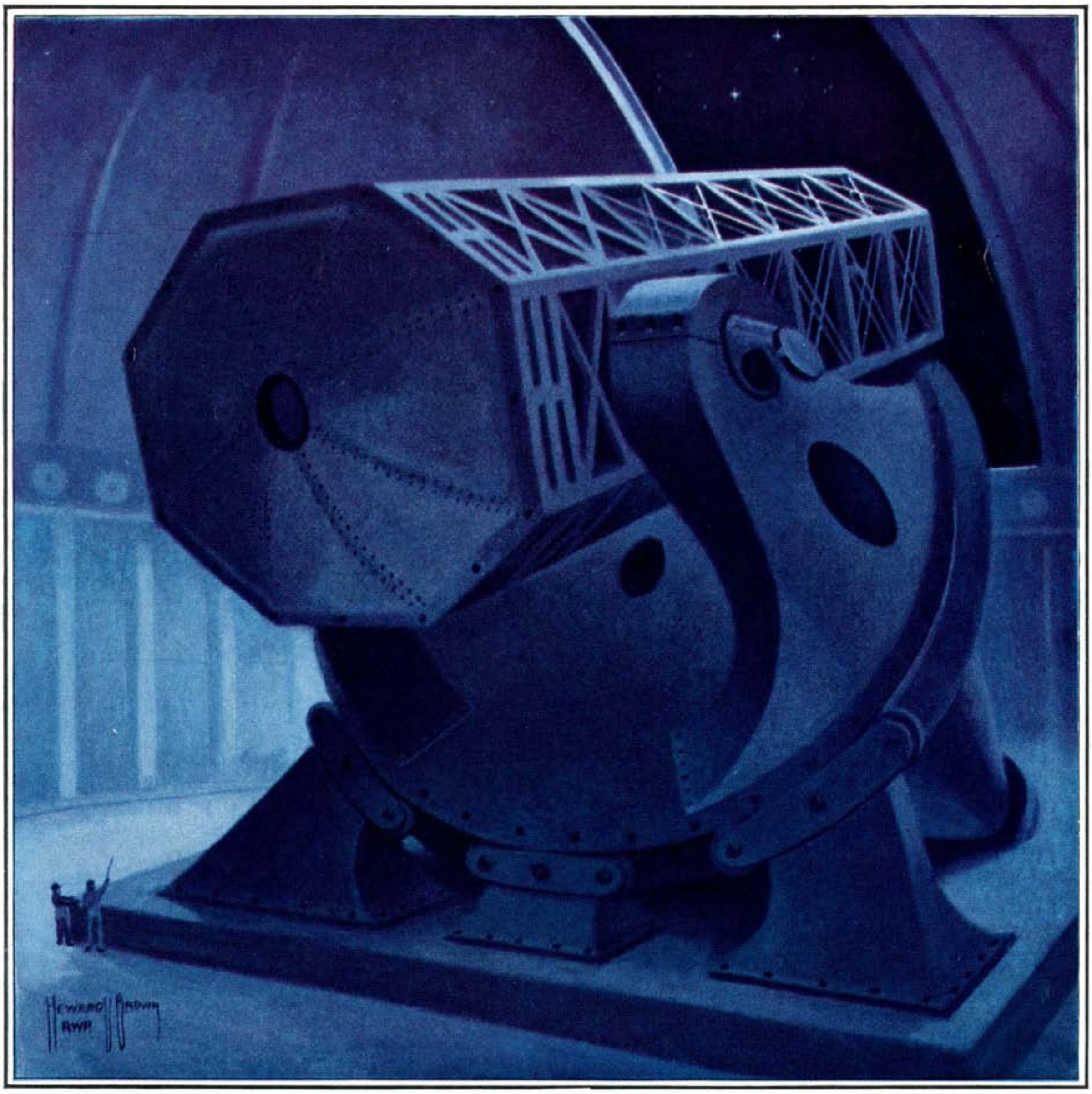
ASTRONOMICAL NUMBER

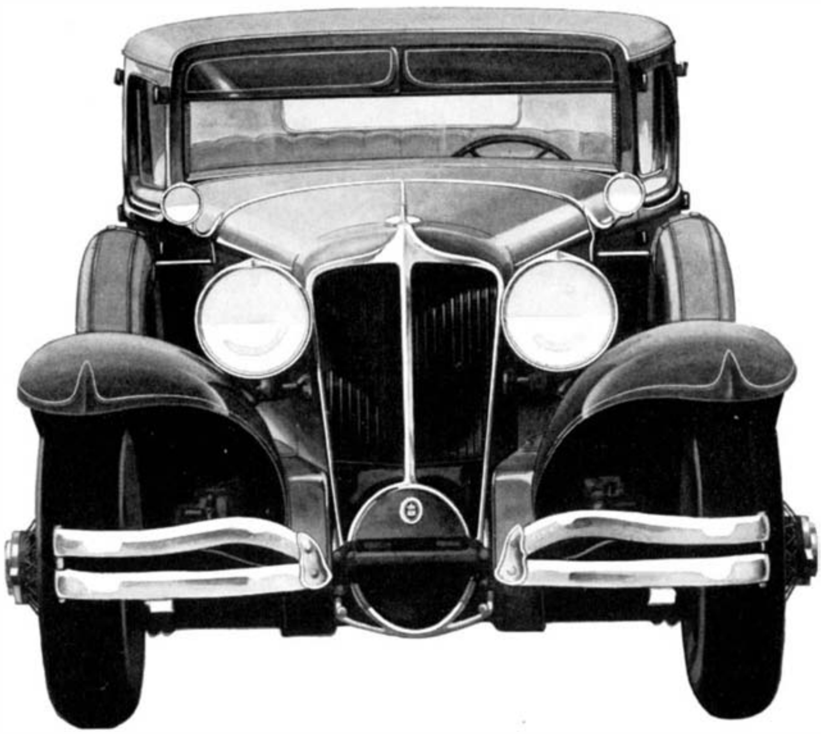
Signaling to Mars—Amateur Astronomers' Activities

SCIENTIFIC AMERICAN

October 1930 ★ 35¢ a Copy



Work Has Begun on the World's Largest Telescope



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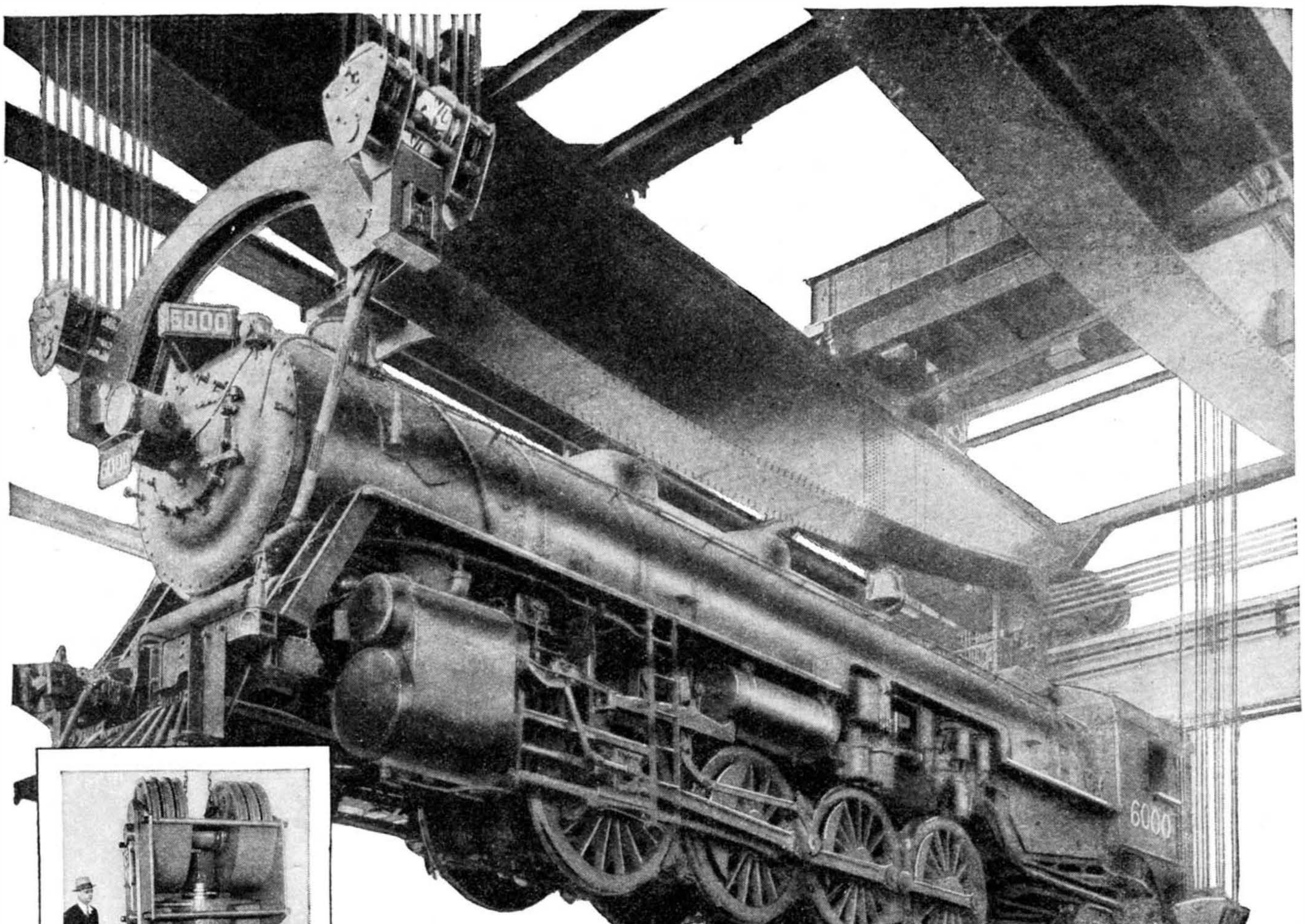

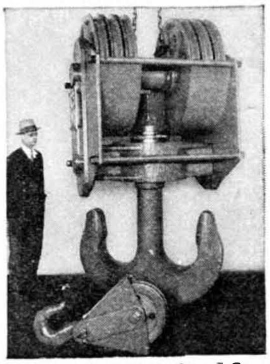

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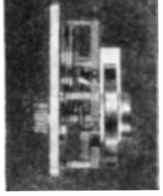

SKF Bearings are also used on delicate scientific instruments where the demand is for extreme precision instead of extreme strength.

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Across the Editor's Desk

NEW cover design . . . new style for title on cover . . . new cover painting size . . . new contents page layout . . . new typography throughout . . . new layouts for articles . . . new and better paper stock . . . better reproduction . . . better printing . . . better engraving . . . new and more pleasing in appearance from cover to cover. Thus may be described the November issue of the SCIENTIFIC AMERICAN.

It has been said truly that all progress is change. The SCIENTIFIC AMERICAN, bringing to its readers the news of progress in the scientific world, has always endeavored to set the pace. Therefore, when we decided three months ago to change our entire format to keep in the forefront of the publishing field, we called a conference of experts in various phases of the business. Cover designs were made and rejected until one was found which we felt to be most suitable for our SCIENTIFIC AMERICAN. Typography was studied from all angles and a type family was selected that is at once dignified, readable, and flexible enough to afford variety. Sample layouts for articles were worked over by our make-up editor and he promises us that forthcoming issues will present a better and more up-to-date appearance than ever before.

But with all these changes in the mechanical make-up of the magazine, our editorial policy will remain unchanged. We will, of course, continue our endeavor to obtain for you each month the very best articles on every branch of science, and to prove our point we will proceed to outline in brief a few of the feature articles scheduled for early release.

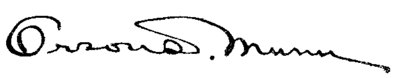
The November issue will be our annual Industrial Number, and prominent among the articles will be one dealing with the hydrogenation of oil and coal. Heralded widely in the daily press, this process promises to be revolutionary in the oil industry. By means of it, it is possible to treat crude oil with hydrogen so that 100 gallons of gasoline can be produced from 100 gallons of crude. Sounds almost impossible, doesn't it? But we learn from the article that the Standard Oil Company is erecting three plants for this work, and that the process has proved entirely practicable.

There are many rumors abroad in the land regarding the future of television, and to clear up some of the misconceptions on the subject, we are going to publish an article by a prominent English radio authority in which is pointed out the fact that television is greatly in need of new ideas—and less ballyhoo. We believe that this is one of the first clear-headed, unbiased surveys of the entire television field as it is today, that has ever been published.

Occasional cool mornings about this time of the year bring to mind the fact that the football season is not far off. Timely, then, is an article on hand which reveals the surprising fact that when you pay five dollars for a ticket to a football game, you actually pay at the rate of $24.25 an hour to watch this thrilling sport. This seeming anomaly is explained by the fact that, in the average game, the ball is in actual play for less than 12 minutes! An expert in industrial time studies has made a critical and accurate survey of a series of games between famous teams and gives his results and conclusions in an article that is both interesting and informative.

The electrification of railroads is a subject that is of vast importance to industry in general. The average person, however, whether he be an investor in railroad stocks or interested in the subject for its own sake, is often misled in his search for information by conflicting published statements. We have therefore obtained, from an authority in the field, an article that tells dispassionately and without bias, the whole truth on the proposition and what it all means to the general public.

Other articles that will appear will cover such subjects as how industrial wastes are reclaimed, the story of cork, radio weather vanes ten miles high, seismology, "slotted wings" of birds, how sugar is made, and others. We hope that when the November issue reaches your hands you will enjoy it as much as we have enjoyed working on it and selecting its new style.



