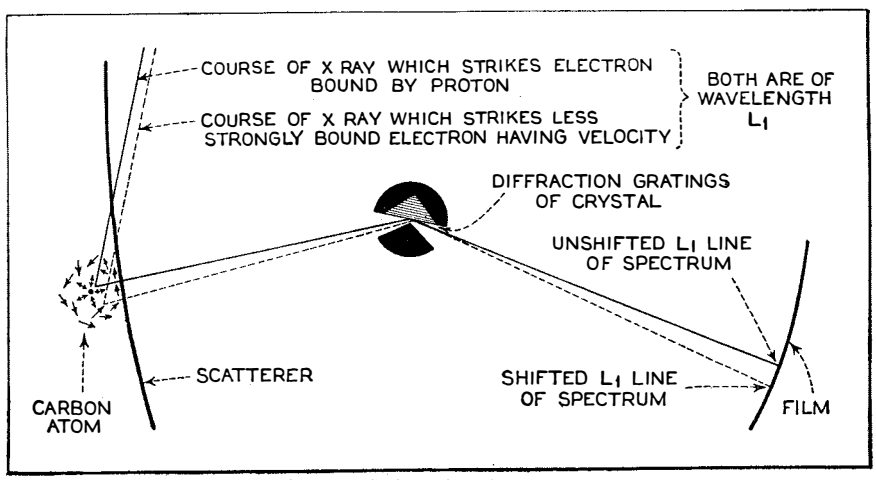


Figure 5: **The proof that the electrons are in motion**

"And this," said I, "produces the spectrum which is recorded there?"

"EXACTLY," answered Dr. DuMond, "and this spectrum" (See page 282) "shows all the Fraunhofer lines characteristic of the X rays emitted by the focal spot of the X-ray tube (as modified by being scattered from the carbon) and, *in addition*, it shows these same lines slightly shifted as well as widened or blurred. One more diagram and it will all be clear."

Here is the sketch (Figure 5) which Dr. DuMond made, in its essentials.

"Let the solid line represent the course of a photon of X-ray energy coming from the tube and striking one of the electrons which is too tightly retained by the proton to be dislodged by the X-ray photon which strikes it. This photon, as we have seen, gives rise to a spectral line which leaves the scatterer with precisely the same wavelength with which it arrived. It therefore is unerringly diffracted and reflected by the gratings of the crystal to its proper location in the spectrum upon the photo-film. Since it is of wavelength L_1 we will call its record upon the film

'unshifted L_1,' and mark it on the sketch.

"The dotted line, on the other hand, represents the course of a photon of X-ray energy which strikes one of the electrons which has, we say, 'initial momentum,' and is not too strongly bound to be capable of recoiling under the impact of the photon and thereby modifying its wavelength. We can imagine it moving about the proton (see Figure 5). When the photon strikes it, the resulting beam of energy does not leave the scatterer with exactly the same wavelength as the beam caused by the impact with the electron which is much more tightly bound by the proton.

"These two beams therefore differ slightly in wavelength on leaving the scatterer and are consequently, as we have seen, diffracted through slightly different angles at the calcite crystal. Accordingly the beams diverge during the remainder of their course and the modified beam, whose course is shown by the dotted line, arrives at the photofilm in a position shifted away from that of the unmodified one. Its original wavelength, like that of the other, was L_1, but after being scattered by the carbon its record upon the film is both shifted and blurred. This is so because of the random modification in wavelength with which it and millions of others like it leave the scatterer—due to their collisions with the rapidly moving electrons having random momentum, and hence velocity, within the atom. That is the whole story, and here is the evidence that proves it."

DR. DuMOND handed me three photographs, or spectrograms, taken with the multicrystal spectrograph.

"The two lines in Figure 6 marked α_1 and α_2, close together, which run through all the pictures," said he, "are a 'doublet' which occurs in the spectrum produced by radiation from a certain kind of X-ray tube. (X radiation from an X-ray tube having a target of molybdenum.) These two sharp lines were caused by the reflection of X-ray beams from electrons severely bound and incapable of recoiling under the impact of photons; hence incapable of modifying the photon energy, frequency, and wavelength. The wide, blurred line marked α_c is the shifted image of these same two lines. They are so blurred and fuzzy that their separate records can no longer be distinguished; they have fused into this one. The greater shifts and blurrings of this doublet in the second and third pictures are caused by increasing the angle between the primary ray and the scattered ray thrown off the carbon scatterer, thus increasing the effectiveness of the modifying effect on those rays which suffer collisions with the moving electrons."

"Well," said I, "it really is an X-ray 'microscope' after all, isn't it? It makes visible the effects caused by the moving electrons, even if they themselves still remain invisible."

"Yes," said Dr. DuMond, "if you broaden the meaning of the word microscope to include an instrument that 'looks at' electron momenta but does not attempt to look at electron positions.

"The speedometer on an automobile tells two things; how far the car is from

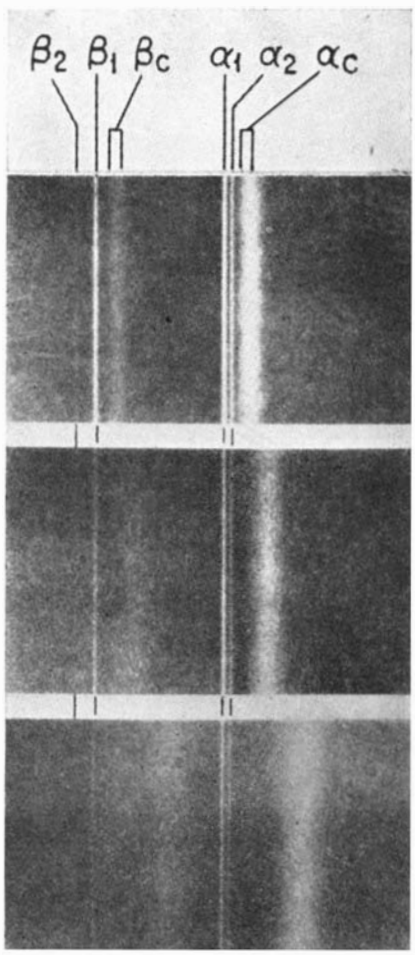


Figure 6: **Three of the spectrograms showing shifted and blurred lines caused by motion of electrons in atoms of the scatterer. The larger shifts and blurring of the lower two are due to increasing angle of the primary and scattered rays**

home (trip mileage) and how fast it is going. This can be done with an automobile with sufficient accuracy to avoid arrest for speeding and to find one's way on a road map; say to within five miles an hour on the speed and within seeing distance on the position.

"In the present state of our knowledge this cannot be done with an electron, even theoretically. This is because in every experiment made on the tiny electron to determine its position or its momentum some agent must be used such as another electron or a photon. (We have no smaller tools to work with.) It has been shown by Heisenberg, a young theoretical physicist (For picture, see SCIENTIFIC AMERICAN, September, 1931, page 170.—*Ed.*) that even under ideal conditions every experiment we perform with such an agent to determine the position of our electron destroys to some extent the possibility of knowing accurately its speed at that time. Similarly, he has shown that every experiment performed to determine the speed destroys to some extent the possibility of knowing accurately the position. In each case the very conditions which make for greater accuracy in a determination of one kind make for a correspondingly greater inaccuracy in a simultaneous determination of the other kind, due to the introduction of elements of uncertainty or randomness or unobservability. The precise quantitative statement of this principle is called the principle of uncertainty. It is doubtless an attempt to express a new and very deep-rooted principle obeyed in the tiny sub-sub-microscopic world which interests physicists so deeply.

"THE foregoing discussion shows why the experiment we have performed with the multicrystal spectrograph cannot strictly be compared with looking at electrons through a microscope in the ordinary sense. Our experiment has been devised in such a way as to give maximum precision in our information about electron speeds (or momenta) and hence is utterly unfitted to give information about the positions of electrons. If you wish to call it a momentum microscope rather than a position microscope you may perhaps do that."

As I looked at the laboratory in which Dr. DuMond and Dr. Kirkpatrick performed their experiment, I was struck by the fact that so much of the apparatus had a home-made appearance.

"Yes," said Dr. DuMond, "almost anyone can waste money on research but the real art in our job consists in doing it economically. Funds for work of this kind which has no self-evident direct or immediate application to make life easier or pleasanter for mankind are extremely scarce and hard to obtain. Nevertheless, work of this kind is of great importance. It has been said that in order to have applied research you must have pure research to apply. Certain it is that before one can invent new and useful things and processes the inventor must be in possession of the natural laws, properties, and behaviors which he is to use.

"Scarcely a single application of electricity today would be possible if Faraday had not discovered his law of electro-magnetic induction. Yet when asked what his discovery was good for he could only answer, 'Of what use is a new-born babe?'"

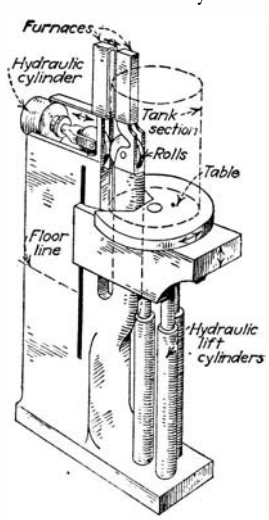
FORGE WELDING

Used in Fabricating Large Pressure Vessels

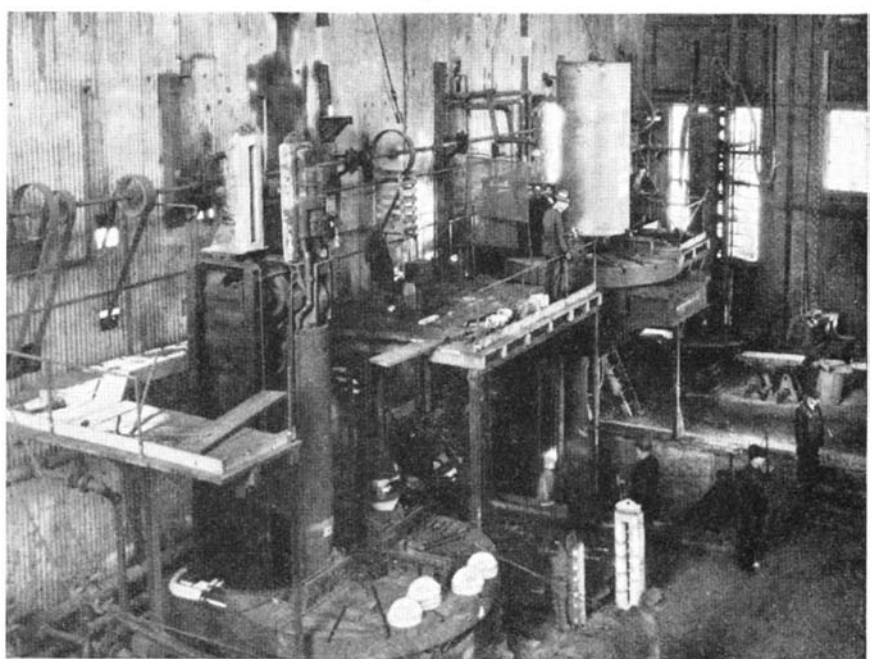
WELDING is one of the oldest of arts. It has, however, been brought to a high state of efficiency, especially in handling large pieces such as pressure vessels, boilers, and tank cars. Welding operations can be roughly divided into two classes. First, the fusion processes—thermit, gas, and electric-arc methods which weld at temperatures in excess of 4000 degrees, Fahrenheit, producing a deposit of metal somewhat of the nature of a casting which fuses to and joins together the pieces of metal. The other or forge method welds at temperatures of 2600 to 2800 degrees, Fahrenheit, when the metal is what might be called "sticky" or "tacky." Forge welding is the work of the ordinary blacksmith, but the same methods are employed on a gigantic scale. Although the forge proper disappears, a substitute is provided. In the Rowland process, as carried on at the Carbondale, Pennsylvania, plant of the American Welding Company, equipment is used which can care for very large work.

Let us assume that a tank car is to be fabricated. The tank is made of three plates bent and welded and then in turn welded together and the two heads welded on. After the plates have been bent to a cylindrical form, the "overlap" is tacked at two or three points by electric welders. A crane picks up the cylinder and places it on the table which is ten feet in diameter and is raised and lowered hydraulically. Gas-fired furnaces four feet high and a foot wide will be noticed in our diagram. The lower four feet of the overlap is between the furnaces. The expert welder now starts his flame and the metal is rapidly raised to 2700 degrees, Fahrenheit. He judges by his eye and checks with an optical pyrometer.

Two rolls will be noted in the diagram. One (the one inside the cylinder) is fixed and the other which opposes it can be made to exert a pressure of 39,000 pounds. The welder lowers the table and brings the rolls to bear, gently at first and then with full hydraulic pressure, upon the overlap. Moving the cylinder up and down rapidly between the rolls serves to "iron-out" the overlap until it has been reduced to the thickness of a single plate. The proper curvature is maintained by rotating the table through a small angle. A second heating and rolling finishes the four-foot section, about eight minutes being required. Then the next four feet are welded and so on. The cylinder is then annealed in the vertical oil-fired annealing chamber illustrated. Here it is maintained at a temperature of about 1000 to 1200 degrees for about 18 to 20 minutes. It is then removed, re-rolled, and cooled for two or three hours before additional work is done on it. The sections are then welded together by special hammer welding equipment. The finished tanks are carefully inspected and finally filled with water at 500 pounds pressure to test for strength.

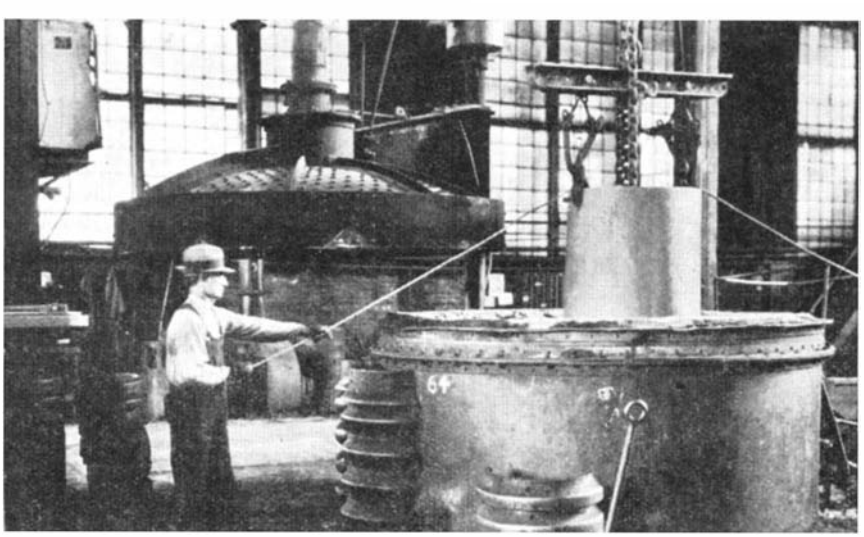


Vertical welder showing how a tank section is raised and gas welded



Illustrations courtesy *Chemical and Metallurgical Engineering*

The work, such as a section of a tank car, is lowered hydraulically between gas furnaces and opposing hydraulically-applied rolls which "iron out" the overlap

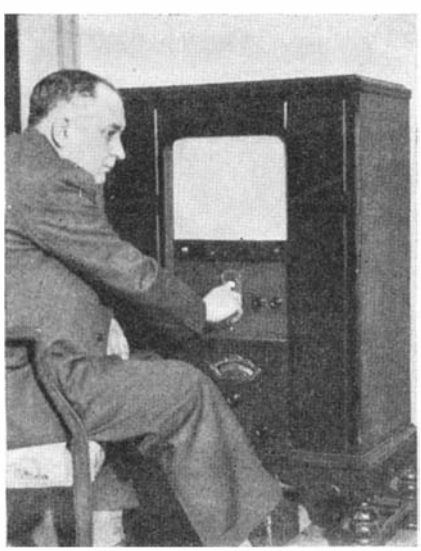


Tank sections, 16 feet long and 97 inches in diameter, can be annealed in this vertical oil-fired furnace. The cover is swung away for loading and unloading

WHERE IS TELEVISION?

By A. P. PECK

"TELEVISION is here" says the technician; and the public looks around for a television "machine" with which it can see stage presentations, boxing matches, horse and automobile races, and all the other interesting events that go to make up our complicated national life. But the public looks in vain: Here is a televisor that shows a picture the size of a postage stamp; here is one which gives an image, somewhat distorted by a huge magnifying glass, apparently about six inches square. But the images in these televisors show only head, or head and shoulder views, of one or, at the most, of two persons, and to see even these limited pictures the spectator must be very nearly in a direct line with the televisor. The much-touted 10-foot square television screen of Sanabria can, in this discussion, be dismissed with a few words. It is much too cumbersome to interest the home television enthusiast, and even with its large size it has the same limitations of image as are found in the smaller reproducers.



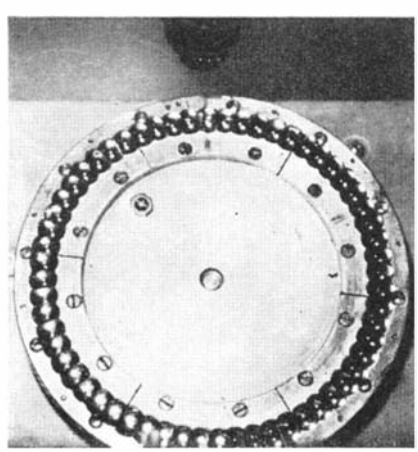
Above: **William Hoyt Peck with his televisor.** *Right:* **A close-up of the lens-mirror disk, with the light-condensing lens housing projecting downward into the top of the picture**

Where then is the kind of television that will give us in our own home the equivalent of a motion picture with sound accompaniment? Quite frankly it is not available. We can today go to an up-to-date radio shop and purchase a televisor that will actually operate but it will have all of the limitations briefly expressed above. It will be erratic in operation; it will require constant attention on the part of the operator; and it will bring to us only mediocre pictures. Thus, television has or has not arrived, according to the standards which each person sets for such entertainment in the home.

Workers in the television field may be divided into two general classes—those who are doing something and telling the world about it, and those who are doing something and saying nothing. Both groups can justify their attitudes: The former is giving the public a new plaything—crude though it is; the latter is working toward a more or less definite end and prefers to withhold the details of results until television on a scale acceptable to the majority can be made available.

A brief survey of the activities of some of the workers in the first of these two groups will give a general idea of what the present offers. (For details on the technical phases of television see February 1927, March 1928, December 1928, February 1930, and November 1930 SCIENTIFIC AMERICAN.)

The engineers of the Jenkins Television Corporation have developed a line of television receivers and reproducers, a console model of which is shown. The image is viewed through a modified shadow box mounted in the console, being projected onto a translucent glass screen so that it can be watched by a small group of people. This company reports that it is experimenting with a transmitter operating in the neighborhood of five meters. In this region congestion is at a minimum and the carrier wave can be held steady enough for satisfactory transmission.



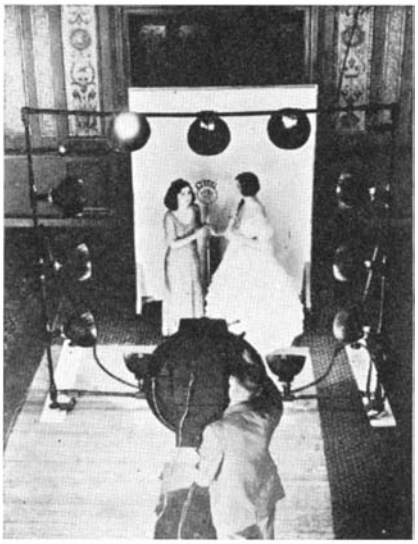
The Freed television receiver and reproducer, showing the shadow box which can be folded downward

Jenkins' engineers also talk of a new type of "camera" or television pick-up for use in theaters and out of doors and of a new method of increasing detail in a received image. So far, this development is all in the future, and the receiver with a small image, lacking in detail, is all the public can have at this time.

In one of the models put out by the Freed Radio and Television Corporation, a crater-type neon lamp supplies the light which is modulated by the incoming signal. This light is projected through a series of lenses arranged in a spiral on the usual scanning disk. This lens system serves to enlarge the image as it is projected on a screen, and so to make it visible by several persons at one time. On the front of the cabinet is a hinged arrangement which serves as a shadow box, and which may be closed to cover the screen when the set is not in use.

THE latest development at the time of writing is the lens-mirror disk of William Hoyt Peck (no relative of the writer). In this system, a scanning disk about one foot in diameter gives an image, projected on a screen, about a foot long. Arranged in a circle around the edge of the disk are 60 lens-mirrors (or the proper number according to the number of units used at the transmitter). Light from a crater-type neon lamp is focused through a lens system onto the lens-mirrors, which are individually tilted so that a scanning effect is obtained. The designer claims that far more efficiency is obtained from the neon lamp with his system than is possible with any other system in which only part of the light is used at any one instant.

In a demonstration of the Peck system, the writer noted fair definition, but



In the foreground is the Jenkins television "camera" used to pick up visual programs at any location

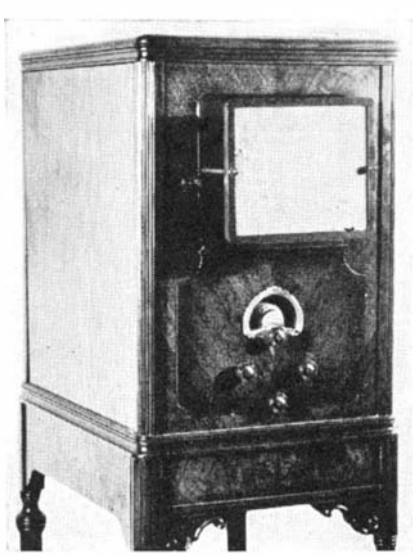
insufficient illumination on the foot-long screen. This was explained as being due to the lack of a satisfactory light source which, however, is being developed. The best feature of the televisor was the fact that a large group of persons could view the image from various angles, and did not have to be directly in front of the screen. This factor is one which is stressed below as being highly desirable in a satisfactory televisor. Peck's televisor is not as yet on the market, but licenses are being arranged for manufacture in the very near future.

STATEMENTS from a few of the workers in the second group mentioned above—the silent hard workers—will indicate to some extent what may be expected in the future. John V. L. Hogan, of Radio Pictures, Inc., who for some years has been engaged in intensive development work on television problems, recently told the writer of some of the features that television must possess before it can be considered an important factor in our daily life. "The image," said Mr. Hogan, "should be at least six inches square with detail sufficient to show recognizable features of persons in close-ups and recognizable action in scenes which take in more area. The large magnifying glass for enlarging the image is definitely out. The image may be viewed directly as formed or projected upon a screen. In any event, the image must be such that it can be seen by a group of people seated as they would be in a home living room, and not by only one or two directly in front of the televisor. The reproducer or televisor must be simple enough in operation to require no more attention from the user than is needed by the present day broadcast receiver.

"I do not believe that the scanning disk or drum, as such, will be a part of the really successful television receiver of the future. By this I do not mean that mechanical methods of scanning and reproducing will be discarded in favor of some such electrical method as the cathode-ray tube, but the bulky scanning disk must go. Its inherent undesirable features cannot be countenanced in a radio vision receiver that is to be used by the general public."

MENTION was made of the use of motion picture film for television transmission as opposed to direct scanning of actual figures or scenes. Mr. Hogan expressed himself as follows: "When experimenting with television as we are, and as others are doing today, it is essential that all available factors be eliminated or stabilized as far as possible. Scanning a film does just this with one part of the transmitting equipment. All other factors being equal, we know that the transmission tomorrow will be the same as it is today, using the same film, and thus we are able to check differences in operation that would be more obscure if direct scanning were employed. When television becomes an accepted fact for the general public, I believe that films will furnish the bulk of the programs. Their use will make possible a far wider range of television entertainment than could be attained by direct scanning, although the latter will be of great value for 'spot pick-up' of news events and the like."

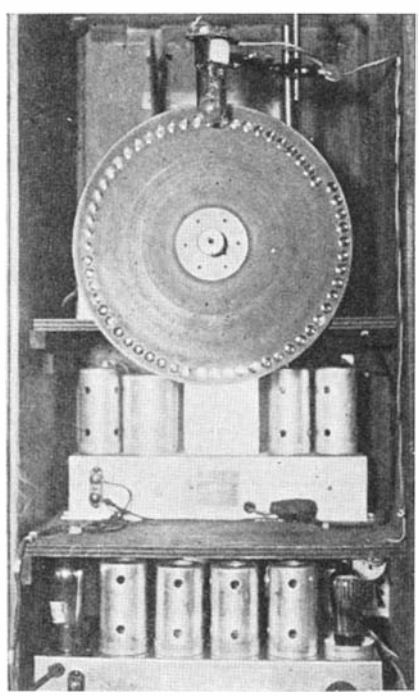
It has been well known for some time that the Radio Corporation of America has been experimenting behind closed doors on all phases of television. In an annual report to the stockholders of that corporation, James G. Harbord, Chairman of the Board of Directors, made the following statements of interest at this time:



In the Jenkins console televisor, the reproduced image is viewed through a modified shadow box

"While television during the past two years has been repeatedly demonstrated by wire and by wireless on a laboratory basis, it has remained the conviction of your own Corporation that further research and development must precede the manufacture and sale of television sets on a commercial basis. . . .

