SCIENTIFIC AMERICAN

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

EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor

CONTENTS · OCTOBER · 1932

ACROSS THE EDITOR'S DESK

ORGANIZED transportation by air is playing an increasingly large part in business in this country. Large transport companies are operating on schedules that are adhered to with the regularity of clockwork. Safety is the watchword, and the physical and mental comfort of the passengers is given every possible attention. To present to our readers a graphic picture of this newest form of business travel, we asked Charles R. Marshall, a typical business man, to write of a recent trip which he made across the continent, with various stopovers. He has done so, and the results of his efforts will appear in our November number. Mr. Marshall is thoroughly sold on the desirability of air travel for the business man. You will find out why when you read his article.

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When, with the aid of a few strips of paper, pencils, and a pair of scissors, you can demonstrate to your own satisfaction some of the properties of the curved space of Einstein and Riemann, advanced theories of physics become clearer. Parallel lines that meet; parallel lines that remain parallel, yet diverge; straight lines that come back to their starting points; space that is finite yet endless—these are some of the anomalies of logic that will be explained in an article scheduled for our November issue. John P. Nikonow has prepared this article for the layman who has difficulty in grasping some of the fundamentals of the abstruse concepts of space and he has succeeded admirably in presenting demonstrations that the reader may duplicate for himself and thus see the evidence in his own hands.

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"The time is near when photo-elasticity will be taught in every major engineering school and applied in every modern engineering laboratory. Photo-elasticity has already materially contributed toward the solution of many problems in stress analysis, and further progress may be anticipated—notably in such fields as impact stresses, tool cutting, stresses due to centrifugal forces, and gear action. Within its scope, photo-elasticity is more powerful than the most powerful X rays. . . ." This quotation from the article, "Looking at Stresses," by Max Mark Frocht, Ph.D., gives succinctly the author's interpretation of the value of the newly developed method of determining the complex stresses set up in all sorts of engineering structures. The method of seeing these stresses will be described in an article scheduled for publication next month.

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A beautiful new bridge which takes its place among engineering and architectural marvels of the day has just been completed at East Pittsburgh, Pennsylvania, and will be discussed in an article scheduled for publication in our November number. This bridge, spanning the valley of Turtle Creek at a point where it is crowded with great industrial plants and railroad tracks, has been named the George Westinghouse Bridge, in honor of the founder of the huge business, the main plant of which lies in the shadow of its arches. The great central arch is the world's longest of its type.

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Our "shop" article for the November number will take the reader through a watch factory and show him something of the way in which the almost microscopic parts of accurate time-keepers are fabricated and assembled. An idea of the interesting facts about watch manufacturing that will be presented may be gained from the statement that it takes almost as many preliminary drawings to design a new watch as to design a locomotive! One of our editors has made a study of the subject and has prepared an informative article which will be illustrated by a series of specially posed photographs.

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To the average person, high-tension transmission lines are most mysterious. The wide swath cut through hillside forests like the path of a monster war tank, the tall skeleton steel towers in stately lines across valley and hill and river, and the gracefully curved wires that swing between these towers like the web of a gigantic spider, all aid in building up the mystery. Electric power is essential to our modern industrial era and from this necessity has grown the distributing system, the physical aspects of which—the transmission lines—intrigue the traveler through the country-side. An expert in high-voltage transmission has prepared, at our request, a comprehensive article, to be published soon, which clears up much of the mysterious background of how these lines are planned and constructed.

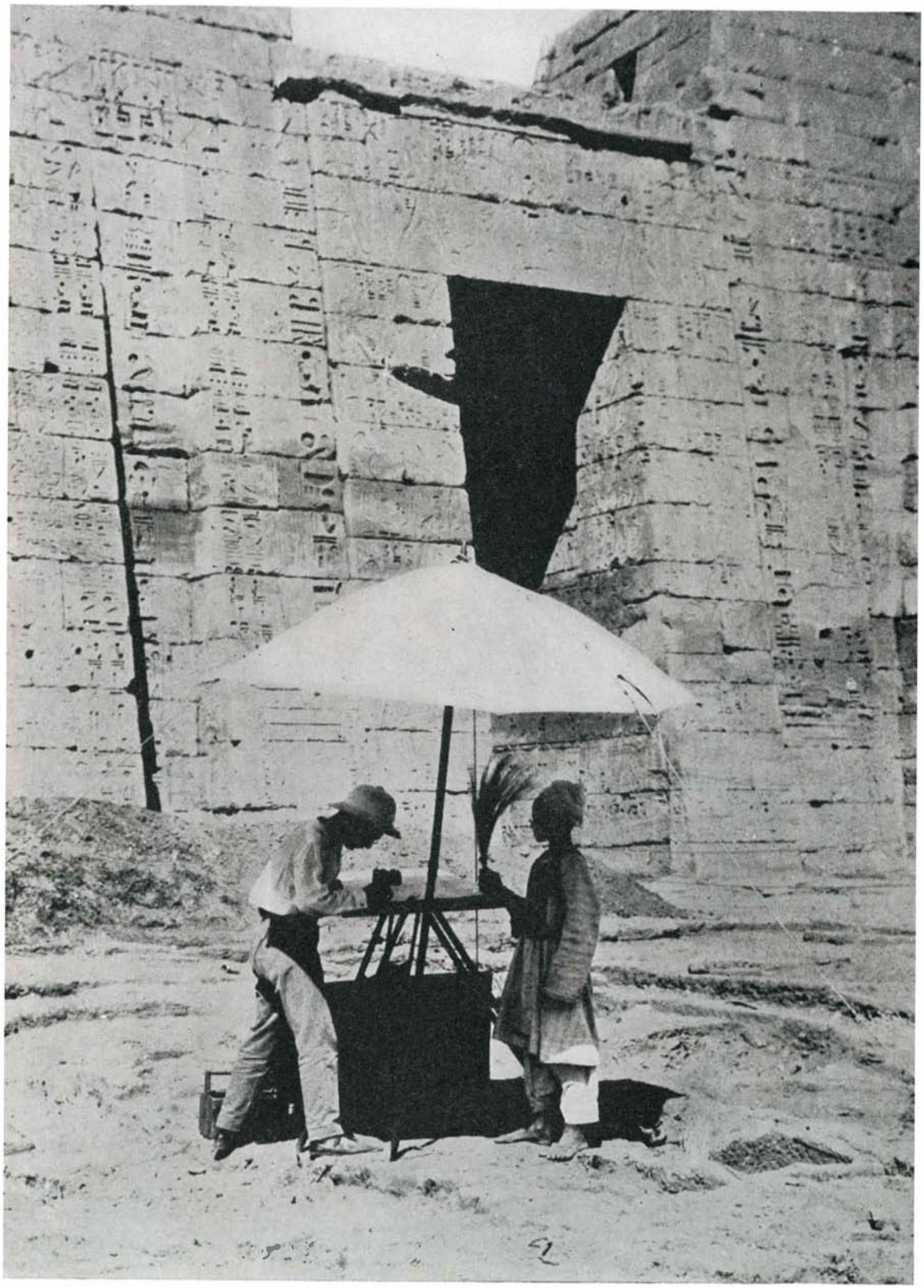
Editor and Publisher

SCIENTIFIC AMERICAN, October, 1932. Vol. 147, No. 4 entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Scientific American Publishing Company, 24 West 40th Street, New York City. Subscription price $4.00 per year. Foreign $5.00.

FRANK J. SPRAGUE

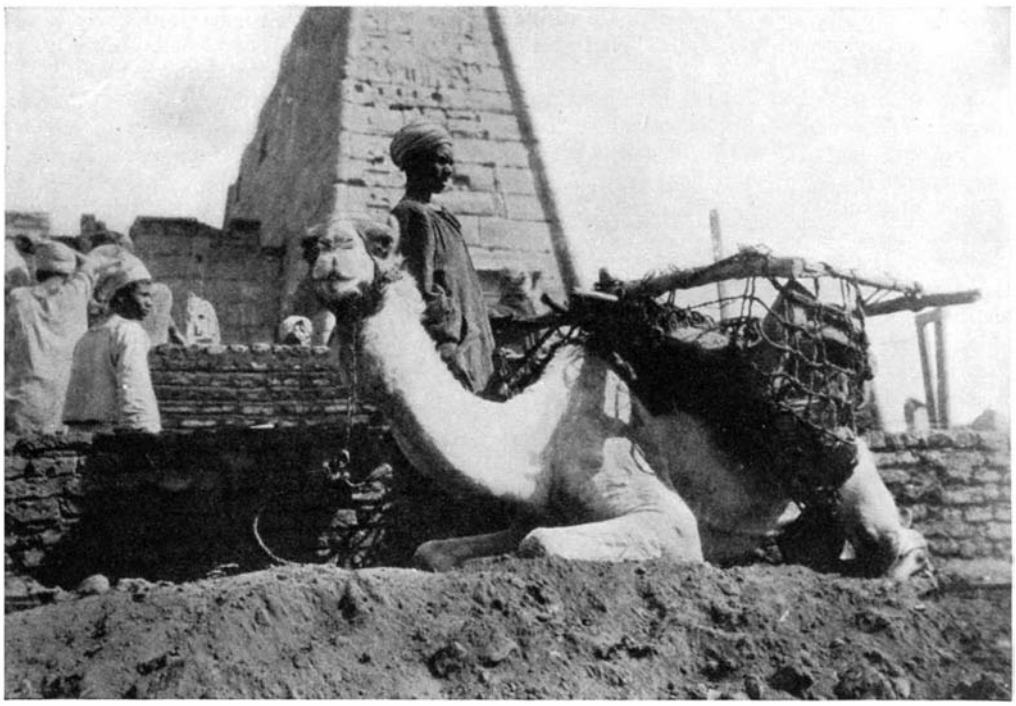
FOR his many important achievements in the field of electrical traction and his development of electrical elevators and their control, constant speed motors, and automatic remote control systems, both as a pioneer and as a diligent worker even now at the age of 75, tribute was rendered by many notables to Dr. Sprague recently on the occasion of his birthday. One of our really great electrical pioneers, he has been called the father of electrical traction. He was the first to demonstrate, in 1886, the practicability of motors for railway use. When others were skeptical of the practical value of alternating current, as opposed to the direct current upon which, in the early days, the future of electricity seemed to be based, he advised active prosecution of alternating current development. Dr. Sprague was the first to apply electricity to the elevator, and to the present day has continued his work in that field. In 1926, he perfected the first operative dual elevator.

Dr. Sprague was educated at the United States Naval Academy 1874-1878, resigned from the Navy in 1883, was an assistant to Thomas A. Edison for a year, and then formed his own company, the Sprague Electric Railway and Motor Company which later merged with the Edison General Electric Company. He then formed the Sprague Electric Elevator Company and finally the Sprague Electric Company.



RECORDING THE PAST DESPITE WIND, FLIES, AND HEAT

OUTSIDE the temple of Medinet Habu, at ancient Thebes (usually known as Luxor), an artist-draftsman is drawing in ink on enlarged photographs of the temple walls. He is tracing the lines of the original inscriptions, after which the rest of the photograph will be bleached out, leaving only the ink lines, from which blue-prints will be made for further study. Frequent "proof-reading" (see page 202) insures correctness of the reproductions.



The local trucking service is taking a rest at the Theban temple of Medinet Habu. Both the epigraphic and the architectural survey go hand in hand and require the transfer of material

NEW KNOWLEDGE OF THE RISE OF MAN

By A. A. HOPKINS

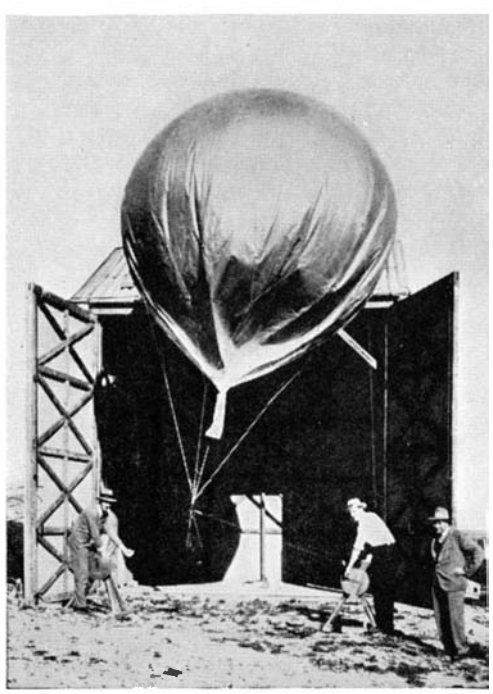
WE have published many articles on the human development of physical man from paleontological times, but there is a gap between primitive man and the rise and early advance of civilization. It is largely due to the Oriental Institute of Chicago, under the leadership of Dr. James Henry Breasted, that this gap is being slowly but surely bridged. The American headquarters of the Institute are in its beautiful new building at the University of Chicago, and its researches are being continually fed by the 12 field expeditions which operate along a far-flung front of some 3500 miles from Alishar in Anatolia on the north, to Persepolis in Persia on the east, and to Luxor in Egypt on the south.

MUCH archeological research has shown that the region which curves like a horseshoe around the eastern end of the Mediterranean has proved a great factor in human development. The ancient lands of this region form an almost unexhaustible storehouse filled with perishing and still unsalvaged evidences showing early human development.

Heretofore no comprehensive and systematic effort has been made to save and study, as a whole, these enormous and vanishing bodies of evidences. This situation forms a challenge to modern science which has laid upon it a two-fold responsibility: First, the task of salvaging the evidence by scientifically organized and well equipped field expeditions; and second, the study, interpretation, and correlation of the great bodies of evidence which may thus be gathered.

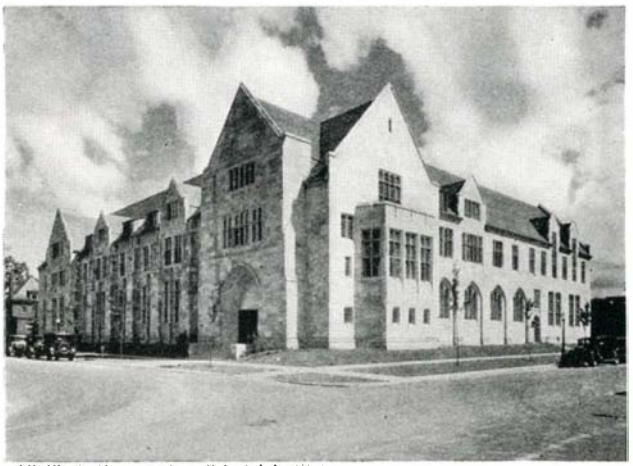
The Oriental Institute was organized to meet this challenge, aiding and enriching modern knowledge with a fuller vision of the rise of man. It is a great research laboratory for the investigation of the early human career, especially the transition from savagery to enlightened life; of the emergence of civilized societies; and of the Oriental background of European and American civilization. The Department of Oriental Languages of the University of Chicago was the original basis of this investigative body. To the ranks have been added other specialized groups of investigators having no teaching duties and appointed solely to carry on a series of related research projects in the vast field of early human development upon which modern human life has been built.

Before the magic carpet whisks us to the Near East let us visit the new building of the Oriental Institute as did the writer just before the opening last December. At that time, Dr. Breasted and his son, Charles Breasted, the Executive Secretary, kindly acted as guides for the writer. The main floor



Captive balloon for aerial photography. Camera shutter is released by electricity

contains exhibition rooms and a lecture hall. On the second floor are offices and a beautiful two-storied library with a minstrel's gallery serving as stack rooms. The sculpture throughout is symbolical of the aims and contents of the building. If you are inclined to Assyrian studies, perhaps you will take a look at the files of the great cuneiform dictionary which will be published in the fulness of time. Over a million cards are now in the file and probably a million more will be required before the actual dictionary volumes themselves can be blocked out and the word discussions prepared for publication.



All illustrations courtesy Oriental Institute

The Oriental Institute in Chicago is the first planned research laboratory devoted to studying the rise of man

EGYPT would be the natural gateway for our entrance into this charmed world of long ago. It is, of course, obvious that the study of early man must carry the student into the dim ages of the past; hence the Institute's investigations in the Near East have been concerned with the problems of natural science, especially geology. A Prehistoric Survey has undertaken the first detailed investigation of the geological history of the Nile Valley in connection with a careful search for the earliest evidences of the appearance of man. Some of the finds mark for us the advent of man in Egypt.

The scientific researches in the Faiyum Lake depression indicate the advancing desiccation of north Africa and disclose the approximate date of the creation of the Sahara Desert. It began in the Paleolithic or Old Stone Age. Such a tremendous change completely transformed the life of man on the North African Plateau. Before desiccation set in, this vast area was well watered and was inhabited by the earliest hunters on the African continent of whom we have any knowledge. Desiccation drove both hunters and animals into the Nile Valley, the cattle became domesticated, and the Egyptians invented the plow. On the basis of these two achievements—cattle-breeding and agriculture—there arose in the Nile Valley the earliest known society of several million souls, a social and governmental structure the emergence of which was the dawn of civilization.

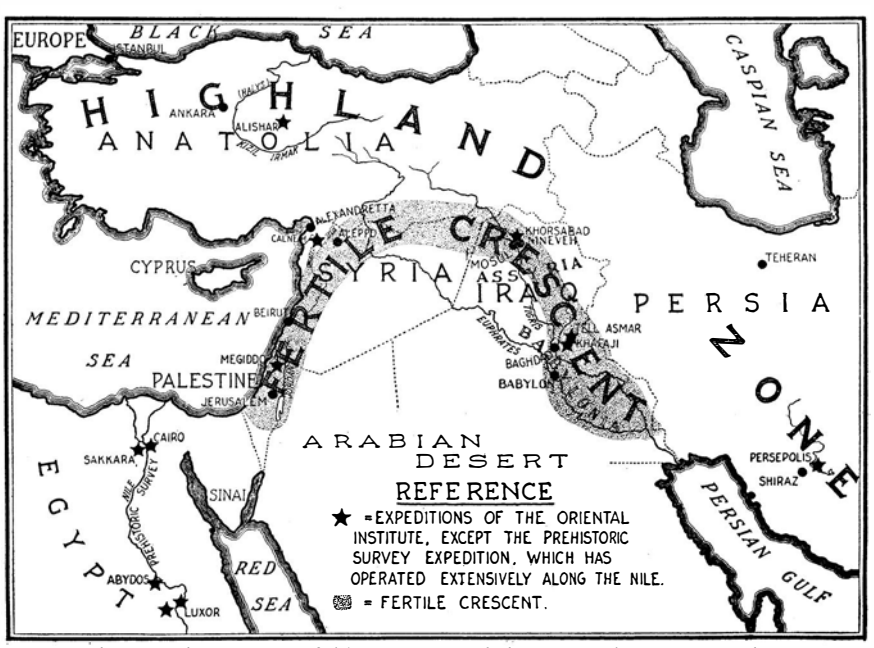
In the masonry tombs at Sakkara (the cemetery of ancient Memphis), on the west bank of the Nile some 14 miles from Cairo, is found an elaborate picture of early society in the magnificent colored wall-reliefs. They date from 3000 to 2500 B.C. and depict the industrial, agricultural and social life of Egypt in the Pyramid Age. They form the earliest graphic revelation of the life of man. The Sakkara Expedition of the Institute is reproducing these wall-reliefs in color.

For nine years the Oriental Institute has been copying thousands of lines of the so-called "coffin texts." About 350 such coffins are preserved in the Cairo Museum while many more are scattered throughout the museums of Europe and America. The documents are for the most part inscribed on the insides of beautifully painted Egyptian coffins of some 4000 years ago. They deal largely with social idealism and altruistic conduct. The literature that resulted had eventually a great influence on the religion of the Hebrews. These writings were afterwards largely absorbed into the famous *Book of the Dead*, which cannot be understood without a thorough study of the coffin texts.

In the next few years the results of these painstaking researches will be published in a series of five volumes which will reveal a new chapter in the progress of early man—the dawn of conscience. In connection with the Egyptian Exploration Society the Institute is saving the records of the beautiful temple of Seti I at Abydos. These reliefs are among the loveliest works of art surviving from the ancient world. They will be reproduced in color as will also be the ancient paintings on the walls of tombs in the great Theban cemetery.

About 2000 B.C., national development all around the eastern end of the Mediterranean led to international rivalries out of which came the Imperial Age. Early in the 16th Century B.C., Egypt gained a prominent position and for 400 years was imperial mistress of the ancient Oriental world. As the first world-power, Egypt was able to create colossal monuments, many of which still survive and await rescue and study. This vast group of monuments forms the largest ancient body of evidence still left unsalvaged in the Near East. It consists chiefly of inscriptions and reliefs on the walls of the great tombs and temples of the Nile.

At ancient Thebes, known more widely as Luxor, the Institute began, in the winter of 1924-1925, what has become its largest undertaking in the Near East—the Epigraphic and Architectural Survey Expedition. For seven years the experts have been working at the colossal temple of Medinet Habu. The enormous body of inscribed and sculptured records will be saved for all time in a series of ten or twelve folio volumes. These records, dating from about 1200



Map showing the extensive field operations of the Oriental Institute in the Near East. There is a grand total of 13 undertakings of which 12 are still in progress

B.C., disclose Europe for the first time entering the arena of Oriental History and reveal something of those migratory movements which carried the Etruscans from Asia Minor to Italy.

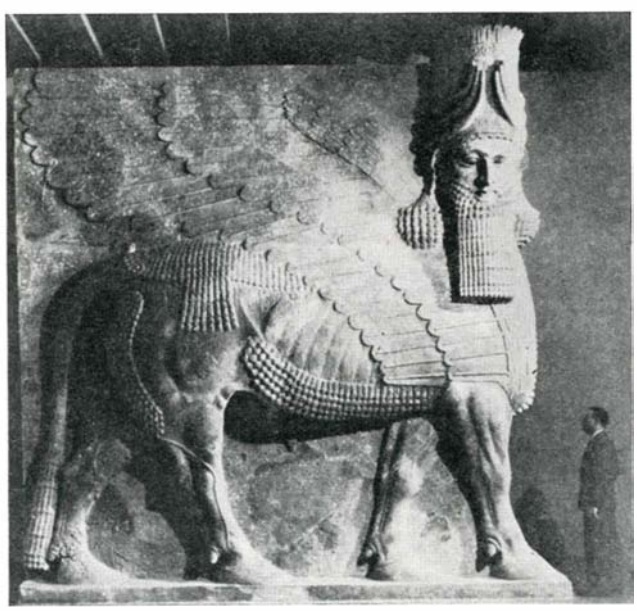
THE first step in the practical process of saving these inscriptions is making a series of many hundreds of photographs, which have been enlarged to the size of an artist's portable drawing board. With these the artists go to the wall, where they inspect the original inscription and also do much penciling directly on the enlargement. With India ink the artists then carefully trace all the lines of the original directly on the face of the photographic enlargement. (See illustration, page 198.) The ink-traced photograph is then bleached in a chemical bath so that the photograph disappears, leaving only white paper bearing the ink lines. From this ink-drawing the darkroom assistants make contact negatives, printed on brown iron-paper. Thereupon these paper negatives make very simple the production of blue prints which can be cut up into sections and pasted on convenient correspondence-size sheets of paper, leaving ample margins for corrections.

The epigraphers take these blue prints to the wall, where they compare the artists' work, sign by sign, with the original inscription. This is a kind of "proof-reading" which is done repeatedly for the purpose of eliminating all mistakes. When the artists have entered all corrections on the drawings, the result is a facsimile of each inscription containing far more than a photograph can record. This facsimile combines three things: the speed and accuracy of the camera, the skill and clearness of the artist, and finally the reading ability of the epigrapher, who sees much which is not recorded by camera or artist.

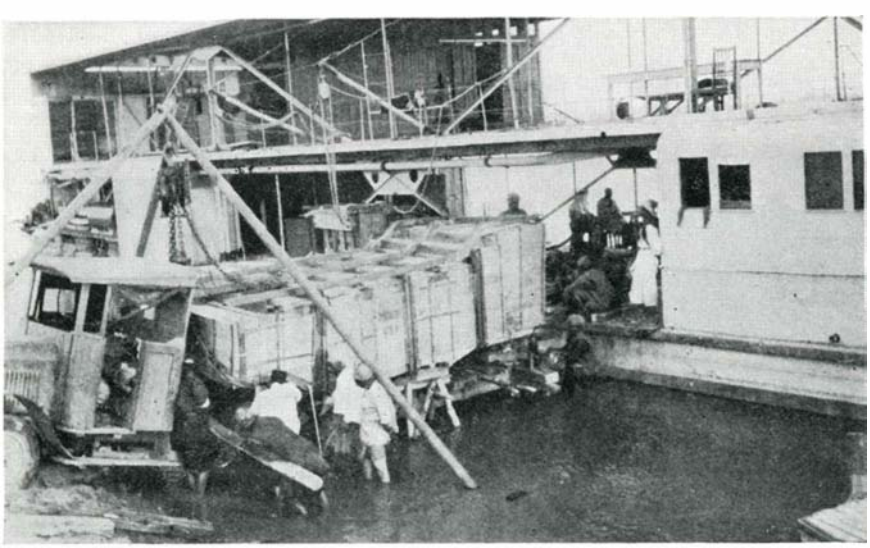
The same expedition is conducting extensive excavations in order to recover the architecture of the great Theban temples and other buildings. They find that the largest halls of this Pharaoh's palace had vaulted ceilings and were not, as we had formerly supposed, flat-roofed like Egyptian temples. The halls were forerunners of the clerestory architecture of Europe with high nave and lower side aisles.

As far as the human career in northeast Africa is concerned, the Institute is salvaging and studying evidence along a chronological series of periods extending from the geological ages down to the emergence of Europe in the history of the East.

By a reference to our map we find what is termed a Highland Zone, which gave rise to a Highland civilization extending from the Aegean Sea to Persia. South of this zone lies the great Semitic world; between are smaller groups of adjacent cultures. Within this area lies a great desert, the fringes of which form a "fertile crescent" where all these cultures met and commingled. The once teeming cities are now reduced to silent mounds, but mounds which embalm great archives of cuneiform tablets. In Palestine, Syria, Anatolia, Assyria, Babylonia, and Persia, the Institute has selected a great group of historically significant or promising points at which to plant a series of expeditions, each of which is investigating a particular civilization together with its related cultures. Next year the Prehistoric Survey will shift from the Nile to the Tigris and Euphrates to try to fill up the gap before the historic age of writing.



Above: **Legs of the great winged bull found at Khorsabad, 15 miles from Nineveh.** ***Left:*** **The re-assembled bull in Assyrian hall of the Oriental Institute. It is 16 feet high, weighs 40 tons**



Loading the largest fragment of the bull upon the Tigris River steamer. The block weighed 19 tons; had a cable broken, the loss would have been irreparable

The oldest centers of early civilization in Western Asia were along the east end of the Highland Zone and in Babylonia and Assyria which now form the modern kingdom of Iraq. The Institute holds a concession to excavate four ancient city mounds. The most important is Tell Asmar where a headquarters building has been built.

Tell Asmar has been identified with

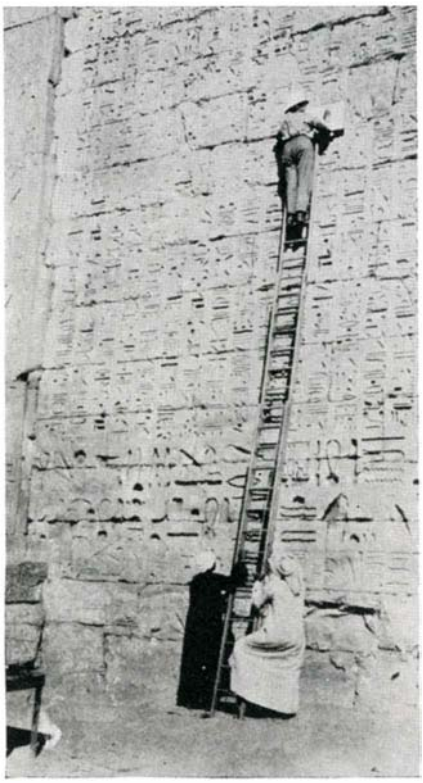
the ancient Ashnunnak—a city-kingdom which once extended from the Persian frontier to the region of Bagdad. There is a succession of ancient palaces at Tell Asmar, where several Babylonian kings built upon one another's structures. Fortunately it was the custom of the time to stamp the ruler's name on the bricks, thus rendering invaluable assistance to the modern historian. Among the discoveries which have been made is a bathroom with a baked tile floor and plastered with bitumen. The floor is provided with drain tiles to carry off the water from the shower bath.

The importance of these researches lies in the fact that this region east of the Tigris stretches eastward towards the Persian mountains; that is, toward the eastern end of the Highland zone, where dwelt round-headed peoples like the Armenians. Such Highland peoples overflowed into the lowlands of the south and their influence extended as far as Bagdad.

IN Iraq, the Royal Air Force gave great assistance, Great Britain holding the mandate for Iraq. For example, where a desert surface is suspected of containing ancient foundations, a photograph is taken from the air and when the plate is developed the lines of the ancient walls may be traced quite clearly. They are betrayed by the absence of grass. The grass of the plains is nourished by the winter rains and grows chiefly in the spring, but fortunately it never appears on the shallow soil covering the walls of an ancient site. Although the walls may be invisible, their ground plan is thus revealed.

Captive balloons such as used for meteorological observations were employed. A reel carried several hundred feet of strong cord which served to bring the balloon to earth. Another reel carried a similar amount of electric cable through which the shutter release on the camera was operated.

At Megiddo, these balloons are being used to photograph the city plan as fast as the streets are excavated. A tall ladder supporting a photographer is also used for the same purpose.



Epigrapher who can read inscriptions is "proof-reading" the tracings

At Khorsabad, 15 miles north of modern Mosul on the site of ancient Nineveh, the expedition has discovered a series of relief sculptures. The most notable piece is a huge winged bull which now adorns the Assyrian hall at Chicago. Its transportation was one of the feats of modern archeology. Such a winged bull was called by the Assyrians and Hebrews a *cherub*, a term which was curiously misunderstood by older biblical interpreters.

The most important of the Highland peoples were the Hittites and the great mound of Alishar was selected for excavation. They disclose for the first time the successive stages of ancient life in Anatolia from the Stone Age at the bottom, some 80 feet below, to the latest Turkish levels at the top—a range of some 5000 years.

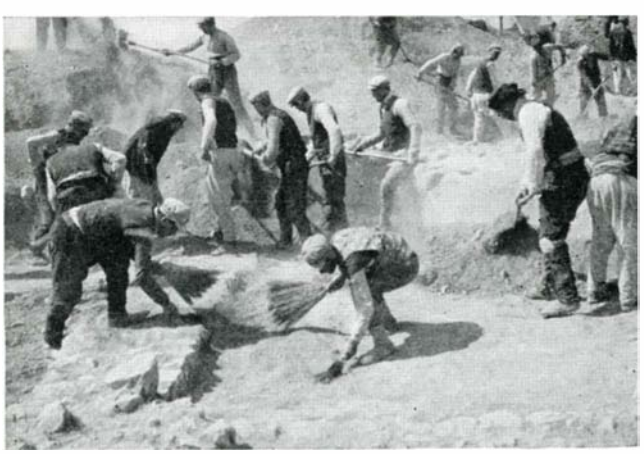
Palestine offers a fertile field for exploration and those of the Institute at Megiddo are most important. This is one of the great battle fields of the world. The strong fortress city commanded the pass from very early times and it was through this pass that Allenby advanced to his great victory on the plain of Armageddon near the close of the World War. Thus far the excavation has descended to the stratum of the Hebrew kings. The work was illustrated in our issue of June, 1931.

THE ancient Hittite Empire not only included all of what is today Asia Minor or modern Turkey but extended southward into Syria. In northern Syria we find great numbers of ancient city mounds once inhabited by the same Hittite people whom the Institute is investigating in its Anatolian excavations at Alishar. About halfway between Aleppo and Alexandretta there lies an ancient mound which explorations have identified as probably the important ancient city of Calueb.

Persepolis, the magnificent capital of the Persian emperors, lies 40 miles from Shiraz high on a plateau among the Persian mountains. Its chief founders were Darius and his son and successor, Xerxes. On the spacious terrace are the colonnades of the imperial palaces, rendering it one of the most impressive places in the world. In 1930 the Persian cabinet granted a concession to the Oriental Institute to excavate and restore Persepolis.

Here we must leave this fascinating chronicle of achievement. We wish to acknowledge our debt to the publications of the Oriental Institute in the present brief review of their activities. This great institution is adding a larger though remote world. It is recovering as speedily as is commensurate with safety the fragments of the world's greatest epic—the conquest of civilization.

Work by the Anatolian (Hittite) Expedition on the citadel mound at Alishar. Explorers cross-cut the mound



The natives work with meticulous care, superintended by a member of the expedition. Not even a needle escapes

OUR POINT OF VIEW

Air Transport

DESPITE adverse conditions, air travel is increasing. During the first six months of this year, passengers carried on air transport lines in this country totaled 223,834 as compared with 176,143 during the first six months of 1931. This figures out as a 30 percent increase. Airmail poundage for the same period showed a 6.4 percent drop but air-express poundage increased 72 percent.

All of which promises much for the future of civil aviation in this country. Even the airmail poundage is in effect an increase for it has not decreased in anything like the proportion of income and business revenue decreases. If this country can support its air services to this extent under adverse conditions generally, it is to be expected that when normal times return, the aviation industry will make unprecedented strides ahead.

After the World War we were for a time far behind European nations in the use of the airplane. By 1929, however, we had made such progress as to eclipse individual European nations in some respects. Now, we are far ahead in miles flown, route-miles, and in many other ways. Yet much remains to be done. We have some of the fastest commercial planes in the world, but we haven't the largest, nor have we attempted to build a stratosphere plane. Perhaps faster and larger planes will be necessary in the future, and future transatlantic services may depend upon stratosphere planes. No one knows the answer to these conjectures but we ought to investigate all such possibilities and find out for ourselves. We have made some splendid records in the past; why not make more, not for the superficial glory but in the interests of the greater progress that would surely follow?

"Seed"

WHEN an independent individual makes a scientific discovery he is free, if he can, to make a fortune from its proceeds, but when a scientist attached to a university makes one there is a tradition that he must exert no effort to profit personally by it but must publish it for the benefit of humanity. Too often this means that humanity receives benefit only after an astute person who has never contributed the shred of an idea toward the original discovery reaps a munificent profit from something he did not create. This tradition of science began before the days of mass production and vast fortunes. Today it is anachronistic.

To remedy the same anachronism Professor Winterton C. Curtis of the University of Missouri recommends that this tradition be broken in the following manner: University scientists will go through the formality of taking out patents on their discoveries wherever practicable, and assign these to permanent holding companies organized by the universities. Commercial firms wishing to manufacture will then deal with the university holding company.

The scientist would not receive personal gain but he would have the satisfaction of seeing a fair share of the ultimate profit returned to his institution where it would be used for advancing further research—in other words as "seed"—and, still better, to science.

Several universities are employing this method already. There should be more.

A Weapon for Peace

FROM the welter of plans for world peace, of treaties and disarmament programs, there stands out one significant act, or rather statement of international policy which bids fair to eclipse all others in its potentialities as a war-preventive. This is the twice repeated and emphasized Hoover-Stimson doctrine that neither gains of territory nor agreements favorable to the victor, achieved by force of arms, will be recognized by this country. Since this non-recognition policy was first promulgated by Mr. Stimson in January, it has been accepted by the League of Nations, acclaimed widely throughout the world, and recently adopted by Latin-American countries apropos the threat of war between Bolivia and Paraguay concerning the disputed Chaco territory.

This powerful new policy has put teeth into the Kellogg-Briand pact, an admirable document which previously was nothing more than an evidence of good intentions, a theoretical outlawing of war. Hence the scene now changes. A nation is not so likely to go to war if she is predestined to lose all the fruits of a possible victory over her enemy. If her grievance has to do with territory or commercial relations, she will know beforehand that she can not hope to gain by force; if she has suffered a real or imaginary slight, she will feel more inclined to permit an international tribunal to exact the apology rather than sacrifice the lives of thousands of her youth. Nations start offensive wars usually to gain material advantages over other nations, to punish the foe by taking land or cash indemnities or both.

Out of this non-recognition policy may grow ideas for commercial and financial "blockades" against belligerent nations. Such blockades, applied by neutral nations together with a strict adherence to the Hoover-Stimson policy, might in time really make wars impossible. Then perhaps would come the long-desired millennium when disarmament is no longer an international problem, for nations would have no armament to relinquish.

Ideas

INDUSTRY not only maintains its research and engineering departments but it also has its ear always to the ground, listening for the faintest murmur of an idea. Even with all the attention given to any process or product by the experts—the development work right down to the last rivet, the last coat of paint, or the last chemical bath—industrial products and the processes by which they are made are never quite perfect.

Back in 1910, the Westinghouse company instituted a plan for cash and salary-increase awards for employee's ideas. The plan was a good one, for the employee in the actual production work will often see what the expert in the laboratory has failed to see. Since 1910, more than 47,000 ideas covering methods, design, improvement of apparatus, prevention of accidents, and the like have been submitted by the company's employees and 25 percent of these have been approved.

The Westinghouse idea plan has been used as a model by many other industrial organizations. And yet, what does it all mean? Simply this: that when the experts have found "all" the "bugs" in the process of constructing, for example, an electric motor, an employee who winds that motor discovers still another "bug," tells the company how to save a few cents in wrapping the coils, and the company gains thereby. The employee is rewarded; the saving is passed on, in part at least, to the customer; competitors have to meet the lower price; and buyers are benefited generally. It *is* a good plan.