»BEYOND COMPARISON—*William Beebe*

»It is COMPREHENSIVE and AUTHORITATIVE—*Chief Justice Hughes*

»Will long REMAIN UNCHALLENGED—*President Angell of Yale*

»So vivid and easy...so alive...it HOLDS A CHILD'S INTEREST —*Mrs. Franklin D. Roosevelt*

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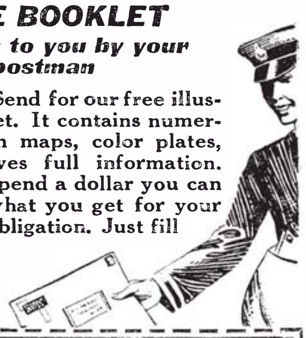

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October, 1930 *ORSON D. MUNN, Editor* *Eighty-sixth Year*

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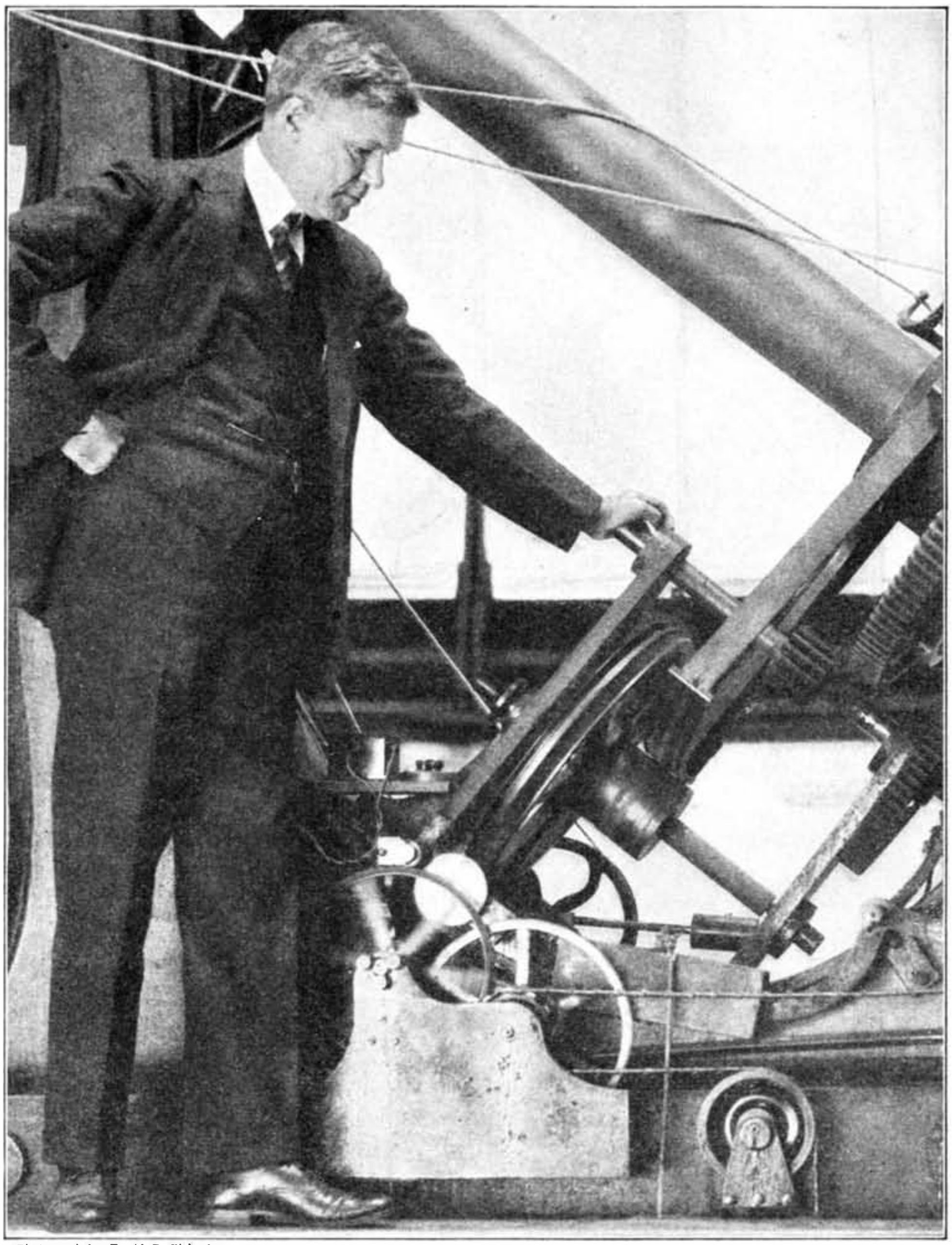
IN THIS ISSUE

The SCIENTIFIC AMERICAN Digest

COVER

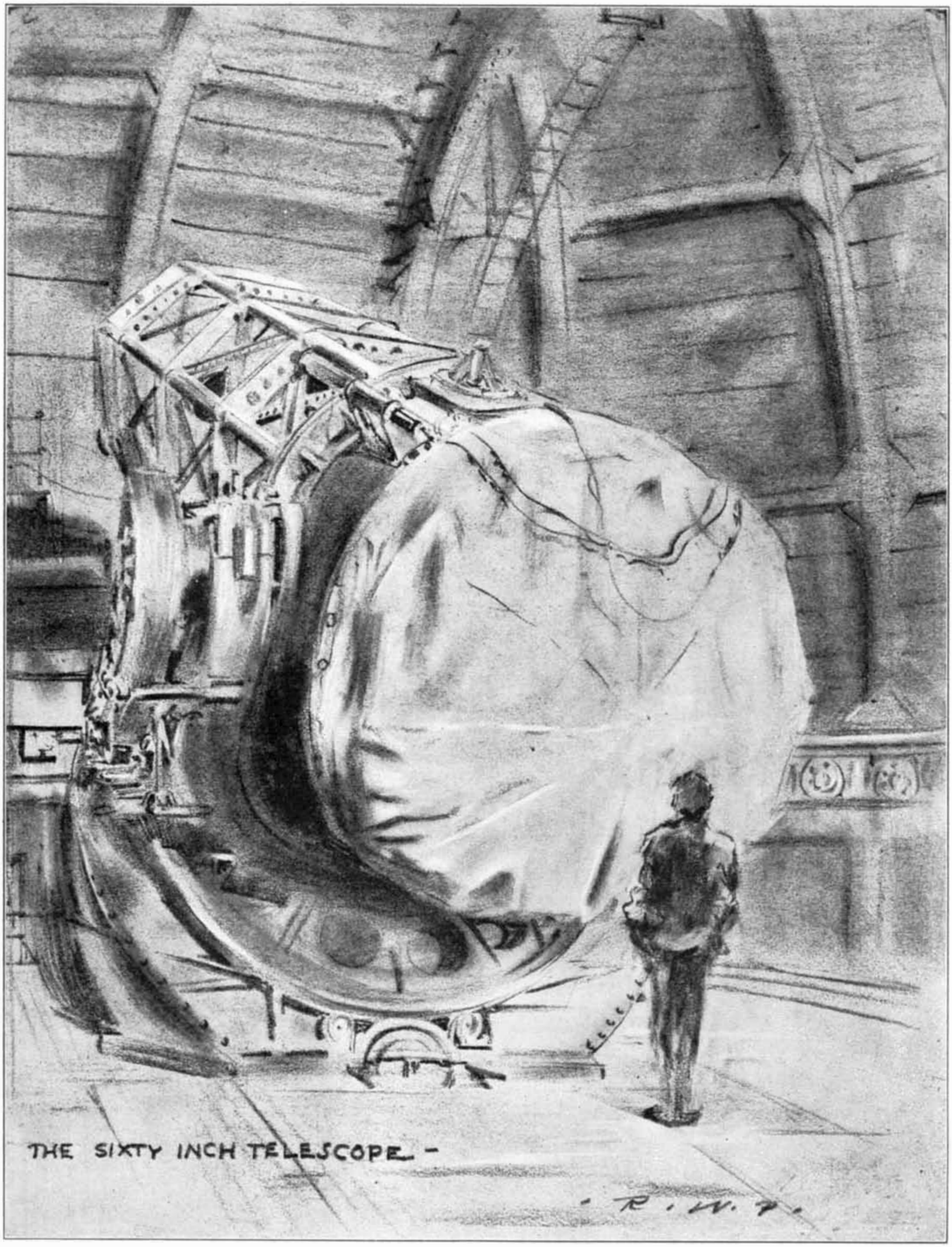
A member of our staff asked Russell W. Porter, who was returning east from his season's work at the California Institute of Technology, what the new 200-inch telescope would look like. Mr. Porter's answer was given with a pencil. Later his sketch was followed by Howard V. Brown, our cover artist. This is the fork type of mounting tentatively adopted for the model built by the Warner and Swazey Company. The telescope shown will weigh 750 tons.



Photograph by David B. Pickering

S. A. Mitchell

FOR the determination of the distances of 1000 stars, Professor S. A. Mitchell, Director of the Leander McCormick Observatory at the University of Virginia, recently has been honored by other astronomers—as Professor Russell explains on page 280 of the present number. The stars whose distances were determined are within the galaxy —that is, within our own "island universe." They range from six to 600 light years. The work involved no simple, easy "mass production" method of ascertaining these distances, but each individual star required much painstaking labor and application. Dr. Mitchell's prominence in astronomy, however, is based not alone on this kind of research; he is a leading authority on solar eclipses, his large book, "Eclipses of the Sun," being the standard work on every aspect of the subject. Professor Mitchell also has done research at Yerkes Observatory, also at Columbia. He is a Canadian.



THE 60-inch reflecting telescope at Mount Wilson Observatory. A sketch made in the daytime when the observatory dome was closed and the mirror disk of the instrument was further protected against temperature changes by a jacket. Russell W. Porter, the artist-astronomer, called this sketch "The Slumbering Giant." Further details will be found on page 256. The tentative design for the 200-inch reflector (see front cover) employs a similar mounting, largely because it has proved so satisfactory on the much admired 60-inch instrument

A group of members of the American Association of Variable Star Observers visiting Georgetown Observatory during a Washington meeting. About half are "professional" and half "amateur" astronomers, but in astronomy such a distinction seldom is made, because the amateur has done so much professional work in the past

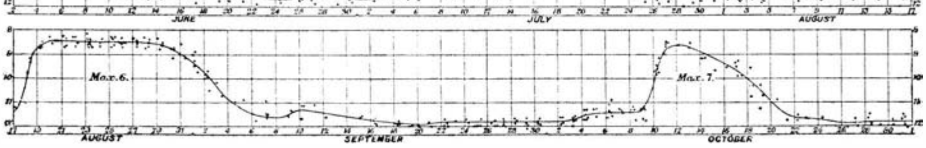
One Touch of Nature

By DAVID B. PICKERING

The American Association of Variable Star Observers

OF the tens of thousands of millions of stars which photographs taken through the world's great telescopes will show us, all but a few thousand, a mere handful, are staid, well balanced citizens of space. All, of course, are suns, larger and brighter on the average than our glowing orb of day, but so vastly distant that they appear but as points of light even through our most powerful instruments. In human affairs our concern is with those who disobey the laws of society and ignore its conventions. Even so, in the world of stars we are drawn to those non-conformists whose vagaries, in many cases, seem to be beyond the pale of the law. Unlike their more regular brethern, they dare to change their brilliancy—throwing into space at times vast quantities of light; while at other times, so prodigal of this commodity have they been, that they shine with but a fraction of their former brightness.

The basic laws that underlie these changes in brilliancy are, in many cases, still a mystery to man, but his urge to know the truth impells him, nevertheless, to study them with sometimes passionate intensity. These lawless ones are known as variable stars. In the catalogues of the heavens they are designated by certain Roman capital letters, and the name of the constellations in which they appear. Thus we have SS *Cygni* —the variable star SS in the constellation of Cygnus, the Swan. To an observer with a small telescope, this star remains in comparative obscurity for an indefinite period, and then with startling rapidity grows in brilliancy to nearly 100 times its former state. It is one of the most mysterious and and therefore most famous of all variables—a veritable François Villon of the skies, whose next daring move his closest observers may not even guess.



From the *Journal of the British Astronomical Association*

Light curve of the variable star SS *Cygni*, 1927, from observations by the Variable Star Section of the British Astronomical Association (another amateur and professional body—in fact, this point of view is world wide)

LET us recite an emotional experience from the life of any variable star observer:

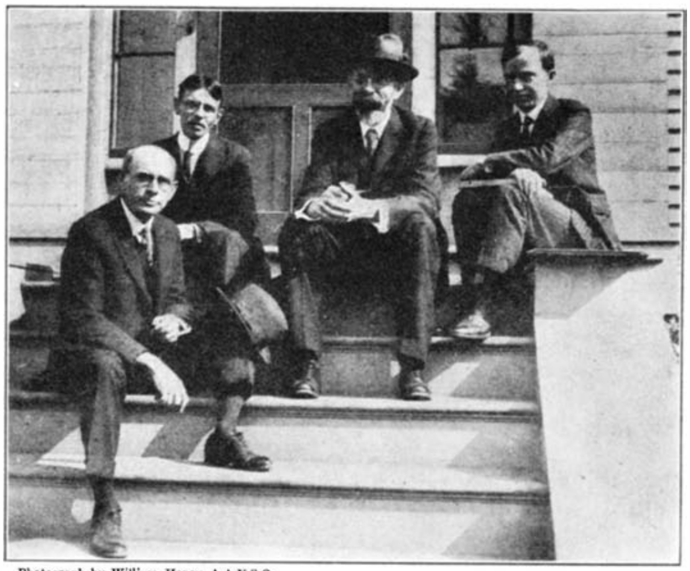
"Watchman, what of the night?" Many times throughout the day this phrase had trailed dimly through his mind as he sat in his stuffy office in the city, immersed in the details of accounts. Many times he had glanced quizzically through the window at the occasional clouds that sailed above the sea of brick and stone without. Later, from the window of the train that bore him to his suburban home, he noted with a thrill that the October sun decended through a cloudless sky.