"It is felt that in the practical sense of the term, television must develop to the stage where broadcasting stations will be able to broadcast regularly visual objects in the studio, or scenes occurring at other places through remote control; where reception devices shall be developed that will make these objects and scenes clearly discernible in millions of homes; where such devices can be built upon a principle that will eliminate rotary scanning disks, delicate hand controls, and other mov-



A rear view of the Freed televisor showing the lens disk, the crater-type neon lamp, and the two radio sets for sight and sound reception

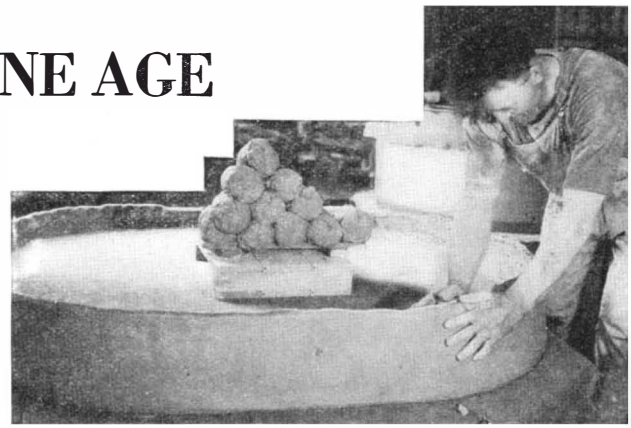
able parts; and where research has made possible the utilization of wavelengths for sight transmission that would not interfere with the use of the already overcrowded channels in space."

Television today, then, seems to boil down to just this: If you will be content to see pictures that are not even comparable with the earliest movies, or if you are experimentally inclined, you can have television in your own home and can "look in" on programs which are available at more or less regular intervals. If, however, you want something that will compare favorably with your home movie equipment in quality of image, you cannot have television today, and you probably will not have it for some time to come.

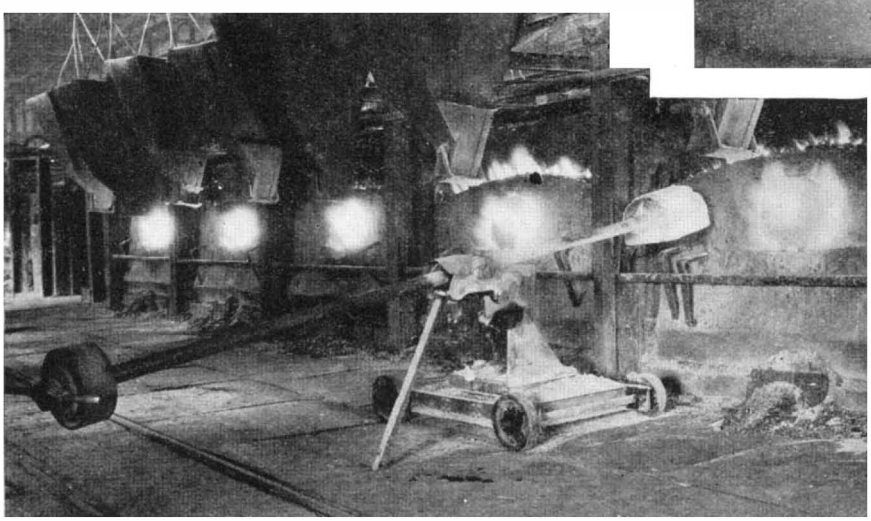
GLASS AND THE MACHINE AGE

New Mechanical Processes Have Increased Production and Lowered Costs

By ALBERT A. HOPKINS

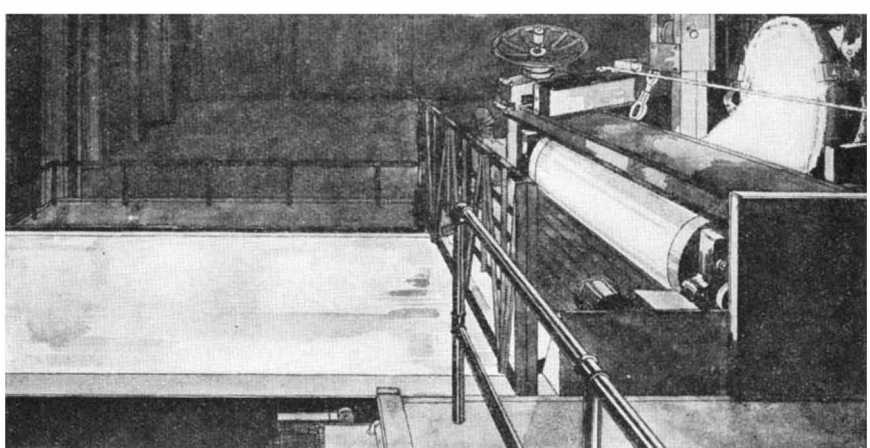


In the roller casting process, glass is melted in large hand-made clay pots



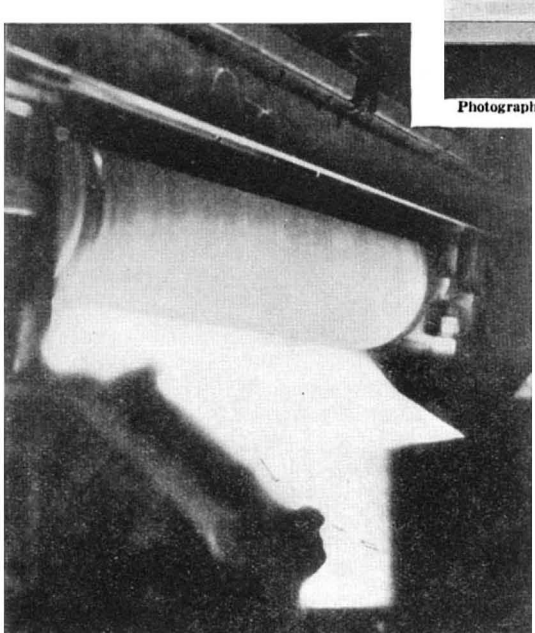
Left: The "batch" in clay pots is melted in furnaces using gas as fuel

A FEW years ago the writer visited various glass plants and was astonished at the crude methods which were used in both plate and window glass factories. It really seemed a miracle that there was any product at all. Another visit of inspection only a few months ago showed a marked change, for glass manufacture had entered the machine age. We have at various times described the manufacture of blown glass, bottles, tubing, and plate glass. We will now consider only plate and flat-drawn window glass and safety glass for automobiles. Another great field for glass is for actual building construction but that will be another story—a few years hence.



Photographs courtesy Libbey-Owens-Ford Glass Company

After the batch in the pots is melted it is cast through rollers on the movable casting tables, producing an unpolished blank of plate glass



Courtesy *World's Work*, photograph William Rittase

Beginning the flow of molten glass from the pots through rollers onto the casting tables

The raw materials that go into glass manufacture must be pure, and this is assured by constant inspection, care and chemical tests. When hundreds of tons of silica sand and other materials are consumed daily the problem of inspection naturally looms large. The great companies have sand pits or quarries as near as possible to their plants—quality permitting. The Allegheny Valley in Pennsylvania may be termed the center of the industry although glass sand is found in 30 states. The "batch," as it is called, is composed of silica sand, soda ash, limestone, salt cake, charcoal, arsenic, and "cullet" (pieces of broken glass). The ingredients are processed and reduced to proper fineness, for the quality of the glass depends upon the care with which the component parts are mixed.

There are two methods of plate glass manufacture. For large sizes of glass such as used in store fronts and very large windows the Bischeroux-pot casting process is used. Plate glass blanks for smaller sizes such as are used in automobiles and mirrors are made by the tank drawing process.

In the pot casting process the pots are fabricated by hand as it has never been found practical to make them by machinery. The finest quality of imported and domestic clays are dried, aged, and cured. The pots are built up by expert workmen out of balls of wet clay. The pots are preheated in

Courtesy *World's Work*, photograph William Rittase

When the cold glass blank is ready for grinding it is cemented to grinding tables with plaster of Paris. Men with wooden soled shoes tramp on the glass and distribute the plaster

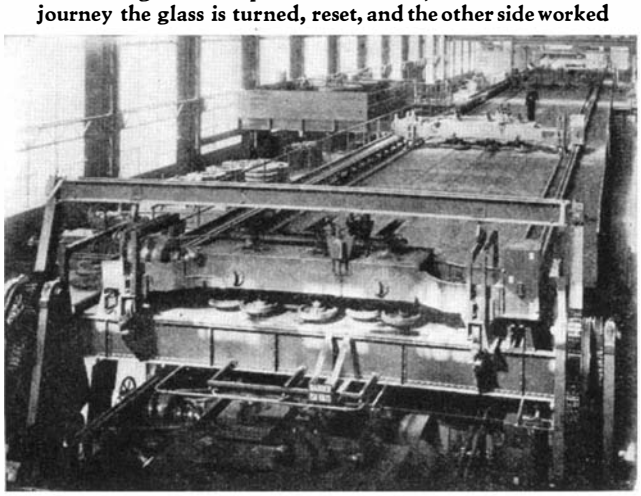
heroic treatment to which the glass blank is submitted in the grinding and polishing operation it must be held firmly in plaster on the metal table. One of our illustrations shows what seems at first to be a manhandling of the glass but it is really a "foot operation" which answers much better than do machines which have been devised for the same work. The table is flowed with plaster of Paris, the glass blank is laid on it, and men with wooden soled shoes tramp back and forth over the surface of the glass, forcing an even distribution of the plaster.

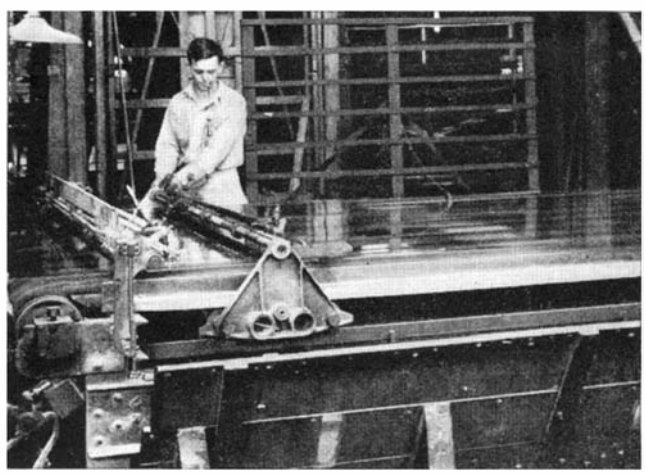
The rough plate is now firmly held in plaster on a

ing from this machine the plate is thoroughly washed, and then delivered to the final inspection department. Here it is graded and inspected.

THE old process of making window glass was crude in the extreme. The molten glass was blown into hollow cylinders which were fabricated by skilful heating, blowing, reheating, and dextrous manipulations. The ends were removed from the cylinders, which were then split longitudinally, and the glass was flattened out. This process gave a sheet of glass that was only approximately flat and the spoilage was large. This process was used until 1903 when a machine for blowing the cylinders was developed. It was a great advance but there remained all the defects of "cylinder glass." Experiments on making a flat sheet direct had been carried on since 1857 but it was re-

Machines grind and polish the blanks; at the end of its journey the glass is turned, reset, and the other side worked



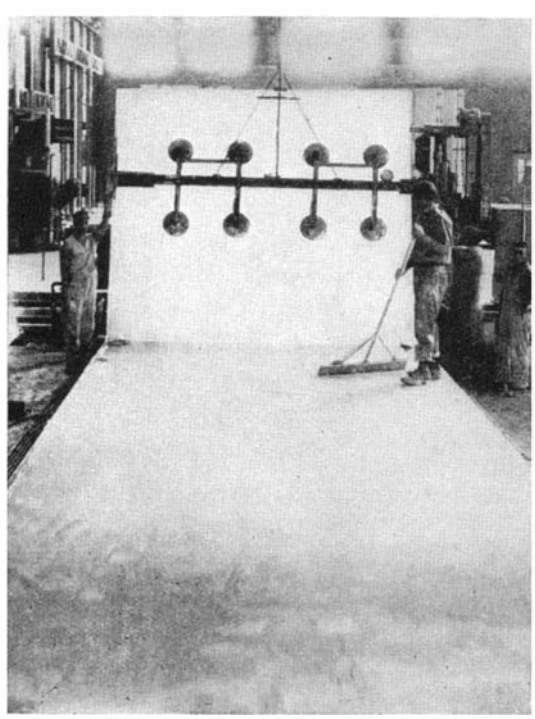


The ground and polished glass is cut into convenient lengths and examined by experts for even minor defects

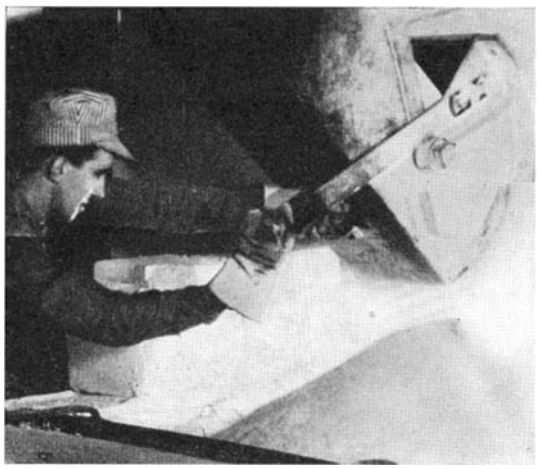
a pot kiln before being placed in the gas-heated melting furnace. The well-mixed batch is then fed into the pot, the front of the furnace is closed, and the mixture is then subjected to a high temperature from 24 to 30 hours. The firing is done scientifically by experts. At the proper time the pot is removed from the furnace and conveyed to the Bischeroux casting machine. The molten batch is poured through rollers onto a moving table, forming the unfinished plate glass blank. The blank then passes from the casting table through a long annealing lehr where under gradually diminishing heat the glass is carefully tempered. This precision in annealing or tempering is another important contributing factor to high quality in plate glass.

AFTER emerging from the lehr the blanks are given their first inspection. The glass at this point has a rough surface and is hardly transparent, but it is ready for the grinding and polishing operations. Owing to the rather

long line of moving tables. These tables pass under a series of rotating and oscillating grinders using sand as an abrasive until the rough surface is ground down to the point where it is smooth enough to be polished. The moving table passes on under another series of rotating felt polishers where, using rouge as the polishing agent, the glass finally emerges several hours after it has entered the grinding and polishing machines with one side completely ground and polished. About thirty grades of abrasive and polishing agents are employed. After further inspection the plate is mechanically lifted and turned to start again the long journey back through another grinding and polishing machine which finishes the reverse side. On emerg-



Sheets of glass are handled and turned mechanically with the aid of suction disks

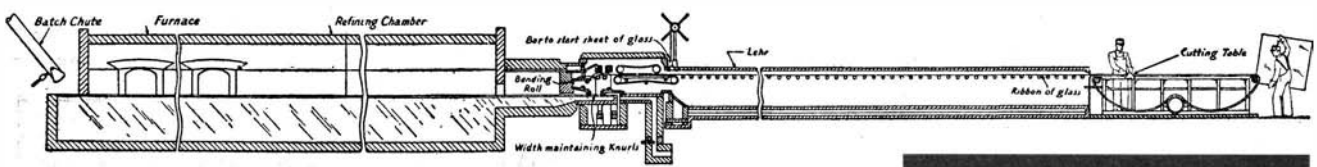


The materials are weighed out and mixed and are shot into the furnace from this chute

The question may arise as to how the glass is started on its continuous course. The machine is reversed and a mechanical "bait," consisting of a flat iron bar three inches wide and about six feet long, is attached to strips of flexible metal that allow the bait to pass over the bending roll down into the glass. Then the machine is started in its forward motion, pulling the bait with its adhering mass of plastic glass over the bending roll onto the horizontal flattening table and thence into the lehr. The bait is cracked off

in pairs. The transparent plastic is rigidly cleaned and inspected. A bonding agent is applied to the plastic sheet and the "sandwich" is made of the two sheets of glass and the plastic. Heat and pressure conclude the process, except for the undercutting to permit sealing the edges with a weather-proof compound. Automobile manufacturers are supplied with glass cut and ground to templet. Safety glass enables automobile owners to reduce the 65 percent of casualties caused by flying glass.

We are indebted to Mr. Bryan Warman of the Libbey-Owens-Ford Glass Company for an instructive personally conducted tour of several of the large Toledo plants of that concern which are well worth visiting.



Sheet-drawn flat and drawn plate glass is made in a continuous process, the furnace running for long periods. Path of the glass is shown

served for an American inventor, Irving W. Colburn, to develop a workable machine for producing commercial flat-drawn sheet glass.

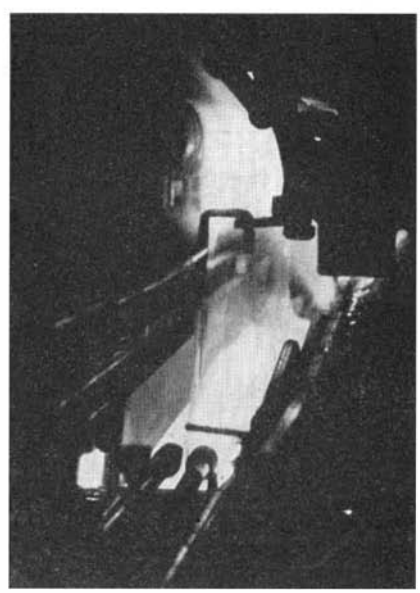
In the flat glass process both plate and window glass can be produced, the principle being the same. The preliminary operations are very similar to those employed in other forms of glass manufacture. The "batch" is shot into the horizontal furnace through chutes where it is melted under a heat of 2500 degrees, Fahrenheit. This operation is a continuous one running uninterruptedly for months and in some cases years. The furnace contains from 600 to 900 tons of molten glass. The molten glass passes from the melting chamber to the refining chamber where it is gradually settled or refined preparatory to entering the shallow drawing pot from which the sheet is drawn. Here the proper degree of heat is maintained for the ultimate formation of the sheet.

THE molten glass is elevated or drawn a few inches and then passes over a bending roll, still in a semi-molten state, onto a flattening table. As the glass is raised from the fire chamber the natural fire finish is applied to both sides of the sheet. Leaving the flattening table and slowly hardening, the glass is moved horizontally, perfectly flat at all times, into a long annealing oven or lehr more than 200 feet in length. The gradual annealing under a scientifically regulated and steadily diminishing temperature tempers the glass, leaving it free from internal strain and giving it that uniform strength and freedom from brittleness which makes this glass so easy to cut.

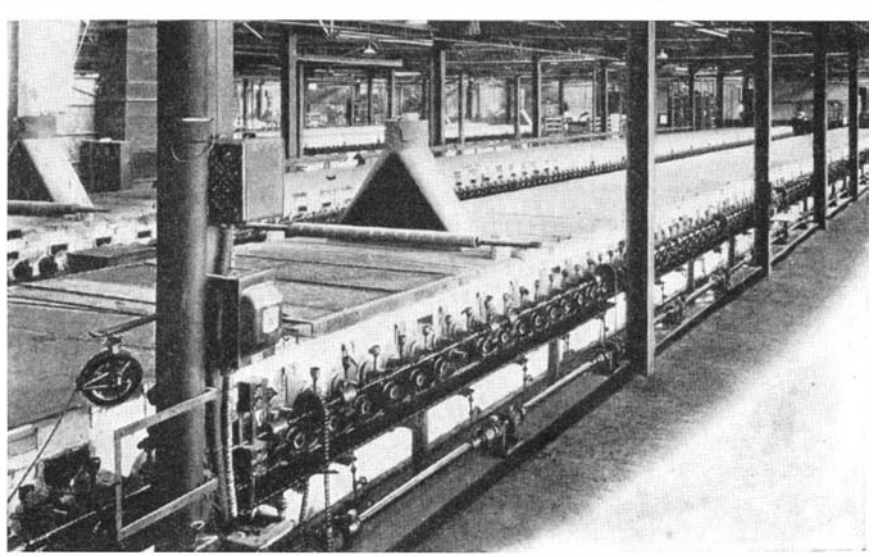
and the pilotless continuous sheet of glass passes endlessly into the lehr.

When the glass leaves the lehr it passes onto a cutting table. Here it is cut into sheets of suitable size, dipped in a hot solution of hydrochloric acid and then distributed to the several cutting stalls where experienced cutters carefully select sheets, grade them, and cut them into commercial sizes.

THE process of manufacture of safety glass is extremely interesting. In brief the glass is composed of two sheets of high quality glass with a middle sheet of transparent plastic bonded to them. All glass for lamination is carefully inspected and is kept



The molten glass passing over a bending roll to a flattening table



The "lehr" or annealing oven is 200 feet long. The glass is subjected to constantly lessened heat. Slow annealing toughens the glass and takes out the strains

Archeologist's Findings Near Giza Write

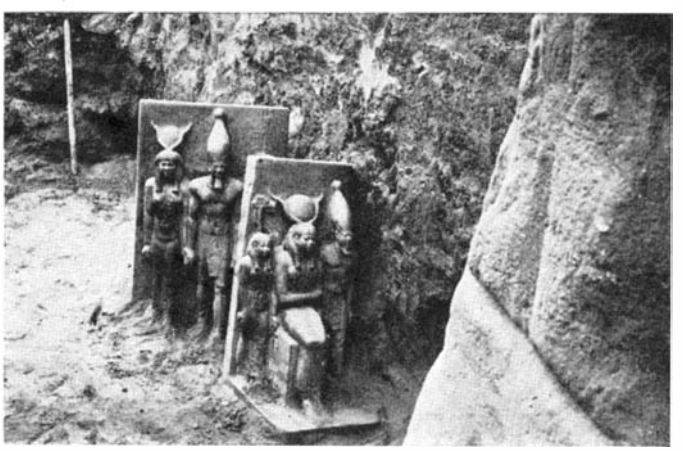
A NEW CHAPTER ON EGYPTIAN ART

Right: Adjacent to the Mycerinus pyramid at Giza stands the Mycerinus pyramid temple in the ruins of which Prof. Reisner found important early sculptures. *Below:* Colossal alabaster figure of Mycerinus. Head is projecting from the sand

THE concession granted by the Egyptian Department of Antiquities to Professor Reisner to excavate near the pyramids has been rich in yield, resulting in discoveries which have necessitated a complete revision of the history of Egyptian art during its first great creative period, the Fourth Dynasty (*ca.* 3050 B.C. to 2900 B.C.). The objects here illustrated are in the Boston Museum. Prof. George A. Reisner, Director of the Harvard University-Museum of Fine Arts (Boston) Expedition has just issued a beautiful book, "Mycerinus," which describes for the first time the discovery of some of the earliest known royal sculptures of Egypt. The excavators of the temple near the third pyramid of Giza were quick to realize, when these discoveries were made, that they were face to face with the first great creative period of Egyptian culture, when sculpture in the round was perfected and was given its characteristic style and attitudes which were to persist throughout Egyptian history.