ULTRA-VIOLET LIGHT AND FORGERY

By ELBRIDGE WALTER STEIN

THERE is a constant war between the forces of organized, law-abiding society and criminally minded evil-doers of whom the forger is a conspicuous example. The struggle is not always an even contest and sometimes it seems that the criminals have outwitted those who support the law and the government. But, stimulated by necessity and aided by science, the pendulum after a time swings the other way, and again our solid citizen is more nearly master of the situation.

Forgery is one of the branches of crime that each year takes a heavy toll from American business. No accurate and complete record of the amount of the loss is available but it runs into many millions. To stop this unwarranted stream of gold from flowing into the pockets of the forger is one of the main battle objectives of the law. The work of the forger, however, is not always easy to discover and is not usually discovered until after the damage has been done. He is armed with a chemical arsenal of coloring and decoloring substances as well as an exceptionally high degree of skill in their use. He takes every care to leave nothing behind that may help to uncover his forgery or identify him. The expert who investigates documents that are suspected of being forged relies upon his knowledge and experience aided by the implements and processes of the scientific laboratory; he must constantly be ready to take advantage of all new aids placed at his disposal.

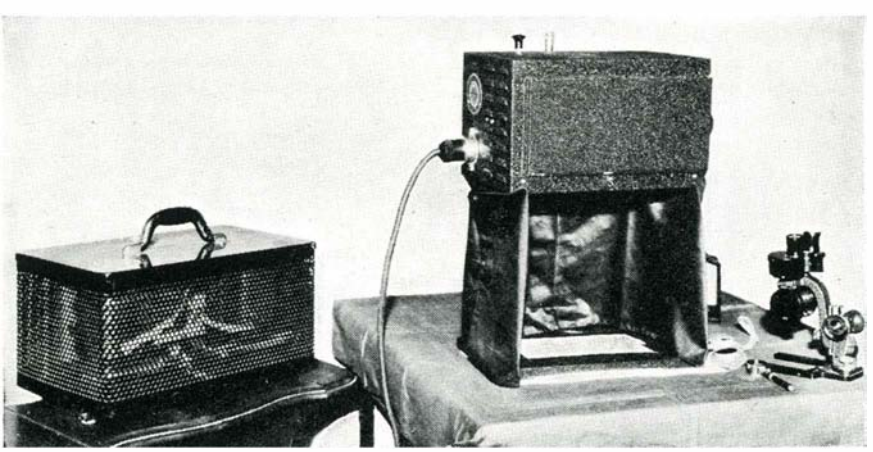
SCIENCE has now put another powerful instrument in the hands of the expert to assist in the discovery of fraud in documents. This instrument is the quartz mercury vapor arc which radiates a high percentage of ultra-violet rays. These rays are not a recent discovery; neither is the mercury vapor arc an invention of yesterday. But the application of ultra-violet rays in the examination of documents has not heretofore been thoroughly investigated over a sufficiently wide field so that authoritative statements could be made concerning the results. New uses are constantly being found for the valuable ultra-violet rays, and the experiments described in this article were conducted in order to widen still further the horizon of their application, especially to explore more thoroughly the field of their possible value in the correct solution of document problems, forgeries and so on.

IN detecting forgery by means of the ultra-violet rays, professional investigators such as the author of the accompanying article make chief use of the physical phenomenon of fluorescence. The author wisely states that the cause of fluorescence is an excursion into technical optics which he will not attempt here. Nor, for several good reasons will the editor, one reason being that the cause of fluorescence in solids is not known. Of course, we may go so far as to say that radiation at a certain wavelength is absorbed and a new set of radiations excited by the original radiation is given off; also pointing out the convenient fact that it happens that the received ultra-violet radiations do not affect our sense of sight but that the re-radiated waves do, being longer. However, this is not the ultimate explanation. The interested reader is referred to the article "Fluorescence and Phosphorescence," by Prof. R. W. Wood of Johns Hopkins (incidentally a contributing editor of this magazine) in the Fourteenth Edition (1929) of the "Encyclopædia Britannica".—*The Editor.*

The ultra-violet rays are invisible, being outside of the field of visibility on the violet or what is known as the cold end of the spectrum. The light generated by the quartz mercury vapor arc is not all invisible ultra-violet and, in order to use the rays to which the eye is blind, it is necessary to filter out most of the visible light. In the examination of documents this filtering is done by means of a glass screen which holds back nearly all of the visible light but permits the invisible ultra-violet rays to pass through. Such a screen (made on a base of nickel oxide) is a very dark red-violet color appearing black, and from this appearance the early experimenters called ultra-violet rays "black light."

The effect of filtered ultra-violet light which is a valuable aid in the detection of forgery, is called fluorescence. Although the rays themselves are invisible, they are capable of generating visible light when they strike certain substances. Fortunately, a number of these substances are used in documents and give this peculiar fluorescence when flooded in darkness by ultra-violet rays. The explanation of the cause of fluorescence is an excursion into technical optics which will not be attempted here. Of greater interest are the practical ways that these effects can be used to detect evidences of fraud in documents.

There are three main divisions in a fluorescence study of a document: First; certain kinds of materials can be distinguished from each other although by ordinary observation in daylight they are identical. Second; certain things that are invisible even under the microscope are made visible by



Equipment for investigating documents by means of ultra-violet rays. The lamp above sheds its rays downward. The object shown at the left is a transformer

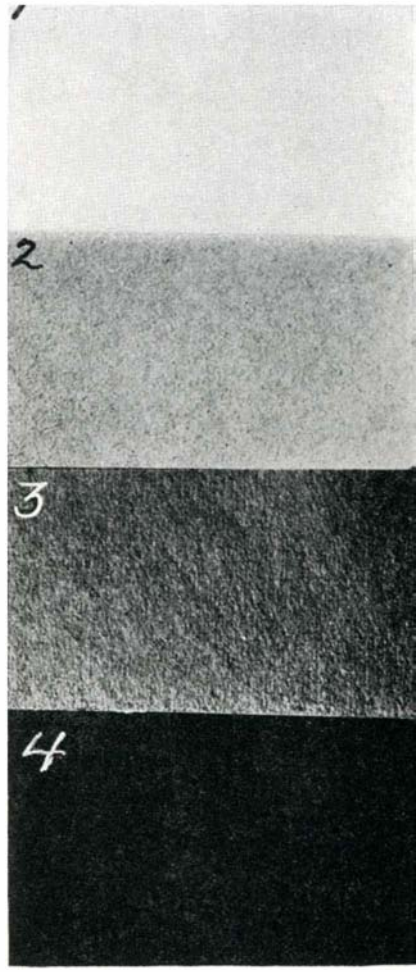
filtered ultra-violet light. Third; and perhaps the most valuable phase of the fluorescence study of a document, is the possibility of photographing the peculiar effect of the ultra-violet rays on document materials. It is also a surprising and helpful fact that the sensitized photographic plate records things that cannot be seen by the eye even when the document is exposed to the ultra-violet rays.

Fluorescence of a document takes several forms, depending upon the paper, ink, or any chemical or other materials in the object examined. It is sometimes a silvery glow like phosphorescence, while other materials, which under ordinary light seem to be white, will appear a surprising dark brown or bluish color. Chemical erasures which show no trace whatever of their existence in ordinary light, often appear as a dark blot when a fluorescence study of an erased area is made.

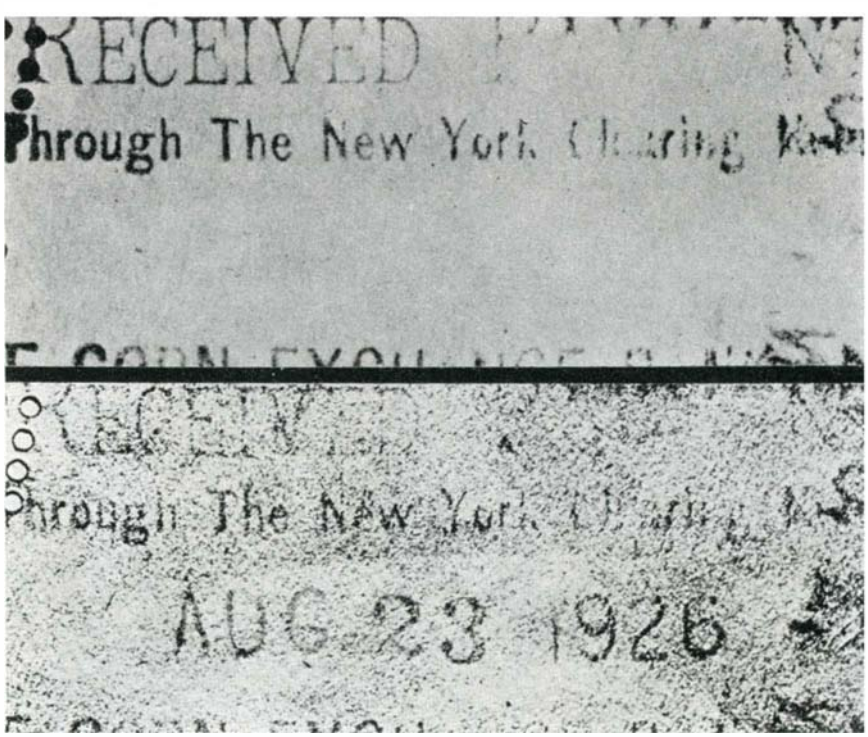
The studies illustrated in this article were made with a Hanovia quartz mercury vapor arc. This lamp is a powerful source of concentrated ultra-violet rays. The intensity of the light from a quartz mercury vapor arc can be best understood when it is realized that sunlight contains only about seven percent of ultra-violet rays but that approximately 28 percent of the entire radiation of the mercury vapor arc is ultra-violet. If the human skin is exposed for some time to the unfiltered rays of this lamp, it will produce the same effect as sunburn.

Papers made of different basic materials or sized with different compositions can be positively distinguished from each other by the fluorescence test. Therefore, a document consisting of several sheets with a substituted page on different paper can thus be shown to be irregular. Paper made of pure cotton rags gives a clear white fluorescence, while that made of pure linen rags is a distinct bluish color under the ultra-violet rays. Paper containing chemical wood-pulp appears as a dark grayish brown, the depth of the shade depending upon the proportion of the wood-pulp to other ingredients. Mechanical wood-pulp paper appears almost black when a fluorescence study is made of it. Vegetable or animal size and various coating materials have their own individual reaction to the test which makes it possible still further to distinguish between different papers.

ALTERATIONS in documents, such as changed dates, elimination of words or sentences and fraudulently added matter, may sometimes be shown with startling clearness. The residue of erased writing often stands out sufficiently plain so that the original writing can be read. This remarkable disclosure is the result of fluorescence. In some instances the erased ink lines, or rather the place they occupied, do not fluoresce, while all the remaining paper gives off the strange effect of the light; in other instances the erased ink lines give a distinctive fluorescence of their own which in either case makes a definite contrast between the erased ink lines and the surrounding paper, thus giving visibility to the original writing. Such a result is often of the greatest importance in the study of a disputed document. One of the commendable things about this process is that the document is not harmed or changed in any way, so that no matter how fragile or how valuable it may be, it can be studied under the effect of the ultra-violet rays with no danger of the slightest injury.



In ultra-violet rays, pure cotton rag paper is white, as in 1; linen rag paper is bluish, 2; chemical wood-pulp paper brownish-gray, 3; news-print paper almost black, 4



Upper: **An ordinary photograph of a rubber stamp with the date removed.** *Lower:* **The ultra-violet rays brought out the evidence of the same stamp**

In the past, with the necessary knowledge and the proper materials, it has been possible to restore chemically erased iron-base ink by subjecting the document to chemical fumes which discolor the residue of iron remaining in the paper. This result is explained by the fact that a chemical erasure takes only the color out of the ink, while the iron remains in the place occupied by the original pen strokes. This, when discolored, makes the original writing again visible. This process of restoring erased ink always produces a temporary yellow stain on the document and occasionally some of this stain never entirely disappears.

Another phase of the fluorescence study of a document of great importance is that heretofore there has been

Upper: **Ordinary photograph of back of a check in area where endorsements should appear.** *Lower:* **Ultra-violet light shows evidence of three endorsements**

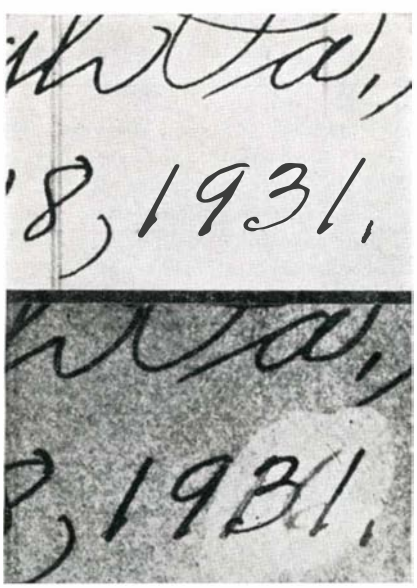
no way to restore bleached or erased writing that had been written with nigrosine or any other aniline ink, but repeated experiments now prove conclusively that the residue of many of these inks fluoresces in a pronounced way, so that they can be photographed and made visible although not a trace of them can be discovered on the altered document. In this respect the fluorescence caused by ultra-violet light supplies a valuable and unique service.

A RECENT practical application of the ultra-violet rays was made by Albert D. Osborn in the trial of the case of People *v.* "Nate" Raymond, tried in New York in January, 1932 in which he was convicted of fraud in relation to stock certificates. The rays showed that under the endorsement, "Nathaniel L. Raymond," the name, "Kidder, Peabody & Co." had previously been written. The rays also showed that the date put on by a rubber stamp had been removed and a new date inserted. The jury examined the document under the light, this being among the first, if not the first, use of the ultra-violet test in a jury case.

The ultra-violet rays will not make every eradicated writing legible but there are certain erased writings which, when they cannot be read by a fluorescence study of the front of the sheet, can easily be deciphered by examining the back of the paper under the rays. Of course, the writing is then reversed and must be read backward or by the aid of a mirror.

Sometimes the field in which an erasure has been made is shown as a distinctly disturbed area even when the details of the original writing cannot be deciphered, and when it can thus be shown that an alteration has undoubtedly been made, it casts a suspicion on the document and compels an explanation by the persons who would profit by the alteration; when the change is a fraudulent one, these explanations are usually so improbable as to condemn the document.

A valuable part of a fluorescence study of a document is making the effects permanent by means of photography. Fluorescence not only can be recorded on the photographic plate but these effects can be enlarged and put into such concrete form that anyone can see them and, when they are properly explained, understand them. An additional and highly important value of photography, as stated above, is the fact that certain details can be recorded on the photographic plate which are not actually visible to the eye even under the ultra-violet rays. This startling result has two main explanations: First, the necessary visible light produced in generating the ultra-violet rays is reduced to the lowest practical point when making a fluorescence study, and this dim light necessarily increases the difficulty of seeing the complete details of fluorescence. The second reason is that the rays themselves, which cause fluorescence, are wholly invisible, but the effect of some of them passes through the lens of the camera and makes an impression on the photographic plate so that things are recorded which are invisible to the eye. No thorough fluorescence study of a document should omit careful photographing of the effect of the rays. Although fluorescence effects on a document are not easily photographed, it can be done with special equipment and a knowledge of the exacting requirements. The photographs illustrating this article were made with specially designed equipment.



Upper: **The date of a will as photographed in the ordinary way.** *Lower:* **The same area photographed by the ultra-violet rays. It is clear that the date was originally 1916, and that the "16" was taken out and altered to "31" at a subsequent time**

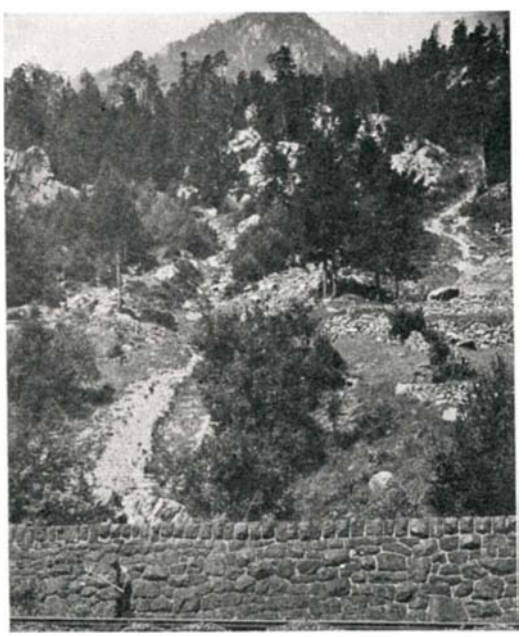
THERE are many lines of document and other investigations in which the ultra-violet rays are very useful when it is possible to compare one thing with another at the same time, because the efficiency of this process as a general testing medium is remarkable. As a rule, bogus postage stamps or counterfeit money can readily be detected when a genuine specimen of the same issue or design can be compared with the one suspected of being fraudulent.

It should be understood that the quartz mercury vapor arc is only an additional tool in the hands of the expert who aims to assist in the discovery of fraud in documents and is not an end in itself but an aid to one qualified to use it. It does not take the place of the one employing it nor does it supplant other scientific instruments or processes. It has had a limited field, up to the present time, in which its value has definitely been proved, but this field undoubtedly will be widened by further experiments and study and by the practical application of the process to the solution of certain classes of forgery problems. It does not replace knowledge, intelligence, or reasoning and it is of value only when used by a skilled and experienced observer who knows what to look for and who can correctly interpret what he sees.

Upper: **Back of a note photographed in ordinary daylight.** *Lower:* **Back of same note, showing the effect of fluorescence by the ultra-violet rays when photographed. Thus, definitely erased ink can be made visible once more**

Photographs courtesy Official Information Bureau of Switzerland

The Swiss Federal Railroads have erected this protection against avalanches on the St. Gothard line between Gurtnellen and Wassen



Upper right: **A wall of masonry strategically placed to break the force of an onrushing avalanche**

Right: **Another type of wall employed in Switzerland to prevent damage to railroads by avalanches**

Left: **A beautiful vista of high mountains that threaten potential disaster to railroads. Engineering skill is constantly on the alert to prevent avalanches from covering or destroying the tracks**

Avalanches and Avalanche Protection

THE beautiful photographs reproduced above show some of the measures that are taken in the mountains of Switzerland to protect the railroads from the devastating effects of avalanches. To the average man, an avalanche is just an avalanche or large snow slide; however, there are different kinds of avalanches, generally classified as either "ground" or "dust" types.

Some of the ground avalanches affect but slightly the actual surface of the land over which they travel, while others dig deeply into it, furrowing it as if by gigantic plows. Both kinds sweep away rocks, trees, and houses that happen to be in their way. When the so-called "black" avalanche comes to rest, it is an ugly accumulation of dirt, tree trunks, and mud-colored snow. The "white" variety, however, though equally destructive, comes to rest with a clean, untarnished, glittering surface.

Dust avalanches are the most dreaded, because while the ground avalanches fall according to well-known rules and at certain times of the year, those of the dust variety are erratic in their movements. Dust avalanches consist of dry, powdery snow, susceptible to the slightest vibration. Loosened from the vertical cliffs to which it has been clinging, it starts to run like grains of sand, growing as it falls by drawing down with it other beds of snow. Gathering speed, it rushes downward with a deafening roar caused by the tornado-like wind that always accompanies an avalanche, uprooting trees, and crushing chalets or whatever else happens to be in its path. At the end of its course of destruction, it covers the ground with a bed of snow from 30 to 50 feet deep.

So-called "melting avalanches" are a regular feature in certain alpine districts when the warm breath of spring softens and loosens some of the frozen snow. These avalanches invariably follow certain tracks, and dwellings are usually huddled together well away from these paths. Long experience has enabled the Swiss people to meet avalanche dangers with adequate measures of defense.—*Marie Widmer*

Some of the

THINGS THAT HAPPEN IN SUNSPOTS

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

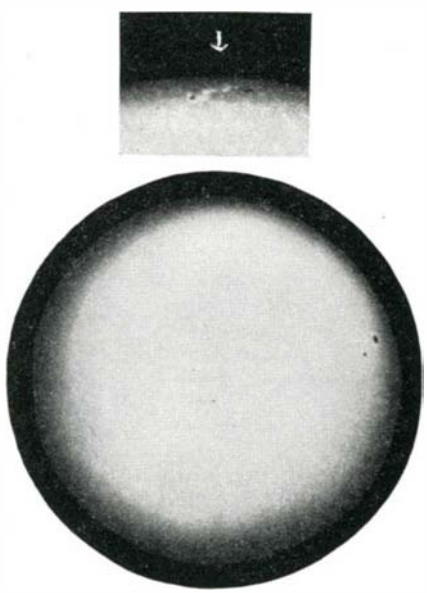
EVERYONE knows that an astronomer may take a photograph in a few minutes, or even seconds, which may record such a wealth of information that it takes him months or years to extract it. But it is not so usual that one worker after another may find the basis for extended research in material which has already been published and made available years before to anyone who cared to pay the mere cost of prints from the original negatives. Yet even this happens, as is illustrated by a fine piece of work which has recently been done upon the spectrum of sunspots.

The reader may pause here to query why we did not say "spectra," as would assuredly be necessary if we were speaking of the stars. There is a good reason: Unlike the stars, different sunspots show spectra which, though notably different from that of the sun's normal surface, are practically identical among themselves; so that we speak of the spot spectrum as a definite entity.

THIS has been realized since the work of Lockyer and Young, more than 50 years ago, but most of the differences are in the finer details and it is only with very powerful instruments that they can be fully displayed. Then they are conspicuous enough. Figure 1 shows two small regions of the spectrum, in the orange and the red, photographed with the tower telescope and the great spectroscope at Mount Wilson. The image of a sunspot was thrown on the middle of the slit, leaving that of the undisturbed photosphere to appear on either side—judiciously screened to avoid over-exposure.

Three types of difference between the spectra of the spot and the disk (as we often call the ordinary surface of the sun) are obvious on inspection. First, a good many lines are strengthened in the spot spectrum, while some are weakened. Second, the lines in and near the spot spectrum present a curious zigzag appearance. Third, numerous faint lines appear in the spots but not on the disk, and are free from the zigzag effect. The first of these peculiarities depends on the lower temperature of the spots, the second on the presence of a magnetic field within them (revealed by suitable polarizing apparatus), the third upon the presenee of compounds which are decomposed at the higher temperature of the disk. Any one of these offers material for years of work. Only the first has yet been analyzed in full, and it is of this that we have now to speak.

The general explanation of the strengthening and weakening of lines in the spot spectrum was given more than 20 years ago by Hale and his colleagues at Mount Wilson. Comparing solar and laboratory spectra they found that lines notably strengthened in spots were in-



Below: **Photoheliograph of the sun, made by Gustavus Wynne Cook, amateur astronomer.** *Above:* **Same of a spot on the limb. Note depth**

variably stronger, relative to others of the same element in the light from a relatively cool electric furnace, than from the far hotter arc; while the weakened spot lines were also weakened or absent in the furnace, and sometimes required the still higher excitation of the condensed spark to produce them artificially. No one has doubted since, that the differences arise because sunspots are cooler than the rest of the surface.

To understand just how this happens we must as usual have recourse to the properties of the atoms which absorb the light. Probably all our readers recall that the arc lines are produced by atoms which retain all the electrons which make up their structure and the spark lines, or "enhanced" lines as they are often called, by atoms which have each lost an electron. To knock an electron out of an atom takes a great deal of energy, so it is not surprising that in the cooler atmosphere above the spots fewer of the atoms are thus ionized, and that the lines of ionized iron (marked Fe^+, at 6407, 6416, 6432, 6456) are greatly weakened. Conversely, there should be more neutral atoms in the spots, and the strengthened lines all belong to neutral atoms (such as those of vanadium at 6111, 6119, of titanium at 6126, of sodium at 6154, 6122, and the greatly widened and winged lines of calcium at 6122, 6162).

But there are exceptions to these simple rules. The line of barium at 6141 is certainly due to ionized atoms, yet it is not weakened at all in the spots (it is mixed up with a closely neighboring iron line in the sun but this is not strong enough to make much trouble). On the contrary some lines of mutual atoms are weakened; for example, those of nickel at 6130 and 6414, although the neighboring nickel line at 6128 is strengthened.

THE first exception is of the kind that "proves the rule." Barium is very easily ionized and even at the lowered temperature of the spots the vast majority of its atoms are in that state. Its enhanced lines therefore do not weaken, and to confirm this explanation it is found that its arc lines do not appear at all. To account for the weakened arc lines of nickel we must go a step further.

The hundreds of lines in the arc spectrum of nickel are all absorbed by neutral atoms of that element, but not all by the same atom. As soon as the metal is volatilized its atoms stand ready to absorb some of the lines, but they would not absorb others unless they have previously been loaded up with energy and so got into excited atomic states. Great numbers of these states are known for the more complicated atoms, each with its own excitation energy. The higher the temperature the larger is the fraction of the atoms which get into these excited states. Hence when we pass from the disk to the spot we find fewer ionized nickel atoms and more neutral ones, but a smaller proportion of the latter are excited. Whether the gain exceeds the loss or not depends on the degree of excitation. Thus the line at 6128 is absorbed by

atoms excited to a degree measured by 1.67 volts, while its neighbor at 6130 requires 4.25 volts. In the latter case the loss exceeds the gain, and the line is weakened. In the former the gain overweighs a little and the line is slightly strengthened. The line absorbed by the unexcited atoms would be considerably strengthened, but these lines lie in the ultra-violet.

A detailed study of the whole sunspot spectrum upon the principles just described has recently been made by Miss Moore, a colleague of the writer's, working at Mount Wilson by special arrangement with the Lick Observatory where she held a fellowship while on leave from Princeton. (This, by the way, is no more than a typical instance of the co-operation which aids so much in the advance of American astronomy.)

The first necessity was to make a complete census of the "atomic lines" in the spot spectrum (leaving aside the still more numerous band lines due to compounds which may be recognized by the absence of the magnetic Zeeman effect). No less than 6635 of these were recorded between the violet and the red. (There are as yet no satisfactory photographs of the spot spectrum in the infra-red.) More than 450 of these lines appear only in the spots. Examples may be seen in Figure 1, at 6134 and 6413. They are faint lines of neutral atoms which are reduced below the line of visibility at the high temperature of the disk.

Next the lines had to be identified by comparison with laboratory data. Much of this work has previously been done by Rowland, but about a thousand new identifications resulted from the later study, largely because we know enough about most spectra now to be able to predict very accurately the positions of many lines too faint to be observed in the laboratory—raising the number almost to 4500.

The way was now open for an exact application of the principles which were sketched above. Methods for estimating the number of atoms involved in producing solar lines of various intensities were already available, so that the various influences affecting the sunspot spectrum could be expressed numerically. For example, the diminution in the number of excited atoms due to the lower temperature of a spot was found to correspond to a factor of 0.65 for each volt of excitation. Taking the temperature of the sun's disk as 5740 degrees Centigrade, the generally accepted value, this leads to 4720 degrees for the spots—in perfect agreement with the value 4750 degrees found by Pettit and Nicholson from the heat radiated from spots.

KNOWING the temperature, the ionization of the various elements can be calculated if only we know the pressure; or, reversing the process, the average pressure necessary to account for the observed ionization can be found. This came out to the 60 percent of that prevailing above the disk. At the same time the total numbers of atoms, neutral and ionized together, could be computed and these came out on the average as 70 percent greater in the spots than elsewhere.

Here apparently is trouble, but it vanishes when we realize that the pressure in question is that produced by the free electrons alone. Above the spots there are more atoms, but these atoms are more sparingly ionized and, when allowance for this is made, the calculated electron pressure agrees excellently with the value just given.

But why should the sun's atmosphere contain more atoms per square centimeter of the surface above the spots than elsewhere? Doubtless because we can see down deeper. Now it is generally agreed that the depth to which we can see is limited by certain opacity or haziness of the sun's atmosphere, which arises from the presence of the free electrons. There are fewer electrons above the spots, hence the gases are less hazy and we see down farther. Once again the numerical data agree quite satisfactorily with physical theory. Here at last we have one spectrum that can be fully accounted for theoretically. The simple statements that sunspots are a thousand degrees cooler than the disk, and that we see down through 70 percent more material containing 40 percent fewer electrons, suffice to predict the behavior of all the thousands of spectral lines. The agreement is quite satisfactory, except that some of the weaker lines strengthen more in the spots than the calculations predict.

We can do something, even with the unknown lines. There are several solar lines in Figure 1 which are so completely obliterated in the spot that it is very probable that they arise from ionized atoms, though we cannot yet say of what kind. There is an especially interesting line at 6155, marked with a question mark in the figure. This is the strongest solar line which had to remain unidentified in the "Revised Rowland Tables." It is decidedly weakened in the spot, but not enough for an enhanced line; hence it must come from a neutral atom and from a highly excited state of that atom. Now the proportion of atoms in highly excited states is small and this line is fairly strong, hence it must be produced by atoms of some abundant element. Most of the abundant elements have had their spectra so thoroughly investigated as to leave no chance for a strongish line to pass unobserved. The observations were least complete for silicon, and the theory of spectra indicated that the silicon atom ought to possess various lines arising from highly excited states, and not yet observed.

A few months after this work was done Dr. Kiess of the Bureau of Standards discovered a large number of new lines of silicon, one of which agrees perfectly with the solar line in question!

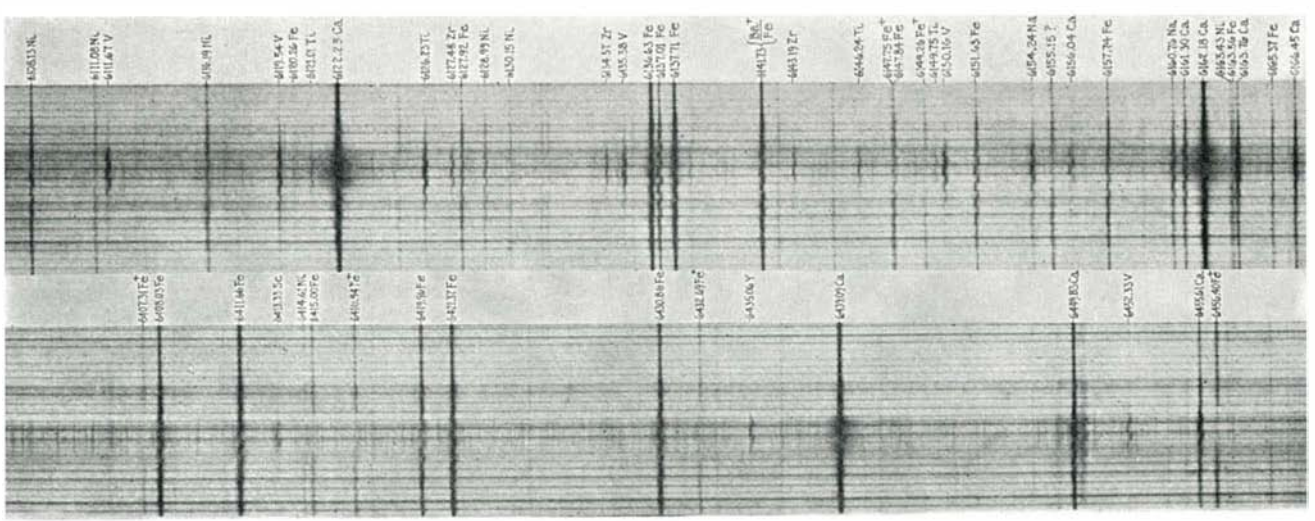
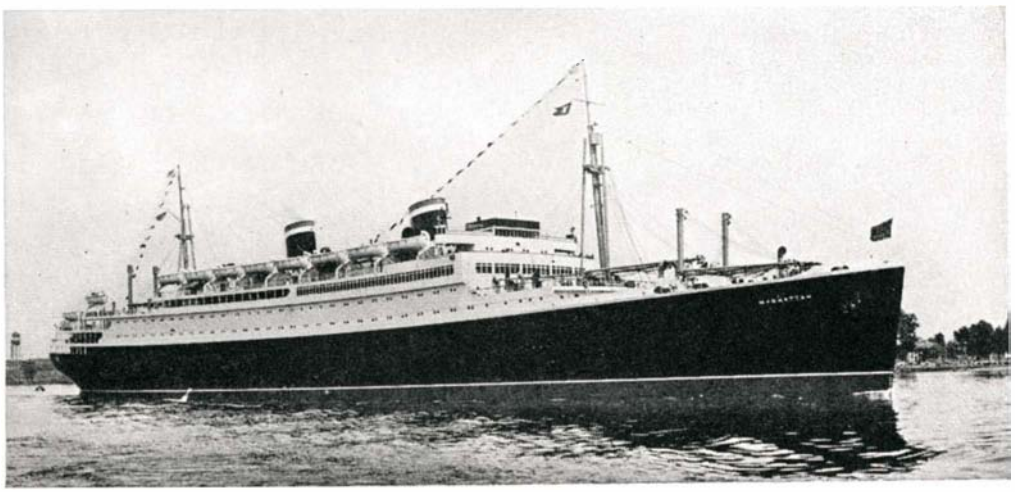


Figure 1: **A part of the red portion of a sunspot spectrum, showing atomic lines**

AMERICA EMERGES FROM PARTIAL MARITIME ECLIPSE



The new *Manhattan*, largest American-built merchant ship and our first for the Atlantic since 1897

By F. D. McHUGH

SALUTED by the whistles of outward bound steamers and those of hundreds of harbor craft, by stunting Navy planes and the airship *Akron*, the S. S. *Manhattan* late in July steamed proudly amid the deafening din into New York Harbor and up the Hudson River to her pier. No notable or hero aboard her occasioned this applause on so grand a scale; she, a new ship just in from her trials off the coast of Maine and thus as yet but scarcely acquainted with the Atlantic, was the notable. Queen of the United States Lines fleet, she is the largest commercial ship ever built in this country, the fastest cabin steamer afloat, and the first passenger steamer built in the United States for transatlantic service since 1897. More important still, she is a symbol of a renascent American merchant marine; in her is to be seen tangible evidence of the re-awakening of American sea-consciousness and our determination to recapture some measure of our lost supremacy of the seas.

The *Manhattan* is not so large, as Atlantic liners go, being only 705 feet long and having only about 32,000 tons displacement when loaded, but she is to be followed by a sister ship, the *Washington*, and later, other and larger liners are expected to follow her across the Atlantic. On the New York to Hamburg route, via Cobh, Plymouth, Southampton, and Havre, she will, under the command of that popular hero of the sea, Captain George Fried, add tremendously to the prestige of our new merchant marine. A promise of future popularity for the *Manhattan* was given in the large passenger list on her maiden voyage on August 10, and it is understood that interest in her abroad rivaled that which has been noted here.

This new liner was designed and built by Americans for Americans, the most exacting travelers in the world, whose patronage has been the pot of gold at the end of the rainbow at which foreign designers of ships have aimed for years. The *Manhattan* is a demonstration that American engineering and American craftsmanship are equal to the task of competing with the great shipyards of other nations. Everything about her is American from stem to stern, and in her have been incorporated beauty, comforts, and modern conveniences comparable with, if not superior to, anything on the sea today.

The keel of the *Manhattan* was laid at the Camden, New Jersey, yard of the New York Shipbuilding Company on December 6, 1930, and she was launched just a year later on December 5, 1931, and christened by Mrs. Edith Kermit Roosevelt, widow of President Theodore Roosevelt. From the date of the signing of the contract, the builders and owners have kept pace with every development in marine architecture and engineering to insure that this ship would embody the last word in design and construction. Every successful device known to the shipping world to safeguard a vessel at sea has been installed on this ship.

The *Manhattan* has been designed to carry 1250 passengers in cabin, tourist, and third classes. Her capacity for general cargo is 380,000 cubic feet, and she can carry 47,000 cubic feet of refrigerated cargo.

Due to important engineering advances that have been made recently, the space al-

Piano alcove of the Chinoise Palm Court, typical of some of the more luxurious parts of the new vessel

lotted to engine rooms is less than half that required on a liner built five years ago. This is a great factor in successful operation, as it means efficiency in technical personnel and more space for cargo. Three large oil-burning drum boilers generate the steam for the twin-screw, Parsons type, triple service turbines which will drive the vessel at a normal speed of 20 knots. In order that the ship may maintain her schedules under varying conditions of service, a reserve has been provided to give increased power when necessary.

One of the most important modern improvements incorporated in the *Manhattan's* design, from the standpoint of passenger comfort, is the "manufactured weather" in the cabin and tourist class dining rooms. This is the same air conditioning system as that which has made theaters cool refuges from summer heat. In these two rooms, atmospheric conditions can be kept ideal for comfort at all seasons regardless of the weather outside by means of units which supply washed and cooled or heated air.

TWO sound systems for talking pictures, radio equipment, and a complete public address system including microphones and loudspeaker amplification to 10 public rooms, have been installed. Music by the ship's orchestra can be broadcast to any of the 10 public rooms, and radio programs, picked up from the shore, can be reproduced throughout the ship by the public address system. Telephones in all cabins allow passengers to call any other telephone in the world when the ship docks and 12 shore trunk lines are plugged in.

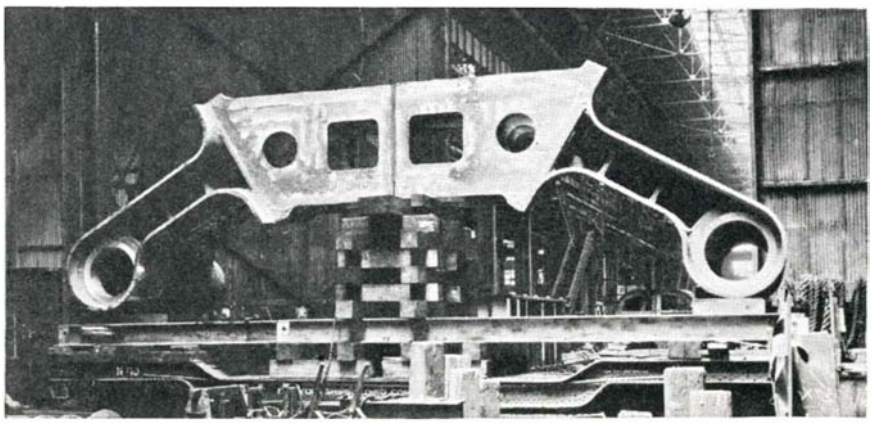
Cabins are of unusually generous size in all classes and all are furnished with full-sized beds. To furnish sleeping accommodations for one or two extra persons when desired, some of the rooms have been fitted with a new type of Pullman upper bed which disappears into the ceiling when not in use.