As the evening meal progressed, as the dusk deepened and the lamps were lighted, wife and daughter wondered at his almost furtive manner. The faraway look in his eyes, the air of

"A.A.V.S.O's" hobnobbing. Left to right: Yalden, Godfrey, Miss Cannon, Miss Potter, Dean Potter, Professor E. W. Brown, Olcott

suppressed nervousness, led them to think that perhaps the daily office grind was proving too great a strain. With a guilty smile he excused himself before the meal was finished, and a moment later, as he passed through the dining room bearing the long yellow tube of his telescope, he was abashed by his wife's expression of quiet resignation. But, once the kitchen door had closed behind him, his spirit, imprisoned during the day, rose to meet the stars that kept their tryst with him—there in his own back yard.

He clamped the tube of his three-inch telescope into the cradle of the mounting atop the post that stood between the rose bushes, and adjusted the screen that shielded his eyes from nearby lights and kept the vagrant breezes from disturbing his charts on the little table at his side.



Photograph by William Henry, A.A.V.S.O.

Group at an A.A.V.S.O. meeting. Left to right: Pickering (the author), Olcott the founder, Yalden, Professor Harlow Shapley (Director, Harvard Observatory)

NOW his eyes rested for a moment on the stars overhead, then dropped westward to the great Cross of the North that glowed in that group called Cygnus — the Swan. There on its side it lay, submerged in the depths of the Milky Way. He lighted his dim lamp and let its red rays fall upon his star atlas. How still everything seemed, here in this secluded little garden. He swung his telescope until it was directed toward the slanting cross; then, while glancing at the sky along the edge of the tube, raised it until it rested some distance above the sparkling star Deneb.

He places eye to the eyepiece and cautiously moves the tube, slowly sweeping it back and forth, up and down. In the round, star-filled field of the eyepiece, the bright asterisms assume many and various forms, but with suppressed excitement he seeks one familiar form in particular. It is an "L" shaped group of stars, resembling a carpenter's square, opposite which is a group of fainter stars which, because of its dome-like shape, is known as the "bee-hive." Between these lies a triangle of stars, in which is located that elusive, mysterious variable, known to astronomers as SS *Cygni*.

On every clear night, for weeks past, he has sought this part of the sky—found and noted the familiar asterisms of this particular field—but on each night, though he knew the exact spot where it should appear, the object of his quest has eluded him. Last night again, it was beyond the power of his glass. Once more tonight, with the patience of a sleuth, he seeks the outlaw. Ah! here at last is the carpenter's square—and there the little bee-hive.

But—what is this! For an instant his heart seems to have stopped beating—then it begins to pound again—he is breathing faster. Something must have happened. Something *has* happened. SS *Cygni* is the brightest star in the field. Sometime within the last 24 hours, this giant sun has burst the bonds of mediocrity and is now radiating with one hundred fold the force of yesterday's energy. No wonder his emotions run riot. Seated here in the silent darkness among his roses, he is the lone observer of this tremendous cosmic event—the witness of a mystery which no man has fathomed.

The kitchen door swings wide. A stream of light from within flows across the lawn to the telescope. A girlish treble calls: "Hey, Dad, you goin' to the movies?"

Tomorrow's paper will tell of the gowns worn at the Vandercliff wedding—but there will be no mention of this magnificent gesture on the part of the Creator.

OBSERVING variable stars is the job of a trained amateur astronomer. The word "amateur" means one who does a thing because of his love for it. It is often wrongly applied to a fumbler. I have never known an astronomer—man or woman—who was not an amateur. If it so happened that astronomy was also his vocation, his professionalism was quite a secondary matter. What more natural than to find a brotherhood of interest among astronomers, such as exists perhaps in no other branch of science. Quite likely it was this fraternal instinct that, 20 years ago, brought together the late Edward C. Pickering, Director of the Harvard College Observatory, and William Tyler Olcott, an amateur telescopist of Norwich, Connecticut. Pickering, the professional, had a job for amateurs. Olcott, the amateur, was looking for a chance to aid science. Pickering became the "Big Brother" of all variable star lovers. Olcott became the founder of the "American Association of Variable Star Observers."

In was in 1911 that this Connecticut attorney began to enlist the services of other amateurs in the great game of estimating the brightness of the long period variable stars. In that year, seven men formed an Association, and began work. At the end of three years there were about 20 members. Today the Association numbers about 300 men and women in 23 countries of the world.

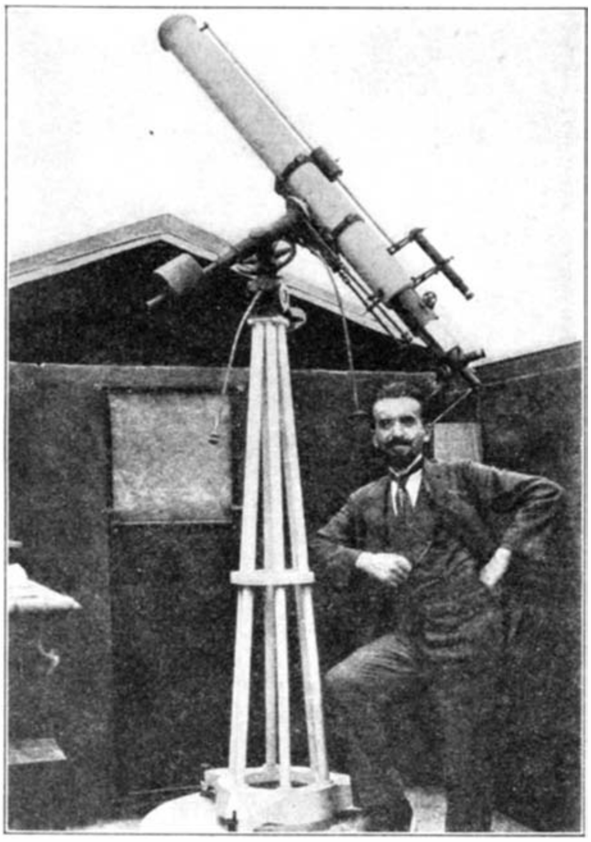
The fact that some of the stars are not constant, is the "touch of nature" that has "made kin" of hundreds of people all over the world—people whose vocations are almost as varied in character as are the stars themselves. Among the great amateurs of the country who make astronomy a profession, and who form the solid background and support of the Association, are several famous men, who, though listed as Honorary Members, are active in the extreme. Upon the shoulders of Dr. Harlow Shapley, Director of the Harvard College Observatory—"the man who remeasured the universe"—fell the cloak of that "Big Brother" who was our original inspiration. Professor S. A. Mitchell, the genial Director of the Leander McCormick Observatory—"the man who made a thousand parallaxes"—is devoting himself to the great task of revising our charts; redetermining our fainter magnitudes by the aid of his 26-inch telescope, in Virginia. Professor Ernest W. Brown, of the Yale Observatory, found that the earth and moon were out of step, and set certain members of our Association "marking time" for this pair. Largely through the efforts of this group, he has recently determined that the earth is the culprit—being out of rating to the extent of one second in a hundred years. This friend and companion of ours never misses a meeting of the "A.A.V.S.O."

BUT most of the variable star observers make of astronomy an avocation. There is Leslie Peltier, for example, whose home on the farm lands near Delphos, Ohio, is many miles from a railway. As a boy he would take his little two-inch glass out into the fields, then make his reports of the brighter variables regularly to the Harvard Observatory. Long since he graduated to a six-inch instrument, and for years was the outstanding "ace" among "A.A.V.S.O." observers. Incidentally, Peltier is the discoverer of two comets, one of which is Comet 1930a, the first to be found this year.

Speaking of comets, the second discovery of the year—1930b—was made also by another member of the "A.A.V.S.O.," Max Beyer of Hamburg, Germany. Though a true amateur, and a major contributor to the Association's reports, he is the publisher of the well known Beyer-Graff Star Atlas which so many of us use.

In the little town of Faenza, Italy, the town whose distinctive pottery gave to the world the name "faience"—lived the postal clerk, G. B. Lacchini. With what ardor he loved the stars and with what great facility he observed the changes in the variables, his long record of faithful service, preserved at the Harvard Observatory, will attest. The authorities at Rome, recognizing his rare ability, have recently taken him from the postal service and made him a member of the staff of the Royal Observatory of Catania, thus granting his heart's desire to devote his life wholly to the stars. His little family moved from their home in the north, to far away Sicily. From the shadow of Mount Etna, his charming daughter, Bianca Rosa, sends me occasional verses in excellent English. Today Lacchini contributes more observations to the "A.A.V.S.O." than any other member.

Lacchini and I had corresponded for a dozen years or more. Then one memorable day in 1926, we met—in Faenza. It was the first time that Lacchini had ever seen a member of the organization which he had served so faithfully, and for so many years. It was a day to be marked with a white stone. On that occasion, too, I met those fine protégés of Lacchini—Benini and Ancarani—who have remained in Faenza to carry on the work he began. Together with one Gallanti, they have organized the "Osservatorio Urania Lamonia," where, with an eight-inch reflector, the property of the "A.A.V.S.O.," they are doing faithful work for the Association.



The topnotch observer of the "American" Association of Variable Star Observers is an Italian, Lacchini, who lives near Mount Etna

Variable star observers commune at Faenza. Left to right: Benini, Pickering, Lacchini, and Ancarini. The organization is international

In the city of Seattle, Washington, lives another man of Italian birth, D. F. Brocchi, an engineer and draftsman for the Northern Pacific Railroad. He too employs his talents making master charts for variable star observation. Later he checks these with the sky by the use of 10- and 12-inch telescopes of his own making. Lacchini and Brocchi and I have for years been responsible for the chart work of the "A.A.V.S.O." Lacchini and Brocchi have never met. Brocchi and I have never met. We are separated from each other by thousands of miles—yet what chums we have become, and what fun we are having, through this common interest.

For many years the head of the "Baron de Hirsch Trade School" in New York City was J. Ernest G. Yalden—the sage of Leonia, New Jersey, whom his friends have affectionately dubbed the "Baron." This tall, bearded genius, with the heart of a boy and the brain of a philosopher, resigned his post some time ago to devote himself entirely to the study of time and the stars. His versatility is astounding—yachtsman, navigator, mathematician, architect, astronomer, and outstanding authority on the ancient art of sun-dialing. He is chief advisor to the Association on observatory construction, and is Chairman of the Committee on Lunar Occultations, another of our important activities.

The Rev. Mr. Tilton C. H. Bouton was a minister of the Gospel in a New Hampshire town when he joined our forces in the early years of our activity. He has since retired and moved to St. Petersburg, Florida, which he chooses to call the "Starlight" City. With the kindly manners of the "old school," with a mind ready and able to grapple with the mysteries of Nature, he has been an example of dependability to his fellow members. He varies his observational and lens-making activities by collecting china and building bows and arrows of rare excellence.

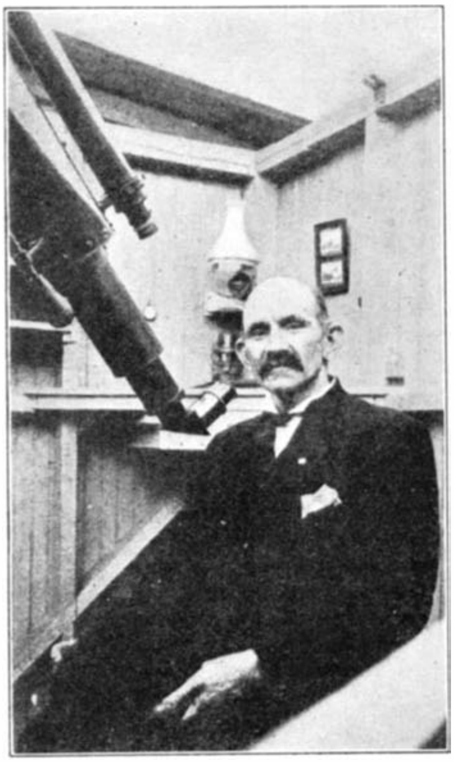
IN 1927 the Association sustained a great loss in the death of its President, Dr. Charles A. Godfrey, a leading physician of Bridgeport, Connecticut. What volumes could be written about his career. He had no means to buy a telescope when as a country boy the stars beckoned to him, so he made his own mirrors and mounted them too.

Another whose memory shall ever be green in the minds and hearts of his fellow members, was Charles Y. McAteer, of Pittsburgh, one of the seven original members of our Association. During his busy, happy life, he spent many hours out of every 24 at the throttle of a Pennsylvania Railroad locomotive. A rack in the side of his cab held a Bible and a star atlas—the only guides he knew or required. Finishing his trip when the night was half spent, he would hurry with his telescope out under the stars, there to observe variables until dawn and sleep broke his vigil. "Mac" was a rough diamond—but of the first water. The great in science were proud to call him friend.

Today, there are Arthur Butler of the New York Stock Exchange; George Waldo of the press; Ernest Jones of the insurance world; Charles Elmer, the court reporter—but space precludes an extended category.

Strange to say, among the 30-odd women who grace the membership of our Association, by far the greater number have chosen astronomy for their vocation. Among the latter who play a prominent part in its affairs, is Professor Anne S. Young, Director of the Mount Holyoke College Observatory, one of our past presidents, and now the editor of our publications.