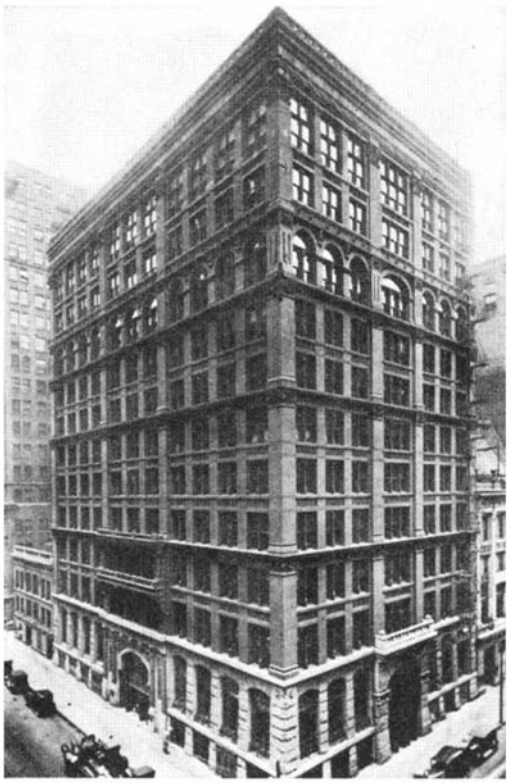
Above: Detail of a "triad" representing Mycerinus, with his wife impersonating the Goddess Hathor, and a local deity. *Below:* Only four "triads" of 42 symbolizing regions of the old kingdom were found

Left: The "slate pair" statue, one of the earliest works of Egyptian sculpture. *Below:* The heads appearing in a re-opened plunderer's excavation



THE FATHER OF ALL SKYSCRAPERS

Demolition of 47-Year-Old Chicago Building Settles a Question of Long Standing



A world-famed architectural milestone: the old Home Insurance Building, Chicago

FOR years there has been considerable discussion among architects and engineers as to what building might properly be classed as the first skyscraper. As a matter of no little importance in the history of architecture, this puzzle has engaged the attention of many minds, and arguments for one or the other building have appeared in many magazines. The question now seems to have been solved decisively by a committee appointed by the Marshall Field Estate for the examination of the structure of the Home Insurance Building in Chicago which was demolished in 1931 to make way for the new 42-story Field Building. The latter, incidentally, will be Chicago's largest office structure.

It has been said that America's greatest contribution to architecture is the skyscraper. To the man in the street, this term simply means a tall building. Actually, however, it is used to designate a type of construction; it designates a building which exceeds in height the practical limit of solid masonry construction. To be more specific, it is a building in which the masonry does not support but rather is supported, together with floors and all live loads, by a rigid, stable metal skeleton.

The absolute and first essential in the structural creation of the skyscraper is the metal skeleton. The economic essential is the high-speed elevator. It follows that the vast number of skyscrapers that have been built and are being built might be derived from and be dependent on the first building of this nature that was erected. The findings of the committee are, therefore, of enormous importance in structural history.

Realizing that the decision of the appointed committee would have a very wide application, its members first of all made an examination of all the original plans of the building and then while it was being demolished visited it daily. Measurements were carefully made of the fifth floor, as that was considered a typical one, and of exterior and interior columns and connections. The wrecking contractor was requested to expose the metal framing of the building in various and special ways for inspection and photography. It is felt, therefore, that the report is based on a careful and thorough investigation.

Of the various definitions of "skeleton" and "cage" construction, the committee adopted the following as its definition of "skeleton" construction:

"A TYPE of construction in which a metal frame or cage composed of girders, beams, and columns supports all internal and external loads and carries all stresses directly to the foundations. This definition does not require that such strains as wind pressure be taken up exclusively in the metal skeleton; neither does it include any particular type of foundation, nor require that the foundation be entirely underground."

To substantiate the claim of any person to the honor of being the originator of skeleton construction, priority must first of all be proved.

Of early buildings which used metal frames in one form or another, there should be mentioned the Crystal Palace of 1851, and subsequent exhibition buildings, particularly those of the Centennial Exposition in 1876. There was also a five-story factory built in 1872 at Noisiel, Seine-et-Marne, which used a decorative iron skeleton of T bars, the open spaces of which were filled with brick and tile in ornamental patterns. Skeleton construction in a "limited sense" was said to have been used in the Produce Exchange Building, 50 Broadway, New York City, and although this was said to be the earliest example of skeleton construction it was dated 1888-89. This building, therefore, was clearly out-dated by the Home Insurance Building.

Mr. Leroy S. Buffington, an architect of Minneapolis, well known in his profession, in reading an essay by Viollet-le-Duc, was struck by a statement of the great Frenchman that, with an iron frame, buildings could be built to an unlimited height. Based on this idea Buffington secured, May 22, 1888, letters patent covering an iron frame for tall buildings. In 1884, he designed a 16-story building with a frame of cast-iron columns and iron beams in which the curtain walls were supported at each floor by the iron beams. This building,

Method of supporting steel beams on a cast-iron column in an exterior wall of the demolished building

however, was never built, at least with this form of construction. Although Buffington never built a skeleton building, he attempted through courts to collect royalties on various others that he claimed had been built as infringements of his patents. In every instance he lost his suit.

The Tacoma Building which stood on the corner of La Salle and Madison

Streets, Chicago, until it was demolished in 1928, claimed to be the first "complete" example of skeleton construction. Upon investigation, at the time of its demolition, it was found that most of the walls were of masonry, this masonry construction absorbing roughly 75 percent of the floor load so that only a small portion was supported by iron.

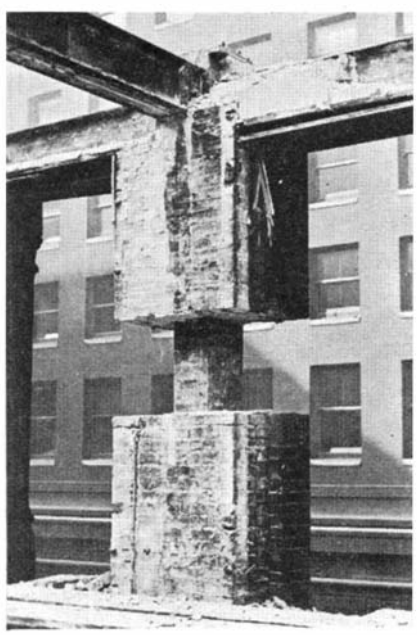
The Home Insurance Building, Major William LeBarron Jenney, architect, was designed in 1884 and was completed ready for tenants in 1885. At first it consisted of 10 stories, but two additional stories were added in 1891. The original building was in the main a rectangle, 138 by 98 feet, with a 50 by 26 foot ell on one corner. On one side at about the center, the rectangle was indented with a light court 49 feet by 33 feet.

THE party walls on the north and on the east sides and on the west side of the ell were all solid masonry composed of common brick from the foundations to the roof. On the two street fronts from the third story window-sill level and on the walls of the light court, there were cast-iron columns superimposed, one for each pier, and each one story in height. Within the walls all floor loads throughout were carried on superimposed cast-iron columns of which there were 39 on each floor from the foundations to the roof. There were no masonry interior walls except a small vault enclosure.

There can be no possible question that the metal frame, assuming the presence of the party walls and the lower two stories of granite on the street fronts (which can be regarded as superterrene foundation), was a perfectly rigid and stable metal cage. In other words, it did not depend in any degree for its stability on any masonry or other construction. Under the committee's definition of skeleton construction, however, it would be necessary to prove that this rigid metal cage supported all the loads of floor and wall. Here again, there can be no question of floor loads for which there is no support other than the columns (except for floors contiguous to party walls), and there is no question of the spandrels which are directly supported by the cast-iron lintels and the spandrel girders, which, in turn, are supported by the cast-iron columns.

Further proof that the walls were supported by the columns alone

Removing the spandrel I beams at the fifth floor level. Uncovered details such as this were examined daily by the committee which studied the work



Masonry stripped from a column to show the weight it supported

Conceding, then, that wherever the metal skeleton is present it did in fact support all loads, it is then necessary to weigh its importance and position in the evolution of the skyscraper. It is believed that the claim of Mr. Buffington as the inventor and the father of the skyscraper should be dismissed for the reasons that he never erected a building embodying his patent (issued after the erection of the Home Insurance Building); that his infringement suits were decided in court against him; and that he, himself, stated that his idea of an iron skeleton was suggested by the writings of Viollet-le-Duc, in which case Viollet-le-Duc would have as good or better claim than Buffington.

AS in the case of every great invention, skeleton construction in its completeness was not nor could it have been discovered by any one man or expressed in any one building. The early buildings for this reason are all more or less transitional and experimental. Each profited by the experience of the preceding and added its contribution in the development of the idea. It is, however, entirely possible, from a consideration of the evidence, to appraise the relative importance of each in terms of its originality and its influence on the work which followed. Acting on this conviction, the committee showed no hesitation in stating that the Home Insurance Building was the first high building to utilize as the *basic* principle of its design the method known as skeleton construction, and that there is convincing evidence that Major Jenney, in solving the particular problems of light and loads appearing in this building, discovered the true application of skeleton construction to the building of high structures and invented and here utilized for the first time its special forms.

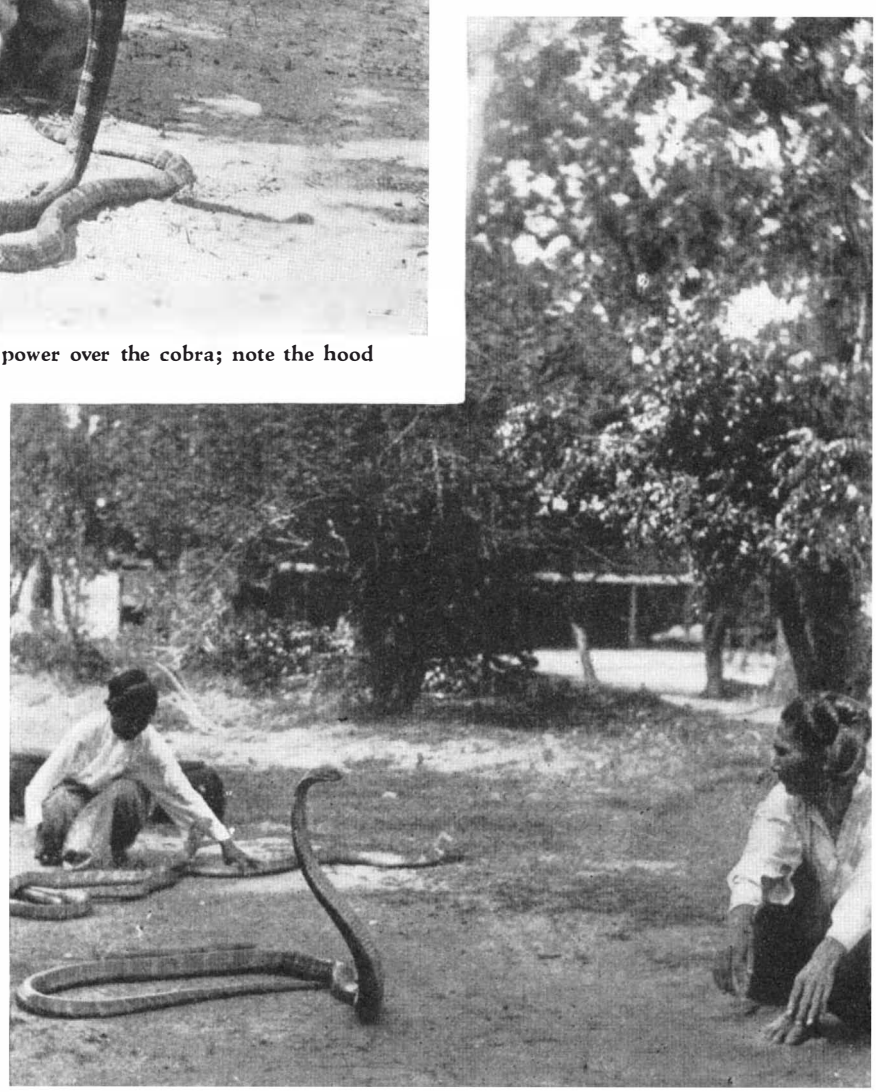
The committee was also of the opinion that, owing to its priority and its immediate success and renown, the Home Insurance Building was in fact the primal influence in the acceptance of skeleton construction. It was the true father of the skyscraper.

THE SNAKE-CHARMING SISTERS OF HOLY POPA*

One of three sisters exerts mysterious power over the cobra; note the hood

EAST of Suez, snakes play a very important part in the life of the average native. All over the East snake worship is practiced and images of gods and goddesses are frequently made in the form of a reptile. Perhaps one of the most striking examples of snake fascination in the East is the solitary instance of the women snake charmers who live upon the sacred mountain of Popa, a rugged and somewhat isolated promontory standing on the borders of the Shan States.

Philip Lauraine, who has had many years' service in Burma, describes these women snake charmers as follows: "These women, three sisters, are the only known women snake charmers in the East, and they guard their profession with a secrecy almost amounting to fanaticism. Away in the fastnesses of their mountain home they live surrounded by the mysticism of spirit beings called *Nats*, and many weird superstitions that effectually keep away the curious sightseer. I managed to induce a few courageous Burmans to accompany me to Popa. The women live in a secluded village about half-way up the mountain. My knowledge of Burmese gained favor for me, and I was a privileged witness of the actual handling of the snakes. These reptiles are king cobras and are one of the most deadly snakes in Burma, and yet these women, Ma Hpwa and her two sisters, have them under control.



A twelve-foot king cobra fascinated into docility by one of the women

*Courtesy *The Illustrated London News*

"Going out into the jungle, they make an annual capture of the finest king cobras that the jungle can produce, and, returning to their mountain village, they release their former pets—exactly a year to the day from the date upon which they are captured—and substitute the new reptiles in their place. This program is followed most rigorously. In all the history of the women snake charmers—who have followed in a continuous succession from mother to daughter for generations past—there has only been one recorded instance on which a girl has kept a favorite beyond the year of its capture, and her temerity was rewarded by instant death from the snake." (This last statement is probably founded on superstition. *Editor.*)

The secret of these women's power has been theirs for generations and will probably remain so for many years to come. The king cobras in which Ma Hpwa and her sisters are exclusively interested are larger than the ordinary cobra, and one of our illustrations shows one 12 feet long.

These cobras feed largely on other snakes. The cobras have the power of dilating the neck laterally so as to form a broad disk or "hood." This dilation is brought about by the raising and pushing forward of the long anterior ribs, the elastic skin being stretched taut over the framework which they form. Erection of the hood only occurs when the reptile is annoyed or disturbed. The cobra is responsible for several thousand deaths in India annually. The venom acts directly on the nervous system and so is much more rapid in its action than the venom of other snakes which destroys the blood corpuscles.

Naturally, a multitude of native "cures," "snake stones," and so on are provided for the dread cobra's bite. There is no real remedy except immediate excision of the site of the wound. Anti-venines have been produced from the blood sera of animals, but they must be administered hypodermically and in immediate large doses—conditions which the poor native can rarely meet; hence the enormous fatalities.

The secret of king cobra charming has been handed down for generations

Watching one of the sisters publicly charming the largest king cobra

General George S. Gibbs

By MILTON WRIGHT

THE ARMY GENERAL AS A CAPTAIN OF INDUSTRY

WHEN the International Telephone and Telegraph Corporation, a 670,000,000-dollar organization with ramifications reaching all over the world, recently sought a man to take the reins of what is known as the International System of communications, it reached into the United States Army and tapped on the shoulder Major General George Sabin Gibbs, Chief Signal Officer and head of the Signal Corps. It was not the first time a great communication corporation had selected an army officer for high executive responsibility; the Radio Corporation of America also is headed by a man it obtained from the army—Major General James G. Harbord.

Why should such corporations consider that an outstanding position in the army qualifies a man for big business? Why, on the other hand, should a man whose entire career has been in the army, who has attained a position of distinction in it, who loves his work and whose present and future are secure, leave the army to embark upon the troubled sea of business? Not knowing the answer, we determined to find out from General Gibbs himself.

"GENERAL," we asked, "why does a huge corporation select an army general for an executive position?"

"Probably because it thinks he can handle the job," he replied. "I suppose in my particular case it was because my training and experience included a wide variety of means of communication—radio, telegraph, cable, telephone, and almost any other method you would be likely to think of. It is a background that few people other than men in my particular branch of the army are likely to have."

"But why should an army officer of high rank retire to accept such a position?"

"Of course, I can speak only for myself," he answered, "but I imagine the same motives have actuated others. In my case, I took on this new task because it offered an opportunity for carrying out an ideal that has been growing before me for a great many years—to weld the various methods of communication into a harmonious whole. Let me explain that.

"Back in the forties, you will recall, the telegraph was invented and telegraph companies were formed to exploit the new invention. There were many companies in the early years, but as time went on, there were mergers and absorptions, so that today there are only two.

"In the sixties the first successful undersea cable was laid. Others followed. Companies were formed to promote this new development, but there was no co-operation with the land telegraph lines. Each means of communication was left to develop along its own path.

In the Philippines in 1898. The Signal Corps extending telegraph lines from the trenches. The man with the white flag at left is said to be First Sergeant George S. Gibbs

"Early in the present century radio was developed and radio communication companies were formed. Again there was no co-operation with previously established means of communition, but only ruinous competition.

"Now, such competition is unscientific and unsound from both a technical and an economic standpoint. Remember, I am not speaking of competition between companies, but of competition between methods. Radio, for example, has a very definite place in the field of communications. For some purposes it is the only practicable method; for others it is by no means the most practical. For some communication purposes, so far as anybody can see, it never will be possible to rely upon radio."

"But don't you believe that some day radio will replace completely telegraphing over wires?" we interrupted.

"No, I don't, and neither does anybody else," he replied emphatically. "Do you know that if radio had been invented first, the invention of sending messages over wires would have been recognized as a very distinct advance and improvement in the art? You realize that with radio there is a very definite limitation to the number of wave bands available for the transmission of messages. A network of wires reaching into all the offices and homes as a distribution system is absolutely necessary—probably always will be necessary—for a workable, comprehensive communications system.

"RADIO, of course, has its place. For use with airplanes or with ships at sea, wire facilities are out of the question. Communications between aircraft, from air to ground, from ship to ship, and from ship to shore need the radio. Not only that, but radio is invaluable in communicating with new places which must keep in touch with the world; Admiral Byrd in the antarctic, for example, was in constant touch with the Sayville, Long Island, station. In places where there is only a small amount of communicating, radio is to be preferred to cables.

"The interests of the public would be served best if, instead of having these various methods of communication compete with each other, they were to supplement each other, so that in any particular case the one best method would be used. Such co-ordination would mean that any particular message could be transmitted in the one way that under the circumstances would insure the

greatest degree of accuracy, economy, and speed.

"That sounds reasonable, but it is feasible only when you have the various methods of communication co-ordinated in one system and under one responsibility. Fortunately, that is precisely what we have. The International System comprises the land lines of the Postal Telegraph Company, the cables of the Commercial Cable Company streaking the floors of the Atlantic and Pacific Oceans, the All America Cable Company linking all the countries of the Western Hemisphere, and the Mackay Radio Company with stations strung along both coasts. To co-ordinate all these systems is my function. It is the very thing I have been thinking about for years."

But how does an army career fit a man for a gigantic task like that? Partly from General Gibbs and partly from other sources we found out. We got the story by piecing together various incidents of his career, which began with the Spanish-American War. George Gibbs, raised in a farming village, had just been graduated from the Iowa State University. Enlisting in the army as a private, he was sent to the Philippines as a member of the Volunteer Signal Corps.

WHEN the soldiers reached Manila they found Admiral Dewey preparing to bombard the city. Now, when you shell a city at long range, you want to know just where your shots are landing—whether they are too far or too short. Young Gibbs went ashore with some of his recently organized signal group and planted flags to indicate to Admiral Dewey's fleet the place where each shot struck. It was hot work and Gibbs was awarded his first decoration for it.

By the time he left the Philippines, he had risen to a first lieutenancy and had participated in 28 engagements. Thereafter he had a number of different assignments, among them the construction of the telegraph system in Alaska. In this service he explored 300 miles of the Tanana River valley on snowshoes. Altogether he built 700 miles of telegraph lines.

He kept climbing up. In 1906 he went to Cuba with a Signal Corps company of the Army of Cuban Pacification, a year later becoming Chief Signal Officer of that army. In that time he superintended the installation of a chain of radio telegraph stations for the Cuban government, one of the most extensive projects of the kind ever attempted up to that time. There, also, he conducted much of the field experimentation

Signal Corps photograph

Brig. Gen. George S. Gibbs being decorated with D.S.M. by Gen. Pershing, 1919

that resulted in the development of the several types of mobile and portable field radio sets that were adopted and became regular equipment of the army.

In the World War he was in charge of communications of the A.E.F. in the combat zone, perhaps as complex a communications job as ever fell to the lot of any man. It was not long before he was back in Alaska again, this time laying a new submarine cable from Seattle, Washington, up to Ketchikan and Seward, Alaska. Under his command the Signal Corps executed every phase of the operation from the survey of the cable routes to the installation of terminal equipment. One of the unique things he did there was to lay the submarine cable across the land of Prince of Wales Island.

To men who know anything about submarine cables this was just something that can't be done. But Gibbs always has been one of those men who do the impossible. He had to get his cables—two of them—from one side of that island to the other in order to continue them up to Ketchikan. To go around the island would mean not only many miles of cable, but laying it in water where there was a terrific tide rip that would be likely to tear the cable to bits on jagged rocks.

On the uninhabited island he found a spot where two bays cut the 50 mile width down to seven. But submarine cables can't be laid on land; they must be kept wet and cool. Dryness or warmth destroys the insulation. It just happened that the temperature and the moisture were right for his purpose. Not only was it cold, but at that particular place there was an average annual rainfall of 200 inches—enough to keep any cable soaking wet in the ground.

And so, in spite of all advice to the contrary, he cut a path across a waist deep swamp, through a dense jungle, over a 450 foot hill and across a swift stream. The men from the cable ship carried the cable on their shoulders across the island, laying it in a shallow trench. When they came to the stream, they felled a four-foot thick tree, packed the cable in moss, slung it from the under side of the tree, and went on. In spite of all the predictions of the authorities, that submarine cable—the first ever to be laid on land—has worked perfectly for eight years.

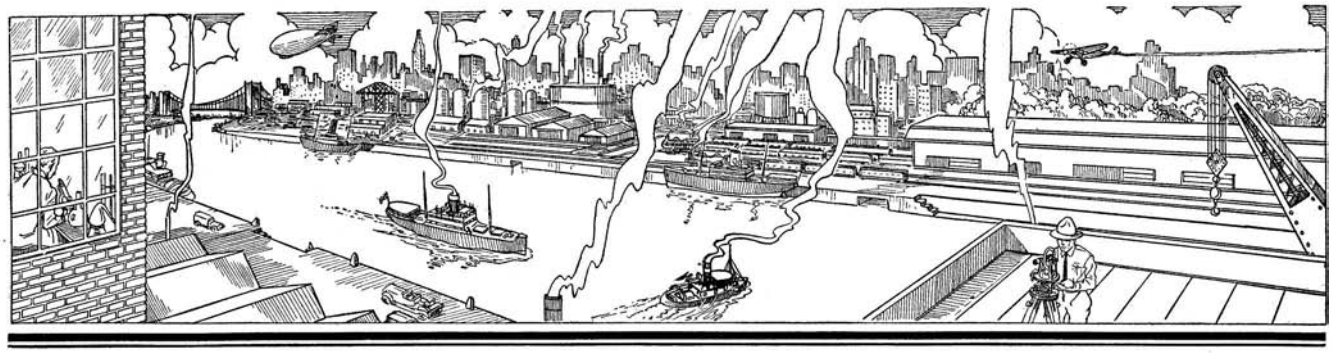
Four years later George Gibbs was a major general in command of the Army Signal Corps.

Laying a submarine cable over land. The spruce logs show the location of the trench

IN civil life when a man embarks upon a career in the communications field he becomes more or less of a specialist in radio or telephony or telegraphy or some other single branch of the art. In the army, however, he must be working constantly with all forms of communications, letting the best interests of the service be the criterion as to the particular method to use in any given circumstances.

So it was that when the International System sought a man who knew all there was to know about all forms of communications they went to the army and selected the man who was the boss of it all.

But there are other qualities needed besides a thorough familiarity with radio and telegraph and cables and telephones. What about qualities of leadership? Well, when a man enlists in the army as a private in the ranks, and, without any West Point training, climbs as high as a man can expect to climb in the army, what better demonstration of leadership can you ask?



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Detecting One Ten-Millionth of a Volt

A VACUUM tube a thousand times more sensitive than its predecessors in the measurement of minute voltages was announced recently by G. F. Metcalf and T. M. Dickinson of the General Electric Company. In the ordinary tube the gas pressure within the tube is of the order of a millionth of an atmosphere; the new

Certain peculiar advantages over brick are claimed for this new tile

tube has been exhausted to a billionth of atmospheric pressure.

The new tube makes it possible to detect voltages of the order of 1/10,000,000 of a volt. It has been possible to do this at radio frequencies for some years, but when attempts were made to amplify voltages whose frequencies were less than 1000 cycles per second it was found that voltages of less than 1/10,000 volt were masked by large random disturbances. When these disturbances are made audible by a loud-speaker they appear as a loud crackling and hissing noise.

The new tube, reducing this noise between 100 and 1000-fold, makes it possible to measure accurately voltages as small as one millionth of a volt, and to detect voltages a tenth as large, at any frequency from zero (direct current) to a million or more cycles per second.