Passenger accommodations occupy eight decks and include the Chinoise Palm Court, smoking room, library, a large swimming pool with underwater lighting, a full size tennis court, deck tennis courts, children's playroom on the boat deck, smoking rooms, a dancing floor, kennels for dogs, shops of various kinds, and all the conveniences that make an ocean voyage one of the most attractive adventures to be had today. Iced drinking water is piped to drinking fountains on all of the passenger decks. A large percentage of the cabin class rooms have connecting private bath or shower and all the other rooms have hot and cold running water. Unlike any other ship, only fresh water for washing purposes throughout is used, being supplied from the ship's ample fresh water reservoirs.

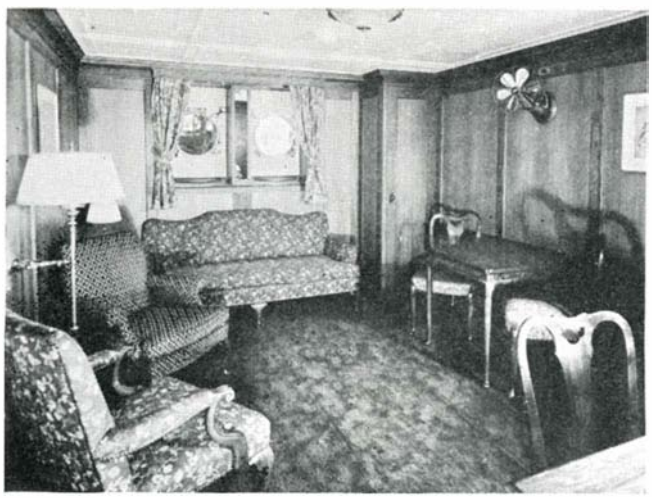
A smoking room in which American Indian ornamentation has been effectively used, adjoins a veranda cafe. A huge stone, wood-burning fireplace, with Indian ornamentation in metal, gives a homey atmosphere to this smoking room. All cabins in cabin and tourist class are carpeted from wall to wall and are paneled so that none of the steel structure of the ship is visible.

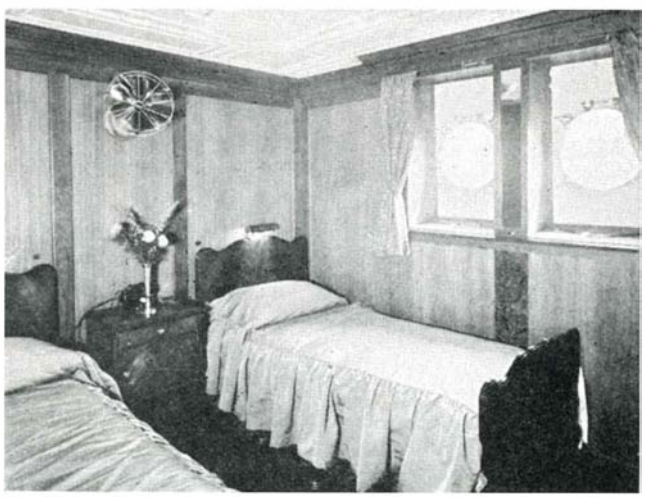
The *Manhattan* represents a high standard of safety from the standpoint of structural strength, water-tight subdivision, and general seaworthiness. The regulations adopted at the International Conference for Safety of Life at Sea (1929) have not only been fully complied with but the ship is subdivided to a higher standard than required by those rules and in excess of any proposed standard including the recommendations of various bulkhead committees in this country and abroad. The machinery and boiler compartments have also been arranged to secure the greatest safety and permit the vessel to reach port from mid-ocean in case of damage. The ship has also been built and equipped in accordance with the rules of the Supervising Inspectors of Steam Vessels of the United States Public Health Service and the requirements of the United States Bureau of Shipping.

The construction of the *Manhattan* and her sister ship, the *Washington*, has meant the employment of an average of 2600 men in the shipyard for a period of two years and 3000 men for a similar length of time in various industries in 43 states furnishing the materials and machinery. The two ships will have cost 21,000,000 dollars, of which it is estimated that 18,000,000 dollars will have been paid out to workmen at some point along the line.



One of the 87-ton "spectacle frames" which carry the propeller shaft ends, and are the largest ever cast in this country, mounted on a railroad flat car





Sitting room and bed room of a suite on B deck. It has all the conveniences of a hotel, including full size beds

FLYING IN THE BEGINNING

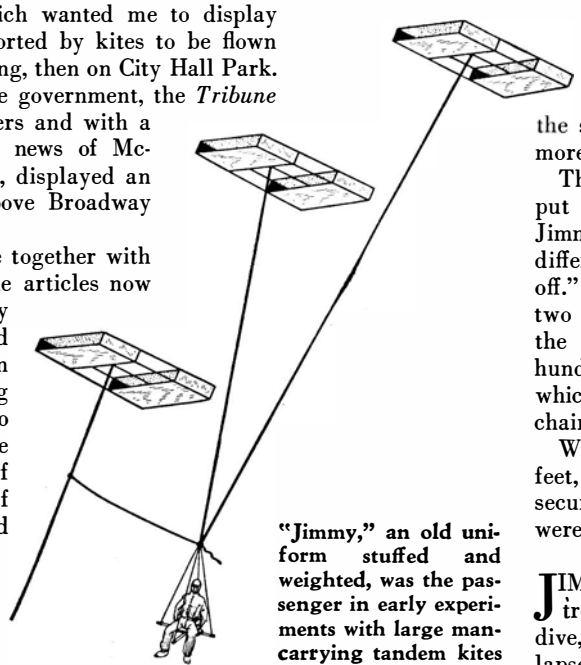
By HUGH D. WISE
Colonel, Retired, United States Army

The author

(*Concluded from September*)

IN the first part of this article, I got somewhat ahead of my story. In the autumn of 1896, while we were still working at Governors Island and when funds were at a very low ebb, I having spent all the money Captain Allen could get for the experiments, I received a flattering offer from the New York *Tribune* which wanted me to display election returns on banners supported by kites to be flown from the top of the Tribune Building, then on City Hall Park. My kites being the property of the government, the *Tribune* paid the cost of constructing others and with a tandem of these we sent up the news of McKinley's election and, at its close, displayed an immense flag a thousand feet above Broadway —a novel spectacle at that time.

The profits from this enterprise together with some money received for magazine articles now made it possible to build some very large kites for man-lifting. I had long wanted to do this but, even then, I had no intention of doing more than lifting an observer to heights from which he could see over intervening obstructions. If that could be done by means of kites, so much less expensive and so much easier to transport than balloons, it would be of great military value. Langley was then at work on his flying-machine and I was in correspondence with him but I was not working in that field.

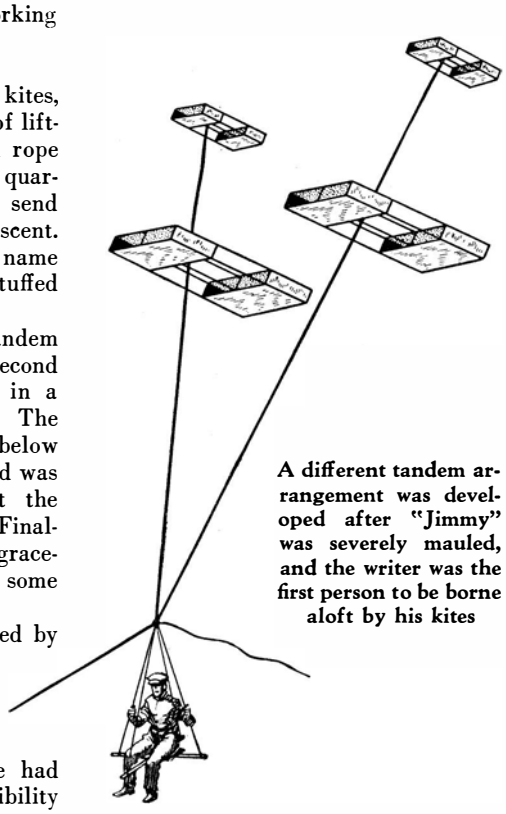


"Jimmy," an old uniform stuffed and weighted, was the passenger in early experiments with large man-carrying tandem kites

HAVING built some very large kites, with nearly 200 square feet of lifting surface, and having obtained rope and a large winch from the post quartermaster, we were soon ready to send aloft a man for the first kite ascent. This man was "Jimmy," by which name we designated an old uniform stuffed and weighted to 150 pounds.

Three kites were sent up in tandem and, where the cord of the second joined the main line, "Jimmy," in a boatswain's chair, was tied on. The third kite was attached a little below that point. A blustery veering wind was blowing, so before Jimmy left the ground he took a severe mauling. Finally, however, he rose and floated gracefully out above New York Harbor some 200 feet above the water.

Ferry boats were nearly capsized by Jimmy's admirers who crowded their rails and whistles shrieked hurrah to his unhearing ears. When he was hauled in he did not know, as we knew, that he had demonstrated not only the possibility but also the practicability of sending an observer aloft on kites. He had not gone very high but all that was needed to send him higher was the support of the rope below him by more kites.



A different tandem arrangement was developed after "Jimmy" was severely mauled, and the writer was the first person to be borne aloft by his kites

The next day the same tandem was put up but, profiting by the mauling Jimmy had received on his first trip, a different method was used for the "take-off." At the junction of the cords of the two upper kites a pulley was rove to the main line and over it passed a hundred-foot halyard to one end of which was fastened the boatswain's chair.

When the pulley had risen about 50 feet, Jimmy was hoisted, the halyard secured to the main line and the kites were run out.

JIMMY, however, was due for more trouble. The second kite, taking a dive, fouled the main line and collapsed. The jerk on the upper kite tore out its center rib and Jimmy, followed by the one remaining kite, plunged to the ground where, unlike Humpty Dumpty, his pieces were gathered together again.

Profiting by this accident, we arranged the tandem differently. The center ribs of two kites were bound together. Two tandems, each of two kites, were made. The upper or smaller kite of each of these was attached to the back of the lower which it thus steadied. Where the two tandem cords were brought together the pulley was rove in and the single cord from that point was supported where necessary by other kites.

A day or so after we had made this new arrangement, and when there was a brisk breeze blowing, I took my seat in the boatswain's chair and was hoisted to the pulley where I secured the halyard. I then signaled to have the kites run out and had the thrill of feeling myself borne smoothly and steadily upward, vis-à-vis Miss Liberty who, across the harbor, seemed to wave her torch to me in a friendly way.

Ferry boat passengers were apparently as interested in me as they had been

in Jimmy and the whistles gave me the same vociferous greeting. It would be an interesting question of law as to how much the responsibility might have been mine had one of those ferry boats capsized but it is certain that no damages could have been collected because all of my assets had gone to the construction of the apparatus.

The daily papers had quite fully exploited these recent experiments so my mail was more than ever full of letters with just the necessary suggestions and advice. One man even sent me a parachute for, having read of my "miraculous escape," supposing it was I who fell when Jimmy got his tumble, he thought I should guard against such accidents.

THIS parachute, conical in shape, was constructed of heavy canvas and iron rings. It was about the size of a large barrel and, perhaps, somewhat lighter. The ingenious idea of its inventor was that in the first rapid descent, air would be compressed in the top of the cone so that there would be more air to sustain it. Naturally, I was not prompt in using this device and, later, when the inventor wrote asking me to report on it, I told him so. In his irate reply he said that I was a coward and that I was afraid to trust myself to the parachute. While I would hate to admit the first of these charges, I fear that I must plead guilty to the second.

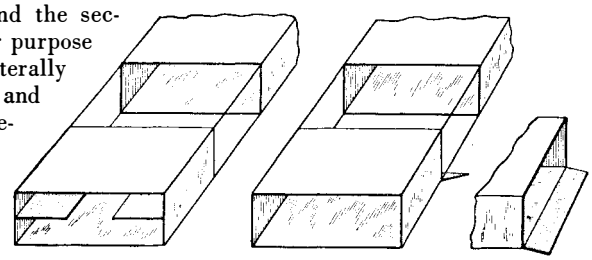
Repeated experiments and numerous ascents resulted in much improvement in our apparatus and in methods of harnessing the tandem but, among other troubles which were accentuated with the heavily loaded kites, was the difficulty of making them fly on an even keel and at desired angles so the different tandems would not interfere with one another.

We therefore introduced, between the lifting surfaces of the forward cells, auxiliary planes or panels which could be adjusted to desired angles to equalize pressure on the two sides of the kite or to make it fly at a desired angle. Later, we placed these panels along the back edge of the lower forward lifting surface. We called these auxiliary planes "balancers" but, as a matter of fact, they were what afterward came to be known as "ailerons," the first similar to the Curtiss and the second to the Farman. Their purpose was to balance the kite laterally or to send it up or down and that is exactly what ailerons are for in the modern airplane with which we were then unconcerned.

Heretofore, Jimmy's ascents, as well as those of my assistants and myself, had been made suspended from the main kite-line but now we began experimenting to the end that a man might ride in the kite, between the forward lifting surfaces or in the chair close up to the kite. For this we used a very large kite and Jimmy, somewhat reduced in weight, was the aeronaut. Poor old Jimmy! He could be repaired, so he always had to try things first. He went aloft repeatedly in different positions but never so satisfactorily as by our earlier methods. The introduction of weight into the kite upset the balance and Jimmy was, of course, not competent to adjust the ailerons while in flight.

We had now satisfactorily established the fact that kites could be advantageously used for carrying aloft signal apparatus, photographic apparatus, meteorological instruments and even a man; that they could be used for running out telegraph wires and cables or even for suspending them and we might have been content simply to improve upon this progress but for an accident.

One day, while handling a large kite of the Eddy type in a high wind, I was lifted five or six feet clear of the ground. To avoid being thrown backward on the kite and smashing it, I reached up and seized the cover at the cross-sticks. This depressed the top of the kite and it went into a beautiful glide forward, landing me gently some yards from where I had stood.



"Balancers," forerunners of the aileron, were developed by the author to afford control of the kites

We at once took the kite to the top of a nearby parapet, some ten feet high, where, facing the wind while my assistants held the kite horizontally over me, I grasped the cord at the intersection of the sticks in one hand and the cord to the lower point of the kite with the other. Then I jumped forward and glided to a gentle landing 50 feet away.

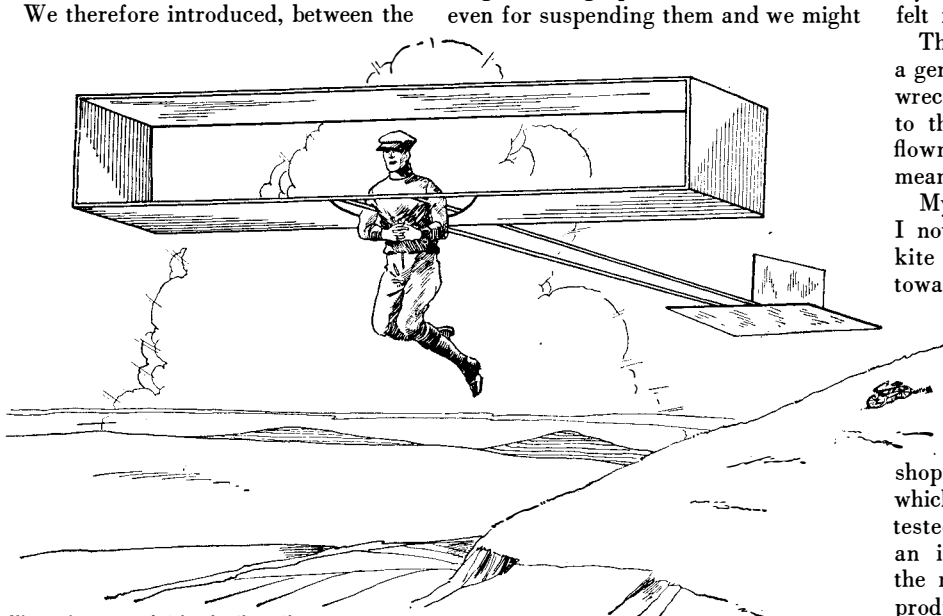
FASCINATED with the sensation of actual flight and realizing that the length of the glide could be increased by rapid motion forward at the take-off, I took my bicycle to the top of the ramp of the old fort. There I mounted, my assistants holding the kite while I took the cords as before. At my signal they let go and I pedaled down the steep incline. Near the bottom, I depressed the tail of the kite, drew up my legs and let go the bicycle and I felt myself lifted and gliding forward.

This glide, however, did not end in a gentle landing but with a bump which wrecked the kite and well nigh sent me to the hospital; but I had glided, or flown if you will, by purely mechanical means.

My interest being thoroughly aroused, I now found myself looking upon my kite experiments as merely directing toward this more interesting phase. When a kite flew without a cord, it was a glider. If a glider could make its own supporting wind, it would be a flying-machine. Why not?

We went to work in the shop producing many small models which were first flown as kites and then tested as gliders by running them down an inclined wooden runway. Finally, the most satisfactory of these was reproduced in size sufficient to support the weight of a man.

(*Please turn to page* 251)



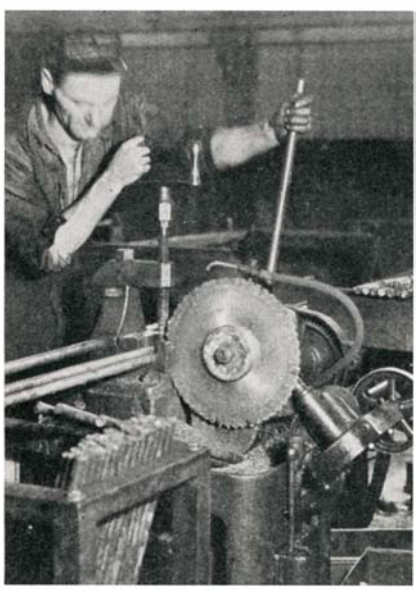
Illustrations from sketches by the author

A bicycle furnished the momentum for the author's first glider flight. ". . . . I felt myself lifted . . . and carried 20 feet up, while I still went forward . . . ."

IN A RIFLE FACTORY

Over 2500 Operations Are Required to Produce Accurate Rifles That Stand the Test of Use

A RIFLE factory, even though prosaic, is one of the most interesting places imaginable. Filled as it is with machinery, it is really the last place where one would expect romance to lurk. Yet way back in 1816 the foundation of a large fire-arms industry was laid at Ilion, New York, where a blacksmith and his son were making the ordi-



Cutting up the bar steel for the barrel; first step in manufacture

nary things required by the farmers of the Mohawk Valley. The woods were full of game and the boy asked for money to buy a rifle. The father, Eliphalet Remington, refused and the son began collecting scrap iron on his own account. From this, he fabricated a gun, for he realized that his only chance of getting a rifle was to make one. He walked to Utica, 15 miles away, where there was a gunsmith who rifled the barrel for him and fitted it with a lock.

The boy's hand-made gun was so good that the neighbors ordered others like it and he prospered in a small way. In time, the elder Remington was glad to get into the business and they moved up the creek where a water wheel gave them power for the grindstones used for smoothing the welded edges of the gun barrels. Many machines had to be developed and in 1850 a battery of trip hammers was put in for forging and welding the barrels. Standards improved and a stock of spare parts was carried; here was the beginning of interchangeability of rifle parts.

The plant soon began to be a hotbed of invention. From the very first the Remingtons were interested in inventors. Ilion became a place of pilgrimage for men with ideas. Inventors came from everywhere and they were never refused an audience. Some brought models, others drawings, while still others had only the idea. Money, time, and skilled labor backed the worthwhile inventions and they were assimilated into the business.

SHIPPING in those days was very primitive. The Erie Canal ran past the plant and when a package of guns was to be shipped, a plank was lifted in the floor of the bridge and the package was handed to the tillerman of a passing boat. The boats all bore names, and the customer was notified to watch out for the particular boat to which his package had been entrusted. As the boats were very slow, there was little danger of a shipment going astray. From such small beginnings arose the great Remington arms plant where 12,000 men and women were employed during the World War.

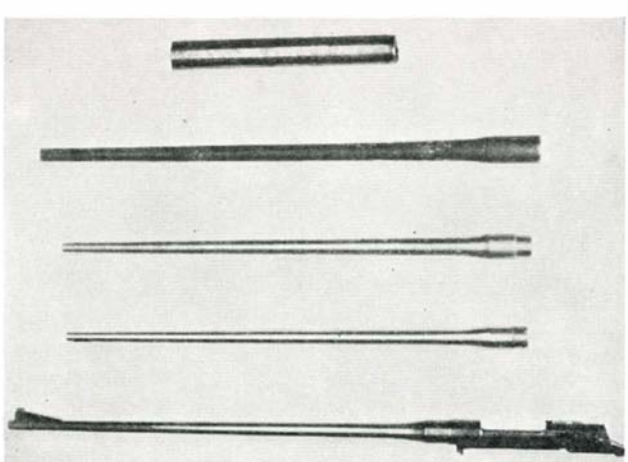
In the old days, a tube was made of a piece of wrought iron, folded over and lap welded, a painfully crude method compared with modern standards. By 1850, the art of gun making had improved; steel was substituted for iron and the hole in the barrel was drilled and reamed before rifling.

In a modern rifle factory, the stock for the barrel comes to the plant from the steel manufacturer in round bars of convenient size (12 or 14 foot lengths) and is cut to the proper length by metal saws. (In rifle manufacture the word "stock" is applied to all raw material and should not be confused with the wooden gun-stock itself.) The specifications for the steel stock are most rigid and no shipment of steel is accepted until it has received the approval of the plant metallurgist. The diameters

Rolling the white-hot steel to a tapered form for the rifle barrel

range from $\frac{13}{16}$ths for .22 caliber barrels to one and one half inches for the high-power rifle barrels. The stock for the potential barrel, after cutting to length, is rolled to obtain a smooth grain and a tapered shape. The metal is elongated from two to three times its original length in rolling.

The next operation shapes the rear end of the barrel to fit the drill bushing of the barrel-drilling machine. These machines have two spindles and can drill two barrels at once. The work is supported at one end by a chuck in the headstock spin-



All photographs courtesy Remington Arms Company

Progress from steel bar to rifle barrel: Steel bar; elongated and tapered; rough turned and drilled; turned, rifled, and highly polished; browned and assembled

dle. The work rotates and the drill is fed by a traversing tailstock in which the shank of the drill is supported. The drill is supported midway by a steady rest. The oil which lubricates the drill is pumped from a reservoir below the machine, a blend of genuine lard oil being used. The shank of the drill is made of steel tubing shaped to provide for the escape of the chips and oil. The hollow drill point is made of high-speed steel and is soldered to the steel tubing. The rate of production is about six barrels per hour from each two-spindle machine.

AT this point begins the long series of inspections which ends only with the shipping of the rifle. As 2500 operations are required in fabricating a finished rifle it will be seen that the manufacture of an accurate-shooting firearm must be under constant examination and control.

After boring, the barrel is reamed; this process enlarges the drilled hole almost to finished size, and at the same time produces a perfectly smooth interior. A certain amount of exterior taper was secured in the rolling process. This is carried farther and more accurately in special taper lathes. After the barrel is machined for sights with a profiler, it is reamed again, this last process being what is known as the "finish ream." It is performed after the barrel has been inspected for straightness, and, if necessary, straightened.

Barrel straightening is performed either on an anvil, as was the custom with the old gunsmiths, or by means of a vertical screw press. This ensures a uniform thickness of wall of the bore. Straightness is checked by sighting through the barrel. The operation of reaming removes any imperfections of the bore caused by the straightening operation. The outside of the barrel is now polished, this operation being termed "spinning."

A major operation is that of rifling, performed on a rifling machine which grooves the interior of the barrel so as to give the bullet a rotary motion as it leaves the bore. The work is inserted in a fixture and is held stationary at the end by a standard three jaw chuck. The cutter, which is of the hook type as illustrated, is pulled through the barrel. A guide set at the proper angle provides the correct amount of rotation, and hence governs the "twist" of the rifling. Nothing happens on the forward stroke; the cutting tool operates on the return stroke only. The depth of the rifling is increased after each stroke of the cutter rod. The operation is slow at best; therefore, a large battery of machines is used.

Polishing the outside of barrel on a wheel is known as "spinning"

Polishing the inside of the barrel with a lap made of a cast-in plug of lead which is charged with oil and emery and rotated, following the rifling grooves

Even the finest rifling tools leave almost microscopic burrs in the barrel, which must be removed as fully as possible in order to ensure the greatest accuracy. To this end is employed the "leading-in" process. A plug of lead three or four inches long is cast, on the end of a rod, in the muzzle end of the barrel. The lead plug conforms to the bore, yet moves freely in it. It is projected far enough from the muzzle for a portion of it to be charged with oil and emery, and is then used as a polishing lap. An individual lap is made for each rifle.

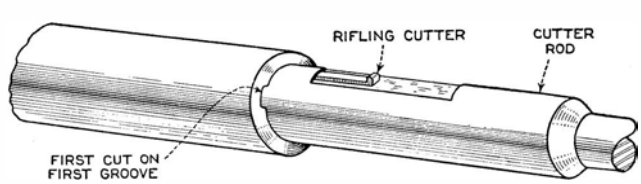
The chambering removes enough of the metal to allow space for the cartridge. The barrel is held in a chuck passing through the headstock of the lathe. The cutting edges of the reamer used have a shape similar to that of a cartridge. The reaming is done in several steps from rough to finishing cuts.

ALL barrels are finished by a process which gives the metal a deep black color, although the step is known as "browning." It is an oxidizing process which leaves a hard, non-glare, durable, rust-resistant finish on the metal.

The barrel is now ready to be fitted to the receiver and finally to the gun stock itself. While the barrel was going through the various stages of manufacture, the "receiver" which holds the rifle mechanism has also begun its long series of operations. The receiver is forged from bar nickel-alloy steel with the aid of drop hammers. It would be tedious to describe the milling and other operations, so we will simply list them:

(A) Machining: Shaving, broaching, power-milling, hand-milling, profiling,

An expert straightening the gun barrel with the aid of a screw press



A rifling cutter attached to the cutter rod starting on the second groove. The cutter works by "pulling" through

drilling, reaming, counter-boring, spline-milling, grinding, thread-milling, hollow-milling, rotary-milling, thread-tapping, boring.

(B) Inspecting: During the course of manufacture the receiver is inspected at 29 different stages; 163 gages of various types are used.

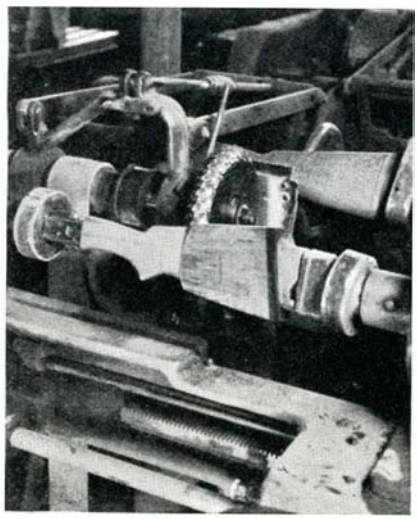
(C) Finishing: Polishing, identification marking, buffing, browning.

Grinding and polishing are, of course, methods of rendering the external surfaces smooth for appearance and handling. These operations are done on orthodox polishing devices, using polishing wheels with suitably shaped edges and finenesses. A high degree of skill on the part of the operator is required to blend the various surfaces.

Engraving is the work of a master craftsman. Since it is done by hand and requires a great deal of painstaking work as well as artistic ability, it is costly. The "Premier Grade" rifles of this factory have game scenes on both sides of the receiver and the entire surface of the receiver bears scroll and foliage decorations. The engraver makes it a point never to engrave two receivers alike, and will if desired engrave the rifle to suit the individuality of the purchaser.

The final assembly of all parts is done by hand with the aid of special fixtures and gages of various types. For every five men engaged in actual fabrication there is one man for inspection.

WALNUT has been found to be the best wood for use in gun stocks. All pieces selected for the purpose pass a rigid examination. The walnut is kiln-dried in a thorough curing process which takes about three months, after which only about 3 percent of the original moisture remains. Before use, the ends of the blocks are coated to keep out dampness. The blocks are then sawn to rough shape. From this point the operations go on quickly, not only for economical manufacturing but to prevent the wood from picking up atmospheric moisture.



The gun-stock lathe makes a perfect form with the aid of a pattern

The potential gun stocks now go through a number of operations of shaping, boring, and milling. The stock is turned to its finished shape on a Blanchard lathe which turns irregular shapes from a master form. The model and the gun stock rotate slowly while the cutter-head, equipped with vicious knives, rotates rapidly, receding or advancing as projections or depressions in the model guide the operation. After the stock is shaped it is "inletted" so that the tang of the receiver will fit into it. This is done on a wood profiler and might be termed "rough fitting." Certain parts are hand shaped. The relief cuts at the comb of the stock are shaped out by hand as is also the pistol grip. Minor refinements, such as this hand-shaping, give the gun distinction and add to the appearance. Such things are valued by discriminating gun-lovers.

After the stock is completely fitted to the receiver, both are given the same serial number and then separated. The receiver is sent to be polished and browned and the stock to be varnished.

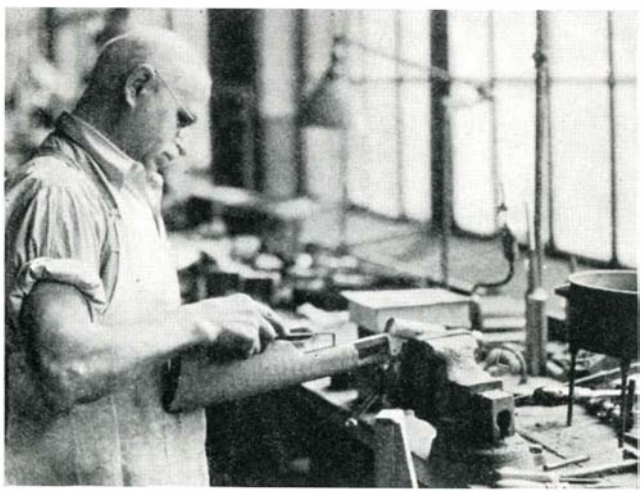
Stocks are filled, rubbed, given several coats of varnish, each of which is allowed to "set," and then rubbed again. The standard finish is smooth, well-rubbed, dulled varnish called "satin finish." Oil finish is applied on high-grade stocks if specified. This type of finish requires a great deal of hand rubbing, but it brings out every nuance of the natural beauty of the fine walnut.

The checking on the stock and fore-end is done by hand with special tools. This rather tedious operation is nearly all performed by women who sit in long rows checkering either rifle or shotgun stocks. Checkering the grips assists in control of the gun because the hand is not likely to slip on the checked surface under any condition of wind or weather.

The receiver, the barrel, and the gun stock are now all brought together and carefully examined by experienced gunsmiths who know every detail of the mechanism.

AFTER assembly, the rifle is ready for tests which are drastic in the extreme. First it is fired with a proof charge which develops a pressure much greater than the maximum charge obtainable on the market. It is then examined carefully for effects of overload. If satisfactory, a mark is stamped on the right side of the barrel, near the breech. After this, a number of rounds of ordinary cartridges of all makes and types are loaded and fired through the rifle to see that it functions smoothly and accurately. Finally, the rifle is re-examined in every particular by the final inspector. It cannot leave the factory unless it bears the stamp of his approval.

Each rifle passes through 2500 operations and when it leaves the factory it will soon be in the hands of some ardent sportsman for use on the rifle range or in the woods. A rifle is of no use without ammunition and in a short time we expect to present an article on this subject.



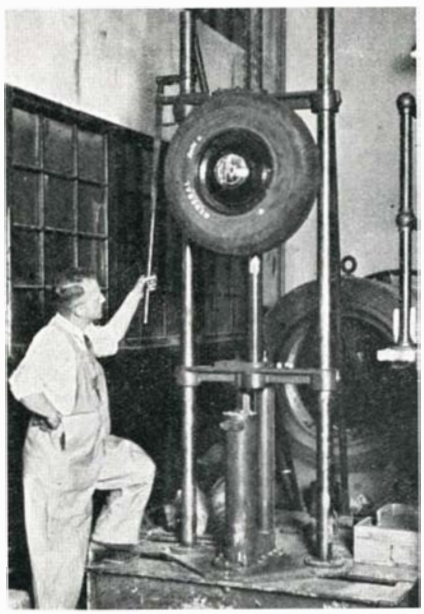
The wooden gun-stock and the receiver are first assembled and then carefully hand-fitted to produce a perfect match

Checkering the gun-stock is painstaking work. A slip of the hand would spoil the stock, but mistakes are rare

FACTORY PUNISHMENT FOR TIRES

TIRES on the road get many a shock and bruise, and if the road happens to be of the unimproved sort the tires take a terrible punishment from sharp rocks, ruts, and bumps. Eventually, these bruises may play hob with the fabric that makes up so large a part of the body of the tire. To find out just what happens to a tire when it is bruised in this way so that, if possible, steps may be taken to obviate such trouble, tires are given more punishment daily in the testing laboratories of one of the larger rubber companies than they would normally get on the roads in weeks.

The tire testing laboratory of the General Tire and Rubber Company is a large room which is kept at a constant



temperature of about 90 degrees in order that the tires may be tested under conditions closely approximating those of a hot summer day on the road. Heat, of course, is one of the worst enemies of rubber.

Into this room, early in the morning, are brought many brand new tires. The tire chemist first puts a tire on the "bruise-break" testing machine, a device that somewhat resembles a pile-driver. The tire is then lifted to a height and dropped, again and again, on an anvil or plunger. The tire is revolved as it is dropped so that it will strike the anvil at many points on the tread. Probably 50 bruises are inflicted on the carcass of the tire in this way.

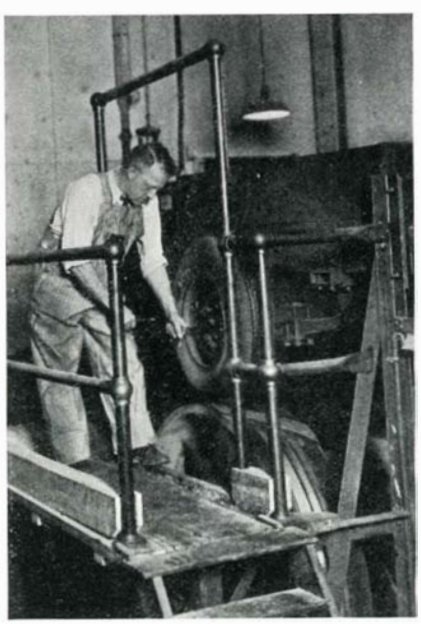
To inflict different kinds of bruises, various types of anvils are used and the tires are tested at different air pressures. The height the tire is dropped is also varied. Care is taken, however, to see that the tire bruise is caused entirely by the blow on the anvil since it is not desired to pinch the tire against the rim of the wheel.

On another machine, the "pulley wheel test" gives the tire the sort of treatment that a front tire undergoes. In making this test, a tire is mounted on each end of an ordinary truck or passenger-car axle over which is mounted a weight box. Into this box are thrown chunks of pig iron heavy enough to overload the tires. The assembled axle and box are then placed on the testing machine so that each of the tires is resting on a large pulley wheel.

On the surface of each of the pulley wheels are two cleats mounted diagonally and projecting about an inch from the surfaces of the wheels. As these wheels are set in motion, the tires spin on the pulley wheels, hitting the cleats as they roll. Hour after hour and day

At the left is shown a Jumbo tire in the "pile-driver" ready for the bruise-break test. Dropped repeatedly onto the anvil as shown above, and other anvils of various shapes, the tire sustains many kinds of fabric breaks and tread bruises

At the right is shown the weight box, used in the pulley wheel test, loaded with several tons of pig iron. Below may be seen the pulley wheel on which a tire is to spin for days, with a cleat over which the tire must bump as the wheel revolves



after day, the overloaded tires roll on the tread-mill on which they are resting, and in about two weeks have been given 10,000 to 15,000 miles of wear. This test does not, of course, test the beads of the tires as there are no corners to be turned, nor can it test for abrasions as it is impossible to approximate the sidesway that comes with the turning of a moving car at a corner.

Often the relative qualities of competitive tires are determined by placing different makes on opposite wheels. Tests are always made against certain standards which the company insists upon maintaining in its products, and, in addition, road tests are being constantly made on passenger cars and trucks where, under real driving conditions, the best deductions are made. The laboratory tests are merely supplementary to these road tests.

PHYSICAL LABORATORIES of the STARS*

By THEODORE DUNHAM, JR.
Astronomer, Mount Wilson Observatory

A THOUSAND years ago the stars were looked upon as fixed points of light permanently attached to the sky. A few brave minds dared to imagine them as more than this, but without accurate measuring instruments there could be only speculation as to the true nature of these points of light. During the 19th Century much was learned about the distances, masses and sizes of the stars. But we are never satisfied. What we should really like to do is to be able to dip a thermometer into the stars, and to attach to their atmospheres pressure gages, and to read off directly their temperatures and pressures.

Unfortunately we cannot do this. But as a matter of fact, Nature has provided us with instruments of great precision which are excellent thermometers and pressure gages—if only we can read them. They occur in great numbers throughout the universe. They are the atoms in the stars.