The president of the Association, at this time, is Dr. Alice H. Farnsworth, also of the Mount Holyoke Observatory, while our vice-president is Professor Harriet W. Bigelow of the Smith College Observatory. Mrs. Margaret Mayall, and Miss Helen B. Sawyer, both of the Harvard staff, are curators of our charts. Dr. Caroline E. Furness, Director of the Vassar College Observatory and author of that splendid treatise, "An Introduction to the Study of Variable Stars," and her assistant Miss Alberta Hawes, are both ardent supporters of the Association and active in its affairs. Equally so, is Dr. Leah Allen, Director of the Hood College Observatory of Frederick, Maryland, and Miss Margaret Harwood, Director of the Maria Mitchell Observatory, on Nantucket Island.



Charles Y. McAteer, one of the seven original members, was a locomotive engineman—"a rough diamond, first water," was "Mac"

Outstanding among the non-professional members is Miss Helen M. Swartz, of South Norwalk, Connecticut, whose devotion to the Association is unquestioned. In Haverford, Pennsylvania, lives Mrs. Otto Haas. Despite the care and responsibilities of rearing her family and attending to her domestic duties, she contributes regularly to our observational records. Still another housewife who devotes her available time faithfully to "A.A.V.S.O." affairs, is Mrs. Mary E. Morris, of Nantucket, Massachusetts.

To our meetings in the spring and fall, come these men and women. Overlords and underlings of big business, professors and students, housewives and teachers, all forgetful for the time being of their daily occupations, they meet on common ground to consider subjects of common interest—to revel in the exchange of thought with kindred spirits. It is at these meetings that Leon Campbell, member of the Harvard staff, and dean of the variable star fraternity, discusses the results of our work. As recording secretary of the "A.A.V.S.O.," it is he who prepares our observations for monthly publication in *Popular Astronomy.*

The dinners with which these meetings invariably close are occasions to be remembered. Thereat we descend from heights of pure research to frolic and fellowship. Woe be to him who tries to hide his pet foible under a bushel of dignity; some one will find him out and exploit his weakness either in verse or song. After every such affair, we return to our familiar stars with a better appreciation of the value of team work.

WHAT a satisfaction it is to know that, because of the far-flung membership of the "A.A.V.S.O.," we are enabled to "spell" one another around the world. Perhaps Peltier of Ohio may be watching for a suspected change in the light of some puzzling star; as daylight ends his vigil, and the shadow retreats westward, he knows that there is a long night ahead in faraway Japan where Sigeru Kanda of Tokyo, or Teiju Kanamori of Naganoken, may mount guard over the same field of stars. When the hours of their stewardship have passed, Chandra of Jessore, India, brings his glass to play upon the sky. Later still the charge may fall to Ehric Liner of Konstanz, Germany, or to A. N. Brown of London. Thus when night again falls upon America, we may feel assured that the sun has not thwarted us.

But, despite this pretty system and these widely separated stations, the Association needs more workers. There are hosts of long period variables and never enough observers to follow all their caprices. We will gladly lead the amateur telescopist into the pleasant and profitable pastures of the variable stars. Through personal contact, by correspondence, or by the aid of literature and charts, we will instruct him in our methods and impress upon him the great assistance which his subsequent service will afford to science. Then, when he has acquired the knack of finding the star fields and estimating the brightness of the stars, and has assured us of his intention actively to co-operate with us, we will welcome him to membership in this happy fraternity of ours.

The very hope of adding one jot to the sum total of accumulated knowledge, seems sufficient reason for anyone to devote time and energy in the pursuit of truth. Perhaps another urge may lie, however, in the response of an eminent man of science when asked why he had given his life to research:—"Because it's so much fun."

OUR POINT OF VIEW

Glenn Hammond Curtiss

THE news of the untimely death of Glenn H. Curtiss at the age of 52, on July 23, came as a shock not only to the aviation world, of which he was one of the few outstanding pioneers, but to the world in general. Inventor, pilot, and manufacturer, he was in turn a bicycle racer and repairer, a motorcycle manufacturer, the first man to make scheduled airplane flights, and finally, an airplane manufacturer. He contributed more to the development of heavier-than-air flight than any other man, and much of America's success in building planes during the war was due to his genius.

After winning many trophies in bicycle racing, Mr. Curtiss made a 10-mile motorcycle record that stood for 16 years. Next he built a motor for an airship, the flight of which was so successful that the government ordered a dirigible. When this was built in 1905, it passed all tests and became Army Dirigible 1. Together with Alexander Graham Bell, he formed, in 1907, the Aerial Experiment Association and built the *Red Wing* which cracked up on its first flight of nearly 319 feet, the first public airplane flight in America. On May 22, 1908, Curtiss flew his second plane, *White Wing*, a distance of 1017 feet and landed safely.

The first previously announced flight in America was made by Curtiss when, on July 4, 1908, he won the first leg of the SCIENTIFIC AMERICAN Trophy by a flight of one kilometer in the now famous *June Bug*. His attempt to take off from the water in the *June Bug*, refitted with pontoons, was unsuccessful but the attempt led to the development of the flying boat which he perfected in 1912.

The second leg of the SCIENTIFIC AMERICAN Trophy was won by Curtiss in the first exhibition flight in America at Hempstead Plains, Long Island. This flight covered 24.7 miles. Then on May 29, 1910, came his greatest triumph: a successful flight down the Hudson River from Albany to New York City by which he won the *World* prize and the third leg of the SCIENTIFIC AMERICAN Trophy, the latter then becoming his permanent possession.

As a builder of planes, Curtiss designed and produced many machines of distinctive design and developed many types of aeronautical motors. In recent years, however, he had relinquished all active interest in the aviation companies that bear his name.

It will be impossible ever to calculate the debt which the world owes to Glenn H. Curtiss but it is an assured fact that aviation will place him forever on the pedestal beside the Wright brothers and Langley. While the world pays tribute to the energy and versatility of the man, SCIENTIFIC AMERICAN, because of its close touch with him during the early skeptical days of aviation, feels that it has suffered a distinct, almost personal loss.

Helping the Deaf

THE almost overwhelming noises of our great cities and of our industrial plants are said to be causing a large increase in the number of the cases of deafness. And it is now understood that deafness frequently tends to cause a mental slowing up and, in some cases, does cause a positive dullness.

The importance, therefore, of the efforts of the Chicago League for the Hard of Hearing to encourage installation of hearing aids on certain seats of churches, theaters, and other large auditoriums so that deafened people may hear and enjoy sermons, music, entertainment, or whatever program is being given, can readily be realized. There are in this country, the Hearing Aids Committee of the above-mentioned organization says, 10,000,000 deafened people, 300,000 of whom are in Chicago. Most of these people have ceased to attend church, cannot enjoy the drama or educational talks, and, since the advent of talking movies, are denied even the pleasure formerly afforded by silent movies. The Committee is backed, in this work, by prominent Chicago organizations.

We wish the League a full measure of success. Theirs is a splendid undertaking and we hope it will be followed in other cities. The world of the person who is hard of hearing is narrow and dreary indeed, and we who have our hearing should extend to him, as much as possible, the means of enjoying the entertainment and cultural programs which so often satiate us.

Before the Accident

DESPITE the disastrous nature of the World War, *The Travelers Standard* voices the opinion that it served a great purpose. It showed how exceedingly horrible a modern war can be and turned men's minds more definitely toward the prevention of future wars. Similarly, the sinking of the *Titanic*, with the loss of 1500 lives, was, it is pointed out, a beneficent disaster because it brought the realization that additional marine safeguards and an ice patrol of the North Atlantic were needed.

In industry, the thousands of safety inventions and devices—mechanical guards over moving machine parts, goggles and masks for workmen, safety valves, protective clothing, and so on—were all born of human agony and sorrow. Someone had to suffer before foremen, plant superintendents, and executives could realize the hazards of old methods.

It is a puzzling and unfortunate fact that foresight, in the matter of industrial safety, has been and is lacking as a rule. The workman has had inculcated in him the spirit of efficiency so that he takes an interest in his work, but he has not yet fully felt the need of accident prevention measures and devices. Working on machinery that is well-protected, he often removes safety devices in the belief, apparently, that he can do his work faster or with less effort.

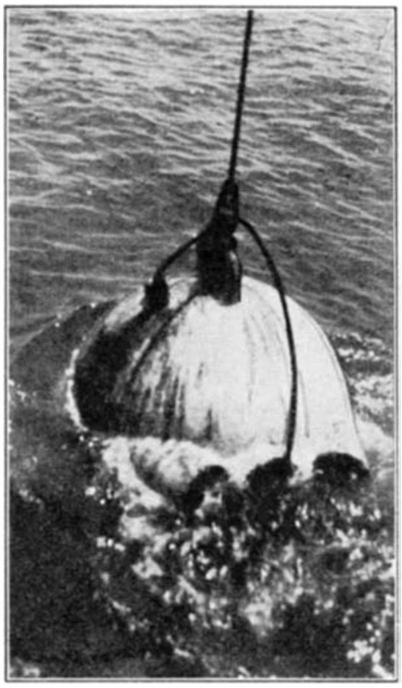
Some plants are making great advances in safety. In these, workmen are taught the meaning of accident prevention measures and are encouraged to look ahead and devise safer methods of doing the things they do every day. But the toll in fatalities and injuries is still far too great. If the human equation is to blame, then change it by an intelligent educational campaign. The result will be safety before, not after, the accident.

International Affairs

THE THREE POWER NAVAL PACT PRESIDENT HOOVER won a decisive victory in the prompt and almost unanimous ratification of the naval pact by the Senate. We believe the Senate reflected the public opinion of the country in their action; nevertheless the outcome is a personal triumph for the President, and coming at the close of a Congressional session where his leadership had been several times repudiated, it must have been gratifying. We believe the President deserves all the prestige he has gained by his patient and tactful handling of this difficult problem.

At the same time we entirely understand and sympathize with the patriotic motives that inspired the small group of Senators, ably led by Hale and Johnson, who unsuccessfully opposed the ratification. There is no gainsaying the facts they brought out

(*Please turn to page* 328)



The "bathosphere" emerging from a quarter of a mile dive. Note the cannon-like eyes

A 1400-foot Dive

By OTIS BARTON

THE 13th expedition of the Department of Tropical Research of the New York Zoological Society under the direction of Dr. William Beebe has had a very successful season in Bermuda and our knowledge of undersea life has been greatly enlarged by the use of the "bathosphere," designed by the writer and Mr. J. H. J. Butler. This spherical steel diving chamber or tank is a single steel casting fabricated by a firm specializing in hydraulic machinery. The first casting weighed five tons, and proved too heavy for Dr. Beebe's winch. This casting was therefore junked and another "bathosphere" weighing 5000 pounds was substituted. It is four feet nine inches in diameter and its walls are more than an inch and a half in thickness to resist the enormous pressure that is found at great ocean depths.

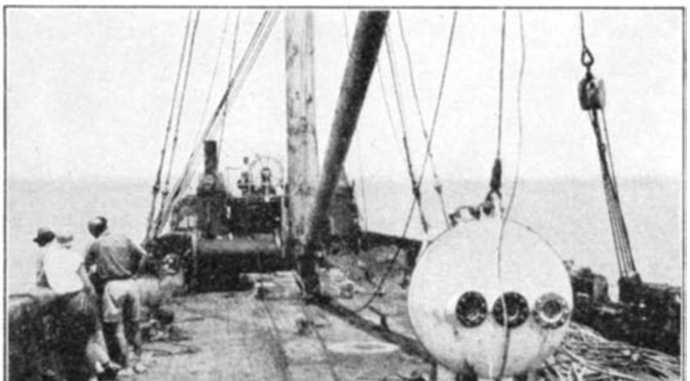
Access to the sphere is gained by a 400-pound door in the rear. It is secured with ten large bolts. In the center of the door is a wing-bolt plug which can be quickly screwed in or out. The door has a circular metal gasket which fits into a shallow groove. This joint, when packed with a little white lead, was entirely waterproof at a test submersion of 2400 feet.

THE windows in front are cylinders of fused quartz eight inches in diameter and three inches thick. They are a special product of the General Electric Company and are fitted into cannon-like projections in the front of the sphere. The joint is secured by a paper gasket and with white lead, and a light steel frame is bolted over the front of each window. In all we had five quartz windows. The first was chipped in an attempt to grind it into its seat. The second gave way under an internal pressure test of 1250 pounds to the square inch. It seems probable that the frame in front was bent and that the resulting shearing strains broke the glass. The third was broken when the frame bolts were tightened unevenly. The remaining two, however, have never leaked a drop, have withstood the pressure under test at 2400 feet, and will no doubt stand much more. We were obliged to seal the third projection with a steel plug.

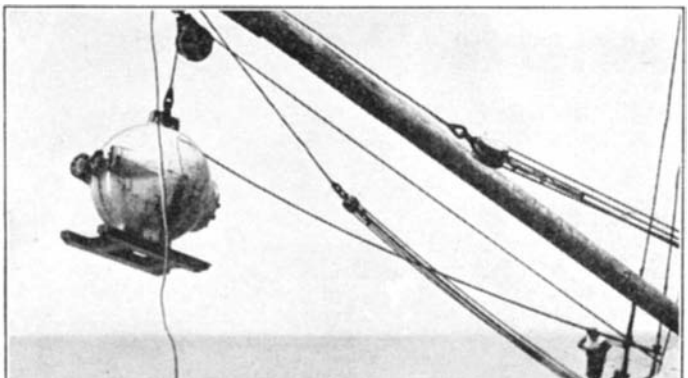
The electric cable was specially made. It is one and one tenth inches in diameter and has heavy rubber insulation. Inside are two conductors for the lights and two for the telephone. The cable passes through a stuffing box in the top of the tank and is squeezed up by two glands, one on the outside of, and the other within, the sphere. The glands proved entirely waterproof under all pressures we encountered, but the higher ocean pressures caused the electric cable to slip in through the stuffing box. It was this which turned us back at 1426 feet. Eventually we succeeded in jamming the cable with friction tape.