Phosphoric Acid Removes Rust

PHOSPHORIC acid is used to remove rust from iron and to prevent further rusting in a process developed by German chemists and reported recently by G. Büttner. The iron is first freed from all corrosion products by treatment in a 15 percent phosphoric acid bath, and after washing with water is treated for a short time in a 1 to 2 percent phosphoric acid bath, kept as hot as possible. The etched iron parts usually dry by the heat absorbed in the hot bath. A very thin phosphate layer is formed, which prevents fresh rusting. This process, as described, or in a somewhat modified form, has found application in the bicycle industry, in pipe manufacture, and in the automobile industry. —*A. E. B.*

New Hope for the Drug Addict

DETAILS of a successful treatment of a case of drug addiction, of 16 years standing, with a chemical that thins the jelly-like consistency of the brain have been reported to the National Academy of Sciences by Prof. Wilder D. Bancroft and his associates, Dr. Robert S. Gutsell and John E. Rutzler of Cornell University.

The chemical is sodium rhodanate. The "cure" of the human drug addict is the final bit of evidence in support of Professor Bancroft's theory that in morphine addiction the jelly-like consistency of the brain becomes thicker, more gelatinous, or, in medical terminology, the brain colloids are agglomerated. The use of the method on a human subject followed observations of its usefulness in animals addicted to the drug. The fact that the craving for morphine can be controlled by sodium rhodanate means that mental rehabilitation will almost surely follow the treatment, he concluded.—*Science Service.*

Tile for Scientific Wall Construction

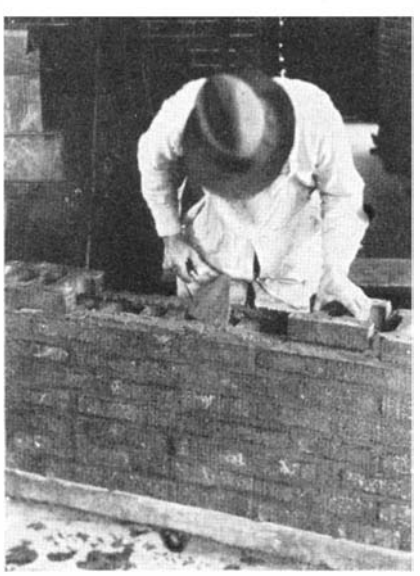
A NEW tile to be used in place of brick in building construction but which is superior to brick in that it meets practically all the requirements for a scientific wall, has recently undergone a series of tests at the University of Pennsylvania. It is in the form of the letter H, the cross-bar of which consists of two parallel webs. Both of the side faces of the H are finished off and either may, therefore, be laid as the wall surface.

This new tile affords the necessary strength, is durable, and lends itself to insulation, reinforcing, damp-proofing, and perhaps also to sound-proofing. It is readily adaptable to the plan and construction features of a building. It is claimed that in the construction of an average house with it, a saving of about 400 dollars should be effected. Its insulation value has been shown by the tests to be 53 percent better than that of a solid brick wall.

The size of the face blocks may be standard size or the tile may be made larger for use as a stucco base or as a backing for stone. In laying, it is as easy to handle as brick and easier to handle than ordinary tile. More time is required to lay one of the new tiles than it takes to lay a standard brick, but this is offset by the fact that each of the tiles lays up the volume of two bricks.

Discovery of the Neutron

THE most significant scientific discovery of recent years was announced recently from Cambridge, England, where Dr. James Chadwick established the existence of a subdivision of matter known



The new building tile lays up a wall that looks like brick but has superior heat insulating qualities

as the neutron. The neutron is a subdivision of the atom and has been fancifully called "embryonic matter"; that is, matter that is growing but not yet born. According to this conception, the neutron represents the first step in the evolution of matter from the elementary electricity which is regarded as the ultimate "substance" of the world.

To understand this conception it is necessary to recall that the atom, once regarded as the smallest possible subdivision of matter, is now regarded as being made up of electrons and protons held together by the attraction between negative and positive electrical charges. The neutron is a combination of a single electron and a single proton, the respective electrical charges having been neutralized by their union. The fact that the resulting neutron carries no electrical charge explains the choice of its name.

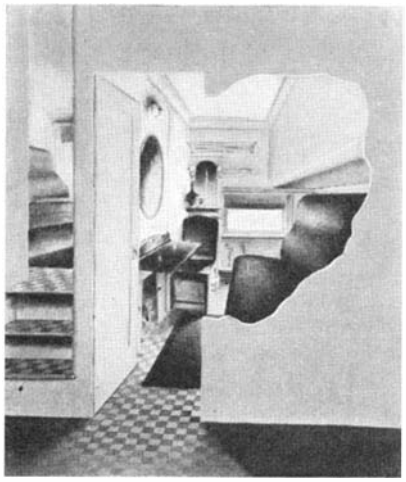
The neutron's principal properties bear out a prediction made by Lord Rutherford 12 years ago in a lecture before the Royal Society, when he discussed possible types of matter then unknown. Neutrons are not waves, but particles, but as particles they have hitherto unknown powers of penetration. It is conjectured that the neutron may be the unit of magnetism, for it presumably is a doublet, as magnets are, with both a north and a south pole.

As to the possible practical applications of Dr. Chadwick's discovery, none is able to predict with any assurance. It may be that it will lead to a development as important as the X ray or it may never be more than a scientific milestone on man's journey to a better understanding of the composition of matter.—*A. E. B.*

New Duplex Sleeping Cars

SINCE the time of the earliest gaudily decorated and uncomfortable sleeping cars in this country, there has been a constant attempt to improve the facilities of such cars for the greater comfort of passengers. Various single room designs have been worked out and some of these are now in use.

A new design recently worked out by the Pullman Company contains 10 standard sections and four single rooms. The design of the latter is such that two rooms take up the space of about a section and a half

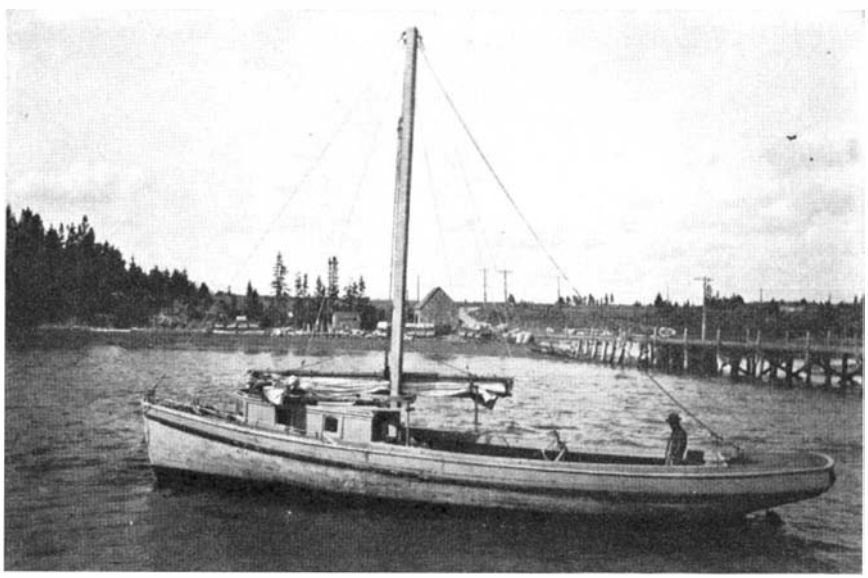


Entrances to the upstairs and downstairs rooms of the duplex sleeping cars, as seen from the aisle

in the length of the car but their width is such that only a narrow aisle remains as a passage on one side of the car. Of each pair of the single rooms, one opens directly off the aisle and the other is entered by three steps leading from the aisle. In this upstairs-downstairs arrangement, each room has considerable space and practically all the conveniences of a hotel room. Each room is equipped with a convertible sofa, an extra chair, lavatory, mirror, space for baggage, and the like.

Smell of Apples Discourages Sprouting of Potatoes

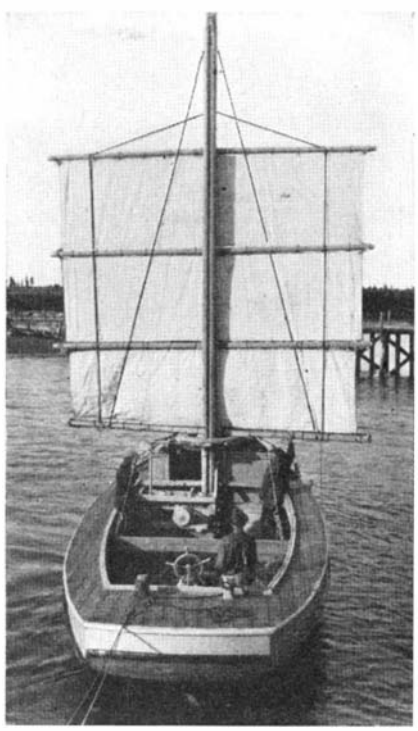
APPLES make the ideal companions for potatoes in storage, according to a report by Dr. O. H. Elmer of the Kansas Agricultural Station, in a recent issue of *Science*. Dr. Elmer's experiments revealed that potatoes stored with apples through the winter remain firmer and show less tendency to sprout than do potatoes stored alone. He attributes this to the volatile substances given off by apples, having apparently established the fact that potatoes will not sprout as long as they can "smell" apples. Apparently only ripe apples will do the trick for Dr. Elmer's experiments seem to indicate that neither green apples nor rotten ones have any discouraging effect on the tubers. Neither have other fruits that he tried, including oranges and bananas. —*A. E. B.*



Experimental model of the improved sail structures, showing *right:* the sails open; and *below:* the sails "furled." Close inspection of illustration at right will show the chains which support yards independently of the sails, and operating mechanism at base of mast

Improved Ship Sail Structures

THE era of the clipper ship is but a memory to an older generation and history to a younger. When, therefore, the 7000-ton cargo steamer *Dartford* was launched in England in 1930 rigged with auxiliary jib-headed sails and top-sails despite the fact that her engines gave her a speed of 10½ knots, she was looked upon by some as an anachronism in trade. However, two sister ships similarly rigged were to follow and, while we have no later information as to their success, the fact that sails were adopted at all indicates that sails, at least as auxiliaries, are not entirely obsolete. Marine experts say that there are many trades in which cargoes could be moved by sail for reasons of fuel economy, and with proper sail handling devices which would cut down the size of crews it is possible that there will be an increasing demand for sails.



An inventor of Chicago, Mr. Roderick Macrae, had these things in mind when he developed and patented the improved sail structures illustrated on this page. One of the important features of this invention is that it provides interchangeable sail-units from which a sail of any size can be quickly built up. Another important provision is an improved hoisting and supporting arrangement for the sails for eliminating the use of guide blocks or hoops on the mast. The yards are in the form of trusses, preferably of steel for the added strength. These yards may be raised or lowered independently of the sails units.

To the front side of the mast, a guide or traveler beam is secured by means of bolts. Secured to the mast above the sail structure is a fitting supporting a sheave around which travels a cable by which the sail structure can be raised or lowered. This cable may be operated either manually or by electric motors. Sufficient slack is allowed in the sail units to give them a proper tension during sailing but to relieve them of all other strain and to permit the chain length and yard truss to assume the support of the yards.

To turn the sail structure and set-up for tacking or for sailing conditions, a sprocket wheel is on the mast just beneath the lower mast yard truss. This may be operated either by hand or by electric motor, according to the size of the vessel using this device.

Engine Exhaust Prevents Ice Formation

ICE formation on the leading edge of the wing still remains one of the dangers in aviation. It has been found that when comparatively large water drops are present in the atmosphere at a temperature slightly below freezing, ice forms rapidly at the leading edge in an irregular transparent coating. As the ice accumulates, it not only adds to the weight of the plane, but, what is far worse, distorts the shape of the wing and so lessens its lift and efficiency. A forced landing may follow.

Dr. Geer and the Goodrich Rubber Company have been experimenting successfully with "rubber overshoes," which can be made to throw off the film of ice. Another promising line of attack is the utilization of the exhaust heat of the engine to heat the leading edge. This idea has been suggested again and again, but it remained for the National Advisory Committee for Aeronautics to obtain experimental evidence in favor of it.

A small auxiliary wing was mounted on the wing struts of a Fairchild monoplane and connected to the apparatus indicated on our diagrammatic sketch. A small water boiler was constructed, through which was passed a pipe for the exhaust gases. The steam generated in the boiler was led through a pipe to the small experimental wing where it heated the leading edge by means of a perforated steam distributor pipe. When the steam condensed, it drained back to the lower portion of the boiler.

Without going into further detail regarding the tests, it is sufficient to say that although a water spraying system provided the right atmospheric conditions, and although temperatures ranged as low as 18 degrees, Fahrenheit, no ice was formed. The amount of heat extracted from the exhaust was quite small, because the boiler was small.

It may be that liquids other than water will ultimately prove more suitable than water for the wing heating system. Alcohol, for example, because of its low boiling temperature, may give better heat distribution. It is conceivable that heat might alternatively be taken from the water jacket with the leading-edge apparatus serving the two-fold purpose of preventing ice formation and acting as a radiator. The Committee is to be congratulated on this successful and highly promising experiment.—*A. K.*

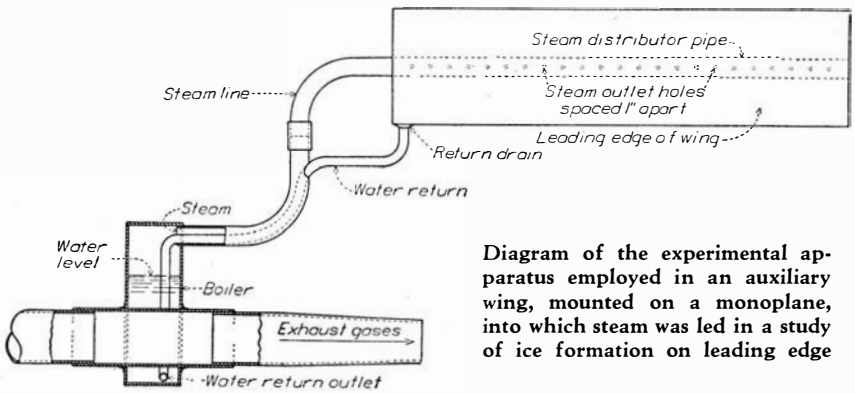


Diagram of the experimental apparatus employed in an auxiliary wing, mounted on a monoplane, into which steam was led in a study of ice formation on leading edge

Airplanes Built in 1931

THE Department of Commerce announces that during the year 1931 the number of airplanes manufactured in the United States totaled 2800, of which 1807 were for domestic civil use. This shows a considerable decrease over the 1930 figures (like almost every other form of industrial production). However, the curve seems to be flattening out and even rising. This year it is expected that the transport operators will positively have to come into the market for replacement purposes.

At airports and landing fields it is reported that there is a large pent-up demand for new planes by schools, private individuals, and business houses. It is probable that the minimum of airplane production has been seen, and that the industry's manufactures will again increase. The bet was frequently made in 1929 that there would be 100,000 airplanes flying by 1935. The optimists now appear likely to lose their money.—*A. K.*

A New Sport Autogiro

THE latest Pitcairn sport autogiro will be exhibited at the Detroit Show. This ship has a gross weight of 1900 pounds and is powered with a Kinner 160 horsepower air-cooled engine. The diameter of the rotating blades has been increased to 40 feet to give even a slower landing and to improve the take-off. A tail wheel is provided to prevent marking the lawns of a pilot's estate when the ship is operated from the owner's own property.

The autogiro in the picture is shown on the lawn of Mr. Pitcairn's estate, and is used by the owner for daily flights from the house to the factory and back. It is really surprising what a matter of fact procedure it is for Mr. Pitcairn to hop off in his plane, just as anyone would get into his motor car and drive off.—*A. K.*

Do Private Pilots Need Examinations?

THE sales managers of our airplane companies have this frequent complaint to make: They secure a prospect and give him a comfortable ride. He is allowed to touch the controls (although he does it somewhat gingerly). He is enthused and wishes to sign up at once both for the purchase of the plane and for a course of flight instruction. He is told that a physical examination by a special doctor, at a fee of say five dollars is the necessary preliminary to flight instruction. Nobody likes to visit a doctor. The mere thought that a physical examination is necessary is a deterrent. The prospective purchaser cools off—and another sale is lost!

Is it so necessary that a more or less rigid physical examination be required? Is it not possible that any person in fairly good health can qualify as a private pilot, even though the requirements for skilled transport pilots must always remain high?

Even the Department of Commerce

The latest Pitcairn sport autogiro

whose main concern is safety and not the sale of airplanes, seems to be taking this viewpoint into consideration. Thus it is liberalizing its requirements in regard to the student pilot's vision. If the vision of the applicant for a student's license is defective, he will not be forbidden to fly but merely required to use corrective glasses while taking instruction. This is undoubtedly a step in the right direction. —*A. K.*

The Modern Supercharger

RECENTLY Captain Reuben C. Moffat of Wright Field, the experimental station of the Army Air Corps at Dayton, Ohio, flew from that field to Washington in one hour and 26 minutes, at an average speed of 266 miles per hour.

The plane employed was a Curtiss Pursuit, the ordinary maximum speed of which at sea level is well under 200 miles per hour. It was the exhaust-driven General Electric supercharger, maintaining the power of the Curtiss Conqueror engine at 600 horsepower at an altitude of 25,000 feet, which made the feat possible.

Our photograph shows Captain Moffat by the side of his plane, pointing to the supercharger. Perhaps our diagram will make the general system clearer than the photograph.

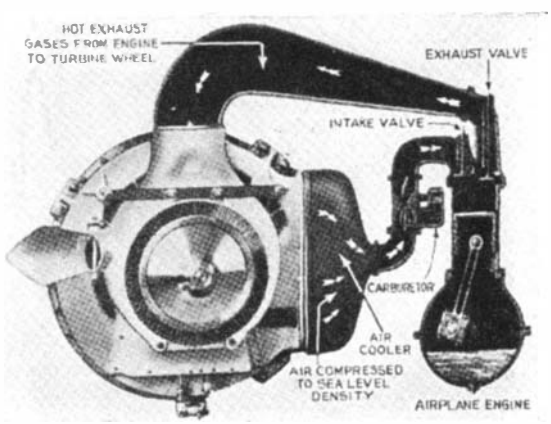
The engine exhaust is completely enclosed in the manifold. The exhaust manifold leads the exhaust gases to a nozzle box which directs the exhaust gases on to the turbine wheels. The turbine is always located directly in the atmosphere without a casing of any kind. The gases pass from the nozzle box, where full sea-level pressure is always maintained, to the high altitude atmosphere at low pressure, resulting in a velocity which furnishes the power to drive the turbine wheels. On the same shaft as the turbine wheels is the impeller of the centrifugal compressor, which serves to compress air from the low pressure of high altitude to full sea-level pressure at which it is delivered to the engine. Therefore, even though the plane is at high altitude, the engine exhausts at normal sea-level pressure and receives its charge at normal sea-level pressure. Therefore it delivers normal sea-level power. If the power is maintained at altitude, the speed is greatly increased over that which is obtainable near the ground.

The exhaust manifold, nozzle-box, and turbine wheels operate at very high temperatures. The turbine has a rated speed of 25,000 revolutions per minute, and the turbine buckets must withstand the enormous centrifugal force at this speed while red hot. A 20,000-foot supercharger delivers about 50 horsepower at the shaft, yet the complete outfit weighs only about 65 pounds. An air cooler weighing an additional 20 pounds is necessary to reduce the temperature of the air after compression.

The compressor is similar to the well-known fan blower or centrifugal pump. However, in the case of the compressor, the speeds of the impeller and the air are far higher, and losses due to air friction must be carefully avoided in their design.

The air enters the impeller near the center through an eye. The inlet tips are bent forward so as to receive the air without shock. The impeller passages then curve gently so as to guide the air with minimum loss until it emerges in a radial direction. At the exit the air already has a high pressure owing to the centrifugal force which acts on it. At the same time, the air has a great deal of velocity. What the aircraft engine needs is pressure, not velocity; therefore the kinetic or velocity energy is carefully converted into additional pressure by leading the air into a passage, called the diffuser. The diffuser is so shaped as to slow down the velocity of the air gradually with a minimum of friction. The air is then ready to proceed to the carbureter at sea-level pressure.—*A. K.*

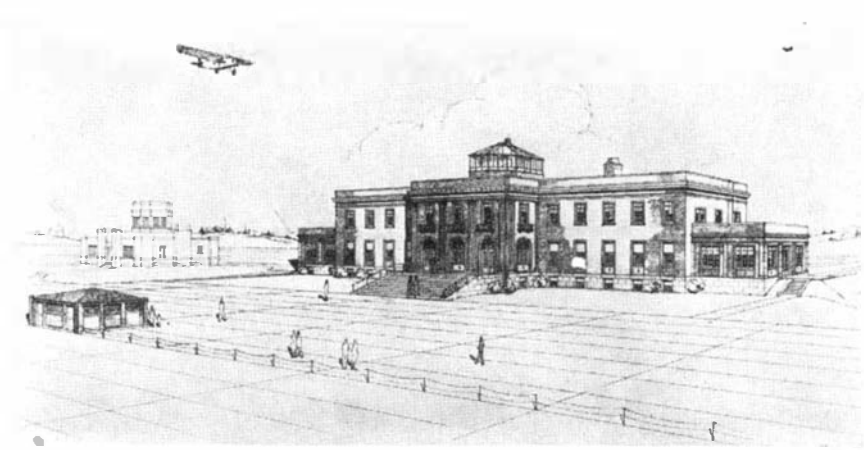
Captain Reuben C. Moffat, of Wright Field, pointing to the supercharger of his Curtiss Conqueror with which he flew, at an altitude of 25,000 feet, at a speed of 266 miles an hour. ***At right:*** **A diagram of the General Electric supercharger**



St. Louis Airport Building

THE criticism is often made that our airport terminal buildings are not at all up to the European standard. The Municipal Airport of St. Louis has taken up the challenge. It is going to build a terminal building, 199 feet long and 67 feet wide, two stories high, of brick construction with an observation tower, waiting rooms, hotel accommodations, ticket office, post office, and so on, at a cost of 150,000 dollars. One entire wing will be devoted to a dining room overlooking the field and adjoining a promenade.

The building will have one interesting departure from the usual airport construction. There will be underground passageways connecting the terminal with another building located on the edge of the flying field where planes can be loaded and unloaded without interruption. Freight will be transported from the terminal building to the plane through one underground passage while the other will be available for passenger use.—*A. K.*



How the St. Louis airport building will look when completed

All First-Class Mail by Air?

A STRONG plea for carrying all first-class mail by air is made in a recent issue of *Airports and Airlines.*

According to official records for the fiscal year 1930, some 345 million pounds of first-class non-local mail were handled by the Post Office Department. The domestic airmail for the same period amounted to some three million pounds and its movement entailed a loss of 15,168,778 dollars. The taxpayers paid approximately nine cents for every letter carried by air, while

the stamp used by the progressive business man cost only five cents. The combined cost of moving the total first-class mail by rail and air was 38,557,319 dollars.

If the figures of one airline operator are to be credited, airmail could be carried at a cost of 40 cents a ton-mile. In such a case, the total cost to the country of carrying all mail by air would be only 36,236,647 dollars. The taxpayer would actually save money on the change from rail and air to air alone.

The argument has aroused much comment, both favorable and unfavorable. The

The roomy and comfortable interior of the cabin of the *DO-K*

main criticism is that it is impossible to meet the 40 cents a ton-mile figure. Another objection is that the railroads, already greatly burdened, would lose some 24 million dollars of revenue per annum.

On the other hand there is no doubt that there would be an enormous increase in the airplane services. One hundred and fifteen times as many miles would be flown, and the number of planes in service would increase proportionately. That, of course, would bring greater economy to air transport operation so that the figure of 40 cents a ton-mile would be less startling.

The argument is not for us to settle, but certainly the suggestion has fascinating possibilities.—*A. K.*

European versus United States Airlines

PAUL GOLDSBOROUGH, a noted radio and air transport authority, writes in *Aero Digest* under the interesting heading "Are European Airlines Better than those of the United States."

Americans still cling to the idea that European air transportation is superior to our own. Mr. Goldsborough is quite definitely of the contrary opinion. The only point of superiority in European practice is that more attention is paid to passenger comfort at the larger European airports such as Croydon and Le Bourget. There is little difference in regard to cost of air travel and in the skill of the personnel.

As regards speed, airway equipment, safety, airmail transportation, passenger comfort in flight, equipment, maintenance, and line supervision, American airlines are definitely superior, according to the opinion of this noted authority.