Now it is true that atoms do not carry indicating dials on which we can read off directly what we want to know about the stars; but although very small they are nevertheless remarkable mechanisms, extraordinarily sensitive to the conditions in which they find themselves. All the light which comes to us from a star has started from individual atoms, and so the light carries with it a record of the physical conditions under which it was sent out. The atoms in the stars have been broadcasting a description of their surroundings for millions of years, but it is only recently that we have paid the least attention. The spectroscope has made it possible to record these atomic messages, but they are always in code. The study of atoms in our laboratories is giving us the key to this code and is helping us to read the information which is hidden in a stellar spectrum.

WE must not ask to see a correct and up-to-date picture of an atom. That has been impossible since 1925, in which year the atom became a Ψ-function in higher mathematics and quite impossible to draw. It is just as real as it ever was, however, and just as reliable. But for our purposes it will be entirely satisfactory to think of the simpler and older model with electrons revolving around a central nucleus.

To make things simpler still, we shall consider only one kind of atom, the calcium atom, because it illustrates so well some of the things I wish to describe. A calcium atom on the model we are using consists of a central positive nucleus which holds by electrostatic attraction 20 negative electrons. Eighteen of these revolve about the nucleus in orbits relatively close to the nucleus and do not take any part in giving out the light which we see coming from the stars. In Figure 1 the nucleus and these 18 inner electrons are all represented by a large dot. But the two outer electrons are very important. These are shown as smaller dots.

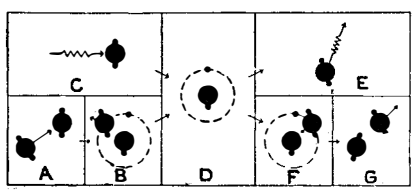


Figure 1: **Atomic transformations. They are explained in the article**

NORMALLY these two outer electrons circulate close to the nucleus. But they may also circulate in a number of larger orbits, of definite sizes. Intermediate positions do not occur. Now it takes energy or work to lift an electron from a smaller orbit to one of these larger or "excited" orbits, and this lifting of the electron can be done in either of the two ways illustrated in Figure 1. The first is by a collision with another atom, as at *A*. The atom is rushing about at the rate of two or three miles a second among other atoms in a star and frequently collides with its neighbors. The violence of one of these collisions may be just enough to raise the electron to a larger orbit, as in *B*.

The second way in which an electron can be raised to a higher orbit is by a collision with a dart of light, as in *C*.

In the atmosphere of a star great quantities of light are coming through from deep layers on their way to the surface. As far as the atom is concerned this light acts as if it were in the form of minute darts of energy, each with a very definite rate of vibration and carrying a definite amount of energy. Those vibrating rapidly have short wavelengths, carry a large amount of energy, and appear blue to our eyes. Those vibrating more slowly have longer wavelengths, carry less energy, and appear red. One of these light darts may strike an atom in its path, and, if the atom can respond exactly to the rate of vibration of the light dart, the energy which the light dart carries may raise one of the electrons in the atom to a larger orbit farther from the nucleus. Since the light dart is made of nothing but energy, and since it has transferred all of this energy to the atom, it entirely disappears as the result of striking the atom.

Whether the atom was struck by another atom or whether it was hit by

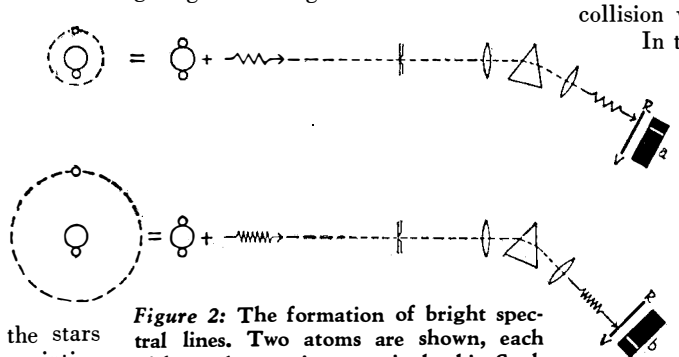


Figure 2: **The formation of bright spectral lines. Two atoms are shown, each with an electron in an excited orbit. Such atoms have in store an amount of energy which depends on the size of the orbit which the electron occupies. When the electron returns spontaneously to its normal orbit the stored energy is thrown out in the form of a dart of light. An electron falling from a relatively small orbit emits a small amount of energy. The resulting light dart has a low frequency of vibration, a long wave length, and appears at the red end of the spectrum. An electron falling from a larger orbit emits more energy, and the corresponding light dart has a higher frequency, a shorter wavelength, and appears in the violet region of the spectrum. The light darts affect the photographic plate where they strike. At *a* and *b* the plates are turned through a right angle, hinging on their longer axes, in order to show the resulting spectral lines**

*Extracted, with minor alterations, from the *Publications of the Astronomical Society of the Pacific* (San Francisco).

a light dart, the result is the same: namely, as in *D*, an atom that is wound up and has stored within it a definite amount of energy—the power to do work of some kind. But this lasts only for an instant. The electron must fall back, *E*. If undisturbed, the excited atom hesitates for about a hundredth of a millionth of a second, and then the electron falls to its normal place again. In doing so it unloads the energy it borrowed by shooting off another light dart exactly like the one which was absorbed. The only difference is that since the atom has absolutely no idea of aiming, the light dart is sent out entirely at random.

There is another way in which the electron can fall back. While the atom is wound up and hesitating, another atom may strike it, *F*, while traveling at a relatively moderate speed. If this happens, the atom may unload its stored energy directly to this second atom. The colliding atom then bounces away faster than it struck, *G*, just as if it had touched off a stick of dynamite, while the electron in the first atom settles back into its normal orbit.

WE may now ask how atoms capable of passing through cycles such as we have described are able to write code messages in stellar spectra from which we may infer the conditions existing in the outer parts of stars. To understand this we must first consider what happens when in the laboratory we artificially stir up an atom to produce a spectral line. This may be done quite easily by means of an electric arc in which many atoms collide so hard with one another that their electrons are forced into excited orbits from which they fall back with the emission of light darts.

If a light dart is thrown out by an atom whose electron has fallen a long distance, that is, from a very large orbit to a small one, then the light dart must carry away a large amount of energy, and it does this by vibrating at high frequency. But if it was thrown out by an atom which had less energy to unload because its electron did not have so far to fall, then the light dart will vibrate more slowly. Since both darts travel at the same speed, the high-energy dart will have a short wavelength, while the low-energy dart will have a long wavelength. Figure 2 shows two such light darts approaching the slits of two spectographs.

The prism bends a high-energy light dart more than a low-energy dart; and the two will strike a photographic plate at entirely different places. Thus by measuring the image on the photograph we have an absolutely direct method of knowing how big a jump the electron made in the atom.

There are all conceivable kinds of jumps between the many possible orbits in which the electrons may start and end, but each sends out a slightly different light dart, which, after passing through the prism of our spectrograph, ends up in a different place on the photograph.

Now to go back to the star. The hot, deep parts of the star are sending out light darts of every conceivable wavelength. Except for a few which are stopped in the atmosphere of the star, these light darts leave the star, and after traveling for years through empty space a small part of them strike the earth, and a still smaller part fall upon the lens or mirror of one of our telescopes, and are collected and sent through a spectrograph. (Figure 3.)

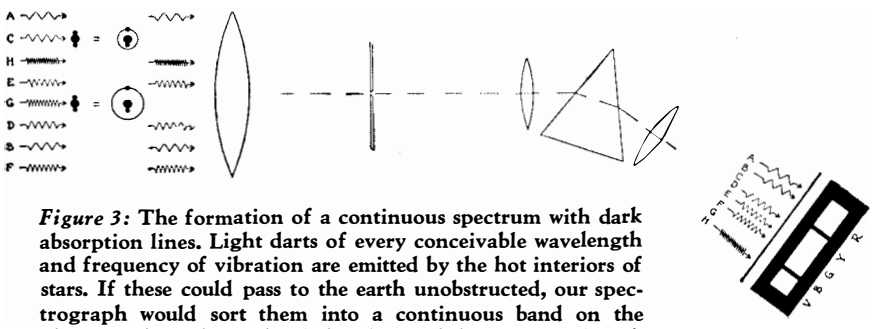


Figure 3: **The formation of a continuous spectrum with dark absorption lines. Light darts of every conceivable wavelength and frequency of vibration are emitted by the hot interiors of stars. If these could pass to the earth unobstructed, our spectrograph would sort them into a continuous band on the photographic plate, the light darts of longer wavelength (red light) going to one end of the plate and those of shorter wavelength (violet light) going to the other end. The two atoms shown in the diagram are supposed to be in the atmosphere of a star and to be capable of becoming excited through the absorption of quantities of energy exactly corresponding to the quantities carried by the light darts *C* and *G*. As a result, these particular light darts are absorbed in the stellar atmosphere and are missing from the otherwise continuous band of color which falls upon the plate. The spectrum at extreme right shows a bright background crossed by two dark absorption lines**

The spectrograph will sort these darts out according to their wavelength, sending the short, blue ones to one end of the photographic plate, the longer, green ones to the middle, and the still longer, red ones to the other end of the plate. Since the deep layers of the star are giving out light darts of every possible wavelength, after passing through the prism, there will be a solid band of color. We call this a continuous spectrum.

But the interesting thing is that some of these light darts do not escape from the star. Some of them of particular wavelengths are sidetracked by atoms which absorb them in the outer layers of the star, and never get to the earth at all. Where they would have fallen on the plate there are dark empty spaces. This is how we first discovered that there are atoms in the stars. These dark spaces on the plate we know as spectral lines and they make up our code message from the stars.

We are now ready to look at the actual situation in a stellar atmosphere. Figure 4 represents a thin slice through the middle of the atmospheres of three different stars. The center one represents the atmosphere of our sun. Light and heat are coming up in great amounts from the depths of the sun below the bottom of the diagram. After working their way between the atoms in the atmosphere they pass on beyond the top of the diagram, through the upper limits of the atmosphere and plunge off into outer space.

At the high temperature of the solar atmosphere, all the atoms are moving about quite rapidly and colliding frequently with one another, so that if at any one instant a snap-shot photograph, such as this diagram, could be taken, we should find that a considerable number of the calcium atoms had just undergone collisions which had lifted one of their electrons into a larger or excited orbit.

At this temperature light darts are also very plentiful, rushing about in all directions among the atoms. By striking normal atoms, they produce still more excited atoms. When an atom which has already been excited by one collision is struck a second time before it has recovered from the first collision, the electron may be knocked entirely off the atom. The mutilated atom which remains is called an "ionized" atom.

We have then in the solar atmosphere at any one instant three kinds of calcium atoms: the normal atom, the excited atom, and the ionized atom.

Now we have seen that any particular atom can absorb a light dart if the energy of the light dart is of exactly the right amount to raise one of the electrons in the atom into one of its possible orbits. If this happens, that particular light dart is lost forever as far as we and our spectrographs are concerned, because the atom, in unwinding, will either send out a second dart in a random direction or else will use the stored energy to kick one of its neighbors, in which case the energy goes into heat and is again diverted.

Thus the atoms in the atmosphere stand at the gateway between the star

and outer space and each one sidetracks light darts of a particular energy and color. The result is that each type of atom is responsible for characteristic gaps or dark lines in the otherwise continuous band of color.

The normal calcium atoms absorb blue light, causing a single dark line in the blue part of the spectrum. The excited atoms absorb red light, causing primarily a strong group of three lines close together in the red part of the spectrum, while the ionized atoms which have lost an electron absorb violet light, causing a pair of conspicuous lines in the violet.

Now the strength of these spectral lines depends in a striking way on the number of atoms causing them, so that if with our spectrographs we can measure the strength of the lines it means that we can count the number of atoms of each kind. When many atoms cause a line, the line is wide and when the atoms are few the line is narrow. This we speak of as differences in line-intensity.

In the sun the lines we are discussing are of very different intensities, but they have intentionally been made equal in Figure 4 so as to bring out more clearly the variations when we pass to other stars.

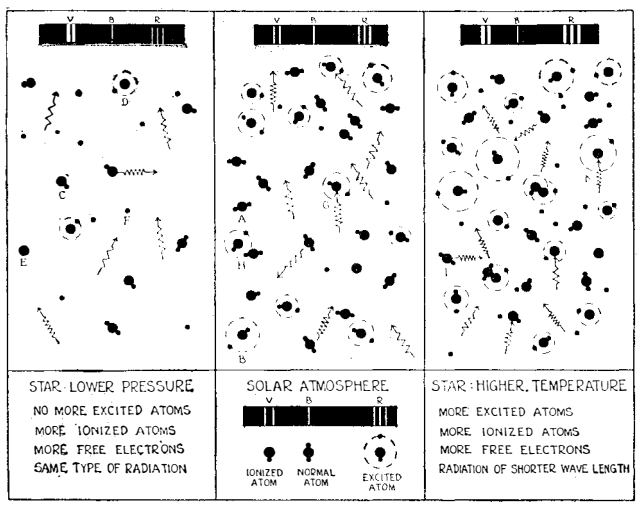


Figure 4: **Atomic processes in stellar atmospheres. *A,* a normal atom; *B,* an excited atom; *C,* an ionized atom; *D,* an excited ionized atom; *E,* a doubly ionized atom which has lost two electrons; *F,* a free electron; *G,* a light dart colliding with a normal atom and exciting one of its electrons; *H,* two atoms which have just collided—one of them is left excited; *I,* an excited atom returned to its normal condition, emitting a light dart at random; *K,* a light dart exciting an ionized atom**

IN the right-hand section of the diagram we have the atmosphere of a star, such as *Procyon,* which is at a higher temperature than that of the sun. The atoms are rushing about more rapidly, and on the average the light darts are more numerous and also more energetic. The vibrations are faster and the wavelengths are shorter. Because the light darts are more energetic and because the collisions are more violent at this higher temperature there will be fewer normal atoms. More atoms will be excited and more will be ionized than in the sun. Now, as we have seen, the width and the strength of a spectral line depends on the number of atoms responsible for it. A single atom would never show a line in our spectrograph, but when several million million are doing the same thing at once, enough light is held back to make a noticeable dark line. In the present case the line in the blue corresponding to the normal atom is weaker than in the sun, while the triplet in the red (Figure 4, at top), corresponding to the excited atoms is considerably strengthened, and so is the pair of lines in the violet corresponding to the ionized atoms. What we can observe is of course only the spectrum and not the atoms responsible for it. So when we see a spectrum whose lines have these relative intensities we must infer that we are dealing with a star that is hotter than the sun.

The left part of the diagram represents the atmosphere of a very different kind of star such as γ *Cygni.* The temperature here is the same as in the sun, but the pressure is much lower. Since the temperature is the same, the violence of the collisions is the same, the number and energy of the light darts is the same, but the pressure is lower, which means that the atoms are farther apart. Occasional atoms will become ionized, just as in the case of the sun, because collisions with light darts will be no less effective. But when once an electron has been torn loose from an atom it will be much more difficult for this free electron to find another mutilated atom with which it can recombine to form a normal atom. And so it happens that in this star the proportion of ionized atoms is greater than in the sun, while the number of normal and excited atoms are both reduced, without changing their proportion relative to one another.

The increased number of ionized atoms results in a marked strengthening of the pair of lines in the violet. The line in the blue corresponding to the normal atom and the red triplet corresponding to the excited atom are somewhat weaker than in the sun, but the relative strengths of these lines remain unchanged.

The net result of all this is that, when we develop a photographic plate taken with our telescope and find on it a spectrum with the red triplet looking stronger than the blue line, we know that the light must have come from a star with an atmosphere at a high temperature, while if we get a spectrum with the violet pair stronger than the blue line, we know that we are dealing with a star whose atmosphere is at low pressure. When we combine this method with what can be learned from the colors of the stars we find temperatures ranging all the way from 1600 degrees Centigrade in long-period variable stars at minimum brightness up to over 30,000 degrees for the hottest blue stars.

THE pressures in the atmospheres turn out to be surprisingly low, and, although there are wide variations from star to star, the pressures do not in general exceed one-thousandth of that of air at the earth's surface. On some stars the atmospheres are at pressures much lower than this. The entire atmosphere of the sun as far down as we can see is about 50 to 100 miles deep, but there is so little stuff in all this depth that it corresponds to only about five or six feet of ordinary air. An amount of material which is absolutely transparent here becomes so foggy on the sun as to be nearly opaque, because of the great number of free electrons and ionized atoms which can stop passing light darts and send them flying off in other directions and even turn them into heat.

Research on the physical conditions existing at the surfaces of the stars involves today two distinct problems. First there is the attempt to record the spectrum with its code message more accurately than ever before. This requires larger and more powerful instruments, as well as a study of every possible source of error. Then will come the second and most fascinating part of the problem, decoding the spectral message and the discovery of new truth about the stars.

●

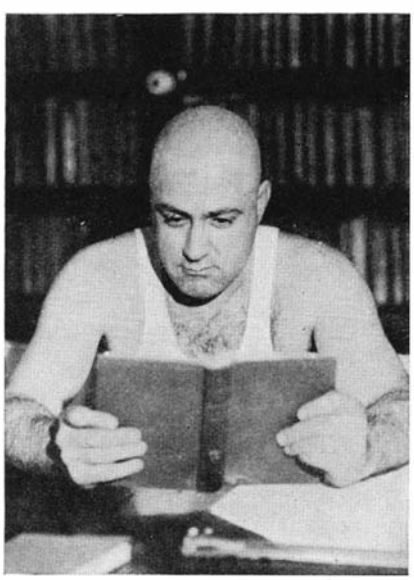
"Looking at Stresses" is the title of an article soon to be published, in which a new and remarkably direct way of "calculating" the complex stresses in engineering structures is explained. By subjecting models to stresses and examining them by polarized light, it has proved possible and practicable to "let the stresses calculate themselves"—they show graphically. The stresses in some structures are so complex that the best engineering methods have afforded determinations which were only approximations.

A noon hour at Central Circulation Branch where 767,000 books are circulated yearly, mainly from 12 to 2 P.M.

Books and magazines are sent for use of patients in the hospitals. Book wagons serve to make a peripatetic library

PROFITING BY ENFORCED LEISURE

THE offices of the SCIENTIFIC AMERICAN being located across the street from New York's great Public Library, we naturally come more or less in touch with its activities. About the time when apple vendors began to appear on Fifth Avenue and a melancholy winter threatened, the volume of readers seemed to increase; they were really readers and not "sitters," for the latter have been eliminated. Prevailing economic conditions, bringing unemployment and enforced leisure, have afforded an unusual opportunity for service on the part of the libraries all over the United States. New York's Public Library with its far-flung branches has met the issue squarely. From all parts of the city, with its cosmopolitan population, has come the constant call for books on economics, business, applied science, vocational opportunities, and the proper use of leisure.



"Stone walls do not a prison make:" Improving leisure moments

Children have felt the depression keenly and are using the libraries more and more for recreation. In normal times they would be in the country or visiting relatives or at a movie but now their leisure time is often spent in reading both at home and in the library where every effort is made to give a good time by story telling or puppet shows.

The book wagon is the forerunner of the sub-branch and the branch proper. There is one in the Bronx and another on Staten Island. Three quarters of the patrons are children.

While depression cannot be said to have crippled our penal institutions, many of the inmates are looking forward to useful lives after they are released. In the last year, reading in the penitentiary increased 25 percent. Hospitals are supplied by the New York Public Library and many an hour of pain is made easier by books.

The book wagons in the Bronx and on Staten Island are well patronized and even meet commuters' trains

HOOVER DAM

Materials, Supplies, Manpower, and Program of Future Work

Mr. Young began his story of Hoover Dam last month by explaining the purposes, plans, and some of the facts regarding the progress of construction on the project. In this concluding part, he carries on with the story from March of this year, and the illustration on the opposite page gives the program of future construction.

By WALKER R. YOUNG
Construction Engineer, Boulder Canyon Project

(*Concluded from September*)

THE first concrete for Hoover Dam was poured on March 5, 1932, in the foundation for the trash-rack structure at the inlet portal of tunnel No. 2. Lining of diversion tunnels was started soon after and in April was under way in three of the tunnels. Concrete for these operations is mixed in a plant located on the Nevada side of Black Canyon approximately one half mile upstream from the inlet portals.

The plant is 78 feet by 118 feet in plan, about six stories in height to top of storage bins, and more than eight stories to top of tower. Four four-cubic-yard mixers are installed on the lower floor. Above the mixers is the control deck, and above this the conveyor floor and the batcher floor. The bottom of the 33-foot high storage bins is nine feet above the batcher floor, and a tower rises 33 feet above the bins. This tower is situated at the upper end of two 42-foot belt supply conveyors which lead from bunkers beneath the railroad tracks at the north end of the plant. It is equipped with hoppers and shuttle conveyors for transportation of material from the supply conveyors to storage bins designated for sand and different sizes of gravel.

Sand, three sizes of gravel, and cobbles, classified and loaded in separate cars at a screening plant located in Hemenway Wash two miles upstream and two miles west of the river, are brought four miles by rail and dumped into the bunkers at the lower end of the double conveyors, each size of aggregate being dumped into its designated bin. The double supply conveyor, running beneath the bunkers, is loaded through a gate in the bottom of the bins and transports the material to the top of the plant where by an arrangement of hoppers and shuttle conveyors the material is transferred to its particular bin.

Cement, received at present from manufacturers in southern California, is shipped in bulk to Boulder City, thence by the United States construction railroad to a junction with the contractor's railroad south of the gravel plant, and thence on the contractor's railroad via the screening plant to the mixing plant. The cement, conveyed by air pressure, is loaded into the covered storage bins at the front and top of the plant through six-inch pipes. The unloading machine resembles a large vacuum cleaner.

When the plant is in operation, the cement and aggregates are fed through compressed air gates to a weighing batcher which is so constructed that the gate will be closed as soon as the weight of aggregates designated has been dumped into the batcher. The batcher load is fed on to a conveyor which transports it to a hopper above the mixer. When desired, the hopper gate is lifted, allowing the cement and aggregates to flow into the revolving mixers. Water of definite quantity from a weighing batcher is fed into the mixer with the other materials.

MIXING is performed for a minimum of 2½ minutes after all materials are in the mixer. Concrete is dumped into agitator drums or bottom dump buckets and transported in 10-ton trucks to the pouring site.

A recording device is installed on the control deck of the mixing plant which furnishes visual information of all operations of the plant, and also supplies a permanent record of these operations.

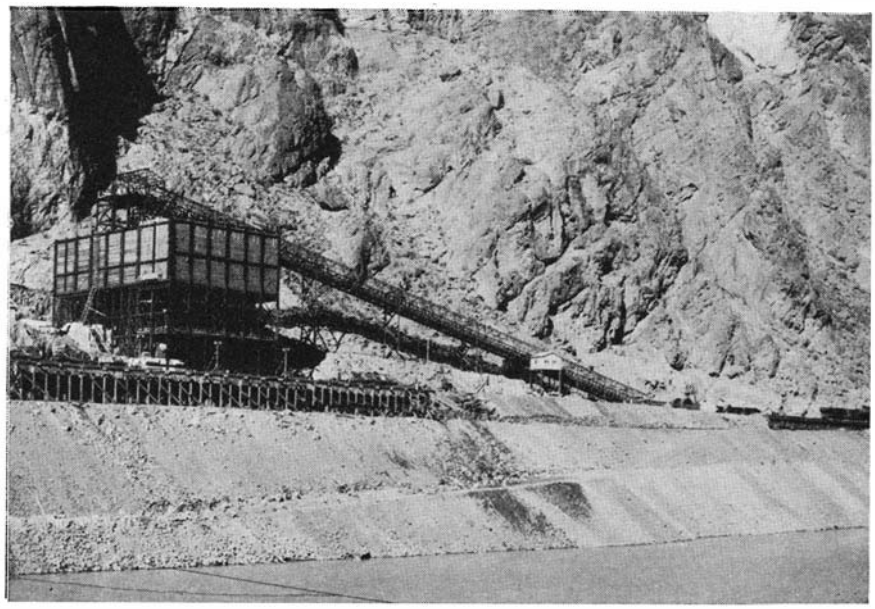
While one batch is mixed, another is placed in the mixer hopper so that mixing operations are nearly continuous. Sixteen yards of concrete can be manufactured every 3½ minutes, on which basis the plant has an ultimate

Parts of Boulder City in the desert. ***Upper:*** **The club house and commissary of Six Companies, Inc.** ***Lower:*** **Government three- and four-room residences**

theoretical capacity of 6600 yards in 24 hours.

The screening plant, which classifies and washes all concrete aggregates, is composed of a group of steel towers containing vibratory or revolving screens connected by belt conveyors.

Pit material, hauled seven miles by rail in side dump cars from the Arizona deposit to the screening plant, is dumped into bunkers at the northwest end of the plant. Conveyors then transport the material to a series of screens, removing first, in turn, the oversize rock, the cobbles, the 1½-inch to 3-inch gravel, the sand, the ¾-inch to 1½-inch gravel, and finally the ¼-inch to ¾-inch gravel. The oversize rocks are conveyed to a gyratory crusher, broken, and returned to the system. The various sizes of cobbles and gravel are carried by lateral conveyors to stock piles northeast of the classification towers and the sand, after being washed, is transported to a stock pile across the tracks southwest of the classification towers.



The great concrete mixing plant on the Nevada side of the river at the Boulder Canyon Project. Here concrete for lining the immense tunnels is being mixed

A CONCRETE tunnel 9 feet by 11 feet in size, located under each gravel stock pile, has a conveyor contained within it which receives the gravel through gates and hoppers located in the top of the tunnel and transports it to a screen, where the material is re-screened, and thence to a shuttle conveyor which dumps it into 50-ton railroad cars. The sand is loaded with a railroad crane equipped with a clam-shell bucket.

The gravel is sprinkled continually while in the stock piles and when being loaded is rinsed by water jets playing on the shuttle loading conveyor.

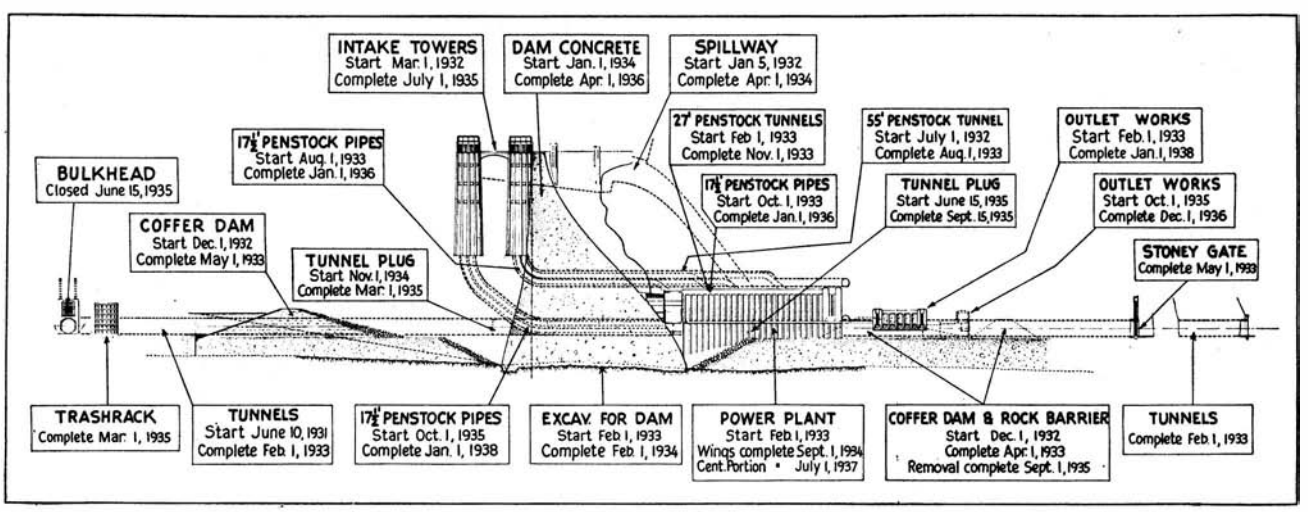
Water for the plant is pumped from the Colorado River through two miles of pipe line and against a static head of 427 feet to a pre-sedimentation tank located on the hill east of the plant. About 98 percent of the silt is removed from the water by a detention period of three hours in the sedimentation tank, and the water is then allowed to flow by gravity to a storage tank and thence to the plant.

The Arizona deposit, from which all aggregates are secured for the construction of Hoover Dam, is located on the Arizona side of the river six miles air line north of Hoover Dam site. The deposit has an area of approximately 100 acres, and its depth, according to the test pits, averages more than 30 feet. It is expected that an average of approximately 2½ feet will be stripped and wasted; thus there will remain more than 4,500,000 cubic yards of material, all of which will be needed.

All concrete aggregates must be hauled from the pit and stored preceding the year 1935, as at that time water will start rising back of the dam to an outlet through the intake towers, thus inundating the deposit. For this reason the pit is now operated on a three-shift basis, and all material not needed at the screening plant is deposited in a raw storage pile northwest of the plant and adjacent to it. At the present time, pit material is loaded out by a five cubic-yard electric dragline into trains of eight to ten 50-ton cars at the rate of 180 to 200 cars a day.

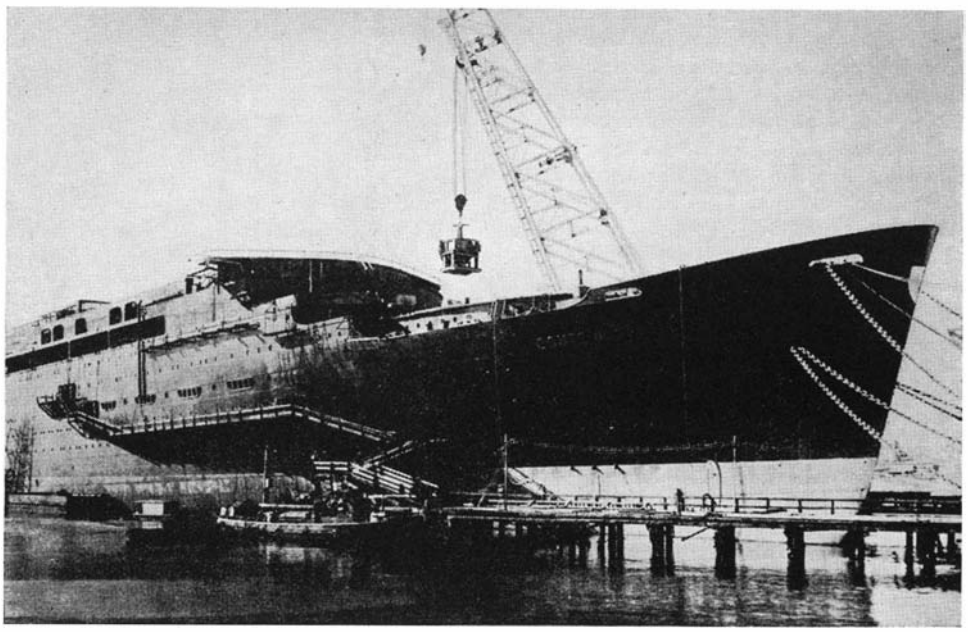
More than 4300 persons are now employed on project activities. Of these, 250 are working for the Government; 3426 for Six Companies, Inc., its subsidiaries, and sub-contractors; 350 for other government contractors; and the remainder for individuals or firms operating business concessions in Boulder City.

A recent report from Six Companies, Inc., stated that of the 3042 men employed directly by it, 1108 were working in tunnels, 758 were employed on miscellaneous work at the river, 250 were engaged in spillway operations, 464 were doing mechanical and electrical work, 214 were employed on the railroad and at the gravel and concrete plants, and 248 were engaged on construction in Boulder City and on general work. The March payroll for the Government, Six Companies, Inc., and other contractors amounted to 565,600 dollars.



The program of future work on the principal parts of the project, with schedules of completion

THE LINER THAT CAN NOT ROLL



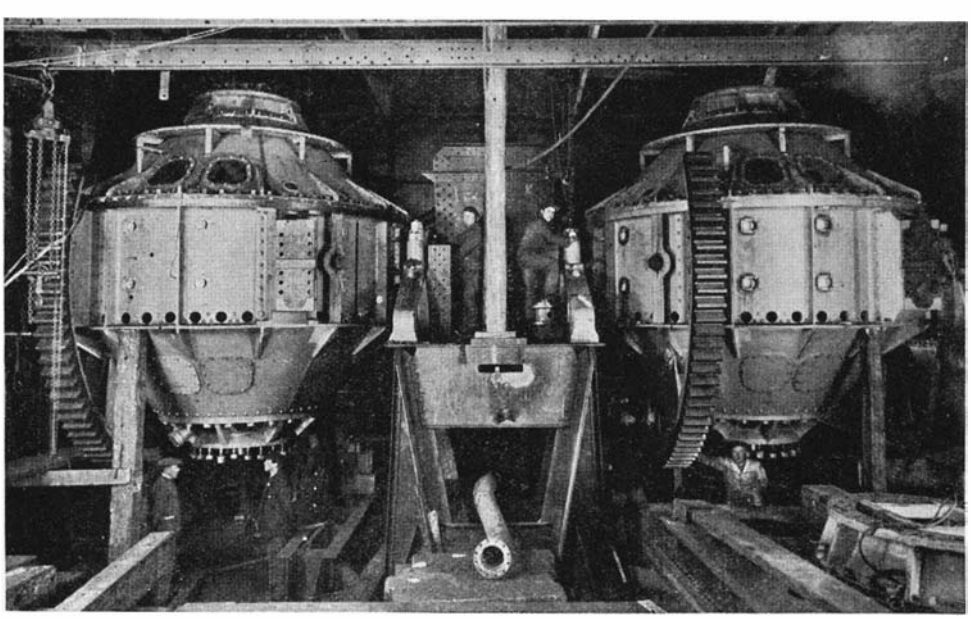
One of the three stabilizing gyroscopes that will prevent rolling of the *Conte di Savoia,* being lowered into her hull at the shipyard in Trieste, Italy. Note comparative sizes

HAILED by her owners as marking the dawn of a new era in the history of the Italian Merchant Marine, the Lloyd Sabaudo liner *Conte di Savoia,* which will sail from Genoa, Italy, on November 8 on her maiden voyage to New York, is seen as a challenge to the merchant marines of other nations to equal her performance. There is no doubt whatsoever that she will live up to expectations as being "the liner that can not roll" for, besides other innovations in her structure. she has, deep within her vitals, a million-dollar plant to hold her on an even keel regardless of weather and waves. This plant, a Sperry three-unit gyroscopic stabilizer, is three times larger than the biggest stabilizer plant already in use. It constitutes, however, only 1½ percent of the total weight of the ship—a mere toy, it would seem, but of tremendous stabilizing power, nevertheless!

The Sperry Gyro-Stabilizer has been in use and has proved its efficacy on yachts and warships for many years. However, use of it in passenger ship construction is an entirely new departure, and the Lloyd Sabaudo thus takes a pioneer step in approaching the problem of building personal comfort into ships through the agency of scientific engineering. Hence the challenge to ship owners of other nations.

In recent years ocean liners have steadily grown in size, partly due to the competitive spirit between nations for the greater volume of business usually accorded a modern marvel of construction, but principally, it is believed, in order to attain a greater degree of stability. The larger the ship the steadier she will be in a seaway. But even the larger liners often come into port hours late with the report: "Delayed by a storm." It is not difficult to imagine the condition of passengers in such a case. With all the luxuries of the finest home ready for their enjoyment and a cuisine that may be world famed ready to sate the most jaded appetite, passengers are forced to languish in their rooms or, if somewhat more courageous, parade the decks miserably.

The *Conte di Savoia,* of 48,000 gross tons and therefore ranking with the largest on the Atlantic, can not only ride smoothly through the roughest of storms but can also very nearly maintain her schedule to the hour. Her passengers will be able to ignore the storm even to the extent of using the ship's two large swimming pools without fear of being sloshed about by rolling. Moreover, by maintaining steadiness of the ship, the stabilizing system gives greater speed in proportion to shaft horsepower and reduces the strains and stresses on the vessel's hull.



Two of the Gyro-Stabilizers being assembled in the new ship. The third was later placed in foreground on the ship's centerline. The entire stabilizing plant weighs only 300 tons

INDEED it may seem inconceivable that so small a plant—the total weight of the three gyroscopic units is 300 tons, the rotor of each being 13 feet in diameter—could check the vital forces of the elements acting upon so great a body as the *Conte di Savoia.* To see how this is

possible, let us consider The Sperry Gyroscope Company's explanation.

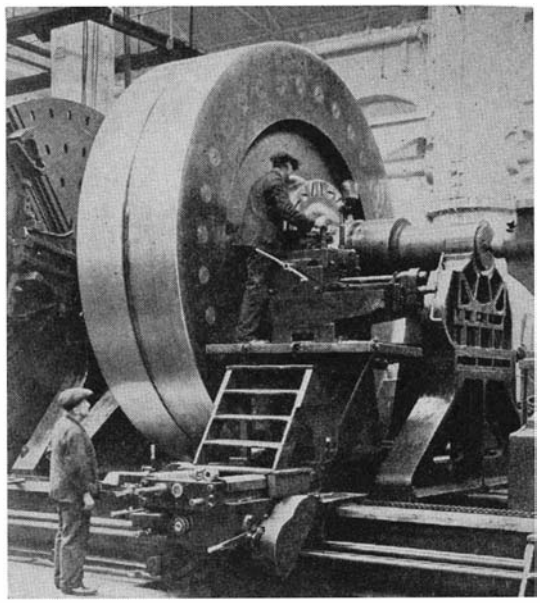
The rolling motion of a ship is the result of fluid pressure acting on the hull and the shifting of that pressure from one side to the other. Waves do not beat against a ship the way they do against a solid breakwater. A ship is free to rise and fall, and the bulk of each wave passes beneath her, imparting a comparatively slight roll before it passes on. A single wave can only *start* the rolling; it takes a whole succession of waves to cause a violent rolling motion. The problem for the stabilizer, then, is but to counteract the force of each individual wave as it hits the ship.