The two largest conductors passed to a 150-watt spot light in the right forward projection. At depths of over 700 feet the beam of light could be seen passing through the water. When more illumination was desired, it was simply necessary for the divers to direct the deck crew, by telephone, to speed up the generator. The light was turned out by the divers when they wished to observe the effects of the natural submarine illumination. To facilitate these observations the entire interior of the sphere was painted black. All observations taken in the depths were recorded by the deck crew.

THE breathing apparatus employed was designed by Dr. Alvan Barach of New York. Clamped to the wall of the sphere were two oxygen tanks, either of which would take Dr. Barach's special valve. We set this valve to allow two quarts of oxygen per minute to escape for the two divers. At this rate, one tank lasted



The "bathosphere" on the deck showing the "eyes." The winch and the steam boilers are at the left and Dr. Beebe (hatless) may be seen looking over the rail



The "bathosphere" is swinging outboard for the dive. Note the skids and the electric cable which carries all the wires for the telephone and electric lights about three hours. Above each tank was a wire mesh tray. One contained soda lime, which took up the carbon dioxide. The other held calcium chloride which absorbed the moisture in the air. Palm leaf fans kept air in circulation. During our deepest dive of 1426 feet we were comfortable and cool, although we were inside more than an hour and a half. The physiological balance was excellent, although after a long dive there was a slight excess of pressure. This we noticed on our ears when the central plug was unscrewed upon reaching the surface.

We always entered the sphere head first, wriggling our way through the narrow manhole. There were no cushions on the floor, for these might hide some of our small implements or obscure leaking drops of water. Our bodies, however, fitted comfortably against the rounded steel walls. The door was put in place with a small hoist. The pounding down of the ten bolts and central ring bolt plug created a fearful racket in the interior. The jarring, however, never seemed to affect the quartz windows.

THE "take-off" always felt smooth, like that of a dirigible. In the air the "bathosphere" swung like a hammock. At times we almost began to feel seasick. Once in the water, however, all was well. We were steady and cool and only knew when we were being lowered by the jerking of the steel cable.

For lowering the ball, we used Dr. Beebe's five-ton winch and special large reel. To operate these, we installed two boilers on the after part of the long deck of our 130-foot lighter, which had once been H. M. S. *Ready*. The lighter was in turn towed by the tug *Gladisfen*, of the New York Zoological Society. This equipment was used on the Arcturus expedition, as were also the three six-ton sheaves. One of these was bolted to the deck about 60 feet in front of the reel, which was amidships. From this the cable returned to the second block close to the mainmast and then passed to the third at the end of the heavy boom.

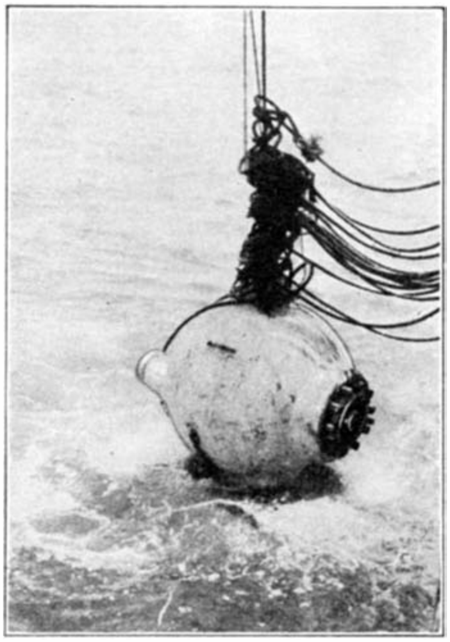
The cable was a special seven-eighths-inch steel-center non-spinning type, 3500 feet long, capable of sustaining 29 tons. The amount of cable paid out was tallied by a special meter wheel from the *Arcturus*, as well as by a system of ribbons tied around the cable.

The comparatively light electric cable was let out by hand, and attached at intervals of not more than 200 feet to the steel one. This was done at first with brass clamps, but later it was found better to tie the cables together with lengths of rope about a yard in length, since these took up much of the twisting. The winch was stopped while the tie was made.

Two of the three windows are closed by heavy three-inch quartz plates

Several problems were naturally encountered in these operations. Perhaps the greatest trouble was caused by the twisting of the rubber hose about the steel cable. When twisting was bad we would tie up loops every 200 feet in a loose coil, through the center of which the steel cable continued to operate. Finally, however, we succeeded in getting out as much as 2000 feet without twisting.

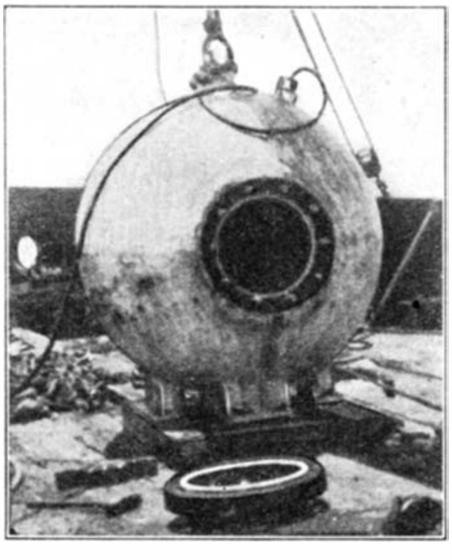
Besides taking observations at great depths in the open ocean, we tried towing the tank along under the vessel, endeavoring to keep the bottom in sight and not to run into any ledges, which rise up quite suddenly in these waters. In this work we nailed a wooden rudder on the rear end of each skid, by which the windows were kept always to the front in the direction of motion. A brace of fish hooks was also attached on a frame outside the window. These proved very sensitive indicators of the currents.

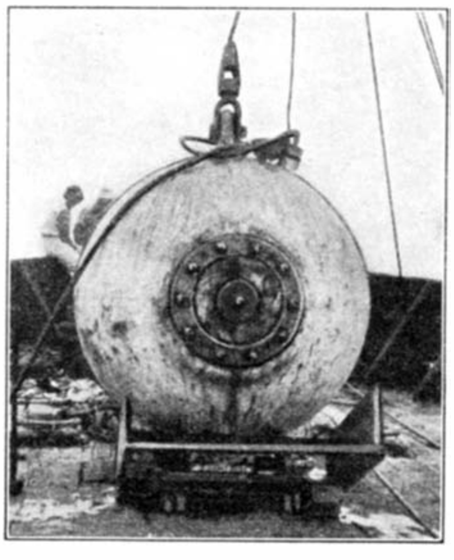


Tangle of steel and electric cables on the first test dive of 2000 feet

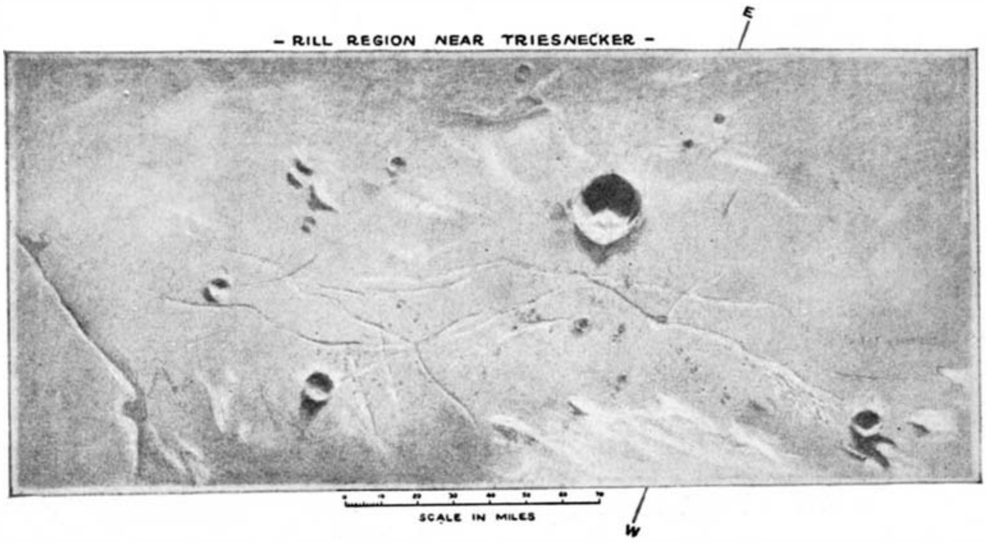
It is with this outfit that we hope next season to study the contours of the bottom down to 500 feet and also to make dives in the open ocean of 2000 feet. The margin of safety seems entirely satisfactory.

Besides the use of the "bathosphere," intensive trawling with meter nets was done, as well as some bottom dredging with the aid of the five-ton *Arcturus* winch. One of the chief objects of the expedition is to determine the continuity of fish life which connects the mid-water zone of one hundred fathoms with that of the ocean's floor two miles down. The expedition has been rendered possible by the generosity of two members of the Society's board, Mr. Harrison Williams and Mr. Mortimer L. Schiff.





After the divers enter the sphere and the four-hundred-pound door is fastened with ten bolts, they are ready to start for "Davy Jones's Locker"



Rill region near the lunar crater called Triesnecker. The drawing extends across about one eighth of the moon's diameter. Lunar "rills" are deep, narrow, crooked depressions, resembling valleys

Moonscapes

A Letter from RUSSELL W. PORTER

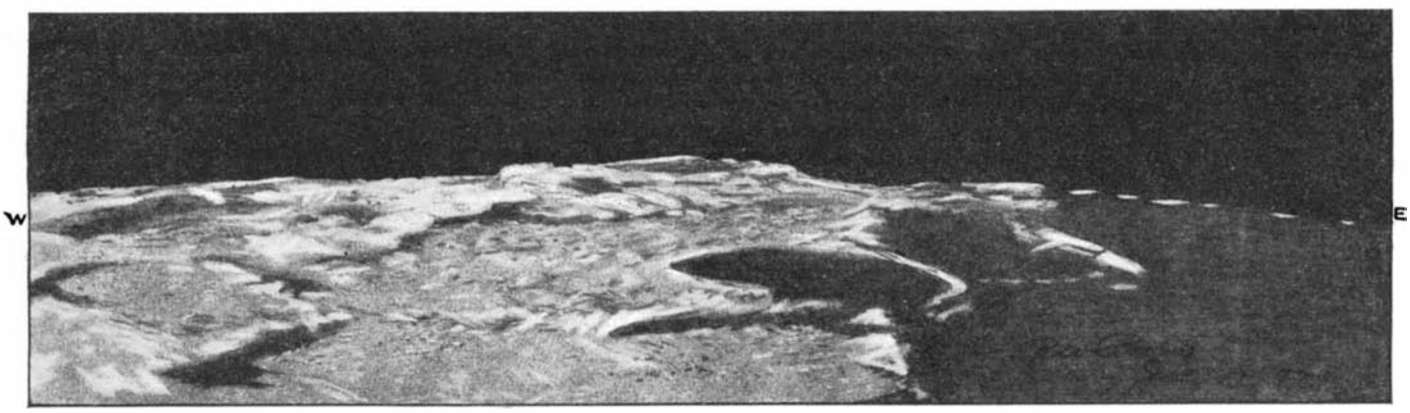
Optical Associate, Jones and Lamson Machine Company; Associate in Optics and Instrument Design, California Institute of Technology; Contributing Editor

ONE of my red letter days came at Mount Wilson when it was suggested by the astronomers that I try my hand at drawing details of the moon's surface—details which are too small to be recorded on photographs. Previous work of this kind, done some years before, together with a facility in using a pencil, made it seem likely that, provided the seeing was good, I would be able to transfer to paper certain lunar objects or markings which would be of value and serve as a kind of standard of seeing.

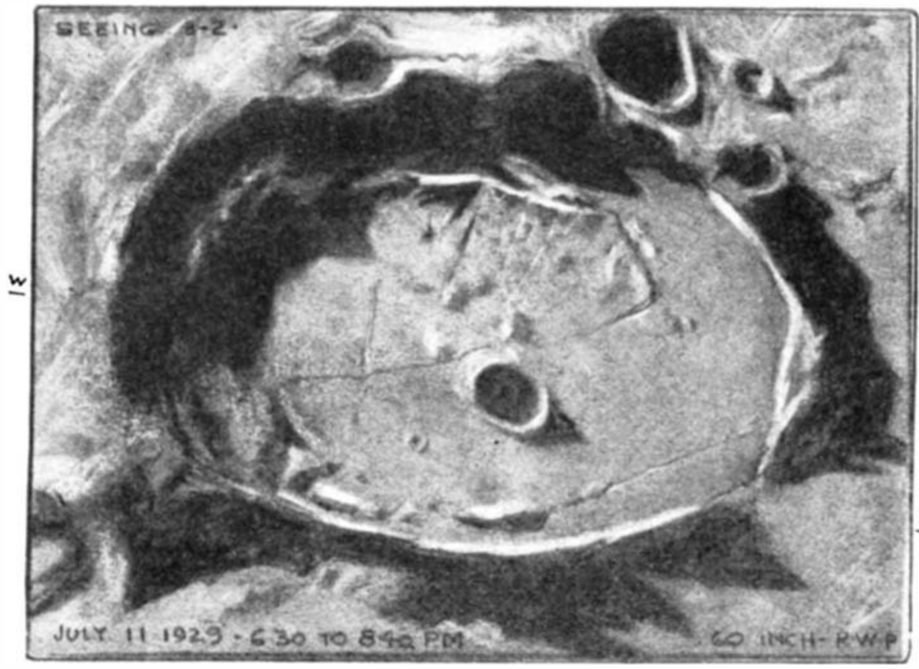
Unfortunately, the nights allocated to me turned out to be accompanied by relatively poor seeing—from 1 to 3 on the familiar Harvard scale of 10. Therefore these three moonscapes have no particular scientific value, but fall into the category of interesting sketches. Nevertheless, the thrill I got at the eyepiece of the 60-inch telescope during the few hours available will live with me for many a day.