American air transportation exceeds the European schedules by 15 to 20 miles an hour. American airway equipment is far superior to European equipment. The European airway is merely a route along which the planes fly. The only aids to navigation are some degree of weather reporting and a radio direction flying system. No emergency fields are maintained and few beacon lights. It is for this reason that night flying in Europe is practically non-existent.

In the United States we now have a 24-hour delivery from coast to coast and a thousand pounds of mail carried daily on schedule. In Europe the biggest stack of mail that Mr. Goldsborough saw did not weigh over 25 or 30 pounds.

Passenger comfort is nowadays given the greatest attention by American operators. In a European plane the passenger, once he has paid for his ticket and taken his seat, is apparently forgotten by the operator until the plane arrives at its destination. "At no time during any flight I made," writes Mr. Goldsborough, "was any member of the crew in the passenger cabin. No meals were served in flight. Strip maps of some flights were sold, but no reading matter was available."

Describing maintenance, Mr. Goldsborough gives his views as follows: "It is difficult to generalize on European maintenance of aircraft and motors on account of the great divergence between the various lines. On certain lines the maintenance is considered by even the layman to be very poor. The reputation of these companies for careless maintenance is widespread."

To bear out Mr. Goldsborough's remarks regarding the speed of European transport planes, we have timely information on the latest German transport plane, the *DO-K*, built by Dr. Dornier, the designer of the famous *DO-X* flying boat. The *DO-K*, shown in flight over a typical German city, is a four-engined plane, with two engines in tandem mounted on each side of the fuselage and carried from the cantilever monoplane wing. It is roomy, comfortable, and carries many passengers. The engines are four air-cooled Walter motors of 240 horsepower each. The gross weight is 13,200 pounds for the plane when fully loaded. The maximum speed is 137 miles per hour. The weight per horsepower, that is the gross weight of the plane divided by the total horsepower, is therefore 13.9 pounds.

An American design would be as efficient aerodynamically, but would have a much lower horsepower loading. The engines would be of 300 or 350 horsepower each for the same gross weight. This means more initial expense and greater running expense, but also greater speed. For American conditions, the designer is right in crowding power. For European service, Dr. Dornier is probably equally justified in his selection of engines. The fact remains that American transport will always be faster than European transport. Our long distances and generally faster tempo make such superiority inevitable.—*A. K.*

Wrapping Airplanes in Cellophane

IN building metal airplane wings it is necessary to protect metal parts from the chemical action of the dope used in the fabric covering. As a rule, aluminum foil is used for such a purpose. Now it is announced that the Goodyear-Zeppelin Corporation is using Cellophane for the same purpose with excellent results. The Cellophane is cut into strips and one side is lightly coated with varnish. When the varnish is "tacky," the strips are stuck on to the structure. The advantages of the now ubiquitous Cellophane as compared with aluminum foil are a reduction in both weight and costs.—*A. K.*

A Cartridge Type Engine Starter

A NEW cartridge type starter for aviation engines has been invented by Roscoe A. Coffman of California and has successfully passed tests by the Army Air Corps. The cartridge, which is ignited by an ordinary flashlight dry-cell, releases a gas which passes through a tube to an

A well-designed German transport, the four-engined Dornier *DO-K*. This is the latest to be built by Dr. Dornier, designer of the famous *DO-X* flying boat

expansion chamber mounted on the rear of the engine. In this chamber the gas builds up sufficient pressure to operate a self-contained starting mechanism. Shortly after the crank-shaft starts turning the starter develops 45 horsepower which is power enough to spin the largest engines now used. The new starter is the lightest piece of machinery in the world for the horsepower developed, weighing less than one half pound per horsepower.—*A. K.*

Arc-welding the seams of a tank. Tack-welds, to hold plate in position for continuous welding, may be seen on seams below (whitish spots)

Eliminating the Carbureter

THE Pratt and Whitney Aircraft Company have recently announced perfection of a new method of gasoline and fuel-oil injection which eliminates the carbureter entirely. Dynamometer and flight tests have been successfully completed after more than a year's experimentation and a Hornet engine of 525 horse-power equipped with the new device has been placed in service on a Boeing mail plane.

The Hornet engine as installed in the Boeing mail plane is, to all appearances, exactly the same as the ordinary Hornet. There is the difference, however, that while the air is still drawn through an air scoop and the usual inlet valves of the engine, the fuel is led not through a carbureter but to a series of nine pumps mounted inside the crankcase. These pumps are worked by a very powerful spring released at the appropriate moment by a series of cams. When the cams release the spring, the piston in the corresponding pump compresses the gasoline with tremendous rapidity up to a pressure of 1200 pounds per square inch. The gasoline rushes through a small nozzle in the side of the cylinder at great speed and, owing to the high pressure, it is completely atomized the moment it gets into the cylinder. Perfect combustion results.

One great advantage of direct fuel injection is that it permits the use of a heavier fuel than gasoline, particularly the hydrogenated or safety fuel produced after exhaustive experiments by the Standard Oil Company of New Jersey. This new fuel produced by the hydrogenation process will ignite only at 100 to 110 degrees Fahrenheit as compared with the below zero flash point of ordinary gasoline. [Flash point is defined as the temperature at which an oil or liquid fuel will, when slowly heated, vaporize to form, with the air over its surface, an inflammable and explosive mixture that may be ignited in one brief flash without igniting the main body of the liquid.—*The Editor.*] The new safety fuel also has a high octane number; in other words, it can be utilized at high compression without the danger of knock. This heavy fuel, which could not possibly be employed with the ordinary carbureter, has given, when used in connection with the direct fuel injection system, approximately 10 percent increase in power. It also adds greatly to the safety of airplanes in a crash, owing to its non-inflammable characteristics.

There are still other advantages in the use of the direct fuel injection system. The airplane has to work under a wide range of altitudes and temperatures. Accordingly, pre-heaters, hot-spot regulators and other devices have to be employed for altitude flying and for cold weather operation. With the direct fuel system, the coldness of the air makes no difference—in fact, the colder the air the better the operation because the volumetric efficiency of the engine then increases. In the meantime, the powerful little pumps can handle the fuel and atomize it perfectly no matter what its temperature may be. In particular, all the dangers of ice formation in the carbureter are now eliminated.

The Pratt and Whitney Company are very careful not to hold out exaggerated hopes for the device and are not, as yet, offering it to the trade in general. Yet, at the time, we believe that this is one of the most important developments of the day. —*A. K.*

Shark Oil for Motor Fuel

MAN-EATING sharks may be driving automobiles if the work of French scientists materializes. Not in the driver's seat, however, but in the fuel tank will Mr. Shark function, for the French chemists propose to extract the oil from his carcass and use it as fuel oil in case a war again isolates the country from its normal sources of gasoline.

The extracts from sharks have been proved to yield a good motor oil, with a maximum of combustibility that leaves no objectionable odor and does not involve discoloration. A specialist in this field has also reported that he found an inferiority of only about 10 percent in the best shark fuel oil, as compared with the usual mineral fuel oils, and considers that even that will be overcome by further experimentation with the detail of motors. Already shark leather is coming into commercial use, and with the improvement of fuel-oil processes it appears possible that sharking around the coasts of Africa may become as extensive an industry as whaling is in some parts of the world.—*A. E. B.*

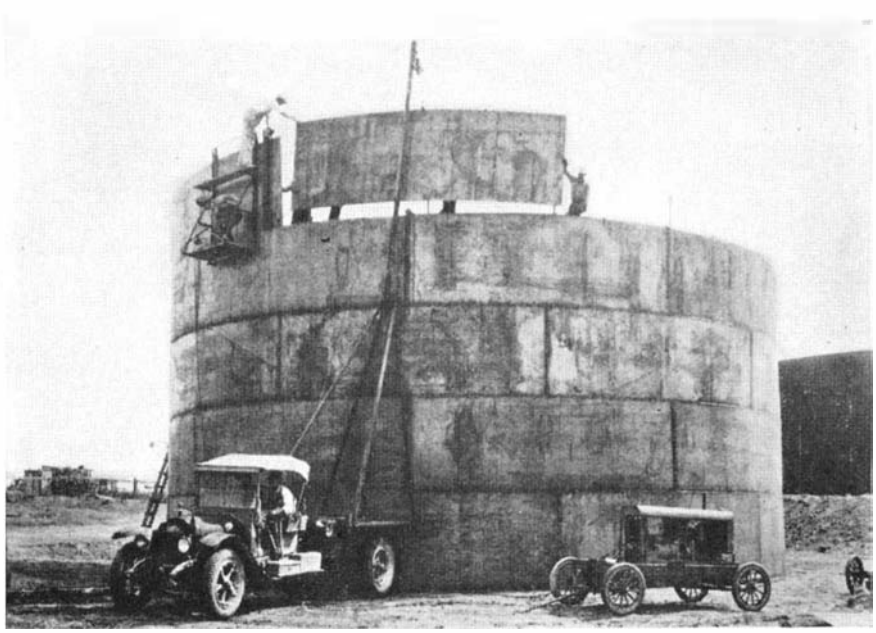
Arc Welding Speeds up Tank Construction

AS engineers become more familiar with the possibilities of arc welding, that method of fusion fabrication spreads to every industry, bringing an efficiency which is spectacular. Perfection in the last year of welding equipment and the development of a commercially practical shielded arc process has removed the human element of uncertainty from welding.

A good example of the efficiency of this process is seen in the construction of field storage tanks of the type shown in our illustrations. This is a 20,000 gallon petroleum tank built for the Echerson Refining Company at Corpus Christi, Texas. With the shielded arc process this tank has been fused into a single unit, and is, in effect, a giant metal stamping, seamless and leak-proof.

Not only is the tank stronger than tanks of traditional construction but it was built in record time for this type of construction. Two factors combined to make possible this improved construction: First, the simplicity of the welding operation, and second, the field procedure. The latter is best illustrated graphically.

The bottom of the tank was laid and the plates fused together with the Lincoln shielded arc process, using Fleetweld electrodes. The plates for the side rings were rolled and assembled in the field without a single bolt or rivet hole. The plates



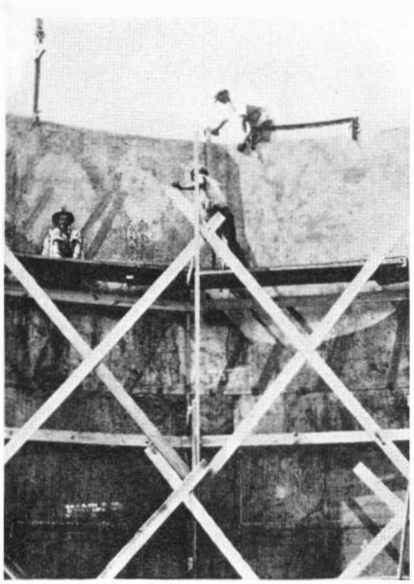
Fitting one of the plates into the ring of the tank. The welder operator prepares for tack welding while a mechanical clamp holds plate in position

were lifted into place by a crane which grips the sheet in the middle and hoists it into place.

When a plate has been placed, the welder operator on the platform tack-welds it while it is held in position with a mechanical clamp near the welder operator's platform. On the inside of the tank the plates are lapped, while on the outside the operator fuses the plates together with a continuous weld.

The tank roof was laid out over a temporary scaffold and welded in the same manner as the tank bottom, the shielded arc process allowing high-speed operations on this flat work.

The tank described is one of two built in Corpus Christi with Lincoln "Stable Arc" welders. After completion they were



Inside the welded tank, the plates are lapped and tacked into place

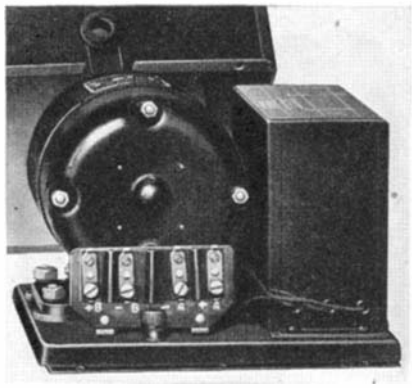
tested for leaks and none was discovered. In addition to this, arc-welded construction eliminates seams and rivet heads which invite corrosion. The tank acts as a single unit in the wind and there are no plate seams to open. The tank is covered with aluminum paint and there are no rivets to sweat and streak the outer surface.

The Human Aura—Fact or Fancy?

IS there such a thing as an aura, surrounding the body of a human being? Some accept its validity and some reject it. In *Nature* (London) the following explanation of one type of aura observation is given:

At the annual general meeting of the British Psychological Society, Prof. D. F. Fraser-Harris read a preliminary communication on a physiological study of the human "aura," as it is called by occultists. By the "aura," or "human atmosphere," spiritists refer to a misty emanation which envelops the living body but can not penetrate the clothes. Unless the body is naked, the aura can be seen only around the head, hands, and fingers.

A typical experiment claimed to demonstrate the aura is as follows: Hold the outstretched fingers of the two hands touching one another at the level of the eyes about a foot or so in front of a black back-



A "B" eliminator unit which delivers 180 volts from a 6-volt source

ground; then after staring at the fingertips for about 15 seconds, slowly draw the fingers apart, when the aura in the form of "greyish mists" will be seen streaming from the ends of the receding fingers.

At the outset, Professor Fraser-Harris said that he questioned the accuracy of these observations. What are actually seen are very dark or black areas corresponding exactly in shape to the fingers, and *inter*-digital spaces filled with the "greyish mists." His explanation is that the black areas are the negative after-images of the pale fingers viewed against the black background and produced by temporal retino-cerebral induction. The grey mists of the interdigital spaces are the whitish after-images of the corresponding spaces of the black ground similarly produced by this form of induction.

That the phenomenon is optical and subjective is shown by the fact that when the conditions are reversed the after-images are also reversed. It is claimed, therefore, that the so-called "aura" of fingers (or hand or head) has nothing to do with vitality, and, under the conditions just observed, is the familiar negative after-image produced by temporal retinal induction.

Moth Balls Check Moles

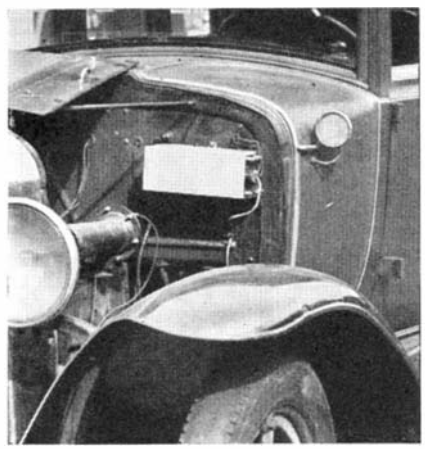
THE best way to get rid of moles in lawns and gardens is to trap them, says the Biological Survey of the United States Department of Agriculture. If there are only a few, however, and it does not seem desirable to resort to trapping, good results may be obtained by the use of moth balls. Open the runways at the edge of the lawn or garden with a trowel and drop in a moth ball or two, or a spoonful of naphthalene flakes, and replace the earth. Moles dislike the odor, and it may prove fairly effective in keeping them away from the garden.

Battery Elimination for Auto Radios

TWO new devices now available solve the battery problem for those who use radio receivers in their automobiles and motor boats. Both operate from a regular six-volt storage battery. One furnishes "B" current for battery-operated sets, and the other supplies alternating current from which can be run any standard type of all-electric radio set.

In the Emerson "B" eliminator unit there is a small dynamotor and a filter system. It delivers 180 volts at 40 milliamperes direct current and provision can be made to obtain any lower voltages that may be needed for the operation of any particular set. The drain on the storage battery is said to be approximately two amperes. The entire unit weighs 18 pounds and is designed to be carried in the box that ordinarily houses the "B" battery of a car or motor boat set.

The alternating-current Dynatrope unit supplies 110 volts at 60 cycles, so that the



The Dynatrope, which converts D. C. to A. C., mounted on an auto

user may operate his standard set anywhere that a six-volt direct-current source is available. It has added uses in that any electrical device designed to be used on alternating current, and not consuming more than 80 watts, can be operated from a storage battery with this unit in the circuit. It comprises essentially a compact rotary converter and a step-up transformer. A cleverly designed chopper serves to break up the direct-current input while collector rings feed the current to the center-tapped transformer primary. The construction is such that arcing is eliminated and losses are reduced to a minimum.

A Floating Metropolis

IN view of the brief note in the article on page 263 of the fact that the United States Navy first developed turbo-electric drive for ships, it is apropos to mention that the new super-*Ile de France* will be, when completed, the greatest electrically driven ship of any kind in the world. This monster of the seas, having a displacement of something over 70,000 tons—no closer approximation has been given out—is now under construction at the Penhoet shipyard, St. Nazaire, France. At present, she is known simply as *T-6*.

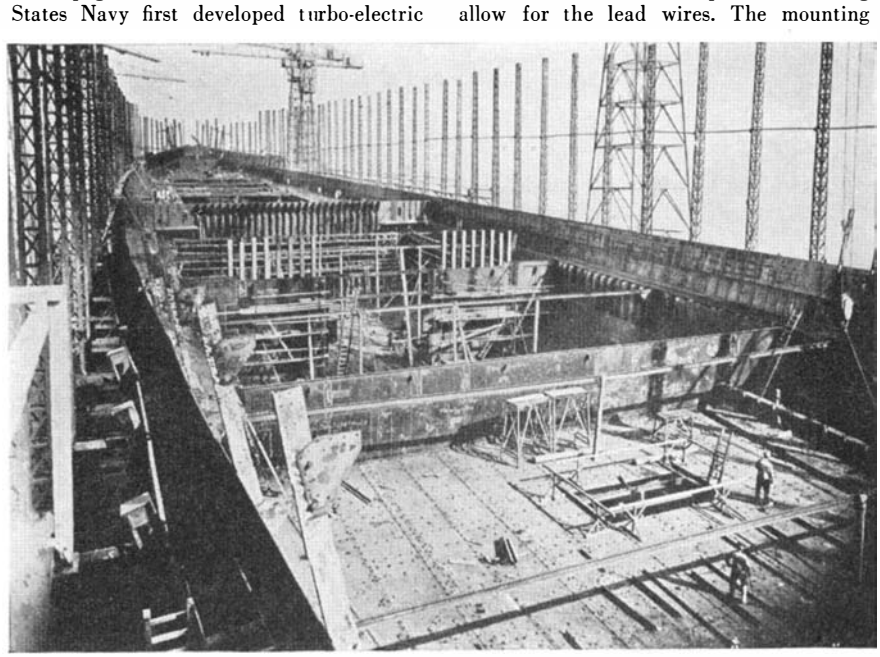
This ship will be 1020 feet long, 117 feet wide, and 202 feet high from the waterline to the top of her mast. She will have a cruiser bow and a load draft of 37 feet. To cost roughly 750,000,000 francs—about 30,000,000 dollars—she will have a passenger capacity of 2132 persons in first, second, third, and tourist classes. According to information given out by the French Line: "At their base, funnels split and run down the sides of the ship giving fore and after stretch in center of the ship."

The *T-6* will be a floating metropolis with "streets" and "squares" in its shopping and amusement center. Among other modern features it will have a glass dance floor.

The speed of the *T-6* has not been announced, but the builders promise that it will make the entire trip between Havre and New York in "considerably less than five days."

Thermocouple Holder

A COMPARATIVELY simple but novel immersion thermocouple, suitable for various laboratory applications up to about 700 degrees Fahrenheit, is shown in the accompanying illustration. The mounting consists of a "spider" with three fixed arms each containing a slot through which other arms, of various lengths, may be slipped and tightened in place by means of wing nuts. Through a hole in the center of the spider a laminated transite bushing passes. This is turned down smaller at the bottom, as shown, and surrounded by a metal ring pipe-threaded, laminated, and spot-welded to the under side of the spider, so that the collar, when screwed in place, will hold the couple tubing tightly in place. Two small holes in the top of the bushing allow for the lead wires. The mounting



The "Floating Metropolis," to be the world's largest ship, under construction

can obviously be adjusted to almost any size or shape of container—round, square, elliptical, or otherwise.

The couple itself consists of Pyrex tubing, closed at one end, and containing two smaller pieces of Pyrex tubing through which the wires pass and from which they protrude just enough to allow for an electrically welded tip which presses tightly against the bottom of the outer tubing. The metal parts are completely heat insulated from the couple itself by means of the relatively thick transite bushing, and internal convection currents are minimized by the close fits throughout. The

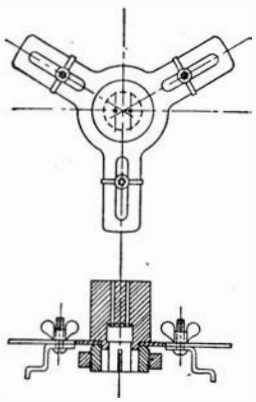


Diagram of a thermocouple holder

possibility of error due to flow of heat along the external tubing is decreased, as compared to that with metal tubing, by reason of the low diffusivity of glass, although the temperature lag at the actual tip is very small. There is no opportunity for contamination, and the whole arrangement is surprisingly durable.

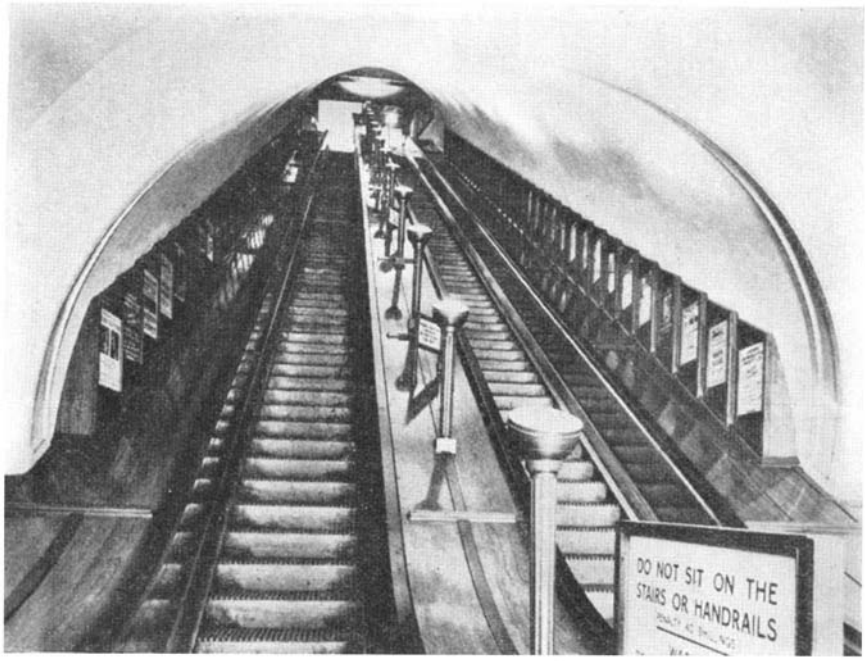
In industry, uses could no doubt be found for such a device, and present practice perhaps simplified. If comparative or absolute temperatures are desired of, for example, liquids heating in open vessels in a furnace, it is a simple matter either to fix the couple permanently or to change the location and depth of immersion as desired. It could also be used in cooling tests where the errors introduced by liquid thermometers, particularly commercial types, are well known, arising chiefly from the exposed stem and considerable lag.

In home-economics laboratories where attention is paid to the internal temperature of foods, particularly as an indication of correct "doneness" while still in the oven—where frequent observation is difficult—the device has proved itself accurate and convenient. No doubt other possibilities would also present themselves.

Fat 'Reducers' May Work Injury

"THE majority of so-called 'fat reducers' offered for sale contain either thyroid extract or laxative drugs," said Dr. F. J. Cullen, chief of the Federal Food and Drug Administration's drug control unit, in a recently issued warning against the indiscriminate use of obesity "cures." "Thyroid extract is a dangerous drug and should be used only under the direction of a physician. This extract may cause a loss of weight in individuals who are suffering from a certain disease affecting the thyroid gland. These persons, however, should be treated and observed by a doctor."

Doctor Cullen stated that products con-



A high-speed escalator installed in London's "Underground"

taining laxative drugs and a poisonous drug, polk root (commonly known as poke weed) will cause a loss of weight in some people, due to their cathartic effects and the irritation caused in the stomach and intestines. This irritation has a tendency to lessen the absorption of food from the intestinal tract and also to decrease the appetite. If these preparations are used for a short time, Doctor Cullen explained, the appetite will increase and weight will be regained on discontinuance of the preparation. "Fat reducers," however, may be used over a considerable period of time and thus cause a chronic inflammation of the stomach and bowel and bring about permanent harm to the user.

Packard Wins an Award

THE Collier Trophy, which is given each year for "the greatest achievement in aviation in America," has recently been awarded for the year 1931 to the Packard Motor Car Company for the Packard Diesel aircraft engine. Some notable records have been made in recent months in planes equipped with this engine.