It will be readily understood, therefore, that a relatively small artificial force, equal and opposite to the disturbing increment of each wave and applied the instant the wave starts, will be sufficient to counteract the wave's force. The Sperry Gyro-Stabilizer must deal only with initial wave impulses and does not have to be inordinately large.

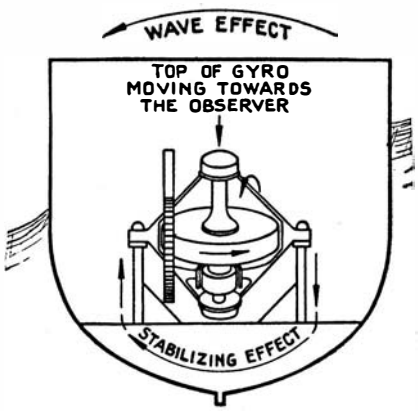
THOSE of us who have spun a toy gyroscope—who has not?—and have felt its strong "pull" against our hands when we tilted it on its axis can quickly grasp the principle of the *Conte di Savoia's* Gyro-Stabilizers. The rotors of the three units, mounted in the hull just below the waterline and approximately beneath the bridge, normally spin in a horizontal plane with axes vertical. (One or more of them may be operating, depending upon the roughness of the seas.) Precession, the fore and aft tilting which is a fundamental gyroscopic principle, causes the rotor to exert a counteracting force against the impulse of the wave as the toy gyroscope exerted a force against our hand when we tilted it.

When a wave, for example, comes in contact with one side of the vessel, this side of the ship would start to rise. The stabilizer, however, detecting the heeling movement at the instant of its inception, precesses and thus applies a righting force. As the wave passes beneath the vessel, the Gyro-Stabilizer reverses its forces and prevents the vessel from rolling in the opposite direction. The gyro accomplishes its work by simply precessing through a small fore-and-aft arc in its gudgeon bearings. Each time this cycle is completed, the effect is the same as though a great weight is gently lifted from one side of the ship to the other and then back again.

The new Italian Line ship, in addition to her even-keel feature, has several noteworthy innovations. She has been given more than the usual streamlining in order to cut wind resistance, as well as water resistance, to a minimum. Her graceful lines are the result of tests of models in standard airplane wind-tunnels, in addition to the usual tank tests which determine the hull's resistance to water. Another innovation on the *Conte di Savoia* is the elimination of the third, or "dummy," funnel and the location of the remaining two well forward to make room for what is said to be the largest sun and sports deck of any liner afloat. A large outdoor swimming pool and a sun-glass roof on this deck are worth noting here. She has 11 decks, and accommodates her passengers in four classes: First, Special, Tourist, and Third. Each class has large verandas and promenades.



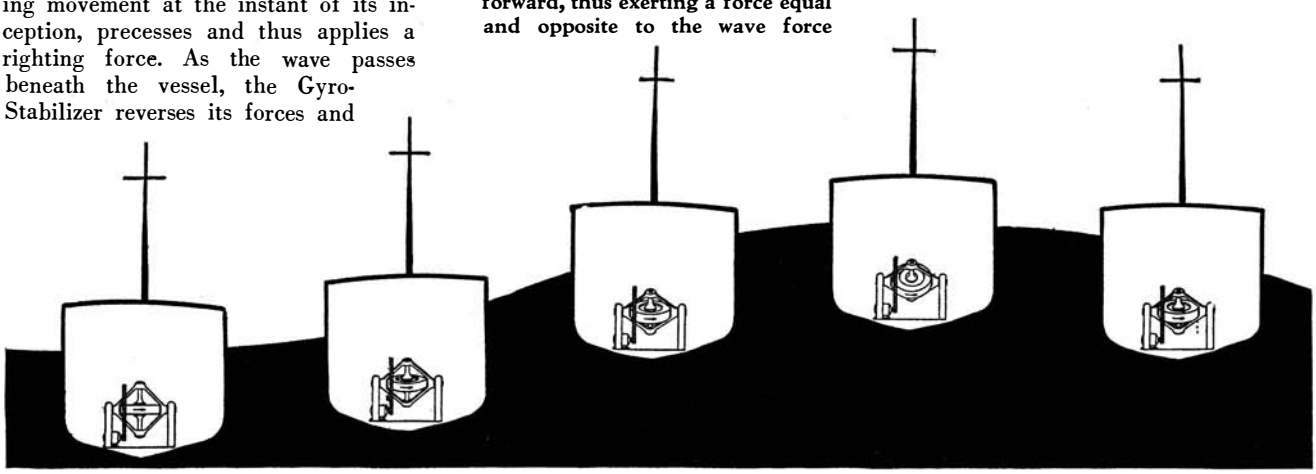
One of the huge gyroscope rotors in process of construction. It has a diameter of 13 feet



Starting with the wave trying to roll the vessel to the left, the top of the stabilizing gyroscope moves forward, thus exerting a force equal and opposite to the wave force

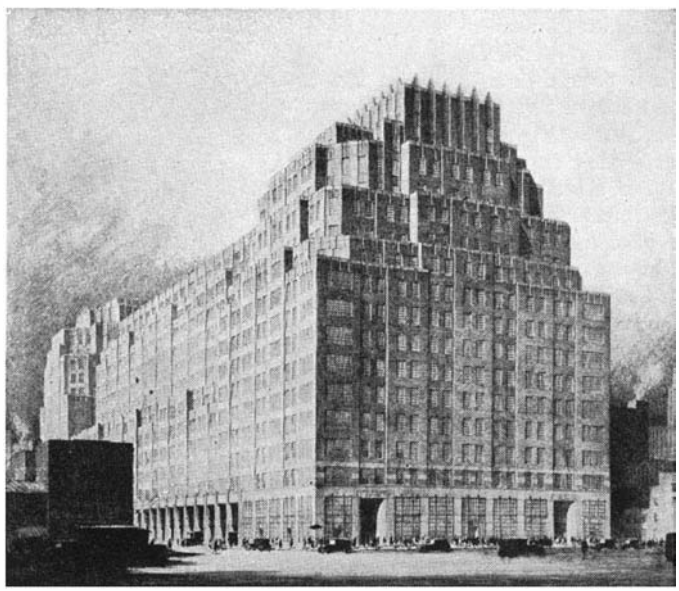
Refinement and quiet elegance are, of course, to be noted throughout. Safety features abound but we shall mention here only the 24 non-sinkable, non-capsizable radio-equipped life boats which can be launched from any angle and which easily carry 3000 persons. A garage carries 30 automobiles.

The *Conte di Savoia* is 811 feet 9 inches over-all; her engines develop 120,000 horsepower; her generators produce sufficient electricity to light a city of 200,000 inhabitants; her control is electrical throughout; and artificial ventilation is provided by 120 machines. Having four screws, her speed is expected to be more than 28 knots. This will enable her to cut the running time between New York and Gibraltar to five days and between New York and the French Riviera to six days.



How a stabilizer lazily oscillates. At left, the rotor's shaft is vertical and the rotor is turning in an anti-clockwise direction. As the wave rolls under the ship from the right, the rotor tilts forward, exerting a downward force on its right mounting

A 'POSTOFFICE' for FREIGHT

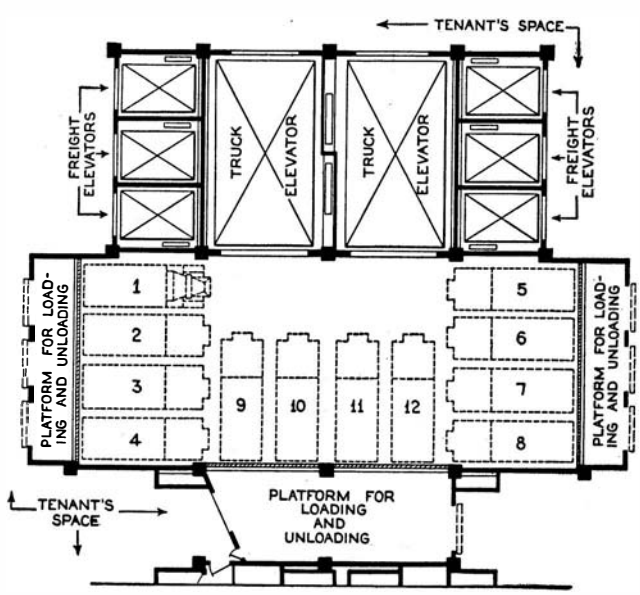


Union Inland Terminal No. 1, as it will appear when completed. It occupies an entire block in a very busy west side shipping sector

THE occupancy in October in New York City of a building now under construction at 111 Eighth Avenue will mark the consummation of the first phase of a plan unique in conception and outstanding in the magnitude of the economic results expected of it. This structure, the Union Inland Terminal No. 1, will go far toward solving the extremely difficult problem of city freight handling and distribution and of traffic congestion in one of the busiest sections of New York City. It is expected to save enormous sums to shippers and receivers of less-than-carload lots of freight. The Port of New York Authority, that bi-state body responsible to New York and New Jersey, which operates the world-famous Holland Tunnels, the George Washington Bridge, the Bayonne Bridge, and other important projects, financed and is building the Union Terminal and plans two more eventually of a similar nature located at strategic points.

Constantly moving by rail and water through the port of New York is a vast trade that has increased so rapidly in recent years that every facility for commerce is being taxed to the limit; some, indeed, are already saturated. Along the Hudson River are located some of the most important piers in the world, in respect to the volume of trade that passes into and out of the city through them. The streets of this same section must also take care of the enormous freight traffic passing between Manhattan and the several railroad terminals in the lower west side and across the river in Jersey City and Hoboken. It is a section of factories and of wholesale houses, the total business of which runs into the hundreds of millions annually. Needless to say, thousands of trucks, both horse drawn and motor, are required to move this freight to and from warehouses, factories, and railroad terminals.

Often one shipper may habitually have small batches of freight ready to go out over different roads at the same time, or a consignee may have to send his truck to several different points to pick up freight that is awaiting him. In such cases, all too numerous every day, the transfer costs mount to high peaks because of the time required or because trucks are not loaded to capacity; and street traffic, congested enough even if this additional travel could be eliminated, is more congested than ever as the trucks shop about to pick up or deliver freight. The public is concerned in this because it must bear the burden of the costs and at the same time have streets, built for its use, so clogged as to be no longer adequate.



Truck facilities on a typical floor. Positions 1 to 8 are regular positions; the remaining four, special

THE plan for inland terminals is the Port Authority's solution to this problem. The three units comprising the complete plan are expected to benefit the public, shippers and receivers of goods, and eventually also the carriers that will co-operate in the proper functioning of the Terminals.

The system as worked out is the essence of simplicity, being merely an adaptation of modern methods of terminal trucking. It has been likened to a postoffice. Taking up the entire city block bounded by Eighth and Ninth Avenues and West 15th and West 16th Streets—a location that is particularly fit for the job in hand since it is in the lower section of Manhattan which suffers most seriously from the present methods of freight handling—the Union Inland Terminal No. 1 will receive from shippers outgoing freight destined for all roads leading out of the city, and also incoming freight from all roads.

The shipper need only send his shipments, of whatever character or destination, to the Terminal and there they will be assorted and delivered to the trucks of the railroads which will carry them. Incoming freight will be stopped as at present at rail terminals and transferred from the cars to trucks. These trucks, operated by the carrier, will then

move it via ferries or tunnels to the inland terminal which has been designated by the shipper. There the freight will be classified for delivery to the consignees' trucks.

Union Inland Terminal No. 1, the first of three such freight centers to be built, is a 15-story fireproof steel and concrete structure 800 feet long by 206½ feet wide with no deduction for areaways or light wells, designed for light manufacturing, commercial uses, show rooms, and executive offices. It will offer special advantages to its own tenants occupying the floors above those where the freight is handled. The basement and ground floor, except the Eighth and Ninth Avenue fronts, will be dedicated to handling freight shipments, with special loading platforms for motor trucks inside the building.

The great excavation necessary for the first of the three terminals, as it appeared in July, 1931. This gives an idea of the magnitude of the building

FOUR large elevators, two at each end of the building, will carry loaded motor trucks directly up to tenants on the upper floors. At each pair of elevators on each floor is a truck lobby 88 feet 6 inches by 36 feet 10 inches with regular positions for eight trucks and reserve positions for four more. Each of these elevators will accommodate motor trucks 33 feet long and weighing 20 tons.

The operation of these large truck elevators, without extra charge to the regular tenants, affords to every floor the advantages of street level location. Trucks enter or leave the building by means of a passageway running through the building from street to street, use the elevators to leave or to reach the various floors, and load or unload in the truck lobbies at platforms level with the truck bodies. Doors in opposite ends of these elevators permit trucks to be driven directly onto the floor instead of into a truck lobby.

When John C. Evans, Terminal Engineer of the Port Authority, turned attention to devising an indicator of vacant truck positions in the truck lobbies of all floors, he found quite a problem. He did not wish to send a loaded truck up to a tenant only to find that all truck positions were filled, and a telephone call system or a regular indicator board would be both inefficient and uncertain. It has been tentatively arranged, therefore, to install a photo-electric cell unit and light in the ceiling and in the floor, respectively, of each truck position. These are not to burn continuously, however, but only when a button is pressed at a traffic control station at the entrance. Furthermore, they will indicate only positive vacancies, and it will be up to the tenant to keep boxes, refuse, and the like from interfering with the cell.

Photographs courtesy Port of New York Authority

Typical trucking activities which block the streets and sidewalks of Manhattan. The new terminals will go a long way toward alleviating such congestion

TWELVE package elevators and 18 high-speed passenger elevators will serve the commercial part of the building. Eight of the passenger elevators are located at each end of the building and two in the center for greater convenience.

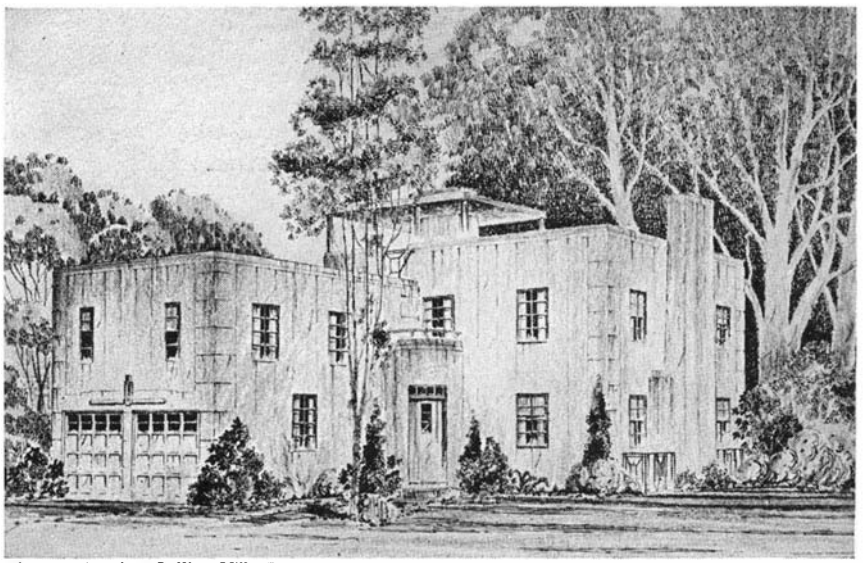
The area of the commercial floors varies from 165,000 to 88,000 square feet and the floor to floor head room of each is 15 feet. Floors are designed to carry a live load of 200 pounds per square foot.

That part of the building set aside for the offices facing Eighth Avenue will be completely separated from the commercial activities except as they may be connected to suit tenants. Eight passenger elevators, the only ones in the ground-floor lobby, will serve the office floors.

The terminal will provide less-than-carload-lot facilities for the following trunk line railroads: The Baltimore and Ohio; Central Railroad of New Jersey; Delaware, Lackawanna, and Western; Erie; Lehigh Valley; New York, New Haven, and Hartford; New York Central; and Pennsylvania.

This first Union Inland Terminal was begun in the spring of 1931 and is to be finished and ready for rail occupancy by October 1 of this year. Its total cost, including the cost of the land and improvements, will be in the neighborhood of 16,000,000 dollars; and its estimated yearly capacity in less-than-carload-lots of freight is 680,000 tons.

HOUSES OF THE FUTURE May Be Made in Factories But Will Be Built to Individual Design*



Courtesy American Rolling Mills Company

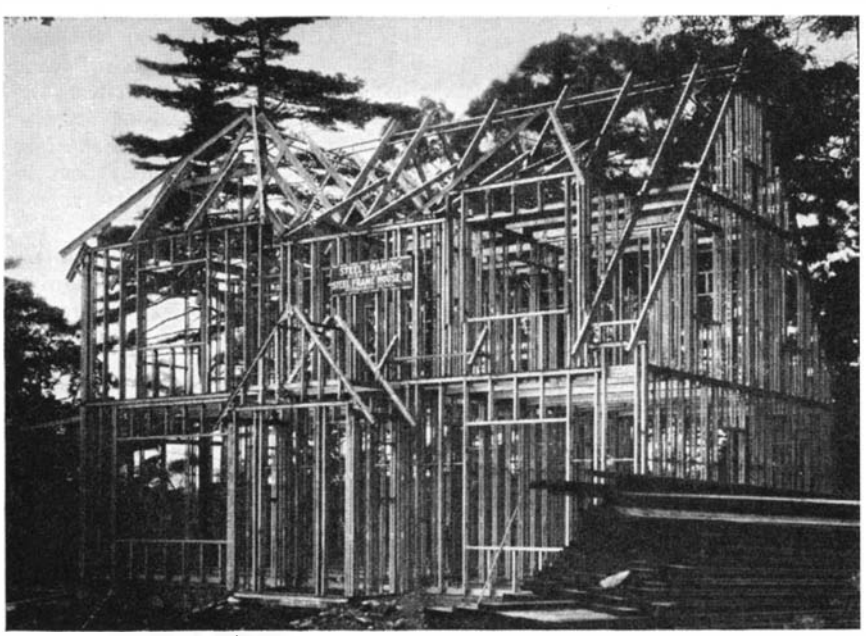
A frameless house of fabricated steel which most nearly approaches, in construction, the house of the future. It is being built in Cleveland, Ohio

EVEN in normal times housing needs close attention, both because it plays such a big part in improving the environment of people, and because it provides an outlet for the large and varied products of industry, thereby making both profits and employment. In abnormal times when the business panorama is being scanned for special industries which should or could be stimulated, housing deserves unusual attention.

Construction represents one of the two largest manufacturing industries even though it is not a single well-integrated industry, but a loose aggregation of building trades and raw material producers. It is also one of the most depressed of all industries, due to a number of complicated reasons. Housing represents only one phase of the construction industry, but it is one of the biggest branches. If housing could be stimulated, the effects would be noticeable throughout the entire industry and throughout many other industries.

There may be no single way to stimulate housing. Mere talk of better housing will not do it. Easier mortgage money would help, but of itself would not necessarily reverse the downward movement. Apparently one thing needed is better houses themselves—houses better planned, better engineered, better executed, and cheaper. In this connection, it must be concluded that serious attention should be given to the development of new methods for making houses by machinery, for making considerable parts of them in the factory, as other things are made successfully.

Consider the relative perfection of the automobile. It is more or less a standard product. The efficiency methods of one manufacturer are the methods of the entire industry, with allowances for individual plans. The product represents the best efforts of great technical staffs, with continuous experimentation and continuous research necessitated by competition. The result is a good product at a low price, available to millions, and a great industry developed within a generation.



Courtesy Steel Frame House Company

An approach of several years ago to the factory-built house. In this, the wooden framing was simply replaced by steel, bolted together and wire-braced

CONSIDER by contrast the average house. It is a clumsy affair consisting of walls and roof and floors, with some desultory conveniences. It has very few of those well planned, highly developed improvements which go along as a matter of course with the automobile, even with the cheapest automobile. The automobile gives so much more for the money than the house that it is no wonder many people seem to take greater interest in their automobiles than in their homes. There may be no simple social or economic reason for this, but certainly one reason lies in the cheapness of the automobile as a quality product, and the costliness of the house as a relatively inferior product.

Centuries ago the house was built by hand, and it is still largely built by hand. Materials are assembled at the building site, labor is brought to the materials, and the house is erected on the spot from a multitude of small pieces. Nails have replaced wooden pegs, glass has replaced oiled paper, some machine-made parts are used, but the assembling is still a slow and wasteful procedure. Advances in the materials which form the house have not been matched by advances in the methods of putting them together.

The actual market for houses is nar-

*Courtesy Ernst and Ernst

rower than it should be. There are 30 million or more families in the United States, and it is estimated that less than 15 millions of them own their homes. Not all of the families living in rented homes could be expected to own houses, but a considerable proportion of them would be owners if circumstances were different. And if there were more individual home owners, the demand for better houses would be greater, thus furnishing new employment for labor, capital, and many industries.

There are three main reasons why more people do not own their homes and, therefore, why they do not have better homes. One relates to income, but this is too big a subject for discussion here. One relates to convenience: The ordeal of purchasing the right kind of house or of constructing it to meet the family requirements is greater, even in proportion, than the task of purchasing any other article of family consumption. For example, it costs the owner much more than ten times the tribulation to construct a 5000-dollar house than to select a 500-dollar automobile.

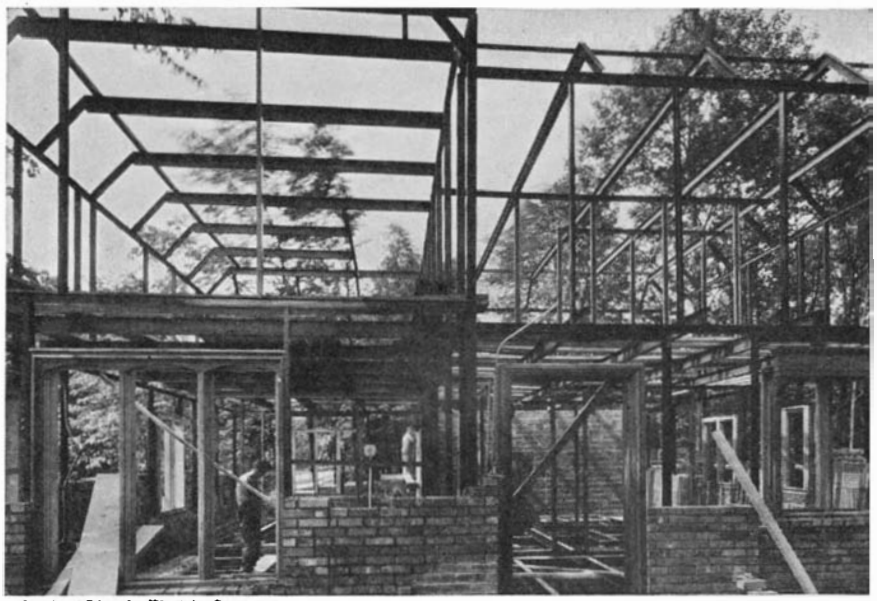
THE third and perhaps the principal reason relates to cost. A large majority of the 15 million families which do not own their homes live on an income of 2000 dollars a year or less. This is enough to support a self-owned house if the production of the low-priced house can be engineered, systematized, and promoted to fit the income of the prospective buyer. But building trades, because of their loose organization which makes industrial unity difficult, are handicapped in the development of the low-priced house. And the handicap also is felt all along the line, extending to workmen, architects, mills, dealers, railroads, and countless others.

In an effort to rationalize or systematize the house building industry (if it is an industry), a number of companies have developed the ready-cut house, which is delivered to the building site in small pieces, cut to fit approximately, to be put together by the usual hand methods. This is a step in the right direction, but it probably is not the true factory-built or "pre-fabricated" house of the future.

The idea of a factory-built house got its first real impetus less than five years ago from the steel industry, mainly because the industry was suffering from over-capacity. At first steel men thought in terms of adapting skyscraper methods to houses, building a house on a steel frame. Later the industry experimented with steel sheets for walls. Now experiments are being made with large units of the house—floor and wall sections. The experiments have demonstrated that these units can be assembled quickly and cheaply.

The lumber industry, fearing competition from steel, began making independent studies. Development of the lumber ideas has somewhat paralleled that of the steel industry, with large sections of a house fabricated in the lumber factory and assembled at the building site. With few exceptions, these experiments with lumber have not progressed as yet much beyond the drafting room. Many materials other than steel and lumber are believed by engineers to be suitable for extensive use in factory-built houses. Copper, aluminum, cement, and glass are included.

One of the chief faults in the experiments lies in the attempt of experimenters to jump too fast from conventional designs to new designs which are more adaptable to factory fabrication. The house is, after all, a thing of sentiment and tradition, and people do not change within a few years their inherited ideas as to what is a proper house.



Courtesy Lincoln Electric Company

Improvements in framing by simplifying it and joining it by arc welding, a process, shown below, which will play an important part in future house construction

THE gable roof, for example, is fairly entrenched in sentiment. It is now rather generally admitted that a flat roof is more practical, particularly in view of modern technical developments which enable a flat roof to shed water and be insulated against heat quite as well as the standard gable roof. Furthermore, the flat roof is much better adapted to factory construction, on which hopes of cheaper houses hinge.

It seems essential that progress toward the factory-built house be step-by-step. As experience and experimentation point the way, and as the public becomes accustomed to new methods, larger units of houses probably can be factory made. It seems possible, for example, that chimneys could be made in large units for subsequent erection. The present factory manufacture of floor sections, sash, doors, and frames is indicative of the necessary trend.

In the future it is probable that the prospective home owner, particularly the man of small income, will select his house in a show room, or from models and drawings. The company which sells the house probably will finance the purchase. The owner will buy his house somewhat as he buys his automobile today. This will require large companies, probably companies operating nationally. Small contractors may be gradually replaced and labor may be temporarily dislocated, but they will find compensatory benefits in modified work and in the greater market for houses. The public at large will gain the advantages of having a new industry, or an old industry reorganized. Now is not the time to expect immediate large-scale production of factory-built houses, but it is certainly the time to welcome and encourage development of the idea.

Horses pull in salmon seines at Sand Island in the Columbia River

SALMON FISHING

Brings Millions of Dollars Yearly to the Pacific Coast. How the Salmon Are Caught and Canned

By C. W. GEIGER

THE run of the Royal Chinook salmon and his cousins, the silverside, blue back, and steelhead, constitutes an annual living tide that ebbs and flows through the Columbia River, leaving behind a wealth of millions of dollars a year. From 10,000 to 12,000 people are anually engaged in this work in the lower Columbia district alone, including the fishermen, buyers, packers, and cannery employees.

Four methods are commonly used in commercial salmon fishing; gill netting, seining, trolling, and the Columbia River fish trap. The records of the Astoria customs house show that more than 2600 fishing boats are registered in the Astoria district, and the great majority of these are gill net boats. A gill net is a highly specialized type of net, composed of very expensive flaxen web and so bounded with cork and lead lines that it floats vertically in the water. Some of the nets fish close to the surface, while the "diver" type drift close to the bottom.

The gill net depends largely upon being concealed, and for this reason the best results come from fishing at night and in muddy water. While swimming rapidly, the salmon strikes the yielding, flaxen mesh. His pointed head is driven into one of the openings. There he is caught, unable to press through and unable to back out, and is dragged into the boat when the fisherman hauls in his net.

MANY a visitor to Astoria, Oregon, has exclaimed in surprise when he has seen horses neck deep in the water struggle in with the end of a vast web that brings to light tons of gleaming fish. Seining operations require a large outlay of gear, as well as a large crew of men. On Sand Island, the most important of the many salmon seining grounds near Astoria, the seines are about 1200 feet in length. They are piled on large flat-bottomed boats, the net being arranged in such a way that it can be dragged from the boat without becoming fouled.

In laying out the net, one end of it is held by a team of horses on the beach, while a power boat tows the net-carrying skiff far out into the river, the net "paying out" behind the boat. When the full length of the net has been paid out into the river, the boat turns back to shore, while a rope attached to the outer end of the net uncoils behind the skiff.

When the shore is reached, teams take this rope and gradually drag the net onto the beach again. As the net is landed it is again loaded on the boat. The slow withdrawal of the net from the river reduces the area of the enclosed space. Salmon which have entered the net are crowded together, and at last are drawn up on the sand. Enormous catches of fish are made by this method; more than 24 tons of salmon have been taken in one haul from a seine at Sand Island.

The Columbia River fish trap is a type of stationary gear which is in reality a maze. Piling is driven into the bottom of the river, and heavily tarred netting is hung on the piles. One long fence serves as a lead by which the fish are made to swim into the trap. They enter through narrow openings which they are unable to relocate later in their efforts to escape, because the salmon by instinct will not turn a sharp corner. He thus remains a prisoner until the trap fisherman raises the "pot" of the trap and removes his catch.

The fourth major method of salmon fishing is trolling. The operations are carried on at sea, off the coast. Spread-

ing poles support long, stout lines, each carrying several hooks. These hooks are not baited, but are trailed behind wabbler spoons which flash through the water. The fish strike the spoons and are drawn into the boat. While considerable numbers of Chinook salmon are taken at sea by trolling, the principal variety caught in this manner is the silverside.

The sea-going troll boats carry cargoes of crushed ice to the fishing grounds and as the salmon are caught they are cleaned and packed in the ice in the hold. Thus they are kept in perfect condition until the boat returns to port. Some of the troll boats can carry many tons of dressed salmon.

The first salmon cannery on the Columbia was located at Eagle Cliff, in the year 1866. That year four thousand cases were packed, and the first packer on the river sold out two years later because he felt that the river was fished out. Gradually the "pack" increased until 1895, when it reached 634,696 cases. However, the salmon could not maintain itself in combat with human greed and ingenuity, without being given a sporting chance to reproduce its kind. By 1913 the annual pack had fallen to 260,000 cases, and the need for regulation became apparent.

The fishing season now opens on May 1st, and closes for a 10-day period in August to permit a portion of the run to reach the upper parts of the river in order to spawn. The season is open the rest of the year, and the beginning of the next, but the month of March is closed for the same purpose. Regulations also prevail during the open season. Every week-end, fishing halts for 24 hours to give the salmon a chance to run the gauntlet of web. Hatcheries now play an important rôle in salmon propagation, and the pack is increasing from year to year.

Columbia River fishermen with salmon in a seine

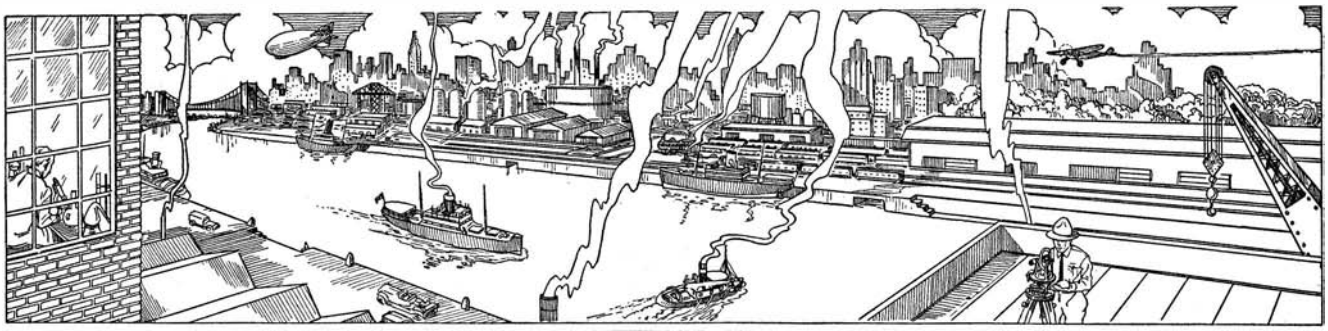
A NUMBER of the small canneries still use the old hand method of dressing fish, and in such places the selection of the butchering or dressing "gangs" is of first importance. Two men constitute a "butcher's gang," and the number of these gangs is dependent upon the output of the plant. Boys place the fish, with the head out, upon the cutting tables. One man cuts off the heads, after which the other removes the fins, tails, and viscera. The dressed fish is transferred to a tank of water, where it receives a washing, scraping and final brushing with a whisklike broom.

The usual method of cutting the salmon is by a machine with the knives so arranged as to cut the fish transversely in sections the exact length of the cans to be filled. Most canneries now use filling machines for all sizes of cans, although a few, particularly those packing flat and odd-sized cans, still pack by hand. A uniform quantity of salt is added by mechanical means when filling each can. The contents of the can are heated, and the greater part of the air is exhausted. The lids are then crimped on tightly, the cans pass through a machine to be washed, and move on to enter a retort for the one cooking they are to receive. The processing time varies somewhat according to the nature of the contents, and the size and shape of the cans.

From Point Conception northward to Alaska, grayfish are caught both on trawl lines and in nets, in great numbers. The grayfish is none other than the fisherman's old-time enemy, the dogfish. As dogfish they are despised here in America, although their food value has been recognized for centuries in Europe. They have been regarded as pests by fishermen, owing to their piratical and destructive habits.

In its endeavors to increase the demand for this low-priced and excellent food fish, the United States Bureau of Fisheries changed the name to grayfish, with gratifying results. As a food, grayfish are equal to sturgeon or medium-grade salmon. Eaten fresh they are excellent, although it is as a preserved product that they find their largest use. Heretofore grayfish have been considered a source of annoyance to commercial fishermen, comprising as much as 50 percent of many catches in nets and traps. Now that they have attained commercial value, they are regarded with more favor, particularly in view of the fact that grayfish are most plentiful on the Pacific coast during the winter, when the salmon canneries are idle.

Potential cans of salmon. Chinese boys preparing fish for processing



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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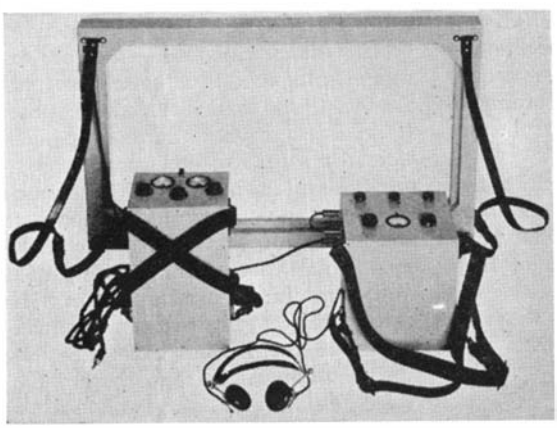
Lehigh University

Science Aids Quest for Gold

IT seems a far cry from the ancient burro and dilapidated pan of the early gold prospector, to the modern electrical apparatus pictured in these columns, yet both represent mile-stones in the perpetual quest for the precious and elusive yellow metal.

This latest development is due to the geophysical firm of William M. Barret, Inc., who designed and constructed the equipment for mining interests. The instrument, which is termed an ore detector, will be used to locate electrically conductive deposits of gold which may occur at depths not exceeding some five to ten feet. Only two men are required to operate the apparatus, which consists of a power unit, a receiver unit, and an exploring coil.



Details of the ore detector comprising, at left, the power unit (a vacuum-tube oscillator and amplifier); at right, receiver unit (inductance bridge and vacuum-tube amplifier); and background, the exploring coil. In the view below: Only two men are required for the operations of the new ore detector

To the left in the close-up of the equipment may be seen the power unit, which comprises a vacuum-tube oscillator and amplifier, while to the right is shown the receiver unit, consisting of an inductance bridge and vacuum-tube amplifier. The exploring coil appears in the background, and in the foreground are the conventional headphones, which are used as null indicators.

In operation, the bridge is energized by 2000-cycle sinusoidal current, the power-level of the oscillator-amplifier being adjusted to meet the requirements of depth penetration. Following this the receiver amplifier is set for the desired gain, and the bridge brought to precise balance by appropriate resistance and inductance controls. The condition of balance is indicated by silence in the headphones.

If the exploring coil is moved over the ground, and a conductive body comes within the magnetic field of the coil, the eddy currents set up in the conductive mass will reduce the effective inductance of the exploring coil, which serves to unbalance the bridge. This condition will be indicated by the appearance of the 2000-cycle note in the headphones, the intensity of the sound depending on the degree of bridge unbalance. A change in the inductance of the exploring coil of one part in a million may be detected readily in this manner.

While this ore detector was designed primarily to provide a means for locating relatively shallow veins and placer deposits of gold, it will be understood that any body which conducts electricity will give a similar reaction with the instrument. The magnitude of the response will depend on the physical proportions of the disturbing mass, its conductivity and depth, and the electrical constants of the surrounding media.

Better Mummies

MODERN science has improved upon the mysterious secret of ancient Egyptian embalmers; mummies discovered 3000 years from now will show our descendents just exactly what we looked like, according to Prof. E. J. Farris, writing in *Science*. The new process of embalming utilizes paraffin and, according to Professor Farris, corpses preserved by the paraffin method do not have the shrunken, dried appearance of Egyptian mummies, but are natural in both form and color. They should last indefinitely, he believes.

The process is essentially similar to one

used for many years in biological laboratories for the preservation of small bits of plant and animal tissue, and lately employed by Dr. G. K. Noble of the American Museum of Natural History in New York for making vividly lifelike mountings of small snakes, lizards, and the like.—*A. E. B.*

Rock Island Project Completed

AN accompanying illustration shows the huge Rock Island Hydroelectric Project, completed, as seen from the air. It will be recalled that construction of this plant by Stone and Webster Engineering Corporation for the Puget Sound Power and Light Company, was described in our November, 1931, issue. The plant will have an ultimate capacity of 252,000 horsepower.

From this striking photograph may be more clearly visualized the manner in which the builders erected first one wing of the dam out to the island in the middle of the river and then the other wing.

This is the first great power plant to utilize part of the vast water power of the Columbia River. Plans now taking shape, however, contemplate its more complete harnessing before many more years pass.