The instrument itself, which I first sketched by daylight [see page 248—*Ed.*], is one of the largest of reflectors, and is greatly beloved by the astronomers. To me, as I sketched the monster taking his afternoon nap, bathed in the dim light that filtered through the shutters of the observatory dome, it seemed to possess a certain sort of personified austerity. If the term "noble" can be ascribed to an inanimate object, I would clothe the wholesome design of the 60-inch reflector with the attribute of nobility.

The moon's image was formed at the Cassegrainian focus near the lower end of the telescope tube, and that night was viewed through a low-powered eyepiece. With the help of the mechanician, Mr. Jones, and the night assistant, Mr. Krisler, my drawing board was fastened with clamps and brackets to the right of and near to the eyepiece, and after many trials was adjusted in such a position that it gave the maximum of comfort and convenience for drawing with my right hand while constantly shifting the eye from the eyepiece to the drawing. A



Region around the moon's north pole, showing the craters of Meton and Euctemon. All of the moon's craters are named and thousands of astronomers, professional and amateur, carry the moon's map as vividly in mind as the map of their own city or state. For many years these "selenographers" have concentrated regularly on systematic programs of observation of certain craters and some, notably Professor W. H. Pickering of Jamaica, believe there are small regular changes due not alone to the gradual shifting of lights and shadows. If these changes are objective their cause and nature are unknown. The moon's temperature range recently has been worked out experimentally by the astronomers Pettit and Nicholson of Mount Wilson Observatory. They state that "the temperature rises from that of liquid air at sunrise to the boiling point of water at noon; returns as the sun becomes lower in the lunar sky, and hovers near that of liquid air during the next fortnight"—that is, during the long lunar night. Even in the lunar day the temperature of the craters shown above is only about 60 below the Fahrenheit zero, because these craters lie where the sun's rays barely graze them; that is, near the moon's limb



The crater of Posidonius. Several smaller craters appear near the crater's rim and a system of cracks covers the floor. Note shadow of peak, near center

lamp bulb clamped to the board, and shielded from the eye, illuminated the paper in such a way as to approximate in intensity the brightness of the image of the moon itself. The drawing paper used was prepared beforehand by rubbing upon it the powdered dust of a soft pencil lead, until an even gray tone covered its surface. Areas darker than this medium tone were then filled in at the eyepiece, while the brighter areas were picked out with an eraser.

The first attempt was made when the moon was in the last quarter. The telescope was in use by others until 2 A.M. and the drawing was actually commenced about 3 o'clock. After exploring the moon's surface along the terminator, where the shadows model the lunar features to best advantage, I picked out an area near the crater Triesnecker, traversed by a network of cracks known as "rills."

MY time was all too short, for daylight put a stop to the sketching at 5 o'clock. But in moments of better seeing there came fugitive glimpses of minute detail almost too elusive to catch and record. Thousands of tiny craterlets appeared, quite generally distributed over the plains, down the crater slopes and filling the bottoms of the rills. They could not have been far from the order of a few hundred feet in magnitude. These craterlets seem to be typical of the moon's surface.

The other two drawings were made when the moon was in the first quarter. The seeing conditions here were no better than before, although intervals of steady air revealed the great wealth of fine detail so rarely to be caught. Some time I hope to have the privilege of pursuing them further under better conditions, and finally capturing them.

I have been fortunate—or unfortunate—enough to have spent several years in the north polar regions, within a few hundred miles of the pole. These recent nights with the moon vividly recalled the trackless wastes of arctic snow and ice, because of the similarity of the desolate and dead moonscape to our arctic regions.

Through the eyepiece of the 60-inch telescope the moon seems very near, somewhat as though looking down upon it from an airplane. Recently I have seen the moving pictures of the south polar regions, brought back by Admiral Byrd's Antarctic Expedition, and here again the likeness to parts of the moon's surface was recalled. I refer more particularly to those lunar features called "seas," immense undulating plains, slightly crumpled, with here and there apparent cracks running at random—all under dazzling sunlight.

Not long after my final night with the moon I drove through the monotonous deserts of Arizona. A feature lying some seven miles off the trail to the south caught my eye and the car was brought to an abrupt stop. There, for all the world, was a "moon crater," transported to our own earth. Within an hour we were on its rim, looking down into that hole nearly a mile wide and some 500 feet deep. It was the famed Meteor Crater, its origin attributed by astronomers to impact from some celestial wanderer. While I do not advocate the impact theory of lunar craters, a startling likeness to them became apparent when I first saw the profile of Meteor Crater looming out of the desert haze.

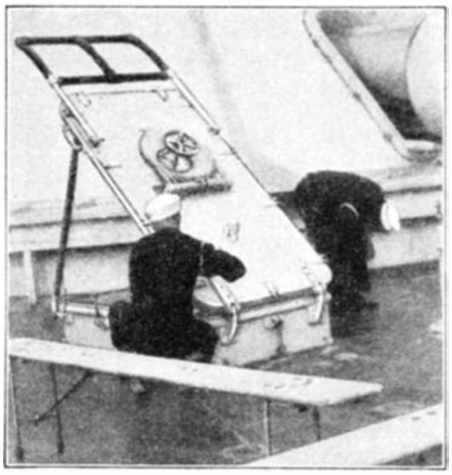
Meteor Crater, Arizona, which resembles some of the lunar craters. Professor Henry Norris Russell says: "The evidence appears very strong that this crater has been produced within modern times, geologically speaking, by the impact of a great mass of meteoric material . . ." (Russell, Dugan and Stewart's Astronomy). This also is the point of view of virtually all men of science. On the other hand the majority of astronomers lean, tentatively, toward the volcanic theory of the lunar craters, while a minority hold the meteoric bombardment theory. There is much to be said on both sides. The argument is summarized by Professor Charles P. Olivier in his work entitled "Meteors." He points out that the strongest argument for the meteoric hypothesis of lunar craters is the great difficulties which confront the volcanic hypothesis. The fact that many of the craters overlap, strongly suggests their meteoric origin. On the other hand, the distribution of the craters ought to be fairly uniform if they are of meteoric origin, and it is not uniform. Acres of ink have been spilled in astronomical journals but the question still may be considered wide open. A committee of astronomers and geologists is studing it

Friday: With holystones, plenty of water, and a lot of elbow grease, the sailors aboard a battleship, in bare feet or boots, scrub down the decks in preparation for the Saturday inspection

Housekeeping Aboard a Battleship

By JOHN DONALD THOMPSON
Chief Boatswain, U. S. S. West Virginia

TO the casual observer, housekeeping on board one of Uncle Sam's battleships should be one of the so-called cinches of the world. That an oil-burning ship would get dirty when out on the high sea where no dirt can be tracked or blown in from the land to the decks and into the thousands of places where the good housewife has learned to look, would seem to be just one of those things that could never happen; but such is not the case. It would seem that it must be one of the tasks of life that had been made easy by nature—no dust, no mud, nothing very much of anything that is at once apparent to the untrained eye.



Every little crack and crevice aboard must be thoroughly clean

A FEW years ago while crossing the continent on the *Olympian*, I was surprised and somewhat amused to hear the subject of the cleanliness of a battleship brought up and discussed most thoroughly by two men who had recently visited on board one of Uncle Sam's best—which is, by the way, still the best at this writing—although I was not a member of its crew at that time.

The ship had interested them very much, and from their conversation I gathered that there was not one tiny speck of dirt on the ship. I, too, became interested as well as puzzled, for that was my job on another one of Uncle Sam's battleships, although it was rather an old one.

While I sat there listening in, I felt like the fox that lay hidden in the brush listening to the two hunters as they discussed the best way to catch a fox. I had been for years trying to keep a battleship clean and am still trying, so, as I sat there listening in, the thought came to me that I would like to tell them something about it and how it was hardly possible to do the things that had so impressed them. But fortunately I kept quiet and the porter, a man wise in the ways of dirt, politely came to the rescue.

"Boss," inquired the porter, "Does yo'all know jes 'bout where dirt is? Jes lots times dey is jes plenty dirt, 'cept you ain't jes know where 'bouts ter look." All said and done, that is the truth.

No matter how much you try, there is always some dirt left. You can wash down and squilgee down the decks most carefully and as soon as the deck is dry, you can sweep down and still get dirt. It can be hidden from the casual observer, and, I sometimes think, from women too, but I have my doubts about the old time skippers. It seems that they find it everywhere—yet we fool them too!

We have a squad—an unofficial squad—with a certain duty to perform. It is this: when the ship has been cleaned up for inspection and as the inspecting party comes along, it is the duty of this squad to cart all the cans of dirt, dirty swabs, brooms, and, in fact, anything that it has been impossible to get rid of, across the deck; then to keep a bright lookout and cart it back as the inspecting or visiting party comes along on the other side of the deck. In effect the result is the

When taking on supplies, a great deal of dirt is dropped on deck from boxes and bags same, but, knowing that the seniors have at one time been juniors, I very much doubt whether the seniors are deceived. But it just has to be done. After the inspection is over, the dirt is put back where it belongs and if you look closely, you will find it. It can not be thrown overboard and on an inspection morning the incinerator just can not burn it all.

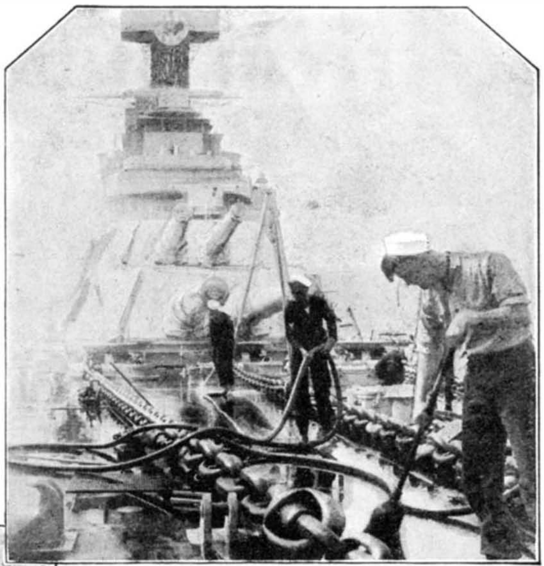
It seems that I have had the job of keeping a ship clean for a long time; even before that I had some part of it to look after. I have had battleships for over four years and I know the job fairly well—just fairly well at that.

A few months ago a woman from the middle west came up to me and asked how a ship could be kept so clean. I felt inclined to talk to her and tell her something about it. Usually I duck out of this if I can, but she explained that she was from an inland state where such a thing as a ship had never been and wanted me to tell her how it was done. After I had talked with her for awhile, she became enthused; she thought I should write it up for others to read. It seems a very dull thing to write about—especially after having just published an article about battleships and not one word about dirt.

BATTLESHIPS do get dirty! They have to be gone over most thoroughly each week from stem to stern and from keel to truck. Beside this, many men are engaged in cleaning up very nearly all the time. In a way a ship reminds me of a baby. You clean and polish him up most thoroughly and you dress him up in spotless linens and then you put him down on the floor. If it so happens that you burn coal and have a scuttle full in the house anywhere, that is where you will find him all smudged up with coal. When you get your ship all dolled up, if you happen to be a coal burner, you will then coal ship. If you happen to burn oil it may be lots worse; you may get a cloud of oil half way up the boat deck when a line carries away.

Then we always have the recruit. You watch him. As he walks along the deck he exudes dirt. First he surreptitiously drops a cigarette butt on deck against a stanchion; 10 feet farther on he drops a candy wrapper; after a few moments he shakes out his pockets. After this he starts in to collect more odds and ends which he tries to distribute about the decks with impartiality. He doesn't mean any harm.

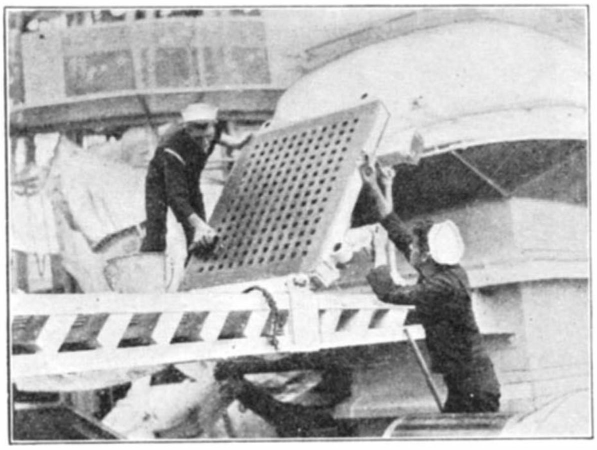
One man is chipping a bit of rusty paint-work when one of the aviators turns on the engine of a 200 horsepower motor—the "prop" does the rest. The rust goes far and wide while the ever-moving feet of hundreds of men pick it up and mix it with grease from half a hundred different places while the finely ground dust from the hardwood decks swirls about and collects on the paint work, mixed with the sulfur-soot that comes out from the stacks in clouds when the tubes in the great oil-burning boilers are blown.



The anchor, coming up from Davy Jones' locker, brings up mud from the bottom. The anchor and its chain must be scrubbed clean

The human element is comparable with the mechanical. One of the greatest causes of troublesome dirt is the endless preparation and serving of food. Again the recruit, of whom a large percent of the crew is composed, drops his food far and wide. After a meal, the decks look as if they had never been cleaned up. But as the sailor makes the dirt, he also has to clean it up, so for an hour after meals you see him cleaning up. The dirt he picks up is dumped in the slop box if at anchor, or overboard through the slop chute if under weigh.