Announcement of the award was made in March by Senator Bingham, of Connecticut, President of the National Aeronautic Association.

London Has Fastest Escalators

TRANSPORTATION authorities of Great Britain are being commended for a new accomplishment in the handling of increasingly heavy traffic in the London subways. Engineers of the London (Underground) Electric Railway Company, Ltd., foresaw the necessity of more efficient facilities and two years ago, in conjunction with the British government, decided upon higher speed escalators as the best means of moving the heavy tube traffic to and from the street level.

The London Underground's improvement plans required an escalator that would be capable not only of higher vertical rises than were possible with the old standard escalator, but also capable of higher speeds —this last to permit a more rapid handling of passengers. This resulted in the Otis Elevator Company designing and building a new escalator suitable for a maximum vertical rise of 90 feet and capable of a speed of 180 feet per minute (twice that of the old), and computed to be capable of handling 16,000 persons per hour (or double the number of the old). They are thus the fastest escalators in the world and are nearly twice as fast as those in this country.

The Underground has already ordered 51 of these new machines to be built and installed at its various subway stations, and for vertical rises of from 24 to 90 feet. This work is now being executed by an Otis associated company, Waygood-Otis, Limited, of London.

This new escalator is already proving a remarkable success. The public is showing no hesitancy in accommodating itself to the higher step-speed; and the quicker transportation is, of course, very popular.

A generation ago, when the escalator was first introduced to the public by the Otis company, some concern was felt as to whether young and old, women and children, would take kindly to stepping on and off a moving platform. However, these fears were soon dissipated; and today, all over the world, moving staircases are a common means of transportation—and a pleasant one. They entail no waiting; and as there is ample room on the steps without crowding or jostling, they are comfortable. Also, there is a sense of security when one rides on an escalator.

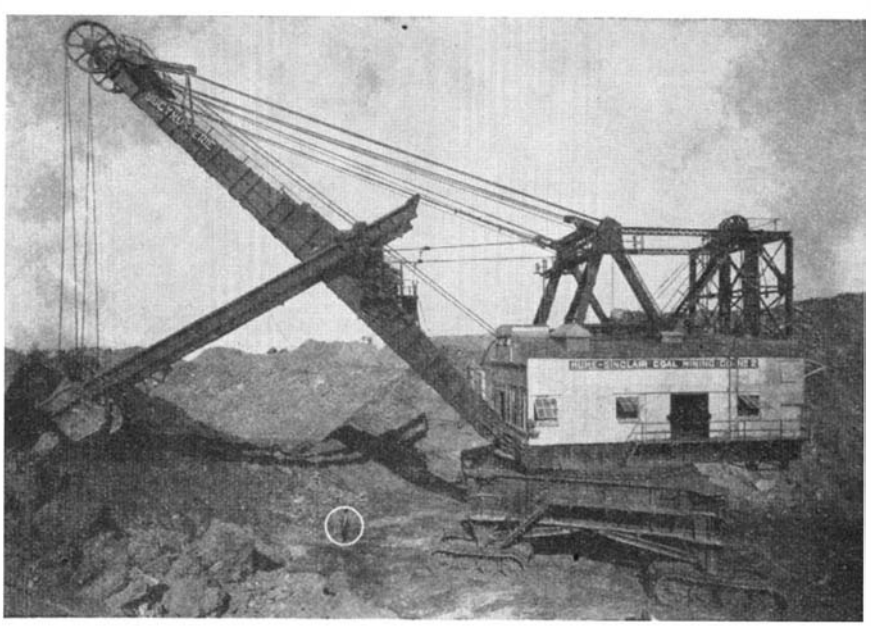
Age-Hardening Soft Metals

AT the meeting of the American Institute of Mining and Metallurgical Engineers recently held in New York City, Paul D. Merica stated that many metals and alloys hitherto mechanically inferior to steel may be brought to the standard of steel, as far as mechanical properties are concerned, because of the development within the past decade of the age-hardening process. Until recently steel has been practically the only metal capable of hardening and strengthening by heat treatment. Now all of the common metals may be so alloyed.

Copper-nickel alloys, for instance, may be heat-treated to exhibit a tensile strength of 175,000 pounds per square inch. After a certain heat treatment, Doctor Merica explained, these alloys harden as they grow older, sometimes at room temperature and sometimes at higher temperatures. A single day is often sufficient to bring about the desired changes in the mechanical properties, although slight changes may continue for a month. Doctor Merica predicted that the next 10 years will undoubtedly witness a substantial realization of the promise contained in the development of the hardening process.—*A. E. B.*

Balanced Hoist on Stripping Shovel

ONE of the few definitely new features in shovel design to be introduced in this country during the past five years—the Bucyrus-Erie balanced hoist for strip-



The movable counterweight greatly increases the efficiency of the stripping shovel. Note the man (in circle) to visualize the size of this huge machine

ping shovels—is announced after more than a year's experience in the field with several installations.

This new hoist greatly increases the output of the stripping shovel by increasing the dipper size and by increasing the operating speed of the shovel. Its essential parts are a movable counterweight with the necessary guides and tackle, so arranged that as the dipper goes up through the bank in its digging motion the movable counterweight travels downward in its guides, counterbalancing practically all of the weight of the dipper and increasing the amount of digging force available. As the dipper is returned to the pit for the beginning of its next cycle, the counterweight is raised in its guides so that it is again ready to counterbalance the dipper on its way up through the bank. Thus, during the hoisting cycle practically all power of the hoist motors is spent in actual digging because the dipper's weight is counterbalanced by the descending counterweight.

Laughing Weakness Treated by Chinese Plant

A SUCCESSFUL method of treating a strange, serio-comic disease has been reported to the American Medical Association by Dr. John B. Doyle and Dr. Luman E. Daniels of the Mayo Clinic. Some people who suffer from this disease fall down when they laugh or get excited. This would be funny if the cause were not a serious disease and if this behavior were not a symptom of it. Physicians call this symptom cataplexy. Suddenly, when anything arouses the patient's emotions, his muscles become weak, and he cannot stand.

Another symptom seen in this disease is an irresistible desire to sleep. The afflicted person may be conducting business, he may be driving an automobile, it makes no difference what. He must sleep, and he does, whatever the consequences to himself and others may be. The name for the entire disease, including both the weakness and the sleepiness, is narcolepsy. It was recognized as a distinct condition in 1880 by Gélineau, a French physician.

This is not to be confused with the disease generally known in this country as sleeping sickness, or lethargic encephalitis, a different thing, in which the brain, to the trained eye of the pathologist, has an abnormal appearance.

In most cases of narcolepsy no cause for the condition has been found. Consequently, in the 50 years since the disease was identified and named, many treatments have been tried, none of which has had very striking success, except, perhaps, the glandular treatment of Dr. J. Ratner and of Dr. Beyermann, two German physicians.

Recently, however, Drs. Doyle and Daniels have employed ephedrine, a vegetable drug introduced into this country less than 10 years ago by a Chinese physician, Dr. K. K. Chen. Six patients whom Drs. Doyle and Daniels have treated, and two who were treated after their method by Dr. H. A. Collins, have been relieved of symptoms, most of them completely.

The discoverers of this treatment do not claim that they have a cure for this disease, for the patients must continue to take the medicine, and some possibly would have to take more of it than would be good for

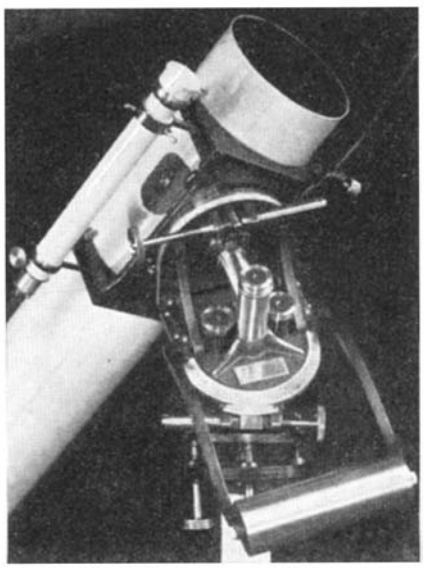
(*Please turn to page* 311)

THE AMATEUR ASTRONOMER

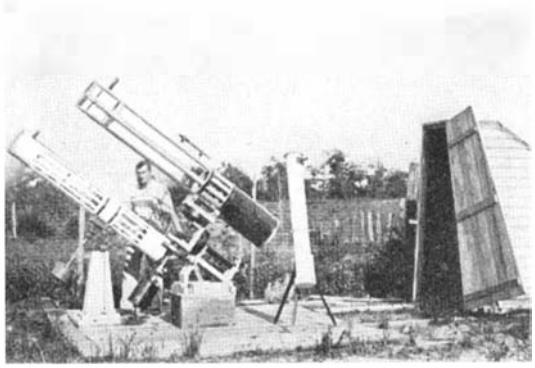
Conducted by ALBERT G. INGALLS

"AFTER all, I am inclined to believe your office cynic is right when he says amateur telescope makers are crazy. Take, for example, my case. I spent the best part of last winter in a cellar workshop grinding, polishing, melting pitch, and swearing this surely would be my final job of telescope making, but now it seems I seldom recollect any of the troubles I had and am seriously thinking of starting another."

That was Paul Linde, of Crossville, Tennessee, speaking, and he voiced the feelings of many who have been bitten by the amateur telescope making bug. It is a persistent, tenacious bug. Mr. Linde's three reflecting telescopes, a six-inch, an eight-inch, and a ten-inch, are shown in the illustration below. "The ten inch," he adds, "has a fixed mounting and is the one covered, when not in use, by the little house on wheels, shown at the right." Later Mr. Linde advised us that he was working on a Cassegrainian telescope.



Sprengnether's smooth job



Linde and his triple battery

Going a bit farther west, we reach St. Louis, Missouri, where W. F. Sprengnether, Jr., a student at St. Louis University, has turned out a mounting (picture at top of page) which looks like professional instrument maker's work. Mr. Sprengnether writes:

"THE enclosed picture is of the six-inch reflector which I built with the aid of the book 'Amateur Telescope Making' published by your magazine. The mirror was ground by means of a motor-driven machine, which I built, similar to those used by spectacle-lens grinders. I made a cast-iron tool having a 12-inch diameter, and a 96-inch radius of curvature. This same tool, covered with felt, was used for polishing but figuring was done on pitch."

Westward again we jump to Riverside, California, where Dr. H. Page Bailey has made a 15-inch reflector and given it a mounting and housing which are unique.

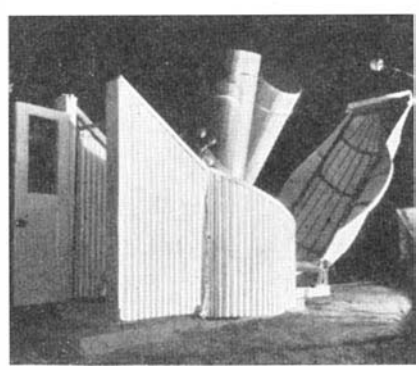
"At the suggestion of Russell W. Porter," Dr. Bailey writes, "I am mailing photographs of the mounting that I've just completed for my 15 x 2½ inch reflector. I use it as a Cassegrainian. I believe this is the first of this type of mounting to be used. I prefer it to other types for the following reasons: Entire heavens accessible; most rigid construction (double yoke); flexure equal in all positions; three point suspension; ease of attaining perfect balance; convenient position of ocular or camera."

What Dr. Bailey has done is to depress the crosshead of the conventional double yoke style of mounting so that the tube can be lowered as far as the pole star. At any given time not quite the "entire heavens" is accessible, but the rotation of the earth brings up to accessibility the small area under the pole. The bearings under the curved yoke head are of the ball type.

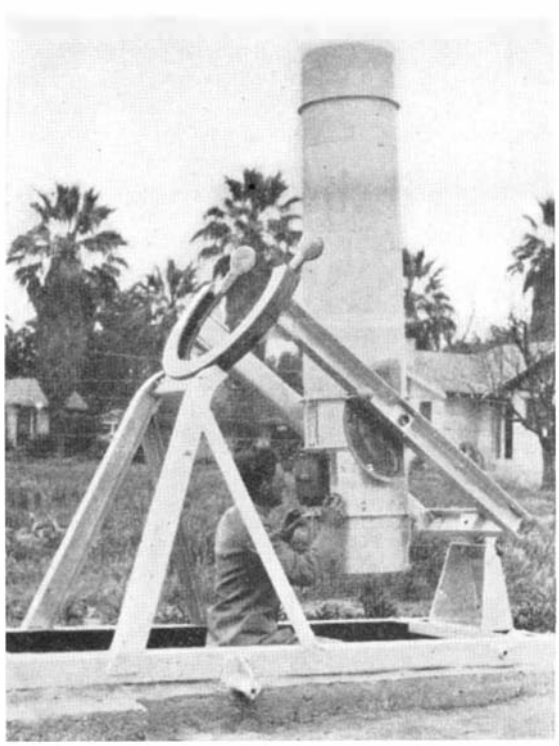
"The framework was built of discarded truck frames," Dr. Bailey continues, "and the driving clock is one of the old style General Electric synchronous motors, made for a phonograph. The worm wheel is connected to the south polar axis by a friction plate. This permits turning the instrument without interfering with the rate of the motor.

"The walls and doors of the telescope housing are fixed, with a light counterbalanced roof that opens toward the south. Its operation is quick and easy.

"Dr. John A. Anderson of the Mt. Wilson Observatory and Russell W. Porter inspected this instrument a few weeks ago, and I believe either of them will give you their opinion of my home made outfit."



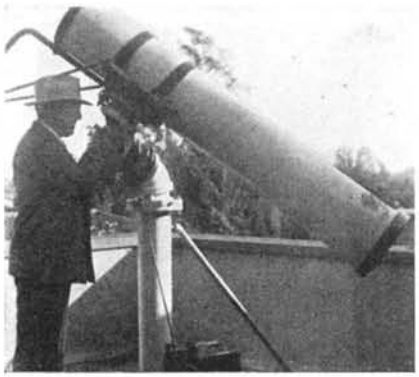
Bailey's housing



Bailey and his 15-inch Cassegrainian

Mr. Porter was asked for his opinion and gave it in laconic form, "Very good." There is a group of amateurs in Riverside known as "The Associated Telescope Makers of Riverside." The school at Riverside recently acquired a 16-inch reflector. In California, astronomy is said to be taught in the high schools, much as physics and chemistry are in the east. We know of no such courses in the east—in fact only a few of the universities teach astronomy to more than a few who expect to specialize.

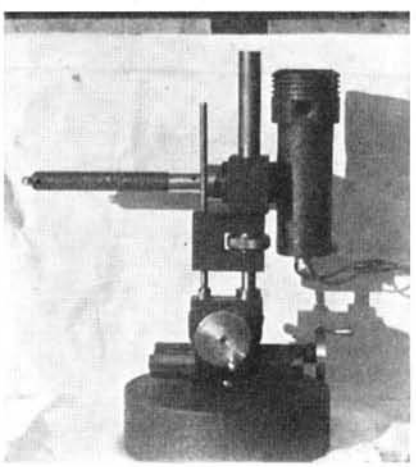
We devoted the whole of our space last August to a grinding machine and a telescope made by Byron L. Graves, 336 South June Street, Los Angeles, and now Mr. Graves is in again with something else—a new telescope with an 8½-inch Pyrex mirror, on a Springfield mounting and a pedestal made of 6-inch pipe fittings, and driven by a Dictophone motor. He has also constructed a dingbat for making the knife-edge test. This, he admits, is against the rules of the game (ATM page 97) but says he made it, anyway, just for fun. Now he is making a Casse-



Graves and telescope

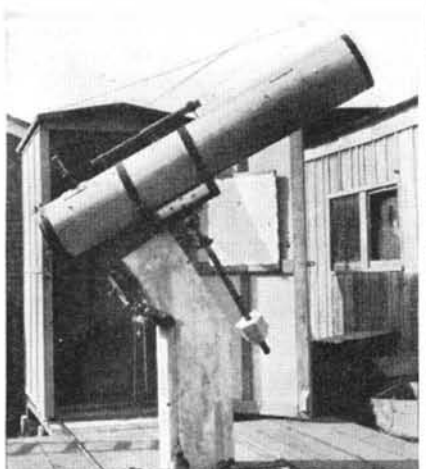
grainian. (By the way, copies of the Hindle monograph on the Cassegrainian-Gregorian are still available for workers who have previously made common Newtonians. Judging by the number of requests for this monograph about 40 compound telescopes must be in various stages of gestation.)

Another "old timer"—advanced amateur



Graves' gadget

worker—is Harold A. Lower of 1032 Pennsylvania Street, San Diego, California, who sends us a photograph of his new 12-inch Cassegrainian-Newtonian combination telescope with its housing rolled off on tracks. He also sent a focograph of the 12-inch primary of this telescope and we hope to reproduce this next month. It is a beauty—showing, in fact, that his mirror is of professional grade. Lower's telescope is equipped with a clock drive and a concrete pedestal that must be really rigid.



Lower's Cassegrainian

CURRENT BULLETIN BRIEFS

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

OFFICIALS AND ORGANIZATIONS CONCERNED WITH WILD-LIFE PROTECTION, 1931 (Miscellaneous Publication No. 122, U. S. Department of Agriculture) compiled by Frank G. Grimes. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

MANNER OF LOCATING AND HOLDING MINERAL CLAIMS IN CALIFORNIA (Bulletin No. 106), by A. H. Ricketts, gives in condensed form the salient features needed by the average prospector and claim owner in initiating and maintaining his rights to mineral ground. *Walter W. Bradley, State Mineralogist, Division of Mines, San Francisco, Calif.—Gratis.*

INDUSTRIAL RESEARCH, MACHINES AND LABOR (Reprinted from *The Pittsburgh Record*, University of Pittsburgh), by Edward R. Weidlein and William A. Hamor, shows how industrial organization reduces the wastes and losses caused by mediocrity. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

NEW FERTILIZER MATERIALS (Circular No. 185, U. S. Department of Agriculture), by Albert R. Merz, deals with the manufacture of nitrogen and various fertilizer materials. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

HOW TO SPEED CARGO HANDLING, HANDLING FREIGHT AT LOWER COST, ENGINEERING ELECTRIC TRUCKS TO FIT YOUR JOB, and PAPER MUST BE MOVED EASILY, CHEAPLY are four informative booklets on electrical plant trucks, profusely illustrated in rotogravure—*The Elwell-Parker Electric Company, Cleveland, Ohio.—Gratis.*

STRENGTH OF BRICK AND TILE UNDER VARIED ECCENTRIC LOADING (Bulletin No. 57), by J. R. Shank and H. D. Foster, gives the theory and describes suitable equipment and a method of loading pilasters for tests to duplicate the conditions under which such building numbers are used. *Engineering Experiment Station, Ohio State University, Columbus, Ohio.—$1.00.*

ANNUAL REPORT OF THE DIRECTOR OF THE COAST AND GEODETIC SURVEY TO THE SECRETARY OF COMMERCE is the hundredth annual report. In the brief introduction Director Patton appraises the relationship between science and the Survey. The report contains elaborate maps. *Superintendent of Documents, Washington, D. C.—60 cents (money order).*

STRENGTH OF CONCRETE BLOCK PILASTERS UNDER VARIED ECCENTRIC LOADING (Bulletin No. 60), by J. R. Shank and H. D. Foster, describes an investigation in cooperation with the Common Brick Manufacturers' Association of America. *Engineering Experiment Station, Ohio State University, Columbus, Ohio.—50 cents.*

THE PREPARATION OF ZONING ORDINANCES (Building and Housing Publication BH16, Bureau of Standards) is a guide for municipal officials and others in the arrangement of provisions in zoning regulations. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

SCOPE OF THE ELECTRON TUBE is an elaborate table giving probably all the uses to which electron tubes are put. *Arcturus Radio Tube Company, Newark, N. J.—Gratis.*

WATERTIGHT BRICK MASONRY (Reprint from *The Architectural Record*—September, 1931), by Dr. F. O. Anderegg, is an experimental study of brick masonry with special reference to watertight construction. It describes the experiments carried on by the Mellon Institute. *The Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

ALUMINUM IN AIRCRAFT gives the accumulation of many years of research and experience with practical applications. The treatment of aluminum is so peculiar that any help is of value. The book is beautifully illustrated. *Aluminum Company of America, Pittsburgh, Pa.—50 cents.*

FINANCIAL DEVELOPMENTS IN LATIN AMERICA DURING 1930 (Trade Information Bulletin No. 775, Bureau of Foreign and Domestic Commerce, Department of Commerce) is an excellent source of reference for those who are interested in the economic affairs of the countries to the south of us. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

ETHNOLOGY OF MELANESIA (Guide Part 5, Field Museum of Natural History), by Albert B. Lewis, is a 190-page treatise on the manners and customs of New Guinea and the islands to the east as far as Fiji Islands, peopled by primitive blacks. *Field Museum of Natural History, Chicago, Illinois.—$1.75.*

SIMPLIFIED BALLISTICS FOR SPORTSMEN, by Harry F. Geist, E. E., describes a mathematical method (Triadic Constant K) for determining instant bullet velocities by relating values in groups of three. Diagrams and charts are given for aligning theoretical determinations with actual shooting observations. An exceedingly profound study. *Harry F. Geist, Oak Park, Illinois.—75 cents.*

AIR COMMERCE REGULATIONS (Aeronautics Bulletin No. 7, Aeronautics Branch, U. S. Department of Commerce) gives the basic regulations pertaining to air navigation in the United States. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

COMMERCIAL AND GOVERNMENT RADIO STATIONS OF THE UNITED STATES contains a complete list of the commercial and government land and ship stations, aircraft, broadcasting, experimental, relay broadcasting, visual broadcasting, and technical and training school stations. It is a book of 252 pages. *Superintendent of Documents, Washington, D. C.—20 cents (coin or money order).*

GLACIATION IN ALASKA (Geological Survey Professional Paper 170-A), by Stephen R. Capps, gives an account of the evidences of glaciation in different geological periods. It is accompanied by two maps. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

PROPERTIES OF FIBER BUILDING BOARDS (Miscellaneous Publication, Bureau of Standards, No. 132), by C. G. Weber, F. T. Carson and L. W. Snyder, gives the results which have accrued from experiments carried on at the Bureau of Standards. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

FLOOR RESEARCH, TREATMENT AND MAINTENANCE, by James Haworth Longshore, is a reliable treatise on the subject of treating and maintaining floors. It is written by an expert on floors. There is also a directory of floors and floor manufacturers. *James Haworth Longshore, 708 Tower Building, Chicago, Illinois.—$1.00.*

CHROME-VANADIUM NITRIDING STEEL (No. CV-1, January 1932) describes the properties and advantages of nitriding steel containing chromium and vanadium—*Electro Metallurgical Company, 30 East 42nd Street, New York City—Gratis.*

SPLIT STAGE LOW TEMPERATURE REFRIGERATION (Bulletin No. 208-A) describes a new phase of the art of refrigeration. *Frick Co., Waynesboro, Pa.—Gratis.*

EXPERIMENTAL STUDIES ON THE DESTRUCTIVE DISTILLATION OF CORN-COBS (Bulletin 107), by O. R. Sweeney and H. A. Webber, is of value owing to the rapid decrease in available wood for distillation which has resulted in investigations of various plant wastes. Corn-cobs, of which 20,000,000 tons are available annually, are especially well suited for this purpose as they are ready for use about ten days after shelling. *Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

THE STORY OF NICKEL (Reprinted from *Journal of Chemical Education*, Volume 8, Nos. 9, 10 and 12), by William H. Baldwin, gives about everything you want to know concerning nickel. *International Nickel Co., 67 Wall St., New York.—Gratis.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 307)

them, for the drug is powerful. However, several hopeless patients thus far have been restored to usefulness and happiness, and, since this treatment is not difficult for a competent physician to administer, there is nothing to prevent its wide use.—*Science Service.*

New World's Speed Record for Automobiles

DESPITE the fact that there was no immediate or serious threat to the world automobile record of 245.733 miles an hour set by Sir Malcolm Campbell of England, last year, Sir Malcolm pushed his record 8.235 miles per hour higher on the sands of Daytona Beach, Florida, on February 24. His new record—the average of two runs, one at a speed of 267.459 south and one at 241.773 miles per hour north on the beach—was 253.968 miles per hour.

Officials notified Sir Malcolm after the two runs that he had also established a new record of 251.34 miles per hour for one kilometer, and a new one of 241.569 miles an hour for five kilometers. Both of these, as well as the mile record, were previously held by him.