Boric Acid Eliminates Electrical Fuse "Fireworks"

WHEN a fuse "blows out" in the household lighting circuit, father simply goes down into the cellar, screws a new one into the socket, and thinks nothing of it. When a fuse blows out on a high-voltage, high-current circuit in a power house or a factory, there is apt to be considerable sputtering, sparking, and spectacular "fireworks." Hitherto this violence had been attributed to the formation of gas, and engineers had sought materials which under the heat of the arc would evolve no vapor. Dr. Slepian of Westinghouse proved it was this very vapor evolution which extinguished the arc, and said the cure for the trouble was some material which would yield maximum volumes of non-explosive vapor. This was found in solid boric acid, which yields water vapor when heated.

From this starting point, Westinghouse engineers developed a fuse which breaks 20,000 amperes at 13,200 volts without arousing any excitement. In the center of a thick-walled cylinder of solid boric acid is a plunger, which would be withdrawn deep into its hole by a spring, were it not held forward by the fuse-wire, which serves as one terminal. When the fuse melts, the arc is drawn down into the boric acid hole where it generates a quantity of water vapor which instantly extinguishes the arc. By special design, the fuse solves the difficult problem of interrupting very small currents as well as large ones.

The boric-acid fuse is usually a disappointment to spectators, who are often unable to detect any sign that it has operated. —*A. E. B.*

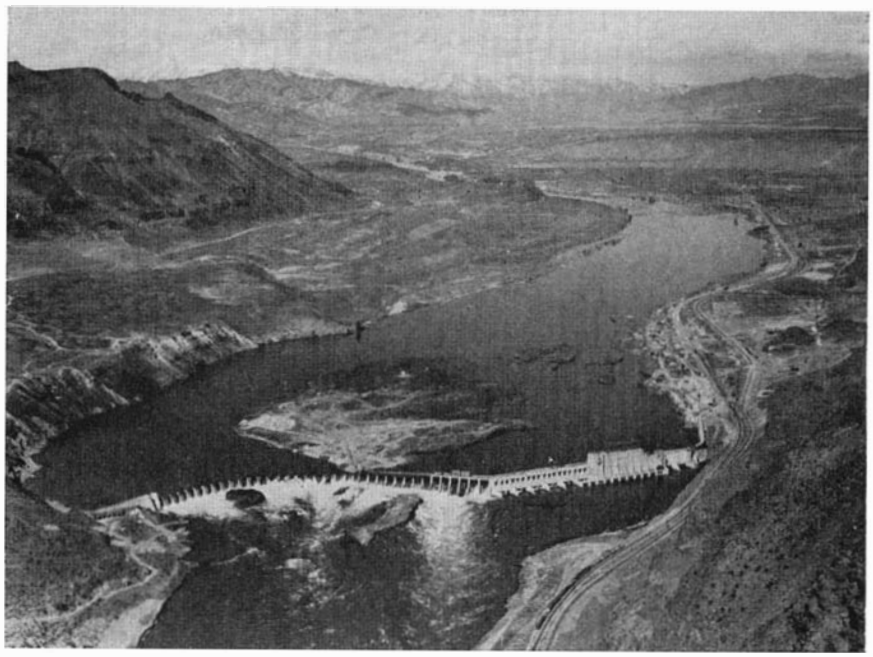
Dr. Slepian showing his new fuse with boric acid as the de-ionizing element. It has just interrupted 20,000 amperes at 13,200 volts

Reginald A. Fessenden

TRITE phrases of sorrow seem to take on a still greater air of triteness when applied to the recent death in Bermuda at the age of 65 of Professor Reginald Aubrey Fessenden. The world of science, and its radio branch in particular, owes a huge debt of gratitude to this outstanding figure who once, at least, defended a correct theory against others who steadfastly held that he was wrong. But time proved the logic of Fessenden's reasoning about radio wave propagation, and today his theory is universally accepted.

Fessenden's interests were widely varied, and in later years leaned toward the problem of safety of life at sea. He developed the fathometer, distance finder, iceberg detector, radio direction finder, radio compass, gyro-compass and improvements, submarine oscillator for undersea communication, and other devices, for which work he was awarded, in 1929, the *Scientific American* Medal for safety at sea.

Professor Fessenden was born of New England parents in Milton, P. Q., Canada, and received his education at Bishop's College in Quebec. For a time he was associated with Thomas A. Edison, and later with the Westinghouse Electric and Manufacturing Company. A detailed list of his achievements would fill columns, but *Scientific American* feels that it could add but little to the glory of a figure that has left such a lasting impression on the pages of the history of science.



An air view of the completed Rock Island hydroelectric plant, first major power plant on the Columbia River

Old Trick Sells "Fat Reducers"

PROMOTERS of so-called obesity remedies and fat reducers are using an old trick, with a modern slant, to deceive fat people into spending money for worthless and dangerous preparations, according to Dr. F. J. Cullen, of the Federal Food and Drug Administration. The advertisements appeal to the vanity of people and also to the fear that they may become so stout they can no longer be efficient in business.

"Surplus flesh," says Cullen, "may be due to two general causes. First, it may be constitutional, or due to endocrine metabolism or digestive processes, abnormal, but natural to the particular individual. Second, it may be due to eating too much rich or fat-building foods and to a lack of healthful exercise. Reducing might not be a difficult matter in the second case, with correct dieting and exercise. But a person who carries excess weight due to abnormal digestive processes should be extremely cautious about reducing and should do so only under the care of a physician. In either case, one should not trust to indiscriminate use of so-called obesity cures."

Cullen points out that the majority of so-called fat reducers offered for sale con-

tain either thyroid extract or laxative drugs. Thyroid extract is dangerous, and should be used only under the direction of a physician. Unwise and long-continued dosing with fat reducers, while it may reduce weight, has a tendency to cause irritation in the stomach and intestines and this may finally bring about permanent harm to the user.

A drug or medicine is misbranded under the Federal food and drugs act if its label has any false or fraudulent remedial claims. The law, however, does not apply to collateral, or outside, advertising. A buyer, therefore, would do well to compare statements printed upon the label of the article with claims made for it in newspapers, magazines, or by radio.

A Science-Minded Burglar

WE have just received a sincere compliment. It is often said that imitation is the sincerest form of flattery but now we think one kind of theft is also. Some highbrow miscreant, evidently a "gentleman burglar," recently jimmied his way into the public library at Cranford, New Jersey, in the night and walked off with an electric fan and about a year's back numbers of the SCIENTIFIC AMERICAN (passing up other magazines close at hand —editors please copy). Why he chose this particular combination has kept us awake for nights. The only explanation we can suggest is that he took the copies of the SCIENTIFIC AMERICAN first and then took the fan as an afterthought: The SCIENTIFIC AMERICAN is "hot stuff." This burglar used his head. But he ought to become a subscriber.

Huge Plow in Operation

WHAT is said to be the largest plow in the world has been operating in Orange County, California, and is described by A. A. Young, assistant irrigation engineer, of the United States Department of Agriculture, stationed at Santa Ana. It is the only plow of its kind and was designed and built to meet an unusual condition existing in the lower Santa Ana River valley adjoining the seacoast.

Originally this area was fertile land, but overflows from the Santa Ana River during floods deposited one to two feet of sand upon the rich soil and made it useless for crop production. Later this sand deposit was covered by a growth of Bermuda grass.

The plow is intended to turn the sand under and bring the rich soil to the top. It has two shares. The smaller one, which is of good size, is set forward and higher than the larger share which is able to plow a furrow 36 to 42 inches in depth and three feet in width. The forward share turns the surface sand and Bermuda grass into the deep furrow where it is covered by the fertile soil turned up by the larger share.

The plow is four feet high and 22 feet long. At turns, it is raised and lowered by a hydraulic lift. It is reported to weigh about one ton and to have cost 2000 dollars. It is drawn by three heavy tractors running in low gear and is reported to be capable of plowing five acres a day.

Improving on the Turtle

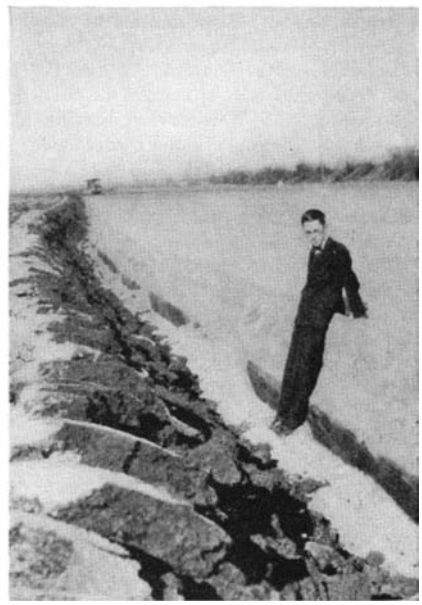
TURTLE oil comes from Mexico, to be used as an ingredient in beauty preparations. It is not suggestive of beauty—its dark fishy character speaks unmistakably of turtles.

"We were recently asked to refine a shipment of turtle oil," says *Chemistry and You*, house organ of the Arthur M. Maas Laboratories of Los Angeles, "and we turned it into a clear product fit for food. Our client was so pleased by our beautification of his raw material that he sampled some, and pronounced it excellent. We understand that, in Mexico, turtle oil is taken internally as a remedy for heart troubles. And if it is used externally as a beautifier by some dark señoritas, it is a cause of heart trouble!"—*A. E. B.*

Had Your Iron Today?

IT has been frequently pointed out that the much needed iron content of a diet can be obtained from fruits and vegetables without an appreciable increase in protein or fuel value. However, no specific research studies had been made of the iron content of the common fruits and vegetables. Hazel K. Stiebling, of the Bureau of Home Economics, has analyzed 237 specimens of 82 different forms, parts, or varieties of vegetables and fruits and has classified them according to the quantity of food iron they contain. Of 98 fresh fruits and vegetables studied, the author classes 17 as "excellent," 24 as "good," 44 as "fair," and 13 as "poor" sources of food iron.

On the whole, vegetables outrank the fruits and fruit juices in iron content, but many of the fruits are "good" and "fair." The thin-leaved greens, such as spinach, turnip tops, dandelions, and kale, are conspicuous for their iron value; lima beans, cowpeas, English garden peas, and vegetable oyster or salsify, are also "excellent." Of chief importance in the group designated as "good" sources are potatoes and thick pigmented stalks and leaves, such as red or green cabbage, cauliflower, brussels sprouts, broccoli, asparagus, and several fruits, including blackberries, blueberries, raspberries, quinces, and Concord grape skin. Approximately half the group called "fair" consists of fruits; the rest are vegetables with edible seed pods, blanched leaves, blanched leafstalks, roots and bulbs. —*A. E. B.*



Depth of the sand overlying the rich soil, and the depth of the furrow made by the huge special plow

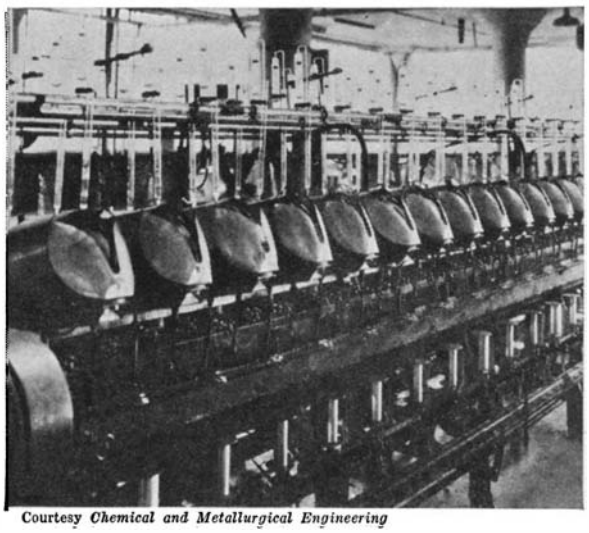
Revolutionary New Rayon Process

A NEW plant for the manufacture of rayon has just been put into operation at Gloucester, New Jersey. So radically different is it from conventional rayon

The huge plow which was built especially for the job of "renewing" the fertility of a sand-covered western valley

The great furrows turned by the plow shown at left. The rich soil from beneath has been turned up to the surface

plants that it gives promise of revolutionizing the industry, for it costs far less to build and to operate, and produces a high quality product at a very much lower cost than has heretofore been possible. The story of the remarkable achievement that has rewarded the inventor, W. H. Furness, after 14 years of experimental work, is told by T. R. Olive in a recent issue of *Chemical and Metallurgical Engineering*.



Courtesy *Chemical and Metallurgical Engineering*

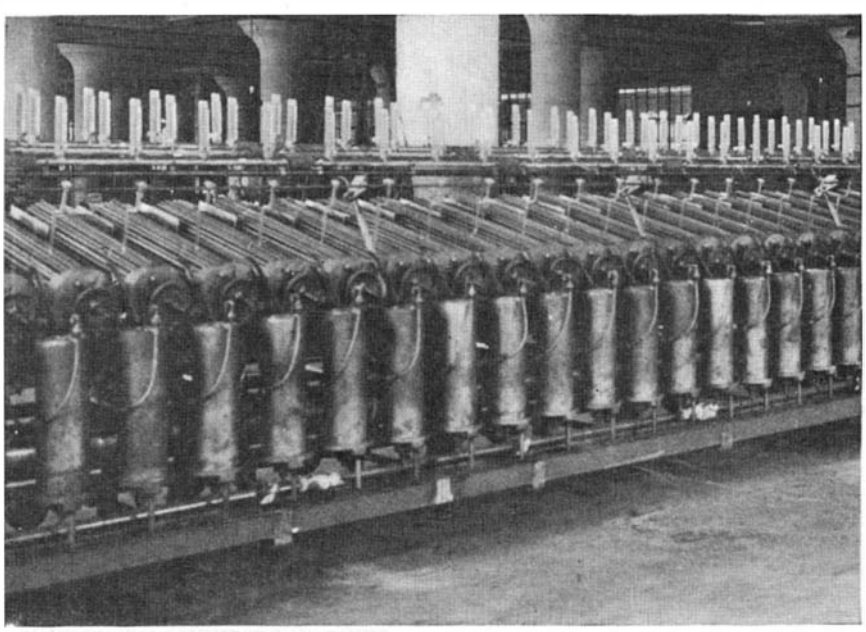
Rear view of the Furness spinning machines, showing glass tubes which spray acid and water on the rayon thread as the cylinder rotates, and also the spools on which the finished yarn is wrapped

The keynote of the Furness process is simplicity, and the heart of the operation is an ingenious machine wherein the rayon thread is spun, chemically treated, washed, dried, and twisted—all in one continuous machine. This machine eliminates several steps in the conventional rayon process and is therefore responsible for the saving in initial cost, labor, power, and floor space which distinguishes the new process.

Rayon is made from cotton or wood pulp or both. About 80 percent of the rayon made in the United States is produced by the viscose process, in which the cotton or wood pulp is dissolved in carbon bisulfide and "regenerated" in an acid bath as a thread of rayon. In the Furness process, the cotton is dissolved in a mixture of copper hydroxide and ammonia and regenerated as a thread by squirting this solution into a bath of caustic soda. This process, technically known as the cupra-ammonia process, is not in itself new, but the technique developed by Mr. Furness in preparing his cotton solution and the ingenious machine mentioned above have so improved this old process as to make it virtually a new one.

The spinning machine consists of a frame supporting three principal groups of parts. The first consists of the equipment for spinning and coagulating and includes, for each position, a metering pump, flexible connecting tubing, a filter, the spinneret, and the coagulating bath cylinder. From the bath, yarn passes over guides to the de-coppering, washing, and drying sections, all of which are embodied in a single rotating, cage-like cylinder of stainless steel bars on which the coagulated yarn winds helically, progressing under jets of acid and then of water. Inside the cylinder for the last few inches at the discharge end are fin-tube steam coils which provide the heat for drying the yarn. A blower connected to a manifold, running the length of the machine, blows air through the steam coils and assists in the drying. From the cylinder, the yarn goes over a guide to the twisting sections, where a "ring twister" puts about 2.8 turns per inch into the yarn and winds it on spools.

The foregoing has shown in some detail the reasons for the economy of the Furness process. It has been pointed out that refrigeration, air-conditioning, and special ventilating equipment are unnecessary, except for fume hoods over the mixers. The spinning solution can be kept indefinitely, and because of this, spinning may be shut down at any time or started up again with very little preparation. Temperatures and viscosities throughout the process are not critical, and require a minimum of control. The process is continuous, once the solution reaches the spinning machine. Furthermore, the recoveries are high, thus decreasing the raw-material cost. About 40 percent of the ammonia and 95 percent of the copper are recoverable. The caustic bath may be re-cycled continuously. Water requirements are extremely low, as are power and fuel. Maintenance seems to be slight, while operating costs, investment, and floor space are all small.—*A. E. B.*



Courtesy *Chemical and Metallurgical Engineering*

A bank of the ingenious Furness machines which fix, wash, dry, and wind the rayon. Vertical tanks in the foreground contain caustic soda which coagulates the thread as the cellulose solution is squirted from the spinneret at the bottom of the tank. The thread then winds up around inclined cylindrical cages where it is finally finished

Beaten Palladium, New White Leaf

AFTER two years of experimentation, the first non-tarnishing precious metal white leaf has been developed to take its place with gold leaf. The metal from which it is beaten is palladium, one of the metals of the platinum group.

Palladium leaf was perfected recently by Theodore Koch and Dr. J. S. Streicher of the American Platinum Works. Until discovery of the method for its production, modern art and architecture did not have a truly non-tarnishing white leaf with the same resistance to oxidation as gold leaf.

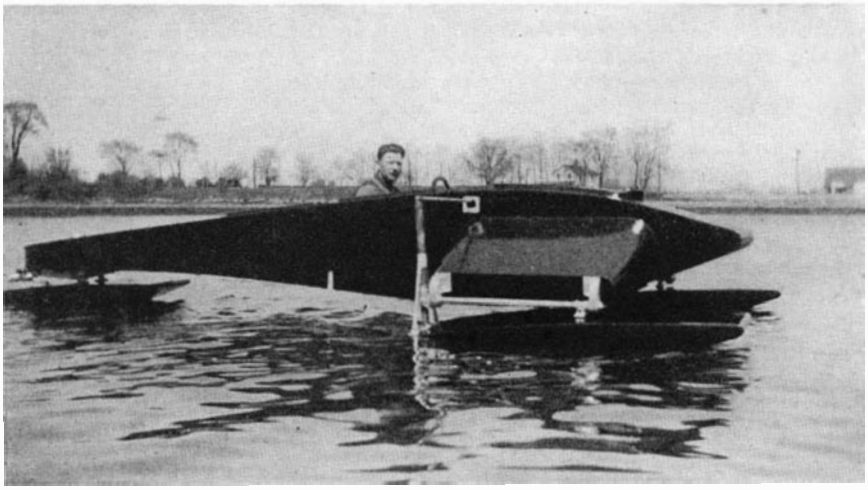
Like platinum, palladium metal resists oxidation and does not tarnish in air. It is not subject to oxidation under heat until the temperature is above 572 degrees, Fahrenheit, according to Dr. Streicher who conducted a series of tests on fine palladium wire in varying temperatures up to 1652 degrees, Fahrenheit.

Palladium has the soft whiteness of color and depth of tone of platinum; it is difficult to distinguish between the two in appearance.

The reflectivity of palladium leaf is about 60 percent that of silver, Koch pointed out, but, with the tarnishing propensities of the latter, palladium's proportionate reflectivity becomes greater within a short time.

Down through the ages gold has never had a satisfactory substitute for permanent non-tarnishing leafing, nor has there existed a correspondingly noble metal in any other color. Period decoration now extant gives indisputable evidence of this color limitation.

With the growing popularity of white metals for decorative purposes, palladium leaf undoubtedly will be found useful in the field of architectural art and interior decoration for murals, metallized effects on ceilings or sidewalls, furniture, picture frames, and so forth; it can also be used



The inventor in his hydroplane. The central body and the three-float suspension are clearly shown. Note the airfoil section used for the fuselage. The side floats are attached by oleo shock absorbers to diminish the pounding of waves

for exterior building decoration. It gives the same rich effect in white that the gold leaf gives in yellow.

Fully 40 percent of the gold leaf now produced is used for the gilding of signs and for the ornamentation of glass or wood by sign painters. Palladium leaf may be similarly used, and it might, for this industry, break the monotony of color due to the painter's limitation to yellow metal.

Palladium can be applied to surfaces with the same facility as other precious metal leaf decorations. It is produced in the standard sizes to which the trade is accustomed. Thirty-five square feet of palladium leaf, which constitutes a book of 500 sheets of leaf, weighs less than one quarter of an ounce.

A "Pontoon Hydroplane"

A "PONTOON-HYDROPLANE" boat, so called by its inventor, Thomas A. E. Lake, son of Simon Lake, the submarine inventor, incorporates, as our photograph shows, a central body or "fuselage," supported by two side or lateral floats or pontoons, and a third float in the rear. (See page 263, October, 1931, SCIENTIFIC AMERICAN, for first report on this boat.)

The planing angles of the lateral floats may be adjusted at will; the rear float may be yawed for steering. The propeller is located below the "fuselage" just between the two lateral floats.

The craft makes a three-point contact with the water. It has the equivalent of great length and beam, but a relatively small wetted surface. The arrangement of the floats is intended to give unusual stability and maneuverability.

The inventor hopes to attain remarkable speeds with this type of hydroplane, far exceeding those of conventional craft of equal power and weight.—*A. K.*

From Bomber to Transport Plane

INTERNATIONAL experts at Geneva cannot decide how air bombing of unarmed cities can be eliminated. Ordering the destruction of bombing airplanes is a futile gesture, because any sort of airplane can be converted into a bomber with the addition of some bomb gear and sighting devices. Conversely, an army bomber can, with some degree of modification, be transformed into a perfectly suitable passenger transport plane.

Proving this last point, it is found that the Boeing Airplane Company is making use of the engineering which made its Army bomber so notable, to build a modern transport on similar lines. The twin-engined bomber, a low-wing, all-metal monoplane, is shown in our photograph. No drawings or photographs of the transport plane are available, but a general description of the new ship will be of interest to anyone who at some time or other hopes to travel coast-to-coast by air.

The new plane will have a high speed of 175 miles per hour, and cruise at 155 miles. Carrying ten passengers and 500 pounds of mail and express and manned by two pilots, the ship will be able to climb to 18,000 feet, or 6000 feet higher than the greatest altitude required to clear the western mountains. The wing spread will be 74 feet, the over-all length 51 feet, and the gross weight 12,000 pounds.

The bomber approaches the ideal of the flying wing. Since the landing gear is retractible, this ideal is approached even more closely than the photograph indicates. The retracting mechanism for the landing gear on the transport will be operated electrically, with a small auxiliary control provided for emergency uses. One would think that no pilot would ever forget to let down the landing gear when preparing to land, yet this curious oversight has happened. In the new ship, when the motors are throttled below a certain speed, the pilot is warned of that fact by a flashing lamp and the sounding of a horn.

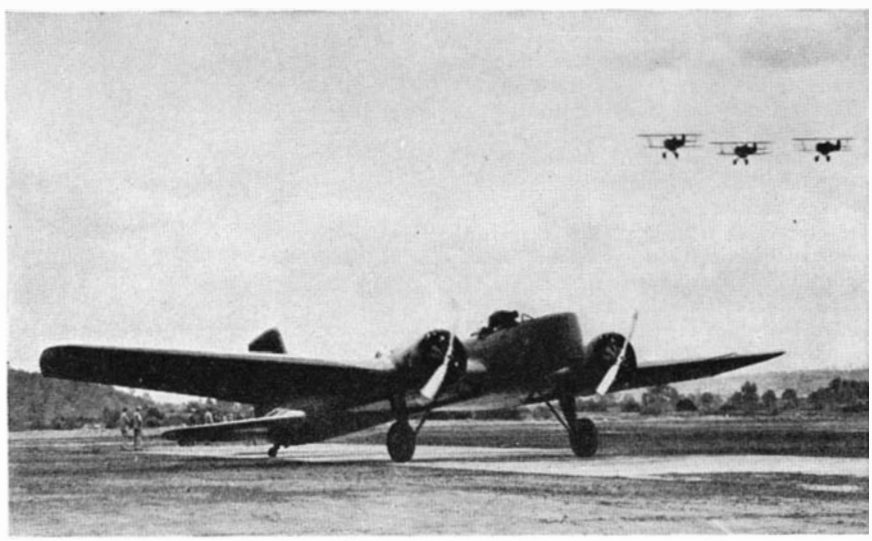
More speed and more passenger comfort are the watchwords to-day. Designers working to army or navy requirements always design around the pilot, the gunner, and the armament. In transport work, the engineers have designed around and for the passengers. The cabin, with an interior height of six feet, will include such travel conveniences as hot water radiators with air-circulating fans which may be reversed for use as cooling systems during the summer season; a double ventilating system including main fresh air intakes and air outlets supplemented by individual ventilating facilities; individual lamps; reclining chairs; and so on. Two pilots, two-way telephone communication, and super-complete navigating instruments all make for safety and reliability.

Our transport operators are having a hard time of it. By hard work and initiative they have built up a wonderful system, but Washington places them in great uncertainty. Thus, rates for mail carrying are being cut, and now the air-mail postage has been increased from five to eight cents. To meet these governmental uncertainties, transport companies are striving for passenger traffic, and are meeting with a real measure of success.

One of the surest ways to attract passengers is to shorten the time for the transcontinental run. United Air Lines are already offering a 27-hour coast-to-coast schedule. With this new ship the time will be cut to less than 24 hours, with the New York to Chicago leg on a five-hour schedule. These are marvelous figures which the railroads may find hard to fight.—*A. K.*

A New Airaft

THE Army Air Corps is supervising the development of a new type of airaft, which is illustrated in the accompanying photographs. The new experimental rafts are not so different in appearance from the standard type of rafts used in aviation, but they embody a new principle of design in the tubing which holds the gas by



One of the noted Boeing Army bombers which serve as the prototypes of exceedingly fast passenger transports. The bomber approaches the flying wing ideal

Alberto Santos-Dumont

THE recent death of Alberto Santos-Dumont, at the age of 59, ends the picturesque career of a noted and gallant aeronaut.

Although a native of Brazil, he spent the greater part of his life in France where he conducted most of his aeronautical activities. He had ample means at his disposal and from 1898 on, he built at least ten airships, one of them the smallest in the world at that time that could carry a passenger. He is credited with the first use of the internal combustion engine in a lighter-than-air craft.

In 1901 he won the Deutsch prize of 125,000 francs, established to encourage lighter-than-air activities, for a successful flight around the Eiffel Tower, covering approximately 6.8 miles in slightly less than half an hour. More than half of this prize he gave to the poor of Paris, and the remainder to his employees.

In 1906, three years after the successful flight of the Wright brothers at Kitty Hawk, he made the first flight in a heavier-than-air craft in Europe with a kite-like airplane of his own design. He presented the drawings and the rights to this airplane to the public.

South America considered him the father of aviation, and his native country presented him with an award of 125,000 francs at the time of his winning the Deutsch prize, and a medal on which was inscribed "Through heavens heretofore unsailed."

In later years, he gave little time to aircraft development, although his interest never lagged.—*A. K.*

means of which the rafts are kept afloat.

In the standard raft, the tube is divided at either side into two separate parts. If the stern half of the tubing is punctured, that half dips beneath the water at a dangerous angle, possibly spilling an occupant overboard. In the new airafts the division is handled in quite a different manner. The tube is divided laterally throughout its length by a loosely hung fold which constitutes two concentric tube compartments extending the entire circumference of the raft. Either of these concentric tubes is capable of sustaining the weight of the occupants; either, in case of failure of the other, can be inflated to the original size of both tubes. The inflation is accomplished by admitting carbon dioxide gas from a sealed cylinder. The inflation apparatus contains an equalizing valve which permits both tubes to be equally and simultaneously inflated in 15 seconds. A check valve regulates the flow and prevents leakage of gas from one tube to the other. A hand pump can be used in an emergency.

The raft, which is canoe-shaped with raised bow and stern, is provided with paddles which are jointed together and which, if preferred, may be used as oars in oarlocks which are provided. The raft is constructed of rubberized fabric; the larger size is designed for four passengers, but the flotation strength is sufficient to carry six or seven. It is 5 feet wide by 12 feet in length with a supporting tube 15 inches in diameter.

These rafts are very useful both for seaplanes and for landplanes when employed over water. They constitute as indispensable a piece of equipment for the flying machine as a life boat is for a ship.—*A. K.*

Ultra-Violet to Illuminate Dashboards

INSTRUMENTS on planes must be illuminated at night. At present the illumination is by means of a small incandescent lamp, but unfortunately it is not the dashboard alone which is illuminated. However carefully the light is protected, there is always some degree of "stray" or reflected light. The dimmest light in the pilot's cockpit is many times brighter than the darkness surrounding the plane. The stray light is particularly objectionable when landing as it makes it difficult to distinguish airport signal lights, or to judge quickly and accurately distances ahead and to the side. It is a condition much like that prevailing in the driver's seat of an automobile when the dash lights are too bright.

Engineers of the Westinghouse Lamp Company have now developed a device which totally removes these objectionable features of dash-board illumination.

The ultra-violet light source recently installed in the "blind-flying" ship of American Airways

Radium paint used on the instruments is fluorescent and glows at its brightest in total darkness. Ultra-violet light, invisible to the human eye, makes the radium paint fluoresce at its maximum. Therein lies the principle of the invention.

An ordinary lamp is provided with a special glass filter placed over the mouth of a small reflector, allowing only the ultra-violet light to pass through. Two filaments are employed as the light source, as a precautionary measure against the failure of one. The light source is so arranged that the whole of the dash is "illuminated" with ultra-violet rays. The radium painted scales stand out vividly, but there is absolutely no interference with the airway or airport signals.

The location of the light source is governed by the size of the pilot's compartment. In big tri-motored ships it is recessed in the ceiling above the pilot's head or in the walls beside the instrument board. In smaller ships the light may be placed under the cowl alongside the dashboard.

We believe that this is another step in the conquest of night flying.—*A. K.*

Coming Out of a Spin

AN occasional newspaper report tells of a pilot who was unable to recover from a spin so that a crash resulted.

Spinning and the recovery from the spin

The deflated type B-2 airaft may be compactly folded

The one-man airaft can be used to carry two men easily

are well understood. It is generally sufficient to put the controls in neutral and the plane does the rest, but unfortunately height is lost rapidly during the spin. In the spin, the nose of the plane is pointed sharply downwards and the plane is rushing toward the ground, at the same time turning about a vertical axis. The airplane is figuratively moving on the circumference of a giant helix or screw surface.

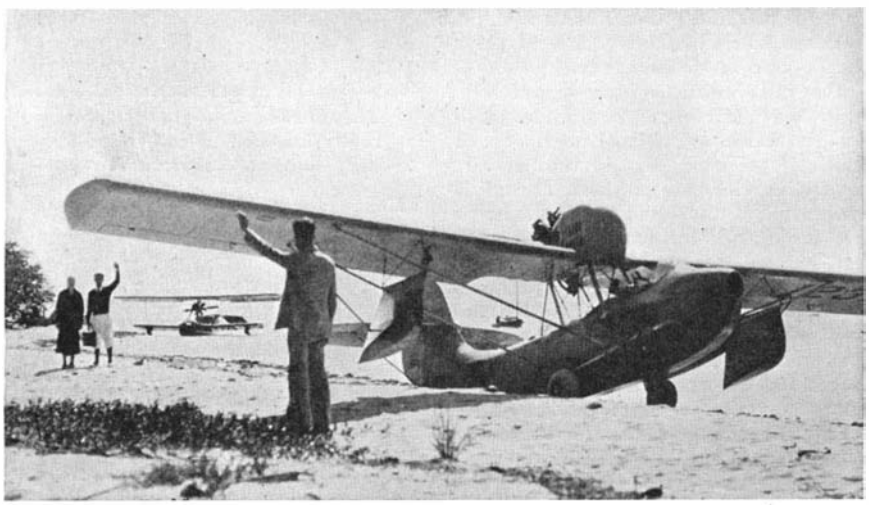
It is advisable to stop this helical motion as quickly as possible, so that the spin becomes a dive. After that it is simple enough to bring the machine out of the dive by using the elevator.

Evidently the rudder is the pilot's best friend in such circumstances. Instead of leaving everything to the plane, why not use the rudder against the spin?

Unfortunately, the rudder is sheltered or blanketed against the air flow by the horizontal surfaces of the stabilizer and elevator. British experiments in the wind tunnel and in full flight have now been confirmed by photographic studies, made by the N.A.C.A., of the air flow around the rudder. In these studies, smoke was directed against the tail surfaces and its motion recorded by a moving picture camera mounted on the airplane. The resulting photographs showed a region of dead air surrounding the rudder. This explains the falling off in effectiveness of the rudder.

A suggested remedy for this vital defect in the rudder is to arrange the rudder so that it is clear of the blanketing effect of the horizontal tail surfaces. There are a number of possible arrangements: The elevator and stabilizer may be placed high above the fuselage, almost at the top of the rudder; the rudder may be made to extend considerably below the horizontal tail surfaces; the stabilizer and elevator may be "swept back".

Sooner or later our designers will give more thought to this "unblanketing" of the rudder.—*A. K.*



The new Curtiss-Wright *Duck*, a two-place amphibion which is built like a canoe, lands on the beach, above, and makes a test flight over the Mississippi, below. Powered with a 90-horsepower motor, this little ship is designed for the private owner or sportsman who flies mainly for sport

The Curtiss-Wright "Duck"

THE advantages of an amphibion for the sportsman are obvious, but amphibions with as moderate power as the Curtiss-Wright *Duck* have not been available hitherto. The *Duck*, with a crew of two, 158 pounds of fuel and oil, and 77 pounds of equipment has a gross weight of 1775 pounds, and with a 90 horsepower Warner engine has a high speed of 90 miles per hour. With a quick take-off and not too high a landing speed, this is an ideal craft for the sportsman owner, who in one purchase becomes free to wander over land or water.

The *Duck* is a pusher; engine and propeller are in rear of the wing. This construction gives good vision to the fliers as well as full comfort. There are also one or two new wrinkles. A leather bumper on the nose prevents damage when running into a dock. The construction of the hull is interesting. It is built by the Pan Yan Boat Company and is made by a special process of fastening cloth over wood with numerous coats of glue. It has been found by experience that cloth or canvas treated in this way is perfectly waterproof. It is only the bottom of the boat that needs to be of wood or metal; therefore, the upper structure can be canvas over a wood frame, and consequently very light.

The mechanism for raising and lowering the wheels is simple and effective. It consists of a worm gear operated by a crank at the pilot's side, which swings the wheels and a single strut landing gear through a 180-degree arc, so that the wheels in the up position are parallel to the fuselage and well above the water line. To avoid the difficulties of the usual shock-absorbing mechanism, the landing shock is absorbed by air wheels of somewhat larger size than usual for a craft of this weight. It is true that the landing gear does not disappear, but this is more than compensated for by the simplicity of the gear.

We have always maintained that a small two-place amphibion should be popular with the public.—*A. K.*

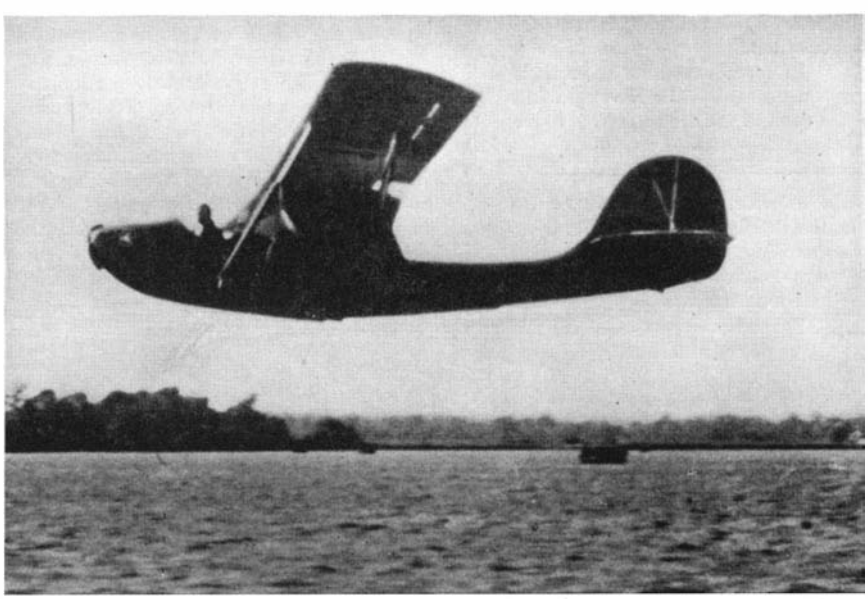
New Features to Mark Navy Airship "Macon"

THE naval airship *Macon*, under construction at the mammoth airship dock in Akron, will embody several changes as compared with her sister ship, the *Akron*, completed there last year.

Such changes do not extend to general measurements. The overall length of 785 feet and maximum diameter of 132.9 feet and the shape were set at the outset for both ships. Neither will they affect location and design of control car and control surfaces.