It is a curious thing, but the slop box has a name all out of keeping with its real contents. It is called the "honey box"! It holds around 1600 pounds and is filled, much more than filled, each day. It is no small matter to get rid of the refuse in the honey box of a large ship. A great many times it has to be loaded on one of the work-boats and carried out to sea and dumped, otherwise bathing beaches might suffer if located in the near vicinity, not to mention the breaking of harbor regulations that prohibit throwing refuse overboard.



When coming in from a long sea trip, the gangways are cleaned before going over the side

It is an art to keep the vicinity of the honey box clean; I never have for any length of time. Five minutes after everything has been cleaned up, along comes more slop, and there you are.

A BATTLESHIP—any ship—uses much food. Each month we take on about 100 tons on a certain day that is set aside for that purpose. A list of these stores reads like an inventory of a wholesale grocer's combined with a meat packing plant. Each and every box, crate, bag, or frozen piece of meat that comes on board brings its full quota of dirt.

We usually finish taking on stores by noon; then, if my friend from that inland state could see us, she would hastily depart and her report to the folk back home would do us very little good. However, we do not take visitors on board during that time, except in rare and urgent cases.

When the ship is got under weigh, the huge links of the chain leave the bottom where they are deeply imbedded in mud and bring some of it up with them, as do the great 10-ton anchors. The chain is washed off with fire hose under pressure, but, mud gets in just the same. I handle the anchors and when I leave the fo'c'sle, it is usually a messy, muddy place: mud, dirty water, and torn up paint work. The boys then go to work and clean it all up again. We average around a

Target practice with the big guns means another cleaning job—and a big one at that. Here sailors are seen scrubbing muzzles, barrels, and turrets of guns after firing

hundred of these evolutions each year.

We go out on the target range and after much practice, the actual firing takes place. After firing half a dozen salvos from a battery of eight 16-inch rifles, the ship is all dirty again—and this time she *is* dirty. Not only that, but everything breakable is broken from the concussion, which now brings us around to the seemingly ever-lasting task of cleaning up once more.

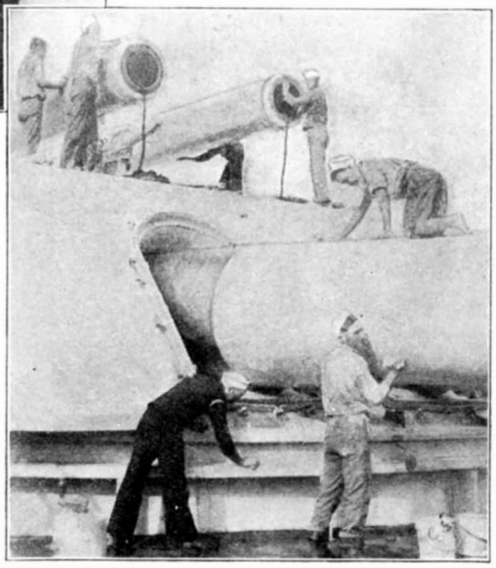
It is said that there is never a time when someone is not painting something on board a battleship. I think

Someone is always busy painting somewhere aboard a battleship

this is so on any ship. It is painted and very soon it is scrubbed off—and then painted again. Thus the battle against dirt goes on day after day.

The ship is so large that one man, even in a supervisory capacity, could do very little with it, so the ship is divided into many parts and even these parts are again sub-divided among the men who belong to that part of the ship. Each man then has a very definite part to play in the morning watch when the decks are wet down and the scrubbing begins. Some are detailed to scrub the decks, some scrub paintwork, while still others scrub canvas and look after boats and the endless pieces of gear that go to make a big ship comfortable as well as efficient. Someone is detailed to look after everything.

The amount of soap, soap powder, scrubbers, polish, and other equipment that I serve out on a certain day each week looks like the beginning of



hostilities on cleaning gear. I have a weekly issue of cleaning gear, a monthly issue, and also a quarterly issue. One can easily see that soap would be issued weekly; scrubbers and such, monthly; while some items like scrubber handles and scrapers would last for the quarter. However, there is an endless demand for all sorts of gear, no matter how much is served out. It is very little trouble to keep the ship looking pretty and nice if you can get enough cleaning gear and paint.

One issue of cleaning gear is made on Thursday. This is for general cleaning and is made on that day because the following day is Friday which with us is "Field Day"; that means that insofar as possible the day is given over to cleaning and tidying up the ship for captain's inspection, which comes on Saturday forenoon.

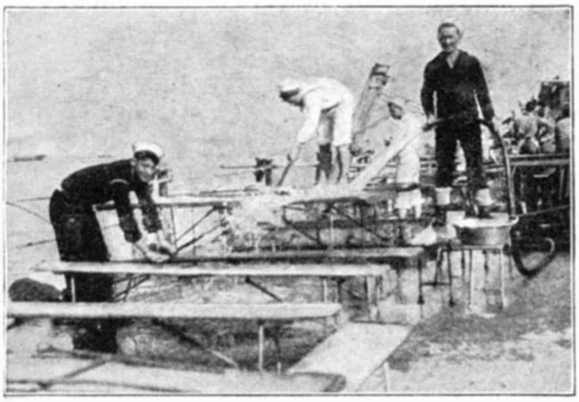
On that day the boys are given 450 pounds of soap; 144 boxes of soap powder; 100 cans of metal polish; 200 sheets of emery cloth; 100 pounds of rags, and a like amount of cotton waste; 50 pounds of air-slaked lime; and one ton of sand! At six o'clock the next morning the boys turn to and spend the entire morning and part of the afternoon in the rather pleasant task of cleaning ship. We still use the holystone on the decks, but I do not believe the boys like that any too well.

There are a good many things about cleaning a ship and keeping it clean without ruining other things as you go along. For example, if you scrub canvas or expensive fire hose while there is sand on the deck, the fabric will very soon be cut to pieces, yet it requires constant supervision to prevent this. One man will be painting aloft; almost invariably if not cautioned, he will spill much of it on the decks below. All of this has to be painfully scraped off. Every spot on the deck—and in the course of a week there are thousands—has to be removed. Lime is used to paint grease spots with good effect, but to complete the job the deck has to be gone over with sand and a holystone.

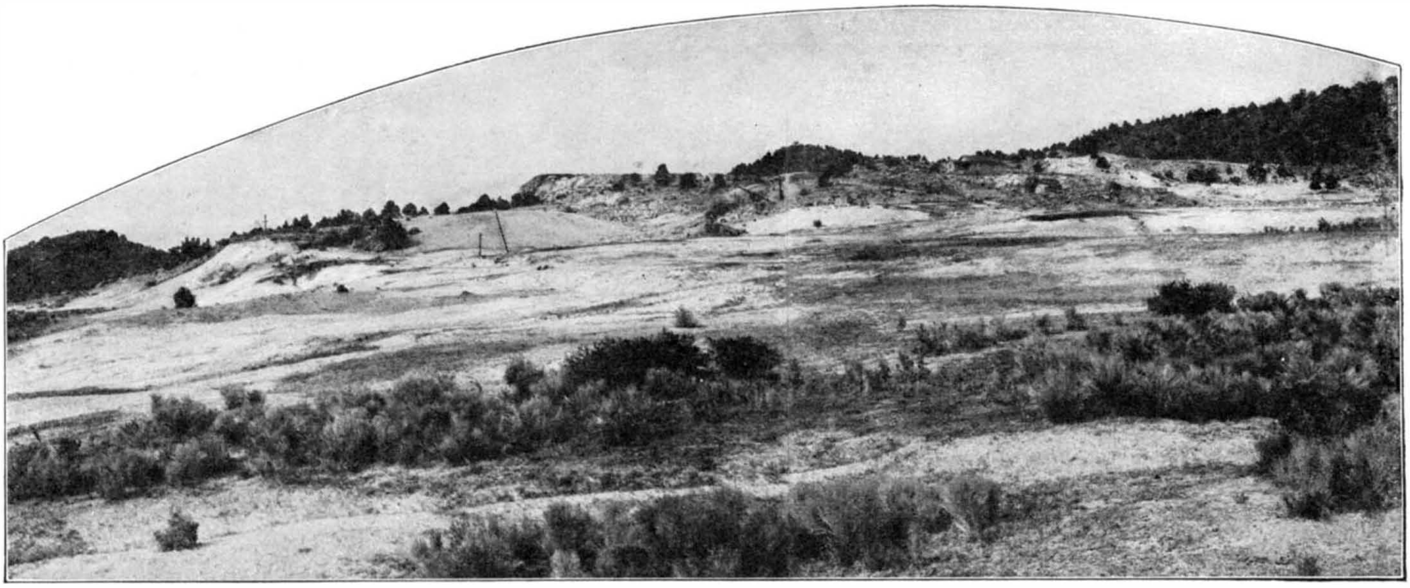
The modern appliances are great inventions, yet each one adds just so much dirt to a ship. The airplane, for example, one would say, surely could bring no dirt! But such is not the case. It is one of the worst offenders. It spatters oil and grease far and wide. Then, due to the fact that to operate the catapults all the stanchions have to come down, much paint work is torn up. This brings not only paint chippings but rust as well.

The ships' boats looking so trim and neat that you see running between the ship and the shore: surely they can bring no dirt. Once again you are wrong, for when I hoist them in—and that is another job I have—they just drip crude oil. After they are hoisted in, kerosene is used by the bucketful to wipe off the sides. Later, the small barnacles are scraped off and some of this is tracked to all parts of the ship.

ON Saturday morning after inspection, usually the ship is open to visitors and they come by the score from every state in the union. The ship is found to be so clean that one is led to believe that it just came that way—probably out of a band-box. Now when I go home—but I guess I'd better not tell anything about that.



Mess benches and tables are brought upon deck, scrubbed, and rinsed with salt water

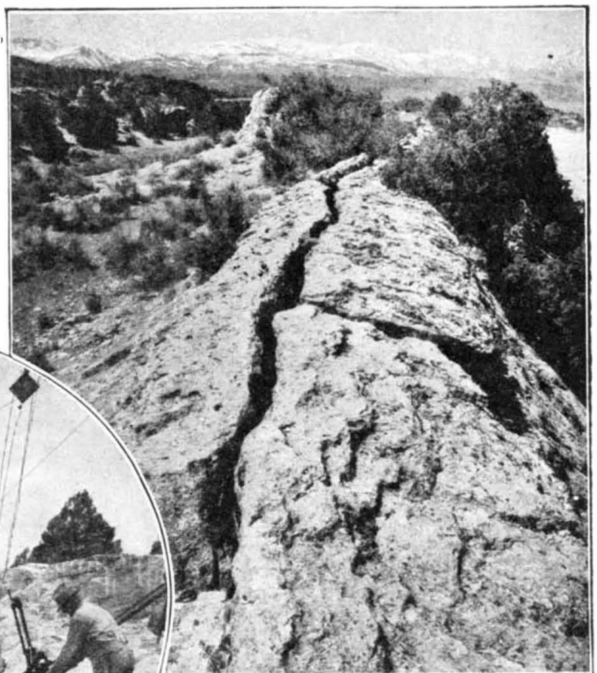


A great hill of travertine formed by the flow of hot mineral water

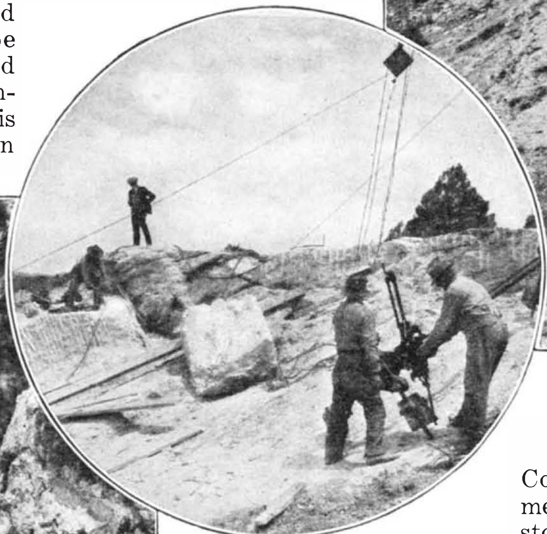
Stone From Hot Mineral Springs

ONE of the oldest building stones with which we are acquainted is travertine. The name is derived from Tivoli, near Rome, where much of Rome's building stone was obtained. Many of the well-known buildings of antiquity were built of travertine faced with marble. Its employment largely depended upon its softness and excellent wearing qualities. Travertine is found as a deposit of calcium carbonate from hot springs, although there is also a silicous type. The cavities which add so much to the beauty of the stone are partly due to the decay of mosses and other vegetable matter.

In 1854 miners prospecting for gold in Mono County, California, found a deposit of stone they called "moss agate" and later it was called marble. It was afterward found to be travertine and the earthquake and fire in San Francisco in 1906 demonstrated the sterling qualities of this building material. The deposit in Mono County is being developed by the California Red Travertine Company of Los Angeles. Modern methods of quarrying are used. The stone when first taken out saws freely and takes a high polish. Some of the stone varies from clear white to gray, cream, and pale yellow. In other sections where the ascending waters have passed through a deposit of metallic oxides, the stone is handsomely banded with other colors. The red travertine is especially beautiful. The designs are largely dependent on the lichens which have grown up along the borders of spring pools and which have been replaced by stone in the course of time.



Photos courtesy Californians, Inc.



Upper Right: **The water from hot springs has caused a great crack in one of the ridges of travertine in Mono County, California.** ***Circle:*** **Some ivory-toned stone of the Roman type being quarried.** ***Left:*** **A travertine deposit from which much stone has already been cut. Waters of the hot mineral springs still bubble through crevices. The color of travertine varies from white to very dark red**

Can We Signal to the Planets?