New World's Speed Record for Motor Boats

PARADOXICALLY, a man may drive a power boat faster than any man had ever driven one before, and still not achieve a world record. That is what Gar Wood did in his boat *Miss America IX* on January 27. On that day he made an average speed of 110.785 statute miles an hour in two nautical mile runs on Indian Creek, Florida, a speed which surpassed the world's record of 110.223 statute miles an hour held by *Miss England II.* Because of the rule of the International Yachting Union that the existing mark must be broken by at least half a nautical mile in order to displace it, Gar Wood missed the mark by 0.03 of a second, or 5.2 feet!

On February 5, however, Gar Wood succeeded in breaking the record by 1.489 statute miles an hour. His two runs over the nautical mile averaged 111.712 statute miles, or 97.013 nautical miles an hour. Thus, for the time being at least, the world's speed record for motor boats is held by an American.

New Fireproof Material from Peat

A SWEDISH chemist, B. Liehr, has found that a fireproof material can be produced from peat by treating it with dilute phosphoric acid. According to the patent description, raw peat is first treated to remove a minor part of its water content, in order to facilitate recovering the chemical solution after the reaction, which is carried out by heating under pressure and is completed in a few minutes.

The chemical reaction consists in an absorption of the phosphoric acid radical by the cellulose and related substances contained in the peat. The mass is afterwards separated from the mother liquor and dried. The resulting product repels water, a property which is valuable when using the material for building and insulating purposes. The water-repelling power of the material can be further increased by impregnating it with suitable substances. The peat can be mixed with other fibrous materials before being treated in the way described.—*A. E. B.*

"Master Lock" Operated by 24 Keys

THE idea that one master-key will operate hundreds of different locks is not news. However, "the man bites the dog" when two dozen keys will make one lock do 24 different things.

Necessity provoked the development of this unique combination of magnetism and mechanics, according to H. D. James, consulting engineer of the Westinghouse Electric and Manufacturing Company, who supervised its evolution and who now demonstrates its efficiency.

"You see," says James, by way of illustration, "one size of the Westinghouse vertical parking machine houses 24 automobiles owned by 24 different people. Each motorist wants an exclusive space or cradle

Twenty-four keys make this lock perform 24 different operations

so that he can come and go as he pleases.

"Formerly we had a sort of switchboard with 24 separate locks and a master lock. The annoyance of finding the right keyhole on a large panel has been eliminated in the new parking machine control unit we have just completed. It is now possible to get the same individual service for 24 customers with only one lock and 24 different keys.

"Inside is an arrangement of levers controlled by the length of the key. As a key is inserted in the lock, a lever moves across a small panel until it comes to rest on a row of six buttons. Then, as the key is turned, a short lug slides along the lever until it is in contact with the exact button controlling the particular cradle for which the motorist holds the key.

"At this instant an electrical circuit is closed and machinery brings the right cradle to the driveway level ready for use. No key can make a mistake."

Students of traffic problems have shown

much interest in the Westinghouse vertical machine since the first experimental model was put in operation in East Pittsburgh some two years ago. Improved machines followed and have been housing cars for Westinghouse employees for more than a year. The recent commercial installation in the Loop district of Chicago has focused attention on its possibilities for public parking and James says numerous other installations are under consideration in several of the larger cities.

Glare-Reducing Headlight Bulb

THE problem of reducing the glare from automobile headlights is one that engineers have been attacking from various angles for some time. The writer of this note recently witnessed a demonstration of a new headlight bulb which appears to hold promise in this field. Two headlights were set up in a darkened room, both equipped with bulbs of the same power, properly focused and tilted at the same angle. One of the bulbs was of conventional design, while the other was of the type shown in the accompanying drawing. The conventional bulb produced the usual glare with which all motor-car drivers are familiar. The non-glare bulb lived up to its name. With this bulb in headlights, it is unnecessary to dim or tilt the headlights when approaching another car, yet the lights will not temporarily blind the on-coming driver.

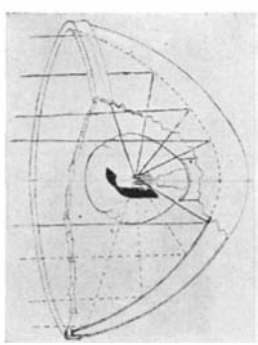


Diagram of glare-reducing headlight bulb, showing shield location

Essentially, the new bulb is of standard design with two filaments of equal candlepower. But placed within the bulb and held by the filament supports is a curved shield made of especially degasified and carbonized metal. This shield intercepts those rays which travel directly forward and also those which ordinarily are reflected by the lower half of the reflector, from which the majority of the glare-producing rays are reflected. In this way, all rays which are projected forward are reflected from the upper part of the reflector and are held well below the eyes of on-coming drivers. This bulb, called the Daypho No-Glare, is the invention of F. W. Hochstetter of Pittsburgh, Pennsylvania. —*A. P. P.*

Vegetable Meat Proposed to Cut Cost of Living

SYNTHETIC beef-steaks that never saw a cow may be the next triumph of chemistry if we are to judge by the announcement of David Wesson, inventor of Wesson Oil and probably the foremost American expert on cotton-seed and other vegetable oils. Dr. Wesson described to a recent meeting of the American Chemical Society a new meat substitute made from cotton seed.

"It is a sweet, almost tasteless flour-like body," he said, "which will keep as well as wheat flour. It carries 50 to 60 percent protein or two and a half to three times as much as is found in meat and available for human food. When properly prepared it is palatable and nutritious. It not only can be but has been eaten by many persons since it was first prepared.

"When mixed with vegetable shortening and water to simulate meat, a meat substitute costing about five cents a pound can be produced. It can be used in hash, croquettes, meat loaf, sausages, sandwich fillings, and so on. Such a product would be a boon to the poor.

"The cotton crop contains enough protein to meet the needs of more than 50,000,000 persons."—*A. E. B.*

Black Diamond Is Hardest Known Substance

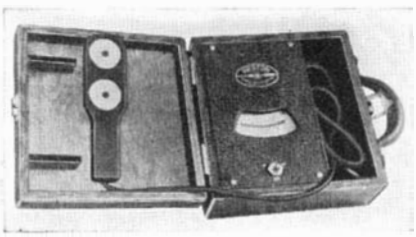
HARDEST of all known substances is the diamond, and that property of the stone adapts it for many uses which, while less romantic than its traditional rôle as a "solitaire," are now indispensable to industry. Industrial diamonds, however, are not suitable for use as gems, being of two types—the black diamond, or carbonado, and bort—says Dr. Oliver Bowles in a report recently issued by the United States Bureau of Mines. The black diamond is the hardest known substance, the claim being made that it is 3 percent harder than the gem diamond. It is lacking in cleavage, is opaque, and resembles a piece of lava or coal. Black diamonds are found chiefly and almost exclusively in the state of Bahia in the interior of Brazil. The second variety, or bort, consists of cull stones from the gem-diamond industry. Most of these are obtained from South Africa. Unlike the black diamond, bort has a distinct cleavage. Although the diamond is extremely hard it is also brittle and is easily shattered if subjected to a sudden shock or blow.

The chief use of industrial diamonds is in the manufacture of drill bits for rock drilling and boring. The diamonds are set in the lower edge of a hollow cylinder of soft annealed steel. By rotation the bit cuts out a cylindrical core of rock. Black diamonds are used chiefly for this purpose. The chief use of bort is in the manufacture of tools for truing abrasive wheels and in the manufacture of cutting tools which are used for turning hard rubber, ebonite, vulcanite, fiber, metals and alloys, mica, and other materials that dull other tools quickly. Diamond tools are of special value for the production of a large number of pieces of exact and uniform sizes. Perforated diamonds are used as dies for drawing fine wire of accurate and uniform cross section. Diamond saws up to 10 feet in diameter are used widely for sawing rock such as marble and granite. The diamonds are mounted in detachable steel sockets inserted at regular intervals around the rim. Small diamonds are used extensively as glass cutters. Fragments of bort are pulverized to form diamond dust which is used for cutting and polishing precious

stones, as an abrasive in drilling diamonds to make diamond dies, and in sawing porcelain and similar hard materials.—*A. E. B.*

Direct-Reading Foot-Candle Meter

SEVERAL months ago we described a new photo-voltaic cell which has been developed by the engineers of the Westinghouse Electric and Manufacturing Company and stated that this has been applied to a laboratory device for making direct readings of light intensity. The Weston Electrical Instrument Corporation has applied a similar cell to a light-measuring instrument called the Illuminometer which



Direct-reading foot-candle meter; light cells at left, scale at right

is now available commercially. This device consists of a searching unit made up of two photronic light sensitive cells on a convenient handle, and a milli-voltmeter calibrated to read directly in foot-candles. The searching unit is connected with the instrument by a six-foot cable. The entire equipment is compact and convenient to carry and weighs only seven pounds.

Each cell of the searching unit is composed of a single piece of coated metal in which a minute electrical current is generated when it is held in the rays of any light. It is believed to consist essentially of a thin layer of selenium on an iron nickel alloy plate, covered by a film of metallic silver. The manufacturers have not made public the method of construction of the cell because of their pending patent claims.

If the metallic cell is constructed in this way, it is similar in principle to that developed by the Berlin scientist, Dr. Bruno Lange last year, and mentioned previously by us.

Chromal

A NEW aluminum alloy called chromal, containing chromium, nickel, and manganese, which may prove important in airplane construction because of its strength, lightness, and resistance to corrosion, has been produced by J. Harden of the Stockholm Metallographic Institute. The alloy is said to have been perfected by means of a special patented process which solves the problem of uniting aluminum with chromium.

Land Area For Food

IT takes more than two acres of crops to produce food for an American, but it takes only one acre for a German, one half an acre for a Chinese, and only one fourth an acre of land to feed a Japanese, according to Dr. O. E. Baker, economist of the United States Department of Agriculture. Doctor Baker points out that these differences in the acreage of crops needed to feed one person are due principally to differences in diet. However, twice as much land is necessary to produce food for a Chinese as for a Japanese, because crop yields are much higher in Japan.

Synthesis of Vitamins C and D

IMPORTANT contributions to the knowledge of vitamins have recently been announced by chemists who are trying to isolate the active ingredient or to produce it synthetically. What is claimed to be the first chemical synthesis of a vitamin was described to the American Association for the Advancement of Science in New York recently by Dr. Charles E. Bills and Dr. Francis G. McDonald, who have synthetically produced vitamin D in laboratories at Evansville, Indiana. They obtained the vitamin from ergosterol, but without using light, either in the form of sunshine or of ultra-violet rays. They treated ergosterol with methyl alcohol, ether, and ethyl acetate under low temperature with a rigid exclusion of oxygen. The vitamin thus obtained was not as powerful, they said, as that obtained by the use of sunshine or ultra-violet light, but it offered unusual possibilities.

At about the same time, a young Norwegian chemist, Ottar Rygh, presented a report of his research work carried on for two years and resulting in the discovery of the formula and constitution of vitamin C. This remarkable work has been conducted chiefly in the laboratory of the Norwegian drug firm, Nygaard and Company, and with its financial support. Ottar Rygh and his assistants not only have been able to prepare the actual vitamin C substance in pure crystalline form and to determine its empirical formula, but they have also succeeded in finding the constitution formula of the substance and accomplishing its synthesis from the alkaloid narcotine, of which the vitamin C substance is found to be a relatively simple derivative.—*A. E. B.*

Yellow Fever Still Yellow

THE United States Public Health Service has recently pointed out that except in reminiscence the average physician rarely gives a thought to yellow fever. No doubt some believe that the disease has been almost eradicated and that it will soon disappear from the entire world; but it is by no means near extinction. There is a vast reservoir of yellow fever in west Africa; the disease still persists in certain parts of Brazil; and in 1929 it reappeared in Colombia. It is not only possible but extremely probable that, because of increased and more rapid means of intercommunication, particularly increase in travel by airplane, yellow fever will reappear in many former centers and even spread to countries never before infected, unless the strictest vigilance is maintained to prevent it.

The virus of yellow fever remains undiscovered. Until recently it was believed that a single mosquito (*Aedes aegypti* variety) was alone responsible for the transmission of yellow fever and that in the absence of this species, which does not breed in ground water, the disease could not be propagated. Then, too, it was fre-

quently believed that this insect would not fly more than about 200 yards. We are now told that there are 13 species of mosquitoes that can convey yellow fever, and that *Aedes aegypti* will travel from 400 to 1000 yards; that, under laboratory conditions, the virus of yellow fever may be passed from one mosquito to another; and that some of the newly discovered carriers breed in ground water.

To sum up the effect which the more recent knowledge of yellow fever may have in combatting the disease, it may be said that, while these new discoveries enable us to combat yellow fever more effectively, they reveal to us the fact that our goal of complete extermination is, apparently, a far more formidable task than we were led to believe a few years ago.

VISCOUNT GREY AND LORD HALDANE

(*Continued from page* 277)

which prolonged the life of the Government another five years, and the cleavage between the two sections of the Liberal party deepened. In 1899, Chamberlain, speaking for the Government, made an unsuccessful overture to Germany for an understanding that might easily have ripened into an alliance.

While Haldane prospered at the bar, his family developed into a remarkable intellectual group under the acknowledged leadership of Haldane's mother, who presided over Cloan, the country place where the family assembled in the autumn. A brother, John, became a famous physiologist, a sister translated Hegel's "History of Philosophy." Notables in education, literature, and politics were entertained at Cloan. Among them were the Greys and the Asquiths.

These autumn holidays were Haldane's only relaxation. When he was in London he was too busy to take any form of outdoor exercise. When he was abroad, he was either on a governmental or a personal mission, and he gained the reputation of being the most industrious man in London. When the Committee of Imperial Defense, organized by Balfour, was under discussion in Parliament, Haldane, although in opposition, made an effective speech in its favor. In consequence, when he was subsequently appointed to the War Office, his selection met the approval of the British press, which welcomed him to the position because of his well known abilities, his interests in imperial matters, and his reputation for being able to work with others. Grey enjoyed no such national reputation but his term as Under Secretary of State had convinced many that he was a straightforward statesman who would defend British interests. In addition. he was known to be a country gentleman, quite independent in his views, who avoided rather than sought office.

In 1895, Germany formally opened the Kiel Canal, and laid down five small battleships. At that time the navy of Great Britain exceeded that of France, Russia, Germany, and Italy. In 1899-1900, Germany laid down five large battleships, and Kaiser Wilhelm II announced that Germany's future lay on the sea. By 1902, Germany had definitely rejected British overtures for an understanding. In 1903, King Edward and President Loubet exchanged visits and the preliminaries of an Anglo-French agreement were discussed. In 1904, Lord Landsdowne and Monsieur Delcassé, the two foreign Secretaries, completed the negotiations that composed the disputes between their two countries, and France gained the diplomatic support of England in her struggle with Germany over Morocco.

France needed support, for Russia, her ally, was prostrated by the recent Japanese victories; and in European diplomatic circles it was known that the Russian army and navy could not intervene in Europe for several years. Germany claimed that the position taken by France ignored the rights of German citizens in Morocco, and she assumed such a threatening attitude towards France that the British Government authorized the Admiralty and War Office to develop plans for joint naval and military action with the French fleet and army in case of a rupture with Germany.

The essence of the Anglo-French agreement was that France would support England in Egypt and the Soudan, and England would support France in Morocco and Algeria. It was natural for Germany to object to this compact, because she had been able in the preceding decade to maneuver France against England, and the new accord not only stopped this pleasant procedure but actually prejudiced German commercial interests in Morocco. Accordingly, in March, 1905, Count von Bülow dramatized Germany's interest in Morocco by forcing the Kaiser to make his startling appearance at Tangier.

Wilhelm II, with a better understanding of British character than his Chancellor, protested in vain against the spectacular part assigned him. Nevertheless, in June of the same year, the German government was able by a threat of war to force the French government to dismiss Delcassé and to agree to settle the fate of Morocco at an international conference at Algeciras in 1906. This triumph of German diplomacy was ostentatiously marked by the Kaiser creating Count von Bülow a prince. In this same year, the Kaiser secured another diplomatic success by negotiating directly with the Czar an agreement that would have detached Russia from France; these two incidents gave the impression that German diplomacy aimed at the isolation of France.

THE action of Germany in forcing Delcassé's resignation was a national mortification of France, but it also caused secret shame among the inner circles of England, for France was being publicly punished for venturing to sign an agreement with England. It is true the Anglo-French agreement called for mutual diplomatic support only, but if diplomacy failed at Algeciras and Germany attacked France. it would be difficult to keep England out of war. This was the major British foreign problem late in 1905, when Chamberlain, by his attack on free trade, split the Unionist Party, and forced Balfour's resignation and a general election. King Edward summoned Campbell-Bannerman to form a new Government that included Grey as Foreign Minister and Haldane as War Minister.

When Grey took over the Foreign Office in 1905, he found its London office presided over by Sir Arthur Hardinge and ably staffed by permanent officials, and a trained diplomatic body headed by ambassadors such as Bertie at Paris, Buchanan at St. Petersburg, Lascelles at Berlin, Rodd at Rome, and Mallet at Constantinople. Besides these he had a competent consular service, a world-wide cable system, and a British banking and commercial organization that encircled the globe so that he had almost complete information of world affairs at his disposal daily. Thus while he had imperial responsibilities he had an efficient imperial mechanism to assist him to sustain the load. Haldane on the contrary found the War Office almost inchoate as it had undergone, without assimilating, two reorganizations since the Boer War.

UPON assuming the Premiership, Campbell-Bannerman announced to Parliament that there would be no change in the foreign policy of Great Britain. This meant continued adherence of the new government to the alliance with Japan and the entente with France. While addressed to Parliament it was notice to Europe of Britain's position. Nevertheless, it was not sufficient for France, so Paul Cambon, French Ambassador at London, inquired, in January, 1906, if Britain would support France by arms if diplomacy failed.

Grey replied that, in his personal opinion, if Germany attacked France as a result of the Morocco negotiations, public feeling in England would not permit the Government to remain neutral.

Cambon, not satisfied with this answer, stated that the German Emperor had given the French Government to understand that the British Government could not be depended upon, and it was important for France to feel that they could rely upon Britain. Grey pointed out that any further commitments would change the entente into a defensive alliance, which would have to be disclosed to Parliament. He added that the British people would certainly be unwilling to fight in order to bestow Morocco upon France, and while public opinion would be strong for France if Germany were the aggressor, he hesitated to say whether British friendly regard for France would be strong enough to overcome the very great reluctance that existed in England against becoming involved in war.

Cambon pointed out that war might arise so suddenly that English opinion could not be aroused in time and France be left facing Germany alone. Cambon knew the general feeling of the British people and the dependence of the cabinet upon Parliament so he probably realized that Grey was committing the Government as far as British opinion would permit; nevertheless he was disappointed with the report he had to forward to his home Government.

Grey, during the same month, dealt very frankly with Metternich, the German Ambassador, telling him that the British did not intend to make trouble at the Morocco conference, but that the public feeling in England would be very strong if France got into difficulties on account of an agreement they had made with England. After much wrangling the Algeciras conference passed over peacefully, strengthening the entente with France and in a corresponding degree increasing the British tension with Germany.

The British Government in the autumn of 1906 sent Haldane to Germany primarily and formally to inspect the German War Office, but authorized him to hold informal conversations with the Kaiser and his officials on British-German relations. King Edward, then taking the cure at Marienbad and aware of the proposed visit, invited Haldane to visit him on the way to Berlin. He furnished Haldane all the suggestions that his well-stocked, sagacious mind could offer and directed Haldane to keep a diary during his stay in Germany.

Many Germans have charged that Edward VII was the real author of the policy of encircling Germany by promoting the alliance between Russia, France, and England. In fact, Edward is often painted as a Machiavel who moved from capital to capital in Europe spinning an anti-German web. The truth seems to be that Edward exerted much more influence upon British affairs than was generally known or a constitutional monarch is strictly authorized to exercise. His participation in foreign affairs was informal but effective. During his annual trips to the continent, he would create an atmosphere favorable to any pending British negotiations, and the representative of the Foreign Office who accompanied him would follow up the genial generalizations of his king with concrete proposals.

Germany had no reason to complain of Edward's activities for the Kaiser each year likewise made European tours during which he endeavored to improve the German position, and as he was under no constitutional restrictions, he frequently initiated diplomatic undertakings without reference to his Foreign Minister. The Kaiser was impulsive and erratic, while King Edward was urbane and discreet; therefore, Edward was a more successful envoy. This personal rivalry increased the ill-feeling existing between Edward and Wilhelm, and had a bad effect on the relations between England and Germany.

ON arriving at Berlin, Haldane, with Colonel Ellison, his Military Secretary, examined the German War Office with particular attention to the plan for rapidly mobilizing the German Army. He conferred with the Emperor; Chancellor von Bülow; von Tschirsky, the Foreign Minister; and General von Einem, the War Minister. He gained the impression that there was an active militarist party in Berlin, but that it was in the minority. He thought the Germans generally were conscious of a growing superiority in the application to industry of scientific knowledge and that the responsible heads of the Army, *at that time*, were looking to a peaceful penetration of the world's markets, with only the moral assistance of great armed forces in the background.

General von Moltke, German Chief of Staff, told Haldane that a war between Great Britain and Germany alone would result in an indecisive trade war, during which the United States would be the real gainer. Haldane agreed with this view, but he considered, though he could not tell von Moltke, that a more dangerous situation for England would arise if Germany over-ran France and established herself across the Channel from England.

(To be concluded in June)

COMMERCIAL PROPERTY NEWS

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

How Does the Law Protect Slogans?

Even Though the Slogan Is Seldom Taken Under the Wing of Official Washington, It Is Not Without a Protector

By John C. Pemberton
Member of the New York Bar

THE slogan is a popular advertising device. Its uses, its possibilities and limitations — advertisingly speaking — are fairly well known. But observed from the legal point of view, the slogan is seen through somewhat of a haze. Few outside of the legal profession have more than a faint conception of the protection the law throws around a slogan, and even the profession is very often somewhat at sea[1].

Well, how *does* the law protect slogans?

A limited number of advertisers have secured trademark protection for their slogans as parts of trademarks. By trademark protection, I mean that their slogans have been registered as trademarks at the Patent Office at Washington[2] and perhaps with the Secretary of State of a number of states[3].

Of course, strictly speaking, trademark registration, by itself, does not guarantee protection to a trademark or to a slogan which may be a part of a trademark. Legally speaking, what trademark registration indicates is: (a) that the owner of the mark so registered has a mark which complies with the requirements of the various trademark acts; (b) that he was the first to use the mark in interstate or foreign trade and began using it on or about a certain date[4]. (c) It gives the registrant the right to use with his mark the phrase "Reg. U. S. Pat. Off." (d) It gives the registrant the right to sue in the Federal courts. (e) It is *prima facie* evidence of ownership. (f) Registration here is a prerequisite for registration in many foreign countries. The Patent Office is privileged to change its mind as to registrability[5] and, of course, the courts are in no way bound by any ruling of the Patent Office.

Then, it must also be remembered that trademark registration applies to the slogan only insofar as the slogan is part and parcel of a general trademark design. If a competitor should steal only the slogan, there is little chance that he could be compelled to cease and desist on the basis of trademark infringement. To prove trademark infringement it is necessary to convince the court that the alleged infringer is using a colorable imitation of your mark. The use of a slogan entirely apart from the general trademark design is hardly likely to be viewed as a colorable imitation of the trademark.

Of course, it is possible to copyright an advertisement or other printed material in which the slogan appears. Labels containing the slogan may also be registered at Washington[6]. But here, again, unless most of the copyrighted material is lifted or unless the label is rather closely imitated, these forms of protection afford little security so far as the slogan is concerned.

However, the law is not blind to the need of slogan protection and the courts have ruled that a slogan which may not constitute a valid trademark, and which may not be registrable as a trademark, *may nevertheless be protected on the theory that it has acquired a secondary meaning in the trade as a result of which it is unmistakably tied up with the name of a certain product, individual or company.*

Here is a case in point:

Henry W. Fishel & Sons, Inc., manufactured and sold imitation jewelry which it featured as "jewelry of distinction." Another organization in the same field adopted the name Distinctive Jewelry Co., Inc. Fishel started a suit in equity to enjoin unfair competition. The specific charge was that the use of the corporate name Distinctive Jewelery Co., Inc., constituted unfair competition.

The case was referred to in a recent issue of *The New York Law Journal*[7]. The reference occurred in an editorial which expounded the theory of the doctrine of secondary meaning as applied to slogans. Briefly explained, this doctrine simply means that a mark, name or phrase—which ordinarily would not constitute a valid trademark—may nevertheless be exclusively appropriated by a company or an individual if it can be proved that it has acquired a special meaning indicating origin or denoting a particular product or business.