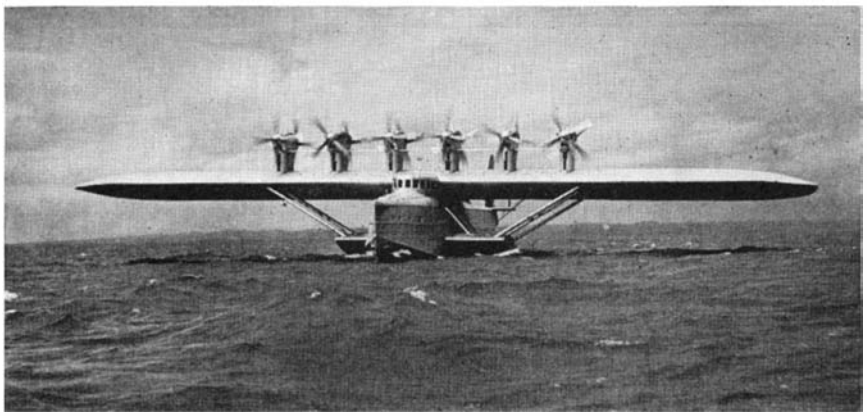
In relation to substituting a gear ratio of two to one in the *Macon* for the ratio of 1.75 to one in the *Akron*, the eight propellers of the latest airship will be bigger but slower than the eight of the *Akron*. This, airship engineers believe, will result in great efficiency.

The *Macon* will emerge from her cocoon-like home entirely equipped with gelatin latex fabric cells, somewhat lighter in weight than rubberized latex fabric cells, while the *Akron's* cells are constructed of half of each kind of these materials. Gelatin latex fabric for cells is a development of Goodyear-Zeppelin laboratories.



From two to four small helium valve hoods will appear on top of the *Macon*, as compared with a single one for valves of the *Akron*, a change to decrease "drag" and so bring greater speed.

No operator will be needed for the *Macon's* telephone switchboard, as with the *Akron*, since an automatic board is being



The *DO-X* against sea and sky. This great boat returned safely to Germany in a fraction of the time it took to make the flight to the United States. Needless to say, it was received with enthusiasm everywhere in Germany. Two more of these giants have been built, the *DO-X2* and the *DO-X3*, and delivered to the Italian Government which replaced the Curtiss Conquerors with Fiat engines

set up for the ship's 16 telephone stations.

Engineers are also cutting down partition weight on the *Macon*. The *Akron* is equipped with seven bunk rooms but the *Macon* will have only two.

The *Macon* is also to embrace changes in the operation of the ingenious water recovery system found on the *Akron*, in which condensers on motors at the exhaust liquefy combustion vapors. Under this system, consumption of fuel does not lighten the ship, but instead builds up a supply of water ballast for constant equilibrium.—*Science Service.*

Lift Increase Devices

THE subject of lift increase devices has been popular with inventors and designers for many years. At New York University and in many other laboratories, active investigation of various systems has been going on for many years. Now the National Advisory Committee for Aeronautics has become interested in the subject, and while its studies have contributed nothing radically new, they have been more thorough and systematic than heretofore.

What is a lift increase device? It is not a method of increasing the lift throughout the flight range, but a method of so changing the characteristics of a wing that it has its normal characteristics in normal flight, and experiences an increase in lift when landing or gliding down towards a landing. Thus it is possible to have a low-lift, and therefore a high-speed, wing and when we wish to land, make it a high-lift, slow-landing wing.

The maximum lift of an ordinary wing can be increased from 50 to 150 percent by the aid of such devices. The landing speed can be decreased correspondingly.

Let us classify some of these methods of lift increasing.

First we have the Handley Page slot, which is a small auxiliary airfoil, normally resting snugly against the leading edge of the wing, but made to move out either automatically or by manual control whenever high-lift is required. The Handley Page slot will increase the lift 40 to 60 percent. When the slot is combined with a flap at the rear of the wing, which is moved downwards for lift increase, such lift increase may be of the order of 100 percent.

Then there is the rear flap alone, which moves not only down but also backwards. The names of Alfaro and Zap are associated with this type. The lift increase may be 100 percent or even more.

In the Fowler variable wing, the rear portion of the wing slides back, so that camber and area are simultaneously increased. The lift increase may be 150 percent or more.

The Leigh slot is a fixed auxiliary air foil, mounted above and ahead of the main wing. Here the lift increase is only of the order of 32 percent, and the top speed is somewhat lessened, but the Leigh slot has the advantage of no movable parts.

Use of these devices makes possible not only a decreased landing speed but also a shorter landing run, the ability to come into a small field over a high obstacle by gliding steeply yet safely, and so on.

The autogiro has made a real impression with the public because of these very desirable characteristics. Why, it may then be asked, do not the designers of airplanes make use of these ideas to come more closely to the characteristics of the autogiro while retaining all the speed of an ordinary airplane? Did not the Guggenheim Fund give a prize of 100,000 dollars early in 1930 to the Curtiss machine which had these slow-speed characteristics?

The answer is a multiple one: The use of rear flaps changes the trim or balance, and therefore stability has to be carefully considered when flaps or variable-area wings are used; human nature is conservative; pilots dislike intensely everything that partakes of the character of a "gadget"; cost and weight are always increased no matter what slot or flap is applied.

Perhaps the history of such devices will be that of the four-wheel brake on the automobile. At one time, no manufacturer would consider the four-wheel brake seriously. One employed it and made a special feature of it. Then every car adopted it. Still, it is difficult to prophesy.—*A. K.*

Weed Seed

HERE'S weed news for the farmer—but it's bad.

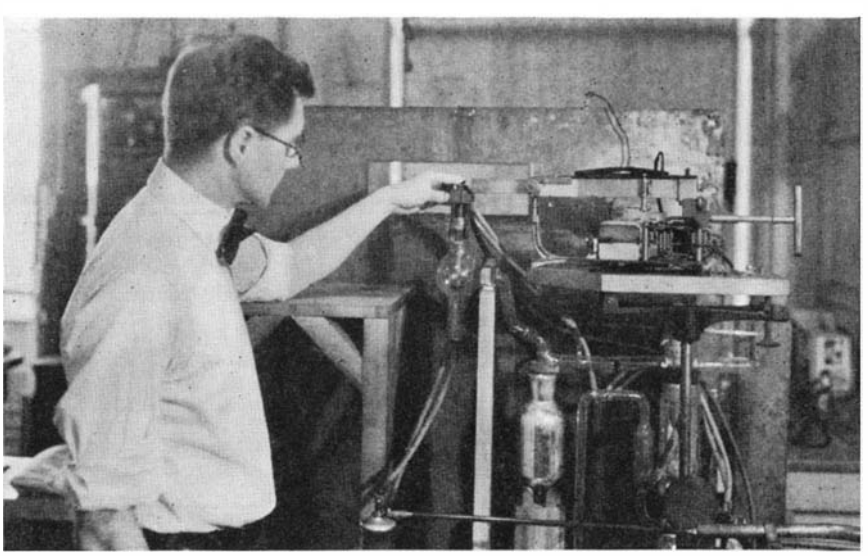
Seeds of wild morning glory, buried for 30 years, sprouted almost at once after being unearthed and planted, the United States Department of Agriculture reports.

The seeds were buried as part of an experiment to discover how long seeds may lie in the soil and still be viable, and to discover how long seeds must be buried to be killed.

The morning glory will be given further opportunity to prove its "staying power," as some seeds buried 30 years ago are still in the ground and will not be removed for 10 more years.

Detects Traces of Elements by Cathode Ray

A METHOD of "weighing" as little as 1/3,000,000th of an ounce of material by "looking" at it with a small cathode-ray tube was described by Dr. G. R. Fonda of the General Electric Company before a recent meeting of the American Institute of Chemical Engineers. A small cathode-ray tube, rather than an X-ray tube, is used by Dr. Fonda in making spectroscopic analyses of unknown substances. A special X-ray tube, in which the target is made of the material which is to be analyzed, is ordinarily employed, but such a tube must be taken apart for the insertion of samples, and many materials cannot be examined in this manner since their presence within the tube would be disastrous to the high degree of vacuum which must be maintained.

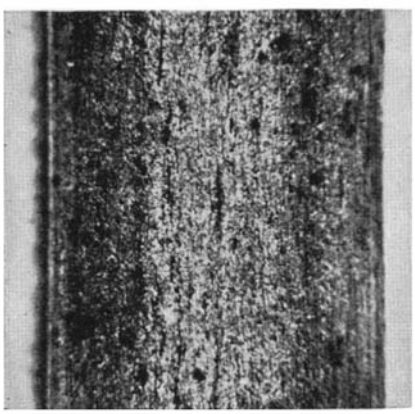


Dr. Fonda demonstrates the small and sensitive cathode-ray tube by means of which he determines the presence of minute quantities of rare elements

Since X rays are produced when cathode rays strike an object in air, Dr. Fonda has been able to make spectroscopic analyses by placing a piece of the unknown substance immediately beyond the window of the cathode-ray tube and making readings of the intensities of the characteristic spectroscopic lines, either visually or photographically. Employing this manner of analysis, he has developed a method for quantitatively analyzing samples containing columbium and tantalum, two elements which present decided difficulties for analysis by purely chemical means, involving much time and requiring careful attention to exact procedure.—*A. E. B.*

New Nail Treatment

A NEW type of nail treatment intended to increase the strength of nailed wooden joints has been invented by the Forest Products Laboratory of the United



Enlarged view of nail surface after treatment and buffing in sawdust

States Forest Service, Madison, Wisconsin. The new treatment is accomplished by chemical means, and results in minute pitting or etching of the nail surface, which causes a very high frictional contact with the wood fibers for a given weight of nail.

The improved nail is intended for use where there is need for increased resistance to lengthwise or sidewise pull. The holding power developed may range from two to three times that of a similar untreated nail, and its advantage over the ordinary type of cement-coated nail is also marked. Unlike a coating, the pitted surface will not rub off in handling or driving the nail. When re-driven after being pulled out of a piece of wood, the nail shows as high a resistance to withdrawal as when first driven.

A patent, to be dedicated to the free use of the people of the United States, has been applied for on the new nail treatment.

Drinking Water for Road Workers

SAFE drinking water for state highway construction crews has become a very serious problem coincident with the increased activity in building more and better roads during the past decade, says Dr. Elmer W. Campbell, D. P. H., Division of Sanitary Engineering, Bureau of Health, State of Maine, writing in the *United States Daily*.

It has caused the Department of Health to seek some practicable means of steriliz-

ing drinking water for crews. After considerable experimentation a method was developed which is very reliable where careful supervision can be secured.

Within the past few years standardized solutions of sodium hypochlorite have appeared on the market which are relatively stable in composition, and it was found that this chemical could readily be adapted to sterilizing water in small quantities. Furthermore, a simple, reliable method is available for testing water treated with the chemical, by means of the chemical orthotolidin, to see if the water is sufficiently treated or is over treated.

When the water is properly treated and mixed it is found that after five minutes' standing practically all disease bacteria are killed, and after 20 minutes the water is completely sterilized, and with no undesirable taste or odor. The hypochlorite is prepared in two-ounce bottles, each containing enough to treat 480 gallons.

New Low-Priced Home Typewriter

AN interesting recent development is the announcement of a new home typewriter, the Royal Signet, produced by the Royal Typewriter Company, Inc. to retail at $29.50. This low price is due primarily to the elimination of the shift key, and the simplification of all controls.

The necessity for shifting has always caused some difficulty to beginners, but there has also been some objection to a single case alphabet in ordinary capitals. This problem has been solved by the designing of a special new single case alphabet of sans-serif capitals, called Monoface, which is attractive and legible. It is claimed that this typewriter greatly facilitates the learning of typing.

The machine is built on a strong, electrically welded steel frame, cross-braced by the typebar segment bearing piece and the carriage rails. The keyboard is entirely standard in spacing, depression and arrangement of keys; it includes 44 characters, full alphabet, numerals, punctuation marks, and signs. The controls include a carriage return and line space lever, right cylinder knob, paper release lever, carriage release lever, and cadmium plated space bar. It has a full length single color portable ribbon, with manual reverse; and adjustable left margin stop. It has a paper table and paper pan intact, with feed roll supported by carriage rail, accommodating an 8½-inch standard letterhead, full width writing line.

The photograph at the right shows the new home typewriter which has been simplified by the design of a new single-case alphabet. A sample of the type is shown in the illustration reproduced directly below

HOWEVER, WITH THE ORDINARY TYPEWRITER TYPE FACES, BOTH ROMAN AND GOTHIC, IT WAS IMPOSSIBLE TO DO AWAY WITH THE DOUBLE CASE AND THE CONSEQUENT NECESSITY FOR SHIFTING WHENEVER IT WAS DESIRED TO TYPE A CAPITAL LETTER.

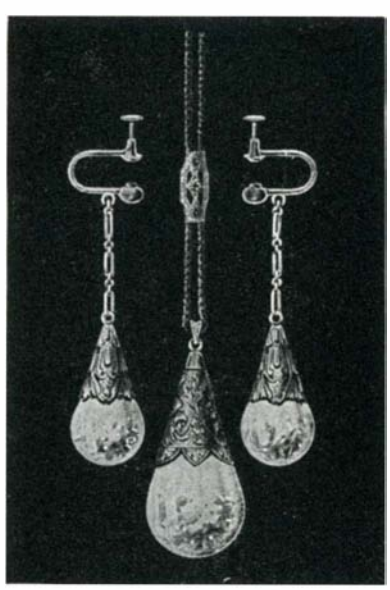
An "Assembled" Jewel

ALL the familiar gems were known and prized in the days of ancient Babylon and old Egypt. Through the ages, it was accepted as a matter of fact that no new gems could be obtained. After a lapse of 2000 years, however, an inventor has evolved a type of gem or jewel which he has named the "Floating Opal." It has features that distinguish it from other gems, the chief one being internal motion—a characteristic which gives it kaleidoscopic, lifelike qualities.

The gem consists of a spherical or tear-shaped globule of heavy glass, filled with glycerine in which float small pieces of precious or noble opal. The globule is hermetically sealed.

In addition to retarding the movements of the opal fragments, the dense liquid has the property of increasing the brilliancy of the opal. This is explained by the fact that the liquid has a high refractive index, which eliminates, to a large extent, surface reflections from the opal pieces and allows the inner colors of the opal to be seen to better advantage.

Even without the magnifying effect of the liquid and the bulb, precious opal is highly esteemed as a gem because of the peculiar play of colors of delicate tints which it displays. These are probably due to the interference of light waves as reflected by the laminated structure of the opal.



Examples of "Floating Opals"

Certain jewelers have attempted to classify the Floating Opal as a synthetic or artificial gem, but the inventor states that it is nearer to nature than all other gems. This claim is based on the fact that diamonds, rubies, sapphires and most other gems require the tedious manufacturing process of cutting, grinding and polishing to make them presentable. On the other hand, the Floating Opal employs the native opal, just as it comes from the mines, untouched by any "manufacturing" process.

The Floating Opal is shown to best advantage by reflected light, which is most effective in bringing out the iridescent colors of opal. The fiery reds can be seen only when a strong light strikes the opal and is reflected directly back to the eyes of the observer. The stronger the light, the more brilliant will be the colors. This gem is the invention of H. H. Welch of New York City, who possesses five patents covering it.

Potash in Texas and New Mexico

EXPLORATION by the United States Geological Survey in the Great Permian Basin has disclosed a supply of potash sufficient to meet the country's needs through any emergency which may arise. One year's work by the United States Potash Company of New Mexico developed 45,000 tons of potash, or about 4 percent of all the country's requirements. The Permian Basin is 300 miles wide and possibly twice as long, lying principally in Texas and New Mexico, but extending north into Kansas and Colorado.—*A. E. B.*

The Chemistry of Autumn Leaves

NATURE'S way of coloring autumn foliage has been subjected to the critical study of a chemist, Charles E. Sando, of the United States Bureau of Chemistry and Soils. He points out that many people erroneously believe that the coloring is produced by chemical changes in anticipation of approaching cold weather and that it occurs only in leaves which cannot withstand frost. Others think that the plant, in anticipation of winter, withdraws starch or other food materials from the leaf into the branches or root stock, and that these changes precede and probably affect color formation. On one occasion the statement was broadcast that, during the growing period, the leaf contains varying quantities of red and yellow oils and that, when the leaf ceases to function, one or the other of

these oils is withdrawn, leaving the leaf colored by whichever oil remains.

The most important plant coloring matters, including those directly involved in autumnal changes, may conveniently be divided into two main groups, says Mr. Sando: those occurring in plastids or organized bodies of the cell; and those occurring in the cell sap, or liquid of the cell. These two groups contain the following pigments:

Chlorophyls, the practically universal green coloring of leaves.

Carotinoids, appearing as yellow, orange, or red pigments, occur in the chromoplasts or associated with chlorophyl in the chloroplasts.

Flavones are yellow or pale yellow pigments soluble in the cell sap, but for the most part practically insoluble in water when isolated and purified.

Anthocyanins are red, violet, blue, and intermediate shades, and are soluble in the cell sap. The anthocyanins appearing as autumnal reds do not as a rule pre-exist in the leaves, but are formed as a direct result of metabolic changes occurring in autumn.

The statement that autumnal coloring seems to be in anticipation of cold weather might lead one to believe that color changes occur before cold weather sets in, whereas observations seem to indicate that most autumnal color changes are brought about by lessened photo-synthetic activity and low temperature, both of which have a resultant effect on the general trend of metabolic activity of the leaves. Autumnal coloration is not limited to those plants which cannot withstand frost, as is evidenced by the fact that winter reddening develops in certain evergreen trees and herbaceous plants.—*A. E. B.*

Nara Buddha Is Example Of Japanese Alloying Art

ALTHOUGH packfong, which resembles the modern nickel silver, was used by the Chinese from ancient times, it has been left to Japan to preserve one of the world's finest monuments in alloyed bronze.

This is the great bronze Buddha at Nara, 53½ feet high, which was cast in the 19th year of Shomu (743 A.D.) with 1,154,097 pounds of crude copper, 20,385 pounds of white metal, 4,866 pounds of mercury, and 996 pounds of green gold. What the "white metal" consists of is unknown; it is so named in the Japanese records.

Real "Artificial" Silk

WHEN scientists learned how to make a silk-like thread from the cellulose of cotton or wood, they dethroned the silkworm as the premier producer of material for stockings, dresses, and other intimate and public apparel for both sexes. Rayon or "artificial silk" is one of the new materials that the industrial revolution has made available generally since the World War.

Science now promises to invade the domain of the silkworm again. The production of real "artificial" silk is promised. The term real artificial silk may sound like a bull, but the new process justifies it.

The real artificial silk is a regenerated silk. The silkworm is a necessary actor in

(*Please turn to page* 247)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

SOME readers will recall the description of a large six-inch binocular made by Hilmer Hanson, R. F. D. 5, Holdredge, Nebraska, which was published in the February, 1931 number. One of the illustrations from the same description is again reproduced for the reader's convenience. A similar binocular with 12-inch mirrors was later made by Martin Rasmussen of the "Amateur Telescope Makers and Astronomers of Tacoma" (SCIENTIFIC AMERICAN, February, 1932, page 99). Later a hint concerning a "binocular reflecting telescope" known to have been made by the younger Herschel (Sir John) a century ago, using mirrors made by his more famous father (Sir William), was found in the December, 1931 number of the *Journal of the British Astronomical Association.* It would appear that the mounting of this historic binocular has long since vanished, but a pair of 6.3-inch mirrors of 86 inches focal length, believed to have been used in it, is evidently now in the possession of Captain M. A. Ainslie, F. R. A. S., of England, a well-known authority on the practical aspects of telescopes (see "Splendour of the Heavens," to which Captain Ainslie contributed the chapter entitled "The Amateur at Work").

Accordingly, copies of the SCIENTIFIC AMERICAN containing the description of Messrs. Hanson and Rasmussen's telescopes were mailed to Captain Ainslie, and portions of his reply, written from The High House, Cocking, Midhurst, Sussex, England, are quoted herewith, and the old Herschel binocular, redrawn from Captain Ainslie's sketch, is shown below at the left.

"One reason," the Captain writes, "why this form of binocular never became popular must have been the difficulty of providing for variation in inter-ocular distance; people's eyes vary enormously in this respect. Also, if used for celestial objects, the eye-pieces would come very inconveniently for the eyes, at any rate for objects at any considerable altitude.

"WITH regard to the binocular reflectors made by your readers, perhaps I may offer one or two criticisms: The first is that, as shown in use by Mr. Hanson in your illustration, the observer's head is so close to the mouth of both tubes that the heat radiated from it would be certain to cause currents of unequally heated air just at the point where they can do most injury to the definition. Over on this side we always make our telescope tubes project a considerable distance beyond the observer's head, for this reason. To show how powerful this cause may be in spoiling definition, I may mention that when the new 24-inch Cassegrain which has been recently put up at Mill Hill, near London, is to be used visually, it is found necessary to put a screen of asbestos behind the mirror to cut off the heat of the observer's head, which is found to affect the figure of the mirror after a few minutes' observation if there is no screen. There would, however, be no difficulty in setting the tubes of the

Mr. Hanson's binocular

binocular farther apart, and carrying them up well beyond the observer's head, if thought desirable. Possibly with a low power, such as 65 diameters, the power mentioned in the account, the definition would not, after all, suffer very seriously from this cause; but with high powers I should expect serious deterioration.

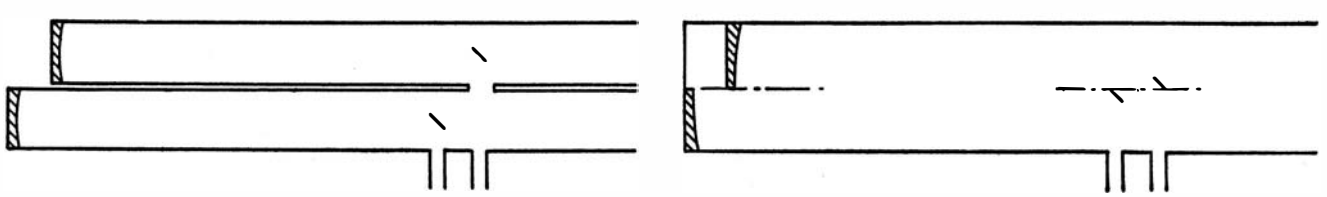
"But, to my mind, a more serious objection to the plan adopted by Mr. Hanson and, apparently, by Mr. M. Rasmussen is that there are an odd number of reflections before the image is formed in the focus of the eyepiece. The result of this is that the image is reversed about a horizontal axis, but not about a vertical one: right remains right, but top becomes bottom. This appears to me to be a serious drawback, if the instrument is to be used for planetary or lunar observation.

"There is another point which has to be remembered by the designer of any binocular telescope; that is, that one must be quite certain that the stereoscopic effect is preserved, and not reversed so as to become pseudoscopic. An example of what I mean is to be found in some binoculars which consist of two ordinary astronomical telescopes side by side: I have a pair of this sort, and the reversal of the relief is ludicrous on some objects. I have, for example, seen Venus apparently hanging *in front* of the distant landscape like a suspended lamp. The general rule is that, if the image is completely reversed (*i.e.*, both horizontally and vertically) then the left-hand telescope must supply the right eye, and vice versa; and the same applies if there is reversal about a vertical axis but not about a horizontal. Thus Mr. Hanson's telescope, if furnished with erecting eyepieces, would be pseudoscopic; right and left are, in each image, in their proper positions, but the right eye receives the image formed by the left-hand telescope (looking toward the object) and vice versa. To be truly stereoscopic, the images should be further reversed right and left. If completely re-erected, the result will be still pseudoscopic, for the reason just quoted.

"Another very noticeable thing about the American instruments is that most of them have metal tubes. Most of our telescope constructors have long abandoned the metal tube for wood, the general experience being that the performance of a reflector in a wooden tube is distinctly better than one in a metal tube. I had at one time a 9-inch in a square wooden tube, side by side with an 8½-inch in an iron tube, the optical quality being the same in both instruments; but there was no mistaking the superiority of the 9-inch. The wooden tube, too, was a great protection against dewing of the flat; this took place incessantly in the iron tube, but never in the wooden. It was not uncommon, on a rise of temperature, for the *speculum* to become dewed in the iron tube: this never happened in the wooden.

"THE advantages of using no tube at all, but merely a frame, have long been recognized over here. Such old-time workers as Lassell, De La Rue, Lord Rosse (in the case of his 36-inch), and others, showed long ago that the freedom from tube currents thus obtained was most striking, although one gets nearly the same effect with a *square* wooden tube, owing to the space at the corners which is clear of the entering light.

"A very striking instance of the advantages of doing away with the tube has recently been afforded here in the case of an 18-inch reflector belonging to the 'B. A. A.', and now at the observatory of the Rev. T. E. R. Phillips, whose name will be familiar to you as that of a very well-known planetary observer, and a leading authority on Jupiter. He has had for many years an 8-inch Cooke refractor and a 12¼-inch Calver reflector, both under domes and in iron tubes. He found that he hardly ever used the reflector on Jupiter or Mars, because the 8-inch refractor invariably gave a sharper and far steadier image; and when he first mounted the 18-inch reflector in its



Left: **Diagram of the Herschel type of reflecting binocular.** ***Right:*** **The proposed Critchett binocular**

wooden tube out of doors, although its performance was pretty good, the 8-inch was still better.

"However, he removed the 12¼-inch reflector from its mounting, and mounted the 18-inch in its place, cutting away the sides of the tube so as to leave virtually a mere framework. The effect, to use his own expression, was absolutely 'startling'. The 18-inch at once surpassed the 8-inch, and is now his regular working instrument under all conditions.

"Over here we suffer, in most places, from dewing of object glasses and mirrors to an extent from which you may be happily free; at least I hope so, for your sake!

"It is, as I remarked above, a matter for sincere congratulation that your amateur telescope makers show such energy. Is their output of practical work in the form of recorded observations correspondingly large?" [No.—*Ed.*] "I ask this, because so often a man who has made a mirror goes on to make another and then another and becomes an amateur optician rather than an amateur astronomer. We have had many cases of this over our side.

"Again congratulating your amateur workers on their results, and wishing the cause of amateur astronomy the greatest success over your side, I remain with many thanks, Yours very truly, Maurice A. Ainslie, Instructor-Captain, R. N., Past-President of the 'British Astronomical Association.'"

PREVIOUS to its present publication Captain Ainslie's sketch of Herschel's binocular was shown to an amateur who was known to be interested in unusual mountings, Mr. James C. Critchett, a retired mining-engineer who lives on the edge of the Imperial Desert in California (address Banner, via Julian) and this is what he writes:

"Good for Capt. Ainslie! But my Yankee blood, originating in New England, says that we must whip the English again, so I send on my single-barreled repeater." [See right-hand sketch.—*Ed.*] "Fine-grind mirror, embed strongly in some kind of cement, let cement dry thoroughly, then saw mirror in halves and varnish the cement which holds the halves together, to keep out moisture. Polish and figure and remove cement. May have to follow the sawing wire down with cement which sets and hardens before finishing cut. The difficulty of making this mirror makes me believe that it would be better to put it up to some one with better equipment than I have, here in the 'sticks.' Years ago I hit upon a plaster which might do: mix plaster of Paris in a solution of copper sulphate and water. It gets very hard and strong, but must be handled quickly."

Now then, who will elect himself the "goat" to try out this interesting suggestion; and who will recreate the old Herschel binocular described by Captain Ainslie? And will there be some more wooden telescope tubes?

SPEAKING of recreating old telescopes, here is a suggestion which someone may be interested in carrying out: recreate the original telescope of Galileo, also Newton's first reflector. Fairly good data for both are available; a real, honest-to-goodness working model to look through, not merely at, is suggested.

CURRENT BULLETIN BRIEFS

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

CADALYTE: A PROCESS AND PRODUCT FOR CALCIUM PLATING is a booklet describing the development of a process for the electrodeposition of cadmium—a most useful process in the field of rust protection. The applications of the new process are numerous and are fully described in the brochure. *The Grasselli Chemical Company, Incorporated, Cleveland, Ohio.—Gratis.*

INDIUM—A RARE METAL; ITS DEVELOPMENT AND CHARACTERISTICS describes the successful work of the research department of the Grasselli company which has developed a process for the recovery of this rare metal. It will be interesting to note what uses will be found for this interesting metal. *The Grasselli Chemical Company, Cleveland, Ohio.—Gratis.*

WOOD POLES FOR OVERHEAD ELECTRICAL LINES (Handbook, Bureau of Standards, No. 16) gives standard values for ultimate fiber stresses of wood poles as used in electrical line construction. Additional information and tables are given. *Superintendent of Documents, Washington, D. C. —10 cents (coin).*

SPEED SPOT WELDERS is a 24-page booklet giving considerable out-of-the-way information. *Eisler Electric Corporation, 744 South 13th Street, Newark, N. J.—Gratis.*

HOUSE INSULATION: ITS ECONOMICS AND APPLICATION is a publication sponsored by the National Committee on wood utilization of the Department of Commerce. Over 40 different kinds of insulation are now on the market. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

SUCCESSFUL MUSHROOM GROWING gives an outline of mushroom culture based on the experience of a mushroom laboratory in the heart of the mushroom growing section of Pennsylvania. There are many new developments in mushroom culture, some of which are still in an experimental stage. The 60-page pamphlet is excellently produced and is filled with practical suggestions. *Chester County Mushroom Laboratories, West Chester, Pa.—$1.00.*

THE EMPLOYMENT OF WOMEN IN SLAUGHTERING AND MEAT PACKING (Bulletin of the Women's Bureau No. 88, U. S. Department of Labor), by Mary Elizabeth Pidgeon, describes an industry in which direct hand-labor plays an especially important part, for although there is a high degree of labor specialization and accuracy of job specification, the replacement of hand by machine labor has proceeded less rapidly than in almost any other of the large industries. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

AERONAUTIC PUBLICATIONS (Aeronautics Bulletin No. 6) is compiled from the library of the Aeronautics Branch and is a valuable bibliography. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

STEEL BONE PLATES AND SCREWS (Commercial Standard CS37-31, Bureau of Standards) is a little pamphlet of value only to surgeons and makers of surgical supplies, but it is interesting to the lay-reader; it shows how even such a curious industry can be standardized. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

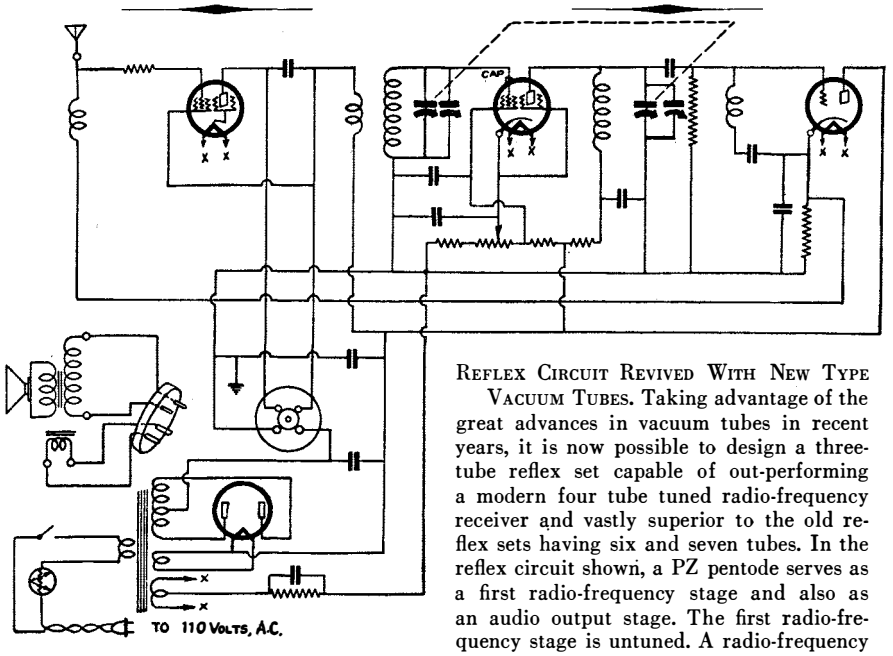
CHANGES IN THE LEGAL STRUCTURE OF THE BRITISH COMMONWEALTH OF NATIONS (International Conciliation, September 1931 No. 272) by Robert A. MacKay. The Imperial Conference of 1930 will no doubt go down in history as an important milestone in the evolution of the British Commonwealth. It will be memorable on two counts: First, for the revival of the ideal of an imperial preferential tariff union, and secondly, for the momentous changes agreed to in the legal structure of the Commonwealth. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—5 cents.*

AIRWAY MAP OF THE UNITED STATES (Aeronautics Bulletin No. 8) is corrected up to March 1, 1932. It gives the route mileage, the type of service, and the operators, in addition to indicating the routes on the map. *Aeronautics Branch, Department of Commerce, Washington, D. C. —Gratis.*

SOUTHWARK-EMERY TESTING MACHINES describes the enormous testing machines which run up in price to 93,500 dollars. This pamphlet will be sent only to those specially interested. *Baldwin-Southwark Corporation, Philadelphia, Pa.—Gratis.*

AN INDEX OF AMERICAN ENGINEERS AND ENGINEERING FIRMS gives a list of 4500 names and addresses of engineers, et cetera. *William Stack, Box 203, Park Ridge, Illinois.—$1.50 (money order).*

TOBACCO AMONG THE KARUK INDIANS OF CALIFORNIA (Bureau of American Ethnology, Smithsonian Institution, Bulletin 94), by John P. Harrington, is a specialized study of great interest to ethnologists. The linguistic method traces through language the psychology and mythology behind it. *Superintendent of Documents, Washington, D. C.—80 cents (money order).*



REFLEX CIRCUIT REVIVED WITH NEW TYPE VACUUM TUBES. Taking advantage of the great advances in vacuum tubes in recent years, it is now possible to design a three-tube reflex set capable of out-performing a modern four tube tuned radio-frequency receiver and vastly superior to the old reflex sets having six and seven tubes. In the reflex circuit shown, a PZ pentode serves as a first radio-frequency stage and also as an audio output stage. The first radio-frequency stage is untuned. A radio-frequency transformer is used to couple the first to the second radio-frequency stage. The latter is tuned by a .00035 microfarad section of a dual Cardwell variable condenser. A variable mu 58 Arcturus pentode is used in the second stage. This is coupled by impedance to the detector. A general purpose 56-type tube is used as the detector. The audio output of the detector is reflexed back through the PZ pentode, which is thus made to function doubly, in the first instance as a radio-frequency tube and finally as the audio output tube. Volume is controlled by an Electrad tapered potentiometer in the cathode circuit of the 58 tube. An amperite is employed to regulate line voltage. A complete set of diagrams and additional information about this circuit may be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York, N. Y.—15 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 243)

its making. Unlike rayon, which is not silk at all, the new fiber is real silk. It is artificial, however, because it is formed into fiber in much the same way as rayon.

In making regenerated silk, the silkworm's cocoon is converted into a sericin-fibroin solution of liquid consistency just about that which occurs within the body of the silkworm before it spins its silk filament. It is a solution of real silk. From this point on, the process uses the experience of rayon manufacture. The silkworm solution is made into yarn as though it were cellulose solution destined to be rayon. It is squirted through very small holes into filaments that are twisted by a spinning machine into yarn.

The *American Silk Journal* believes that this real artificial silk will soon become an accomplished industrial fact. Perhaps it will be called a protein rayon instead of a cellulose rayon since the silk solution is a protein manufactured by the silkworm. It is said that the new product will approach real silk much more closely in its physical and chemical properties than any of the existing synthetic fibers.

The regeneration process has been perfected by the Japanese but the story is that the Japanese government will not permit its commercial utilization because it would seriously affect the established sericultural industry of that country. But American and European inventors have also produced processes and real artificial silk will probably come into use despite Japanese curbs.

The next step would be to duplicate synthetically the protein solution that the silkworm makes and make a real and wholly synthetic silk. Undoubtedly attempts are being made but success lies in the future.—

"Fountain Pen" Iodine Swab

A UNIQUE little device recently put on the market looks like a tiny fountain pen less than three inches long but is in reality a dispenser of iodine for use in emergencies. Well made of hard rubber, it will hold perhaps a hundred drops of iodine. When the cap is unscrewed a tiny hole in the tip of the barrel is disclosed. Drops of the iodine fall from this hole upon an injury when the barrel is held upright and tapped with the finger. After use, the cap is screwed on tightly so that the hole is pressed against soft rubber in the cap to guard against leakage.

Chemical "Fly Swatters"

ECONOMIC entomologists estimate that insects destroy, on the average, not less than 10 percent of all crops, says R. C. Roark, in *Industrial and Engineering Chemistry*. A conservative estimate of the loss in foodstuffs, due to insect depredations in the United States, is not less than 1,000,000,000 dollars each year. In his warfare against insects, man makes use of biological means such as insect predators

and parasites; physical means such as traps, heat, cold, electricity, and ultraviolet rays; and chemical means or insect poisons. These insect poisons are known as insecticides and for convenience are usually classified as fumigants, contact poisons, and stomach poisons.

The ideal fumigant for foodstuffs is ethylene oxide. It is more toxic even than hydrogen cyanide to some insects and is much less toxic to man. The slight residue of ethylene oxide left in fumigated products is believed to have no toxicological significance. Ethylene oxide is essentially odorless, and its use does not injure the taste or appearance of nuts and other food products which are so easily affected by other fumigants.

Nicotine, commonly sold as an aqueous solution of the sulfate containing 40 percent actual alkaloid, is one of the principal agricultural contact insecticides. It is used for destroying aphids and other soft-bodied insects. The pyrethrins of pyrethrum flowers are among the most potent insecticides known and are especially valuable because they are non-poisonous to man and domestic animals when taken by mouth. In the past, pyrethrum flowers have been used largely in the manufacture of fly sprays, roach powders, and other household insecticides. The high cost of the pyrethrins (about 25 dollars per pound in the form of extracts from the flowers) prevents their widespread use in agriculture. Synthetic substitutes for the pyrethrins have been proposed, and some of these appear to be promising. Organic thiocyanates have been the subject of several recent insecticide patents.