Thus, said *The New York Law Journal*, "In this state, the rule was laid down clearly by Laughlin, J., writing for the Appellate Division, First Department . . . that the phrase 'jewelry of distinction' had acquired in the jewelry trade a secondary meaning as indicating a certain kind of imitation jewelry manufactured and sold by the plaintiff company. It was there held that . . . the use of the corporate name by the defendant company 'Distinctive Jewelry Co., Inc.' . . . constituted unfair competition. The decision was based on the theory that the name, phrases, and words employed by plaintiff had acquired in the trade a definite secondary meaning as identifying the business and goods of the plaintiff. The learned judge said:

" 'In such cases it is well settled that the use by a party of a corporate name or of fanciful or descriptive phrases or words, under which goods manufactured and advertised by another have become known in the trade, and which use is intended and calculated to result in unfair competition, even though the corporate name, phrases, or words are not such that one party may obtain an exclusive right to the use thereof as a trade name or trademark, may be enjoined on the theory that the name, phrases, or words have thus acquired in the trade a secondary meaning as identifying the business or goods of the party first using them.' "

Here, then, we find the principle of law on which slogan protection rests. Let me paraphrase it, in the words of another, stripped of everything that does not apply to slogans:

"The use by a party of phrases, under which goods manufactured and advertised by another have become known in the trade, may be enjoined on the theory that the phrases have acquired in the trade a secondary meaning as identifying the business or goods of the party first using them[8]."

It is important to note that the advertiser does not have to prove that the final consumer in the majority of cases ties up the slogan with one particular company. The court specifically says "phrases under which goods . . . have become known in the trade." This is fortunate for the reason that every test ever made has indicated that the public makes a very poor showing when it is asked to connect a given slogan with its real owner unless the advertiser's name happens to be a part of the slogan.

[1] An application to register the words "Good Canada—Nothing Else" was refused, being merely a catchy slogan and not a trademark at all [16 T. M. Rep. 370]. Likewise "When Words Fail—Send," or "Good Candy—Nothing Else." The reason given was that no one has the right "to appropriate entire sentences and combinations of words from the English language and thereby prevent others from using those words" [16 T. M. Rep. 314].

[2] "Cake of the Gods" when used with another mark [16 T. M. Rep. 352]. "Topics of the Day" accompanied by a picture containing allegorical figures [16 T. M. Rep. 365]. "Has a Friendly Flavor" when used with the word "naborhood" [18 T. M. Rep. 470]. "The Spice of the Program" when used with the representation of the Aladdin or Greek lamp [17 T. M. Rep. 24]. "Good to the Last Drop" when used with the pictorial representation of a hotel [18 T. M. Rep. 464].

[3] For the text of the state statutes see "Hopkins on Trade Marks" (4th Ed.). Appendix F. Also "Trade Mark Laws of the World," by John H. Ruege (1928).

[4] Act of February 20, 1905, as amended [16 T. M. Rep. 315].

[5] Sec. 13 of the Trade Mark Act of Feb. 20, 1905 which provides: "That whenever any person shall deem himself injured by the registration of a trademark in the Patent Office he may at any time apply to the Commissioner of Patents to cancel the registration thereof [18 T. M. Rep. 252].

[6] Section 3 of the Act of June 18, 1874 [16 T. M. Rep. 361.2].

[7] *New York Law Journal* of April 4, 1930, p. 74.

[8] From the opinion of Hill, J., in the case of Albany Packing Co., Inc., vs. Crispo (227 App. Div., 591, advance sheets of March 1, 1930).

I seem to recall that even the members of a prominent advertising organization which examines advertising with vastly greater care than the general public, averaged less than 60 percent correct in a slogan test.

The trade, however, because of the very closeness of its association with the advertiser, is likely to score a fair average in associating a slogan with a specific advertiser. A court would not expect an advertiser to prove that 100 percent of the trade thinks of him whenever it comes across a slogan worded in a certain way. If the advertiser could prove that as many as 20 or 30 members of the trade link the slogan with his name, the courts would no doubt decide that he had succeeded in proving that his slogan had acquired a secondary meaning. (Cutler on Passing Off.)

So far as the advertiser is concerned, what all this means is simply that it is up to him *first*, to frame and use his slogan so that it unmistakably identifies *his particular product* (United States Tires Are Good Tires)[9], *second*, make it an especially prominent part of all printed material reaching the trade, including business-paper advertising, and *third*, keep a complete record of all material in which or on which the slogan appears. This latter is important because it enables the advertiser, if he should be compelled to go to court, to show precisely when, where, and how his slogan has been used.—Reprinted by permission from *Printers Ink*.

[9]Other pertinent examples of slogans are: Goodyear Means Good Wear; Never Say Dye Say Rit; Try Sanka and Sleep; No Rolls-Royce Has Ever Worn Out; Prudential Has The Strength of Gibraltar; Follow the Arrow And You Follow The Style; Motorists Wise—Simoniz; Mighty Monarch of the Air; There's Nothing Finer Than a Stromberg Carlson; When Better Automobiles Are Built Buick Will Build Them; Have You A Little Fairy In Your Home?; Next to Myself I Like B.V.D. Best; Friendly Five Shoes—Friendly To The Feet; Shop at SEARS And Save.

Movie Patent Suit Won by Warners

A DECISION in favor of Warner Brothers Pictures, Inc., and Duplex Motion Picture Industries, Inc., was handed down recently in Brooklyn Federal Court by Judge Marcus B. Campbell in an equity patent infringement suit brought by Cinema Patents Company, Inc.

The plaintiff charged that Warners and Duplex were operating a film-developing machine which was an infringement on two patents issued to Leon Gaumont, the first on April 4, 1916, for developing, fixing, toning, and otherwise treating photographic films and prints, and the second on December 26, 1916, for apparatus for drying photographic films.

Judge Campbell held that the machine used by Warners was in no instance an infringement; that the patents, while valid, were merely "improvements in a crowded art," and that the defendant had established its defense of laches, since the plaintiff, although granted a patent in 1916, failed to sue until August 12, 1930.

"Both machines involved are for continuously processing films, but examination of the prior art shows that machines for the purposes were known before the patents in the suit," Judge Campbell maintained in a 48-page opinion. "The machines both accomplish the same result, but that is not enough to establish infringement."

The jurist found on investigation that no such machine as that described in the cinema company patents had ever been operated in this country, although several companies owned the patents over a period of years. Judge Campbell therefore referred to the patents as "paper patents." The court showed that they were owned by Famous Players-Lasky Corporation from November 22, 1926, to January 3, 1929, when they were taken over by the Spoor-Thompson Machine Company until April 11, 1930.

In holding that the Warner and Duplex companies had established their defense of laches, he said:

"The owners of these patents have slept on their rights and I believe there has been acquiescence in the alleged infringement."

It would be inequitable to hold the defendants now, only a short time before the patents expire, the court held.

"Tru-Test" Refused Registration

IT was recently held by First Assistant Commissioner Kinnan that Sears, Roebuck and Company, of Chicago, Illinois, is not entitled to register, as a trademark for a large number of chemicals, medicinal, and pharmaceutical preparations, the notation "Tru-Test," in view of the prior adoption and use by the United Drug Company, of Boston, Massachusetts, upon goods of the same descriptive properties, of the term "Puretest."

After stating that the only question to be determined was the similarity of the marks and noting applicant's argument as to the dress of the goods and that many other registrations have been granted which are more nearly like that of opposer than like that of the applicant, the First Assistant Commissioner said:

"The Court of Customs and Patent Appeals has held that the registrations granted other parties cannot be deemed an aid to one seeking registration.

"The marks are quite similar in appearance and significance when viewed as a whole. Being used as they are in many cases upon goods sold for small sums and purchased by persons of all classes it is considered that confusion would be probable if both marks appeared in the same market, as they well may at any time in the future, upon articles belonging to identically the same class."

Phonetic Spelling Ruled Out

FIRST Assistant Commissioner Kinnan recently held that Peter A. Kanouse, of Los Angeles, California, is not entitled to register, under the Act of 1905, as a trademark for dental, medical, and surgical appliances, a mark consisting of the notation "Truplastic" appearing upon a contrasting background surrounded by an ornamental border, unless a disclaimer of the notation apart from the other features of the mark is filed.

In his decision the First Assistant Commissioner stated that the mark is used upon hydrous cement used in making dental impressions and that such powder becomes temporarily plastic when water is added to it and remains plastic for a period during which suitable impressions can be made, and it is evident that the applicant is unwilling to make the disclaimer because he desires to prevent other people from using the words or the notation and it therefore becomes necessary to determine whether applicant is entitled to exclusive use of the notation alone.

"'Tru' is an obvious phonetic spelling of the word true so that in effect the notation becomes the same as true plastic. That these words are merely descriptive of a hydrous cement used in making dental impressions seems plain enough, and it would appear obvious no one could obtain any exclusive right to the use of these words so as to prevent others from describing their dental cement as a true plastic. The notation is considered merely, only, descriptive of characteristics of the goods."

Forsythe Decision Affirmed

THE Appellate Division affirmed recently an injunction granted the John Forsythe Company, Inc., men's furnishings dealers, enjoining the Forsythe Shoe Corporation from using the name Forsythe in its business.

The Court held that trade names cannot be used by others than their owners even when the firms using such similar names deal in different lines of merchandise. The defendant assumed the name from the fact that it was formerly located in Forsythe Street and contended that there must be direct competition before an injunction could be enforced. The court held "that the whole trend of decisions is to prevent by injunction a threatened competition which is unfair, being calculated to impair the value of a trade name or to deceive the public."

Manifold Patent Held Valid

THE District Court of the United States for the Southern District of New York has sustained the validity of all claims of the Wiswall patent, No. 1534478, for a manifolding book for use in autographic registers, in a suit for its infringement brought by the American Sales Book Company, Limited, against the Autographic Register Company.

The only defense asserted to the suit was that of the invalidity of the patent, District Judge Coxe explained in his opinion. This defense was over-ruled and the Wiswall patent held to disclose invention. The patent relates to the supplies for autographic registers, and not to the registers themselves, which are used principally, it is stated, to provide a reliable duplicate copy of an original sales slip or other memorandum.

Prior to the invention, the court notes, the supplies were in roll form. Subsequent thereto, both plaintiff and defendant began to produce and sell flat supplies, to which the patent relates. "Flat supplies have practically crowded the old roll supplies off the market," the court states.

Despite experimentation, the defendant is said not to have seen the utility of flat supplies until the Wiswall invention was made public. Its sales pamphlets are also said to show "what now seems quite obvious, that Wiswall accomplished something of major importance in the autographic registry art." The opinion states that "wisdom after the event has always been ineffectual to invalidate a patent."

Books SELECTED BY THE EDITORS

PHOTOELECTRIC PHENOMENA

By Arthur Llewelyn Hughes, D.Sc., Prof. Physics, and Lee Alvin DuBridge, Ph.D., Ass't Prof. Physics, both at Wash. U., St. Louis

THE entire field of photoelectricity has been thoroughly canvassed for the material presented in this work. The authors take up both the theoretical and the practical phases of the subject and have succeeded in turning out a book that will be of great value to those interested in any angle of photoelectricity. Parts of the book presuppose that the reader is familiar with advanced mathematics, but the subject matter is so arranged that even lacking this, much informative material will be gleaned. Regardless of what you want to know about photoelectricity, you will find it in this book—if it is known at all. The chapters on technique and applications will be found eminently practical and a fertile source of information for furthering experimental and research work.—$5.20 postpaid.—*A. P. P.*

STANDARD WIRING

By H. C. Cushing, Jr.

EACH year for the past 38 years this valuable little book has been issued to record the most up-to-date information, changes in rules and regulations, new or modified laws, et cetera; just the facts practical people must know with certainty, including "how to do it" and where to get standard and officially approved apparatus, appliances and supplies to do it with. A new section tells "How to estimate on wiring jobs", which will help the owner with information to check up on contractors' prices. 4⅛″ by 6⅝″, flexible, gilt edges. A neat, handy little volume.—$3.20 postpaid.

PRACTICAL MATHEMATICS

By Hobbs—MacLennan—McKinney

SOME years ago Dr. Hobbs was chief author of a book of 172 pages with this same title. In our work, we have found it exceedingly useful and it is frequently referred to by our staff. We welcome, therefore, this new book which gives the same essentially basic treatment of simple mathematics but conceived on a bigger, broader scale, so that anyone rusty on some point can pick it right up without any considerable back reference—a panacea for the busy man. 448 pages divided into 14 distinct units, with 14 sets of questions and answers—one set for each unit.—$2.20 postpaid.

THE BOOK OF METALS

By Donald Wilhelm

"SIMPLY told stories of the metals, their mining, making, alloying, and amazing array of uses—the narratives and the answers to just such questions as executives, investors, and buyers and users of metal might ask"—preface. Not a technical but an authentic book, for each chapter has been passed upon by an authority; the compilation required eight years. From Iron to Platinum, 16 chapters of most readable facts intrigue the reader to the final chapter on the automobile, where over 76 wrought and cast metals alone unite to compose this machine so typical of our age.—$4.20 postpaid.

PROFITABLE PRACTICE IN INDUSTRIAL RESEARCH

Malcolm Ross, Editor

THIS book presents the accumulated experience of the past 25 years in American industrial research. In their own words the 14 directors of research laboratories point out the paths which they have found to lead to success in research, with the least possible unproductive expenditure. It discusses the history and philosophy of science as applied to the practical aims of industry; the organization, personnel, problems, methods of procedure, equipment of the laboratory; as well as international research and other related subjects. A history of achievement which undoubtedly will become a classic.—$4.20 postpaid.

HUXLEY

By Clarence Ayres

BASED on the contention that Huxley, not Darwin, was the originator of the theory of evolution as we understand it today, the author utilizes the fact that it was Huxley who thrust evolution on an unwilling world and fought everyone to sustain his contentions. Whether or not you can agree with this, at least you will be brought into intimate contact with a wholly delightful and admirable character, the essence of which is portrayed most entertainingly and dramatically. A book which undoubtedly will cause much discussion.—$3.20 postpaid.

THE GREAT PACIFIC WAR

By Hector Bywater

A FAMOUS naval expert describes in full detail an imaginary war between the United States and Japan—the outcome of which strikingly demonstrates the utter futility of such a conflict. Told in most interesting fashion, one learns much of the important strategic islands of the Pacific and their relative value as bases for the operation of fleets. Many important lessons will be brought home to the layman, chief of which is the absolute necessity for a trained personnel. This is no jingo outburst, but the sober development from the facts as they now exist by one who speaks authoritatively, from an English viewpoint.—$2.65 postpaid.

WHY WE DON'T LIKE PEOPLE

By Donald A. Laird, Dir. Colgate Univ. Psych. Laboratory

IT matters little how much you know, if you are out of tune with the people and things around you, if you are "maladjusted"—a misfit—you can't go far in this world. A few of us are happily, almost perfectly, adjusted, while the rest of us in varying degrees are not. In the average case, will a man go farthest by (a) learning more facts, (b) working his head off or (c) discovering his own negative personality traits and extirpating them—in other words getting himself adjusted? Dr. Laird's newest book is based on the idea that (c) is the best bet, and among many other things it contains a detailed test by which you can find out just exactly where you stand on the average scale of adjustment—provided you can be frank with yourself. These tests were taken (and originally paid for) by nearly 10,000 business men. Other features of this book will add to a reader's knowledge of human nature, and enhance his ability to analyze people and estimate their motives. The chapters on "Suiting vocation to personality" and "Traits of personality which build leadership" are especially valuable. The book makes easy reading—it is chatty, not a dull report.—$2.15 postpaid.—*A. G. I.*

MEN ON THE HORIZON

By Guy Murchie, Jr.

NO wonder Rear Admiral Byrd was so complimentary in his foreword to this book, for undoubtedly it has characteristics which we have found in no other book of adventure. The author sets out to obtain an understanding of the enigma of the "vast masses of men grouped in races and classes, unknown to each other, uninformed about each other, doubting and disliking each other —and yet all of them made in the same image and of the same material, and all human." Through the countries of the northern hemisphere he works his way, coming in contact with the supposedly rougher elements, experiencing adventure which would test the hardiest fortitude, yet always finding something worth while, something encouraging. His observations of men and countries are a real contribution to anthropology. We highly recommend this work to thoughtful readers.—$3.20 postpaid.

CHILDREN OF A STAR

By Julie Closson Kenley

LIKE "The Astonishing Ant" and "Green Magic" in its general conception, which so delightfully told the story of animal and leaf growth and which by the way have had a most enthusiastic reception, this book goes farther back to beginnings and tells how life first started, how from this small beginning was evolved the marvelous, complicated life of today and how prehistoric man developed into the human race of today. A juvenile book, but admirably presented and composed of authentic material well worth adult reading.—$2.65 postpaid.

WORDS CONFUSED AND MISUSED

By M. H. Weseen, Asso. Prof. English, University of Nebraska

WHAT a useful book this is. Words that need special study and constant watching, that may easily prove a stumbling block to the unwary. Some words are misused or misunderstood because they have the same sound as other words, but different meanings. Many pairs of words are confused because they look alike, but have different meanings. No one person stumbles over all of them but each one of us has a few pet aversions—words that constantly evade us or that we unconsciously misspell or mispronounce; for no one, as a matter of fact, has attained perfection in the mastery of words. The definitions are clearly and succinctly stated and followed by an example of correct usage. An invaluable aid to everyone who wishes to use correct diction.—$2.15 postpaid.

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By Ellison Hawks

THIS seems to be the era of books on ships and sea adventure, each one having somewhat of a different slant, and each one interesting in its own way. But it seems no exaggeration to say that whatever you may have read, you will enjoy this very complete story because of the fact that the author has dug up some interesting old material and brings the development down to modern transportation in an exceedingly condensed yet readable style. Eighty-eight plates and 70 illustrations in the text with explanatory legends, alone would make a perusal of considerable value and the wealth of historical data should make for permanent value for reference. —$3.20 postpaid.

TROPIC NIGHT

By Inez Nichols

A PROBLEM of deep significance to all students of sociology is the study of miscegenation as presented in the present situation in Hawaii. The author of this novel has lived many years in Honolulu and has had unexcelled opportunity for observation and study. In this form, she gives a clear, bold picture of the conditions, but with a deftness and turn of phrase which obviates any criticism of unnecessary realism. More general information can be absorbed in such a running, interesting tale than the average person would acquire from considerable application to heavier bibliography. Read for yourself and you will appreciate.—$2.15 postpaid.

THE DEVIL'S HIGHWAY

By Harold Bell Wright and John Lebar

WHAT a combination! The well beloved writer of some of the most charming stories in our language and the son just attaining a recognized position. As one might expect the result is a story with much of the fluent readability of the old tales, fired with a youthful imagination which projects itself far ahead to a day when science has developed unbelievable phenomena, beside which our present day accomplishments seem infantile. You will enjoy this book and probably read it at one sitting, it is so entirely different from all the others from these pens.—$2.00 postpaid.

THE AMERICAN YEAR BOOK, 1931

Albert B. Hart and W. M. Schuyler, Editors

PUBLISHED under the auspices of *The New York Times*, this yearly series has been planned by a Supervisory Board to which one member is chosen from each of 46 national learned societies. The form, scope, and makeup of the book is thus the responsibility of the Board. Subdivided into 27 fields including some 240 narrative articles, a third of the book's contents is devoted to public affairs, while some 200 pages are given over to scientific subjects. Short, pithy articles give at a glance what has happened in wide general fields and a condensed summary provides a time-saving means of referring to the activities of each separate field. A reference indispensable for all whose activities include economics, editorial work, writing, research, or general affairs of current interest. 5″ by 8″; 937 pages.—$7.75 postpaid.

SEA DOGS OF TODAY

By A. J. Villiers

MUCH has been written concerning sea-faring of the past but this is the first, first-hand story we have seen of present day operations. One reads of prodigies of accomplishment in the polar seas which is comparable to anything previously written; of months of racing by the largest "wind-jammers" to deliver the first cargo of Australian grain; of Capt. Fearson who sailed 36 times around Cape Horn, and a particularly interesting chapter on missing ships. Written by one who went to sea as a cadet at an early age—these are real tales of realities seen and experienced or when the biography leads back, the facts are sustained by every available means. One of the best collection of stories that we have seen.—$2.65 postpaid.

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When you pick up this magazine and read the announcements of national advertisers, you never think to question the sincerity and honesty of their statements. This reliance on Advertising has been brought about by Advertising, and is one of Advertising's greatest contributions to the satisfaction and ease of modern living.

An advertiser deliberately attempting to deceive takes the quick, short road to ruin. The insincere or extravagant statement may have its brief day. But the greater the attention it attracts, the sooner the public will discover its deceit.

The cornerstone of successful manufacturers and storekeepers always has been "keep faith with the public"; give honest values and truthfully represent the merchandise and its service. This principle had to find its expression in Advertising—for Advertising is nothing more than the owner of a store or a factory talking with people in their homes about such things as shoes and soap, radios, or rugs, or blankets.

Public acceptance of Advertising has had a natural growth —from suspicion, to respect, to dependence. This growth parallels the increasing effort of manufacturers and merchants, to add value to their merchandise—to improve quality—to accept responsibility for service and satisfaction.

It pays to read the advertisements. They bring news of what is being fashioned in the workshops of the world for your well-being, comfort and convenience.

"Now I use LUCKIES only"

POOR LITTLE RICH GIRL

Sue Carol's wealth was a hindrance rather than a help. Hollywood thought she was ritzy, but Sue soon proved she was a "regular guy"... she made 14 pictures her very first year... her latest is UNIVERSAL'S "GRAFT." She has reached for a LUCKY for two years. Not a farthing was paid for those kind words. That's white of you, Sue Carol.

I have had to smoke various brands of cigarettes in pictures, but it was not until I smoked Luckies that I discovered the only cigarettes that did not irritate my throat. Now I use Luckies only. The added convenience of your improved Cellophane wrapper that opens so easily is grand."

Sue Carol

"It's toasted"

Your Throat Protection — against irritation — against cough

And Moisture-Proof Cellophane Keeps that "Toasted" Flavor Ever Fresh

"Now we can advertise it"

PRODUCTS are nearly always put on the market before they are advertised. Quite frequently, changes have to be made in an article before the public generally will accept it. Color, design, flavor—those are some of the things the public has to be consulted about. Sometimes a product won't sell at all and simply has to be discontinued. As soon as people show that they welcome an article, and as soon as all refinements and improvements have been added, then you could hear the manufacturer say, "Now we can advertise."

When you buy advertised goods, you may know they have gone through the experimental stages. You may be sure that the manufacturer knows they are right and that he is willing to stake his reputation on them. You may be confident that you are buying goods that have sold and that would continue to sell without any advertising at all. For advertising merely lets all of the people know—now—what considerable numbers would find out by word of mouth ten years from now.

Of course, advertising goes a step farther. Word of mouth hardly ever tells all the uses of a product. It often doesn't give the real reasons for its superiority. Advertising tells people all about a product and the numerous ways in which they can use it.

Let the advertisements be your guide. When the manufacturer says, "Now we can advertise it," you know that you can safely say, "Now we can buy it."

WHY DO YOU POSTPONE STUDY?

You can not get too much knowledge. Education opens a vista of beauty for one person, and fills a gap in the practical training of another. It helps in every way of life, increasing opportunity and the ability to grasp it. ❧ Education enlarges the power of the business executive as well as the worker in the ranks; it increases the capacity of the teacher; it assists the mother in many of the problems that she faces. It broadens the power to serve. ❧ Through a wide range of home study courses Columbia University offers a richer and more satisfying life to adults as well as to youth, to men and women, to workers and students. ❧ These courses reward well the effort and time they require.

COLUMBIA UNIVERSITY

Offers Home Study Courses in the Following Subjects:

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

In this country, we are in the midst of an adult educational movement. Home study courses are being taken by about 1½ million people which is nearly twice the total number of students in our universities, colleges and professional schools. University home study courses are especially important in this movement because they offer careful guidance under experienced educators. ❧ Columbia courses have been prepared to meet the special requirements of study at home. They are sufficiently elastic to be adapted to the students' individual needs. Everyone who enrolls is personally taught by a member of the University teaching staff. ❧ In writing, mention subjects which interest you, even if they are not listed, as additions are made from time to time. ❧ A bulletin showing a complete list of home study courses will be sent upon request. In addition to the general University courses this bulletin includes courses that cover complete high school and college preparatory training.

COLUMBIA UNIVERSITY,—*Home Study Department,* 15 Amsterdam Avenue, New York, N. Y.

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

Sci. Am. 4-32

*Name*_____ *Occupation*_____

*Street and Number*_____

*City and County*_____ *State*_____

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