In the laboratory and limited field tests, rotenone is one of the most potent and promising insecticides. This is a white crystalline material, melting at 163 degrees Centigrade, insoluble in water, only slightly soluble in mineral oils and alcohols, but readily soluble in chloroform, ethylene dichloride, benzene, acetone, and ethyl acetate. Rotenone occurs in the East Indian vine, derris, and in the South American shrub, cube, both plants belonging to the Fabaceae or pea family. Rotenone is 15 times as toxic as nicotine to the bean aphid (*Aphis rumicis*) and is also 30 times as toxic as lead arsenate (the standard stomach insecticide) to certain caterpillars.

Of the greatest significance is the fact that rotenone is not poisonous to man or domestic animals when taken by mouth. This means that spray residues of rotenone upon fruits and vegetables will not have to be removed as is the case with arsenical residues. Rotenone is the most effective insecticide known for killing fleas, lice, and other external parasites of dogs, cats, poultry, and other domestic animals. This compound promises to become one of the most widely applicable, safest, and effective insecticides now in use.—*A. E. B.*

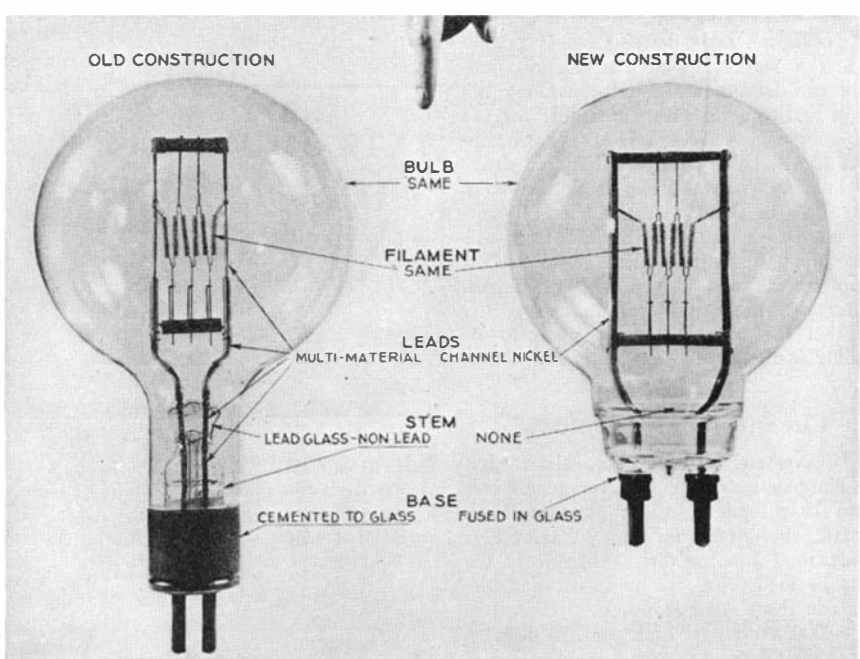
New Lamp Construction

FROM the Lamp Development Laboratories of the General Electric Company, Nela Park, emanates a development in high wattage lamp construction which differs radically from the fundamental principles of lamp design as followed ever since Edison built his first lamp.

The traditional lamp manufacturing process has been followed in the past because such construction had satisfactorily fulfilled every need. Even when the movies and aviation made demands for high-powered lamps in sizes far above standard practice, the development followed naturally along old established lines. However, when we consider that the largest incandescent lamps made contain three pounds of heavy tungsten metal or enough to make forty thousand 50-watt lamps, the matter of filament weight introduces an entirely new factor in lamp design. The traditional has, therefore, been discarded and in its place has been substituted a simplified construction.

Essentially, the ordinary incandescent lamp consists of a glass stem structure which carries the leading-in wires and the filament. Around this structure and sealed to the glass stem is a bulb, and to the bulb a base is finally added making connection with the leading-in wires.

The new problem of high-wattage lamp



New high-wattage lamp construction compared with the old type

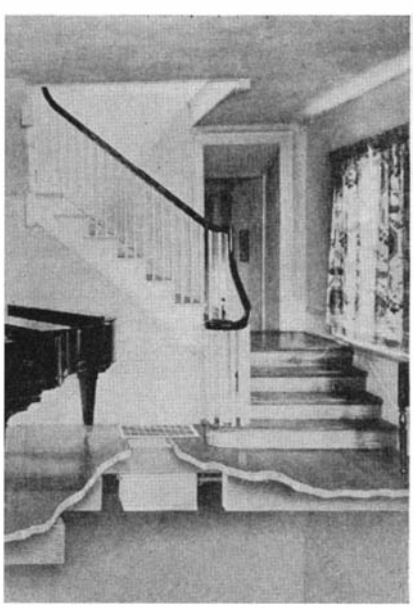
design has led to a simplified construction using fewer parts, and changing the entire operation of lamp fabrication. Starting with two copper prongs which serve as a base, and to which a special heat resisting glass cup is sealed, the entire internal structure is built up from the prongs, and the bulb is sealed to the glass cup as a final operation.

The new lamps, because of their simplicity of design and construction, are more rugged than the old types. This outstanding characteristic is attributable to a design eliminating from the new lamps all of those parts which in the older types were centers of weakness.

Through the elimination of the base, the heavy leading-in wires and the large stem, the new lamps are considerably lighter in weight and shorter than their predecessors. Non-divitrifying glass bulbs, which stand up better under high temperatures, make possible the use of bulbs of minimum size. This greater compactness of the lamp should, as the scope of the development broadens, make it possible to design equipment that is less bulky in size and more artistic in appearance.

Home Humidifier

MEETING the need for an efficient means of humidifying homes and apartments during the winter, a compact device has been perfected by the Carrier

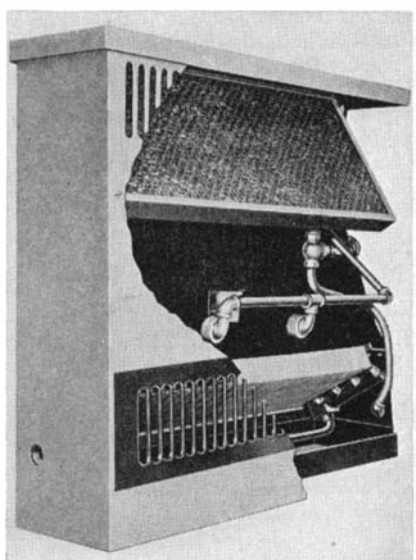


Research Laboratories, Newark, New Jersey. Described as a home humidifier, it operates in conjunction with the ordinary radiator heating system. No duct work is required.

Using the same supply and return pipes already available for the present heating system, the cabinet is installed as a radiator. Small water supply and drain lines are added for humidification. One cabinet will supply adequate humidification for an average small house. The heat from the humidifier supplements but is not designed to replace the existing radiators.

There are two convenient adaptations of the new humidifying device. The "upstairs model" is in cabinet form to fit readily into the place of the ordinary radiator. It requires little floor space, being only 26 inches long by seven inches wide, and stands 25 inches high, or slightly lower than the average dressing table. It comes in grain-mahogany finish on sheet steel or in a prime gray ready for painting or enameling to fit any desired color scheme.

Air from the room is drawn in through a grill in the lower part of the cabinet and passes over a heating coil connected to the house heating system. This heated air then moves upward into the upper portion of the cabinet where it is humidified by contact with a spray from a specially designed nozzle emitting a needle-like stream of water and causing a vapor mist through which the air passes. The air in passing through this mist takes up moisture, thus increasing its relative humidity. The air, properly humidified, then passes through a cleansing filter and thence out into the room through another grill.



Above: **The "up-stairs" or cabinet model of the home humidifier. The "basement" type, suspended under a floor grill, is shown at the left**

No fans are involved in the process as it operates through gravity. Cold air being heavier, naturally falls. As it passes through the grill in the bottom of the cabinet and becomes heated, its tendency is to rise. The heated air passes out through the upper opening, thus making the process literally automatic.

The basement model is a suspended unit designed to be hung under the flooring, with only a grill showing in the floor.

On a normal winter day when the outside temperature is, say, 25 degrees, Fahrenheit, the relative humidity of the air inside the average home is about 16 percent —less comfort than obtains on the Sahara Desert. With the home humidifier in operation, the relative humidity is raised to approximately 32 percent. Health authorities state that a relative humidity of between 30 and 40 percent should be maintained for human comfort and physical well-being.

Molasses Valuable as Fertilizer

INTENSIVE experiments are being carried on by the Hawaiian Sugar Planters' Association looking to the disposal of a part of the 250,000 tons of molasses produced annually by the manufacture of Hawaiian raw sugar, says *Food Industries.* The market hitherto enjoyed for this molasses has largely disappeared, until the

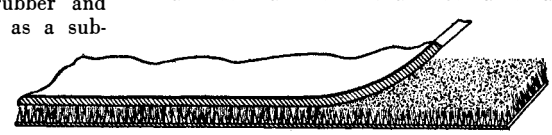
industry is faced with the problem of disposing of about 90 percent of the annual production. It contains on an average about 4.5 percent of potash as K_2O and somewhat less than 1 percent of nitrogen. Its percentage of organic humates is very high.

Partly to render the fertilizing constituents available but mainly to make a portable mixture of the very heavy, viscous molasses, it is subjected to a charring process with sulfuric acid, followed by the addition of basic crude fertilizers which, together with mill ash, result in the formation of a dry, granular, and readily handled product. Experimental research on the fertilizer has been transferred from the laboratory of chemistry to a plantation factory where, at the present time, several types of mixtures are being prepared on a semi-plantation basis.

Soil pot tests carried out at the experiment station have shown extremely gratifying results. One observation points to the possibility that the undefined humic constituents of molasses give the mixture a value to the plant not to be obtained by the employment of any commercial inorganic fertilizer when used on the same basis of plant food content.—*A. E. B.*

Mohair and Rubber Welt Prolongs Shoe Life

SHOES are said to last longer and may be re-soled more often as a result of the development at Sanford Mills, Sanford, Maine, of a patented rubber and mohair storm welting material as a substitute for grain leather. The welt is the section under the shoe upper to which the sole is sewed.



New rubber-mohair welt designed to replace leather

The "live" and resilient new welting is additionally waterproof, relieves the strain on stitches and thus reduces the tendency to break, closes needle holes tightly, and, according to long tests, does not deteriorate for years even when kept in heated rooms and on stock shelves.

By a patented process, the mohair pile fabric, with 20,000 to 40,000 fibers to the square inch, is made a base for the rubber, the resulting material being a tough, flexible substance ideally suited to shoe welts.

A New Synthetic Motor Oil

AN especially interesting fact about a new synthetic oil, Syntholube, sold by Standard Oil, is that it is made from paraffin wax, an element of crude petroleum that oil companies have spent millions of dollars to find ways of removing from ordinary motor oils. The paraffin is not a constituent of the new product, however, but the raw material from which the synthetic oil is manufactured. In the process, the paraffin molecules are broken up and actually rebuilt to make particular kinds of hydrocarbons that research has demonstrated possess highly desirable lubricating properties in a superlative degree.

The unusual qualities claimed for the oil are that it undergoes relatively little change of body with changes of temperature; it will still pour or flow through the pump at temperatures of 20 to 25 degrees below zero; it has exceptionally low carbon-forming tendencies; and it will not oxidize and deposit sludge even under the most severe conditions. If it could be kept free from road dirt there would be practically no need of ever renewing or changing this oil, its originators claim. It is an all-year oil, suitable for use in either summer or winter.

Green Wrapping Protects Food

WRAPPING paper, of a grassy green hue, is superior to transparent wrappers for oil-bearing foods, according to scientists who have recently conducted tests on various wrappers. The green paper, they say, delays development of rancidity by excluding photochemically active light rays. Black paper has about the same effect.—*A. E. B.*

Remove Many Drugs from Market

ON August 27, 1907, eight months after the Federal food and drugs act went into effect, a government inspector bought a package of a medicine labeled as a cure for headaches and as a "brain food." That purchase, according to Dr. F. J. Cullen, chief of drug control, Federal Food and Drug Administration, was the beginning of action that led to the first legal battle involving a drug under the new law.

Federal experts examined the so-called "brain food" and found that it contained a large quantity of a coal-tar chemical, acetanilid. Acetanilid, in some cases, eases pain and induces sleep, but it also depresses the heart and is a poison if taken in sufficient quantities. Labeling the preparation as a "brain food" disarmed the buyer's suspicion with regard to the dangerous character of the article. It also led people to believe that the article actually was a brain food. This drug was not only harmful, but was labeled with words that were misleading and deceptive. The government prosecuted the manufacturer and forced him to change the label.

Cullen points out that since that date Federal officials who enforce the national pure food and drug law have removed from trade thousands of so-called patent or proprietary medicines, pharmaceuticals, and other drug products for which false and fraudulent curative claims have been made. These include preparations advertised and sold for use in such extremely dangerous diseases as tuberculosis, cancer, influenza, rheumatism, venereal diseases, diabetes, and a large number of maladies of such vital organs as the heart, stomach, liver, and kidneys.

Improved Brazing Alloy

A NEW ease and economy in brazing operations are afforded by the "Sil-Fos" brazing alloy, containing silver, developed recently in England. Unlike base metal brazing alloys (which require from 1600 degrees to 2100 degrees Fahrenheit to melt)

Sil-Fos melts readily at 1300 degrees Fahrenheit. This is even lower than the melting point of silver solders containing 50 percent silver, which require from 1400 degrees to 1600 degrees Fahrenheit.

Sil-Fos is free flowing, penetrates quickly and alloys with adjacent metal, making a strong, sound bond. When used with borax flux, which requires a heat of about 1400 degrees momentarily, Sil-Fos becomes even more fluid. At this higher temperature its free-flowing, penetrating qualities are enhanced.

These qualities also lead to economy, since only a small quantity of this new brazing alloy is required. In fact, only a film is needed when joints are tight fitting. Laboratory tests on copper-to-copper lap joints made without using flux have shown an average tensile strength of 33,000 pounds per square inch, with an elongation of 17.2 percent in two inches.—*A. E. B.*

FLYING IN THE BEGINNING

(*Continued from page* 213)

This device had a front cell like the front cell of our kites but it was completely framed to give it rigidity. In place of the rear cell there was a pair of intersecting planes, perpendicular to each other; one was vertical, for holding the head of the glider to its course; the other was horizontal, for regulating the angle of incidence. The central spine consisted of two stout strips which rested upon the frame of the lower lifting surface, about two feet apart in front and coming together at the rear, and it was trussed with piano-wire.

An opening in the cover of the lower surface permitted the bicycle rider to put his head and shoulders up between the two spine-sticks upon which he could rest on his arm-pits while his arms extended down to enable him to grasp the bicycle handles. His head and upper body were therefore within the forward cell while his legs projected below.

When he left the bicycle or, rather, when it left him, he could by shifts forward or backward, by bends, squirms and acrobatic contortion regulate, to some extent, the angle of flight and the balance of the glider.

In the light of subsequent advances, this was a crude contrivance but we seem to have been "getting warm" in our search and a glance at the sketch will show that the machine was strikingly similar to those which, later, were to fly.

Trials soon emphasized a difficulty which we had, of course, anticipated. A kite or a glider must be sustained by air pressure on its lifting surfaces. With a kite this is accomplished by holding these surfaces against the wind by a string. For a glider to rise it must have an air-speed forward to replace the cord pull and we had no means of getting this speed except by the bicycle whose ground speed, especially when retarded by the glider it carried, was not in itself sufficient. We could add to the air-speed by running down the ramp of old Fort Columbus against a wind but calculation showed that, with our best possible ground-speed, we must have at least a 30-mile head wind.

Occasions when a gale like this was blowing in exactly the right direction were not frequent but we practiced to be ready and lost no opportunity when it did come.

Pedaling down the steep incline against even a moderate wind I could feel the glider tug and lift and had learned much of my lesson before the necessary wind came. When, one day, we had the longed-for gale, to my delight I felt myself lifted from my saddle and carried 20 feet up while I still went forward with the momentum. Sliding, twisting, and squirming on the arm-rests, I managed to keep the contraption right-side-up and we went into a glide for a little way until it turned over and landed me with a bump on a smashed machine.

Days were spent on repairs and changes until another favorable gale gave us another chance. In this we had more success but the test ended as before with a bruised experimenter and a broken glider.

Time after time this was repeated and never did my housekeeper need kindling wood nor cleaning-cloths but the gliders were steadily improving and I was becoming more skilful in their handling. Finally, one day in the spring, a test, the last one we made that year, resulted in a sustained flight of 200 yards with a rise of about 40 feet—very little when compared with the recent sustained glide of twenty-one hours by Lieutenant Cocke but enough, at that time, to give us great elation and high hopes.

EARLY in the summer of 1897, my detail at Governors Island ended and I returned to my regiment at Madison Barracks, New York. I took with me the paraphernalia for continuing my experiments but my duties gave no opportunity to use them until winter. Winter on the Canadian border is no time for such work out of doors but I spent much time in my shop preparing for spring. Much of my work was, of course, with models, some of which were tested in a crude wind-tunnel through which the air current from extemporized electric fans was blown.

One model I equipped with a motor consisting of twisted rubber bands which drove a little two-blade propeller. This little machine could rise and scud along for a considerable distance and, though now comparable only to common toys, it was then a scientific curiosity. At least it proved to my satisfaction that all that was needed for the construction of a practical flying machine was exactly what we did not then have—a motor light enough and strong enough to do the work for which we were then depending upon the wind.

My spring experiments never took place for, in April, my regiment went to Florida for mobilization with the Cuban Expedition. Possibly I owe my life to this because fighting Spaniards may have been safer than experimenting with gliders.

Four years later, when I returned from the Philippines, Chanute had made a successful glider. Wright had improved upon it and was harnessing it to the recently perfected gasoline engine. The kite had dropped its cord and become the glider. The glider was manufacturing its own wind to be an airplane. Today, the autogiro is attacking the problem of rising and landing. What will the next generation see in the air?

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

U. S. Patents Lead World

THE American inventor is busier than any of his foreign competitors. Records of the United States Patent Office show that it granted 1,797,380 patents up to the end of 1930. This compares with 825,882 patents granted in France; 754,054 patents granted in England and 531,681 patents granted in Germany. These figures are inclusive from the beginning of the first patent records kept in each of the countries.

Since the beginning of the practice of granting patents to inventors, 70 foreign nations issued 4,395,493 patents to the end of 1930.

Since 1930 patents have been granted in the United States at the rate of about a thousand a week, with the greatest activity shown in the fiscal year ending June 30, 1932, when 52,572 patents were granted.

The explanation for the large number of American patents is said to lie in the encouragement which always has been extended to inventors in this country. The first patent granted in North America was given to Samuel Winslow by the General Court of Massachusetts in 1641 for a novel method of making salt.

Colonial patents were based on the old English "Statute of Monopolies," which established the right of an inventor to receive from the state a grant commensurate with the value of his services. This old law, established in 1623, is the foundation of the present world system of patent laws.

Present American patent laws, however, are directly connected with a provision in the Constitution giving to Congress the power to secure to inventors for a limited time an exclusive right to their respective discoveries.

American patent laws provide more protection for the inventor than he finds under the legal provisions of many other countries. Thus the American inventor does not have to pay a tax on his patent, nor does he have to manufacture in order to maintain his patent. In most foreign countries the inventor must pay annual taxes, also he must begin manufacture within a certain time, and in some countries must manufacture continuously in order to maintain his patent.

Under such regulations the unlucky inventor without capital may forfeit his patent either through failure to pay taxes or failure to manufacture.

"Taylord" Mark Held Descriptive

THE applicant, Lord and Taylor, appealed to the Commissioner of Patents from the decision of the Examiner of Trademarks denying registration of the notation "Taylord" as a trademark for use upon men's, women's, and children's suits, trousers, vests, coats, knickers, topcoats, overcoats, and raincoats, and women's and children's skirts. Registration has been refused on the ground that the mark is a mere misspelling of the word "tailored," would be so construed by purchasers, and that the mark is therefore merely descriptive of the goods.

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

Most of the articles enumerated belong to the class of garments, many of which are known as tailored. As spelled in the notation it would seem that the view of the examiner that the phonetic misspelling is not sufficient to remove the objection of descriptiveness is correct, according to the decision handed down by First Assistant Commissioner Kinnan.

The applicant has contended that the notation is made up from the two words "Lord" and "Taylor," comprising applicant's commercial name, and that those familiar with the applicant's name would recognize that the notation sought to be registered was derived from such company name. It seems, however, that in order to derive the notation from the names appearing in the applicant's company title these two names have to be transposed, and when this is done the notation becomes substantially a word descriptive of a character or quality of the goods.

It would seem obvious the applicant's attempt to register it is to take advantage of this descriptive feature. The notation is, when viewed separately from the applicant's business title, clearly enough an obvious misspelling of the word "tailored" and would be so interpreted by purchasers. The notation is pronounced the same and has substantially the same significance as the term usually applied to goods of this character which are made by a tailor or fashioned after those so made.

The word "Tailored" was registered Sept. 14, 1920, No. 134852, for use upon shoes. Clearly enough this word is not descriptive of shoes. If the applicant's mark were deemed merely suggestive it is thought it approaches too nearly this registered mark to escape the objection that its use might cause confusion in trade.

The decision of the examiner is affirmed.

Chromium Plate Patent Upheld

THE United States Circuit Court of Appeals upheld recently the decision of Federal Judge Edwin S. Thomas ruling that the International Silver Company had infringed 16 claims in the patent issued to Professor Colin G. Fink for a distinctive method of electroplating metals with chromium. The decision held that United Chromium, Inc., holder of the patent, may now seek an accounting. Professor Fink hailed the verdict, which affirmed a decision Judge Thomas had rendered in Connecticut in December, 1930, as one establishing his contention that he was originator of the first commercially practicable method of chromium plating.

While Professor Fink declined to try to estimate royalties accountable because of the infringement, he said it "would not be a few pennies." Besides plating for motor cars and plumbing equipment, he said, his process had made possible the printing of banknotes and stock certificates with chromium plates. These are so durable that they will make 1,000,000 clear imprints, he said.

Justice Learned Hand wrote the opinion, which was concurred in by Judges Augustus N. Hand and Harrie B. Chase.

Welder Trademark Allowed

IT was recently held by First Assistant Commissioner Kinnan that the Westinghouse Electric Company, of East Pittsburgh, Pennsylvania, is entitled to register, as a trademark for electric welding machines, the notation "Weldomatic," notwithstanding the prior adoption, use, and registration by the Williams Oil-O-Matic Heating Corporation, of Bloomington, Illinois, of the notations "Oil-O-Matic" and "Dist-O-Matic" as trademarks for liquid fuel burning heaters and the term "Ice-O-Matic" as a trademark for electrically operated refrigerating units.

The ground of the decision is that the goods are so different that the use of the somewhat different marks thereon would not be likely to cause confusion in trade.

In his decision the First Assistant Commissioner noted that the evidence established that the opposer was the first in the field, had widely used its marks and extensively advertised its goods and that, if there was doubt as to confusion, such doubt must be resolved against the newcomer.

Then, after stating that there was but little in common between the goods of the two parties other than that they both employ electric motors and are automatic in their operation, he said:

"The welding machines produced by the applicant are for an entirely different purpose, are sold to and used by a different class of purchasers, are marketed through different trade channels, and relate to different industries or arts. It is believed that this difference in the goods coupled with the difference in the marks justifies the conclusion that there is no probability of confusion in trade."

Michigan College May Acquire Patents

THE State Board of Agriculture, as the governing body of the Michigan State College, has the power to acquire patent

rights through assignment by gift of letters patent, according to an opinion of Attorney General Paul W. Voorhies, published in *The United States Daily*.

The gift may be from persons receiving aid or assistance of the agriculture college in the development of insecticides, which would be useful toward the advancement of agriculture in the state, Mr. Voorhies ruled in approving a proposed agreement of the State College with a corporation for the manufacture under particular patents of certain compositions for treatment of nursery stock, trees, lumber and other products of a similar nature to reduce parasitic infection.

The action of the State Board of Agriculture in this regard, according to the opinion, would be solely within its control and discretion, and the Board would be responsible only to the people of the state of Michigan.

Canning Method Held Not Inventive

THERE exists no invention in devising a process for canning baked beans by which the beans when baked are placed while hot into heated cans, the United States Circuit Court of Appeals has ruled in holding invalid a patent issued to cover such a process.

There is nothing new, it was determined, "in transferring cooked food into jars or cans while hot." Both the housewife and the commercial canner are said in the opinion of the court to have long employed this method. The specification in the patent stating that the temperature of the baked beans at the time of canning should range from 182 to 190 degrees Fahrenheit is merely stating, it was ruled, "in degrees of temperature what every canner and housewife has known for years, that cooked food must be canned while hot."

The patentee's solution of the problem of how to keep the beans hot during the canning process was also held not to constitute invention. "It was merely adapting a method in common use in hotel and restaurant kitchens to a new use."

The Appellate Court affirmed a finding of the District Court for the District of Massachusetts holding the claims of the patent invalid, which finding had been made on a motion to dismiss the bill alleging infringement of the patent. In approving this procedure, the Appellate Court stated in its opinion that "whenever it is clear that no invention is described in the patent, or from common knowledge the several steps in the process described in the application and claims are old and their combination produces no new result, the courts have not hesitated to dismiss."

The decision was handed down in the case of Friend et al. v. Burnham & Morrill Co.

Warning Against Civil Service "Coaching" Schools

THE following statement is made by the United States Civil Service Commission:

The Commission warns the public against paying money for "coaching" courses in preparation for Federal civil service examinations.

Schools which sell such courses under present conditions accept money under false pretenses. A purveyor of civil service courses is now under indictment in Iowa for false representation. It is expected that other such cases of prosecution will follow soon.

Comparatively few appointments are being made in the Federal civil service. Vacancies which must be filled are filled by the transfer of those in the service or the reinstatement of those who have been in the service, wherever practicable.

It is seldom necessary to announce an examination. In most cases large registers of eligibles exist as a result of examinations held during the past year. When an examination is announced, the applicants are usually hundreds of times in excess of the need.

Money paid for civil service coaching courses at this time might almost as well be thrown to the four winds.

Varnish Trade Name Restricted

THE Federal Trade Commission has ruled that Albert K. Sheldon Company, Boston, manufacturer of a spirit varnish product called "Shelco-lac," must discontinue using that name alone or in connection with other words to designate a product "which is not pure shellac gum dissolved or cut in alcohol."

The commission also prohibits use of the trademark "Shelco" or any "coined word of similar phonetic notation or spelling, alone or in combination with other words, syllables or phrases" to designate a quick-drying spirit varnish of which the principal ingredients are Manila gum, carnauba wax, and alcohol, "unless respondent shall, in equally conspicuous place and type, name and designate said product as 'spirit varnish.'"

Premium Card Copyright Held Valid

A MEMORANDUM opinion of District Judge Jones, of Ohio, follows:

"The suit is one for copyright infringement. Merle H. Walker and the defendant, Donald G. Agnew, while employes of the plaintiff company, conceived and produced the customer's premium record card which was copyrighted by Charles Leigh Sebring, as trustee for the plaintiff assignee.

"While the card may not be a work of pretentious merit, yet it evidences some original intellectual effort as to conception, composition, and arrangement. The Copyright Office thought so, and the certificate of registration was issued.

"There has been such generous use of identical expressions and arrangement in the offending card as to negative the claim or suggestion of difference and the defense of noninfringement. It is elementary in copyright infringement cases that similarities and the use of identical language in a substantial way furnish cogent evidence of copying. . . .

"I find that the plaintiff's premium record card embodies a new, original, and useful arrangement for stimulating the sale and distribution of merchandise; that the plaintiff is the owner of the copyright by assignment; and that all required proceedings for copyright, under the laws of the United States, were duly complied with; that the defendants have substantially copied and appropriated the plaintiff's copyrighted card; and, that the defendant Agnew has, jointly with the defendant The Stubenville Pottery Company, invaded the rights of the plaintiff.

"My conclusion is that the copyright is valid and infringed. Decree may be entered for the plaintiff."

"Spartan" Battery Registration Denied

THE following opinion was handed down recently by First Assistant Commissioner Kinnan, of the United States Patent Office, in the case of The Spark-Withington Company *versus* Price Battery Corporation.

"This case comes on for review, on appeal of the applicant, Price Battery Corporation, of the decision of the Examiner of Interferences sustaining the opposition of The Sparks-Withington Company, and adjudging the applicant not entitled to the registration for which it has applied.

"The applicant seeks registration of the notation "Spartan" associated with the representation of an ancient warrior in armor as a trademark for use on electric storage batteries, storage battery cases, and storage battery cell connectors. Use of the mark upon the goods is claimed since May 25, 1929. The opposer sets up prior adoption and use of the mark "Sparton" upon electric automobile horns and radio receiving sets, and claims ownership of registrations No. 93302, issued Sept. 2, 1913, of this mark used upon electric horns, and No. 245218, issued Aug. 7, 1928, for the mark used upon radio receiving sets, loud speakers, and parts thereof. Opposer further claims ownership of registration No. 216034, issued Aug. 3, 1926, of the mark "Spartan" used likewise upon loud speakers for radio sets and radio receiving sets.

"Both parties have taken testimony. It satisfactorily appears that the opposer was many years prior in the field in the adoption and use of its mark; that it has expended large sums, approximately $3,500,000, in advertising its goods under its mark; that it has sold electric horns to the extent of approximately $19,000,000, and has sold radio sets approximating $36,000,000. Opposer must be presumed in consequence to be in possession of a very valuable good will as an asset of its business. Under these circumstances if there is any reasonable probability of confusion in trade the applicant must be denied registration. . . .

"The goods of both parties are quite generally used together, especially in connection with automobiles, and are so closely associated that it would seem the same mark appearing upon both kinds of goods would result in the presumption of purchasers that both goods had the same origin. The two marks are deemed to be so nearly alike in spelling, sound, and significance that the slight differences would pass unnoticed. . . .

". . . It is believed the applicant should not have adopted a mark so nearly like that of the opposer after the latter had so long, so widely and extensively used and advertised its mark upon its goods. The applicant is deemed to have approached too closely the opposer's mark.

"The decision of the examiner sustaining the opposition and adjudging the applicant not entitled to the registration for which it has applied is affirmed."

Books SELECTED BY THE EDITORS

GENERAL ENGINEERING HANDBOOK

By C. E. O'Rourke, Asst. Prof., Struct. Engr., Cornell

COMPRESSED into the space of 921 pages a large amount of fundamental engineering has been made available for practising engineers and students, without the necessity of wading through detailed and voluminous handbooks devoted to special branches of engineering. To accomplish this it has been necessary to reduce to an absolute minimum the general descriptive matter, historical facts, highly specialized material, derivation of equations and development of theories. A background of general engineering theory and practice is assumed. Thirty-one sections include six which are of importance to all engineers, eleven belong primarily to civil engineering, nine are mechanical, and five electrical. For the engineer this handy volume will represent four or five of the regular bulky handbooks.—$4.20 postpaid.

THE CAUSES OF WAR

THE World Conference for International Peace through Religion organized four international commissions. The first on economic, industrial, racial, and political causes enlisted the able efforts of some of the foremost experts of the world as indeed a glance at the list of eminent names will confirm. The others were formed from the membership of the conference—only in degree less eminent. These latter studied the religious, scientific, cultural, educational, and philanthropic influences. Here, therefore, in this book are gathered all these different studies and recommendations into a co-ordinated and synthesised whole to present a positive picture and ideal of what life today could be in a world more sanely organized, and to indicate ways and means whereby the ideal can be realized.—$1.65 postpaid.

FROM TELEGRAPHY TO TELEVISION

By Lt. Col. Chetwode Crawley, M. I. E. E.

INTO the 203 pages of this book, the author has compressed a whole history of electrical communications. When a compilation of this sort is attempted, the result is far too often a text-bookish affair that is uninviting to the average reader. In the present case, however, the author brought to bear a knack for holding the reader with his interesting style. The only draw-back which this reviewer found is that the book is typically British throughout, and that the data is somewhat biased in favor of British workers. This is not to say that the information given is inaccurate; the sin is one of omission rather than commission.

The author carries the reader through the history of line telegraphy, submarine telegraphy, cables, line telephony, wireless telegraphy and telephony in all phases, and telephotography and television. Regardless of the British bias mentioned, this book is one that will serve, in an interesting manner, to "brush up" one's knowledge of the history of communication, and as a reference book for future use.—$2.65 postpaid.—*A. P. P.*

INDUSTRIAL MANAGEMENT IN THIS MACHINE AGE

By F. W. Westbrook

HOW modern mills are manned and run is told by the author who is a practical engineer and writer for industrial magazines, from information obtained by visits to factories and correspondence with their executives. Factual cases are cited by name where such and such methods are in use, why and how the system was adopted and general comments as to specific need or general availability. This is not the usual dry style of a survey but a cohesive story which is bound to interest all students of economics or management. Certainly it should not be overlooked by any careful plant manager or executive who wishes to avail himself of the best current practice. Many charts support the text.—$3.70 postpaid.

BLIND FLIGHT IN THEORY AND PRACTICE

By Major William C. Ocker and First Lieutenant Carl J. Crane

IT used to be predicted that airplane pilots would in time become mere air chauffeurs. We did not then know that the pilot's native senses are not to be trusted when he encounters blinding fog or storm. Major Ocker, our foremost authority on the science of blind flight, has shown the importance of depending on instruments, and, therefore, that the pilot must be a highly trained, technical person. In this book which was written in collaboration with Lieutenant Crane, instrument aids to the pilot are described thoroughly in 200 well-illustrated pages, and an authoritative discussion is given of the various aspects of blind flight training and of blind flight operations. "Blind Flight in Theory and Practice" is the sort of book no pilot can do without and one which no progressive air enthusiast will be without.—$3.20 postpaid.—*F. D. McH.*

CHROMIUM PLATING

By E. S. Richards

THERE has been need for a book on this subject and this one covers it thoroughly. It describes English practice. Application in automobile practice is probably the most conspicuous use, but there are innumerable examples where this plating is far more important and represents a much greater advance. The author issues a warning that this process is a difficult one to master, that it takes expensive equipment and infinite pains and attention. Diagrams show how to wire various shapes that are to be plated, layouts of economical shops, and protection of workers, among all the details, are treated thoroughly. A welcome addition to the bibliography. —$3.65 postpaid.

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By C. M. Hoke

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

ORSON D. MUNN, President
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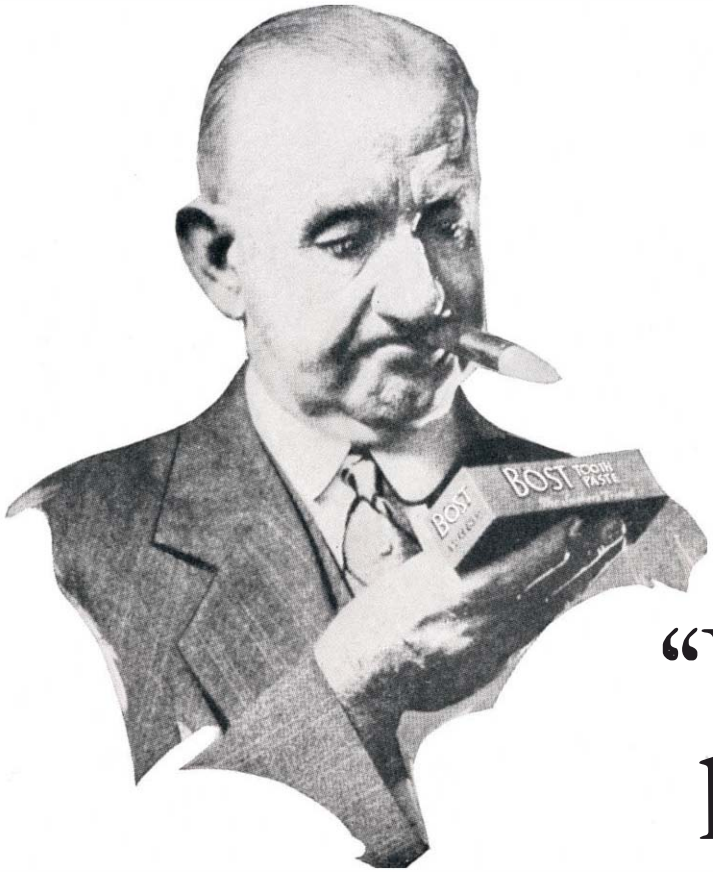

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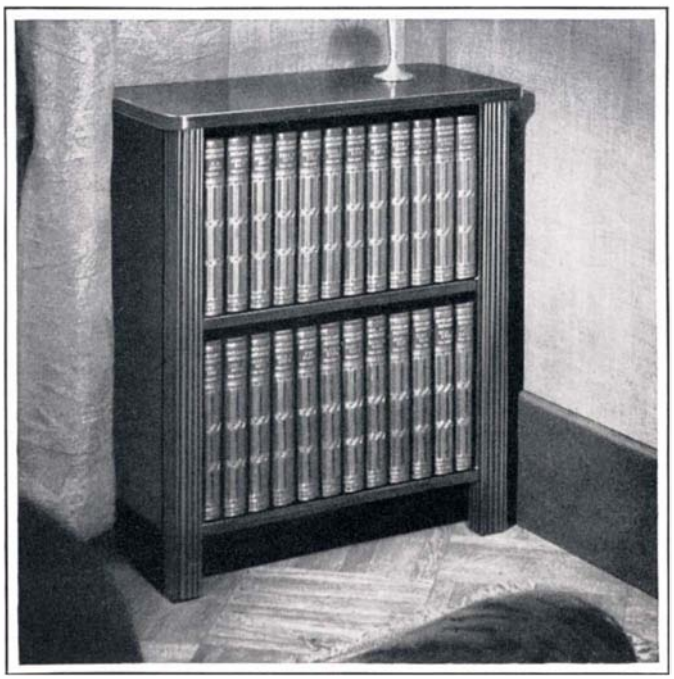

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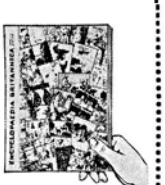

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