By JOHN THOMSON, M.A., B.Sc., Ph.D.
Lecturer in Physics in the University of Reading, England

FROM time to time during the last 50 years suggestions have been made for sending a message to a neighboring planet. In general these suggestions have been scientifically worthless, but for all that the possibility merits consideration. At the lowest estimate a general airing of the question seems to be required, while an accurate statement of the problem and its difficulties is the first step towards any attack which may be made upon it.

The question divides itself naturally into three parts. First, can we send a signal through space so that it may be detected on a companion world? Second, in the event of our being able to do so, is there any possibility of the signal being received and understood? Third, having regard to our answers to the previous questions, what signal would we send?

TO illustrate the difficulties involved, let us consider the possibility of utilizing some form of televisor. In the May "Discovery," (London) mention was made of this means of signaling, and the conclusion rightly reached was that "the prospects of finding planetary neighbors equipped with the necessary apparatus are remote." The complete televisor consists of a transmitter and receiver. The signal propagated through space is, of course, an electro-magnetic disturbance, but this disturbance is obtained at the transmitter from light signals by a series of ingenious energy transformations. Similarly, the receiver, working on the same wavelength, must be able to transform back the electro-magnetic impulse into light signals. Such a process is very complicated and presupposes a vast amount of technical apparatus. But, as will be shown later, in communicating with another planet it is not permissable to assume the existence of any equipment similar to that which we use. The best we can hope for is that our planetary neighbors are aware of the existence of the electro-magnetic spectrum and possess some means of detecting electro-magnetic impulses.

There is another objection to visual signaling, of an even more fundamental nature. It is probable that the possible inhabitants of another planet react in some way to light signals; this appears to be a necessity for intelligent life. To suppose, however, that this reaction corresponds to our own visual sensations is pure speculation. Assuming that a television receiver existed on the planet under consideration, the picture formed on the screen would in all probability convey nothing to the inhabitants. Hence a scientific approach to the problem demands a form of signal much simpler and more fundamental.

Courtesy American Museum of Natural History

Mars as seen from its outer satellite Deimos. A painting by the astronomical artist Howard Russell Butler. Based on composite evidence.

Since we are attempting to communicate from the earth to another planet, and between them no material medium exists, it is at once evident that we must utilize as our signal some form of radiation which is transmitted by a vacuum. This is practically equivalent to saying that we must use some part of the electro-magnetic spectrum. But even a casual examination of the problem is sufficient to indicate that our choice of such radiation is extremely limited.

The mere fact that the solid earth is surrounded by an atmosphere capable of absorbing all radiation to a greater or lesser degree makes our choice a difficult one, while the problem of producing radiation of intensity sufficient to be detected some millions of miles away so far adds to this difficulty that we shall be fortunate to find any type of signal suitable for our purpose. Atmospheric absorption immediately rules out of consideration radiation of short wavelength, since X rays and ultra-violet rays are strongly absorbed by gases. Light and heat radiation do not suffer in this way, but these, as we shall see, are useless for a very different reason. Hertzian waves have been carefully studied in recent years so far as their propagation around the earth is concerned, and it is to such radiation that we must look most hopefully.

FIGURE 1 indicates the relative positions of the earth, Venus, Mars, and the sun when conditions would apparently be most favorable for communication between the three planets. The figure corresponds to what is known as an "opposition" of Mars and an "inferior conjunction" of Venus. It is at such an epoch that these two planets are nearest to the earth. Mars is then on the meridian approximately at midnight, while Venus is (along with the sun) on the meridian at midday. It is instructive to notice that under these conditions the appearance of Venus from the earth is similar to the appearance of the earth from Mars, while the appearance of Mars from the earth is similar to the appearance of the earth from Venus. It is useful to realize the point of view of the possible recipients of our signal.

Now we can not hope in signaling to compete with the sun. If the sun is sending out radiation similar to the one we might choose, then our signal will go undetected. A consideration of Figure 1 will make this perfectly clear. But the sun is continually radiating light and heat, and therefore these signals, as has been stated, may be left out of consideration.

It is obvious then that our attention must be limited to a consideration of Hertzian waves, the type of radiation propagated from a broadcasting station. At the very outset, however, we meet with a serious difficulty. Various writers on wireless communication have described it as "signaling through space," and so far as space is interplanetary, this is just what a broadcasting station does not do. One of the chief reasons why Hertzian waves have become an important means of communication over long distances is that the transmitted signals are confined to a comparatively narrow layer of space in the immediate vicinity of the earth. The signals broadcast do not spread out in all directions; they travel around the earth, practically never rising beyond the limits of the atmosphere.

FIGURE 2 gives a rough representation of the path of a "wireless" ray from a radio transmitter T. The ray may move upward toward a layer of ionized gas known as the "Heaviside layer," but there it is bent downward again toward the earth. A straight beam from the transmitter parallel to the horizon is indicated by the dotted line. It will be seen that the latter could not possibly be detected at any distance from the station, as it would be lost in the upper atmosphere.

This bending of Hertzian waves due to refraction (or possibly in some cases to reflection) is of inestimable value in wireless signaling, and accounts for the remarkably long distances traversed by waves over the surface of the earth, but from the point of view of interplanetary communication the Heaviside layer is an unmitigated nuisance, cutting us off, as it does, from outer space. All Hertzian waves are not, however, equally affected in this way, the bending of the ray varying considerably with its wavelength, and hence it may be possible to find some band of waves which may escape to outer space. Recent experiments appear to suggest that short waves are less bent than long waves, and this is in agreement with the most important theory of the effect. It is probably impossible to produce Hertzian radiation which will traverse the atmosphere in an even approximately straight line, but if the wavelength is sufficiently short, there is a reasonable expectation that the deviation of the ray will be comparatively unimportant. Such radiation has a wavelength of less than ten meters.

Attacking the problem from another point of view, an alternative solution is indicated. Theoretically the use of waves of length greater than 10,000 meters should also obviate absorption and refraction in a layer of ionized gas.

Two possible bands of radiation would therefore appear to be suitable for the penetration of the earth's atmosphere, and we have now to determine which band is more suitable for our purpose in other ways. The question of the intensity of the signal decides, as we shall see, in favor of the short waves. Incidentally, it is useful to note, before we leave this part of the subject, that any radiation which can penetrate our atmosphere will be suitable to penetrate the atmosphere of the receiving planet.

We have said that it is preferable to use a radiation of short wavelength. This arises from the fact that in any attempt to signal over a distance of millions of miles some form of beam is necessary, since, if the radiation were distributed uniformly in all directions a negligible fraction would reach the planet. Now the concentration of Hertzian waves in the form of a beam necessitates the use of a reasonably short wavelength in order that the focusing may be efficient. Hence this is sufficient to decide between the rival claims put forward above.

Having decided on the type of radiation to be used, all that remains is to ask whether a signal of intensity sufficient to be detected can be sent. The answer to this question must necessarily be speculative, for, in the first place, we are not acquainted with any receiving apparatus which the other planet may possess. The signal emitted by our transmitter will suffer attenuation because of two factors. First, the spreading of the beam will decrease its energy per unit area. Secondly, the atmosphere of the earth and the other planet will be the cause of a certain amount of absorption. The spreading of the beam is an unfortunate necessity. By modern methods the pencil of rays could be made very fine indeed, and spreading (except that due to dispersion) could be avoided. But our aim at the planet can not but be very rough, and hence a very fine beam would be almost sure to be lost in space. In Figure 1 a pencil of rays is drawn from the earth to Mars. The pencil shown diverges much more than would be necessary, but in any case its cross-sectional area on arriving at the orbit of the outer planet would require to be at least 1,000,000,000 square miles, in order that there should be a reasonable probability of the planet coming within it.

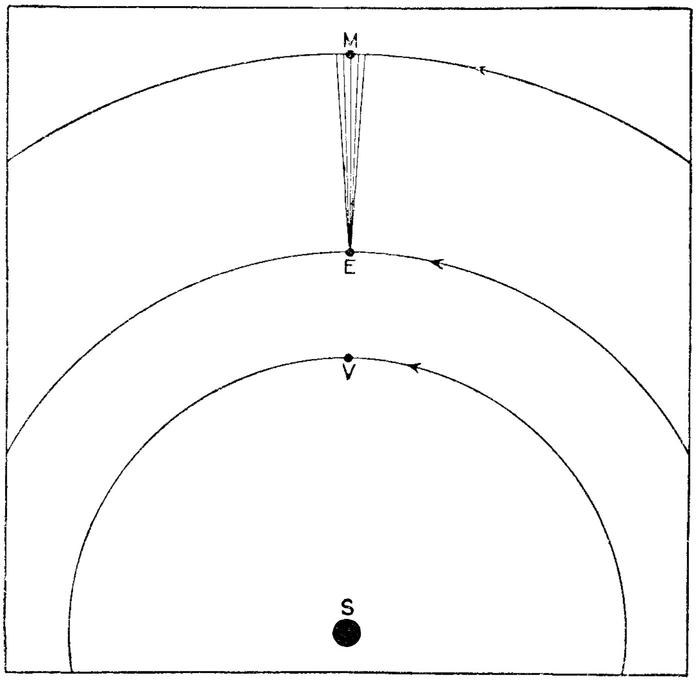


Figure 1: **Optimum conditions for interplanetary signaling between Mars (M), the earth (E), and Venus (V), when all three approach nearest together**

THE sending of a very powerful short-wave signal is not, however, a very serious matter. Even assuming that the requisite intensity could not be obtained at our present stage of development, the problem is merely one of technique. The wireless engineers are quite capable of producing as intense a beam as we may require when the need for it should arise. The directing of the beam, making allowance for refraction in the upper atmosphere, would be much more difficult.

Assuming then that we are able to send a signal, what can be said of the probability of its being received? Many writers have discussed the possibility of there being intelligent life on other planets, but it must be borne in mind that the whole subject is purely speculative. It does not follow, however, that our speculations are irrational or idle. The modern physicist deals largely and with great success in probabilities.

From a philosophic standpoint it appears improbable that the earth is the only planet in the solar system which is the abode of intelligent life. Apart from all biological considerations, this makes an appeal to our philosophic instincts; anything else would savour of (Ptolemaic) egoism. Moreover, it is utterly impossible to argue that the other planets are unsuited for intelligent life, as has been done so often. Such an argument is founded on the assumption that protoplasm is an ultimate essential of life, while there is nothing to show that it is not the essential of life modified by terrestrial conditions. Even assuming that Martian or Venusian protoplasm would be identical with the terrestrial substance, there is still no sufficient evidence to state that life is impossible on these planets, and, where life is possible, intelligent life is probable.

A more important and less speculative question is whether the intelligent life on another planet would be able to detect and understand the significance of a Hertzian wave signal. We must not transfer our own form of intelligence to Mars or Venus, and assume that natural science has been "studied" by intelligences there. We must remember that intelligent beings existed on the earth for some considerable time before any violent interest was taken by them in the phenomena of nature. However, if we assume on the part of these other beings a speculative and experimental interest in the material universe, then we may legitimately hope for some means of detection of short Hertzian waves.

AFTER all, the mechanism of the universe is not terrestrial, and whatever we may think of our conception of Hertzian waves, the waves themselves are common to all space. The reactions of intelligent life on Venus or Mars to material things must necessarily be different from ours, but the reactions must exist, and they will be reactions to phenomena similar to those we experience.

Obviously, of course, the Martian observer will not "listen-in" by means of the mechanism which we employ, and equally obviously the connotation he may give to the signal is beyond our comprehension. At the very best the evolution of an intelligent life on Mars will have followed quite different lines from our own. The accidents of environment will have produced mental processes of which we can know nothing. Indeed, our very terminology with regard to possible inhabitants of another planet will have a wider meaning than the one which we usually assign to it. How far are we justified, for example, in speaking of the "mental processes" of such beings? Yet it must again be urged that the Martian reactions will be reactions towards phenomena similar to those which we experience.

Finally, we must consider what signal we are to send. Here we encounter difficulties quite different from those already discussed. Speaking generally, our message must abstract from human thought and endeavor something which we consider might be recognized as a message from terrestrial intelligence. It would be useless, for example, sending a message in the English language to a French savant, no matter how intelligent he might be, if he did not understand our tongue.

The only ray of hope is our belief that abstract scientific conceptions have a universal foundation in nature. The earth is the third planet in the solar system. No matter how the non-terrestrial intelligence acts, a sequence of three impulses must convey some notion of the number three. Therefore it might be suggested that a beginning should be made in our communication by sending a systematic series of three distinct impulses. We can form no conception of how the Martian inhabitant thinks "three," but it appears probable that our signal would be of a sufficiently fundamental type to cause the requisite mental reaction. If on any occasion it was discovered that signals on the same wavelength were being received consisting of four impulses, we might have some reason to believe that an answer to our signal was being transmitted from Mars. We might, under these circumstances, describe "three" and "four" as the interplanetary call signs.

It may be objected that the suggested message is too simple, and that surely another, conveying more intelligence, could be devised. An eminent astronomer, discussing the possibility of life on the moon, once suggested a signal to our satellite, taking the form of a drawing on the surface of the earth of the requisite dimensions of a right-angled triangle. He argued that this triangle, being of fundamental importance in geometry, would indicate to the possible inhabitants of the moon the existence of intelligent life on the earth. Leaving out of account the fact that Euclidean geometry is but a first approximation to the geometry of real space, did the astronomer not credit the Lunar intelligence with too terrestrial an origin? To imagine that the right-angled triangle, itself a mathematical abstraction, is common to all space, is surely like blaming an Englishman for not speaking Chinese! No! So far as interplanetary communication is concerned, we are strictly limited in our messages to signals of universal nature.

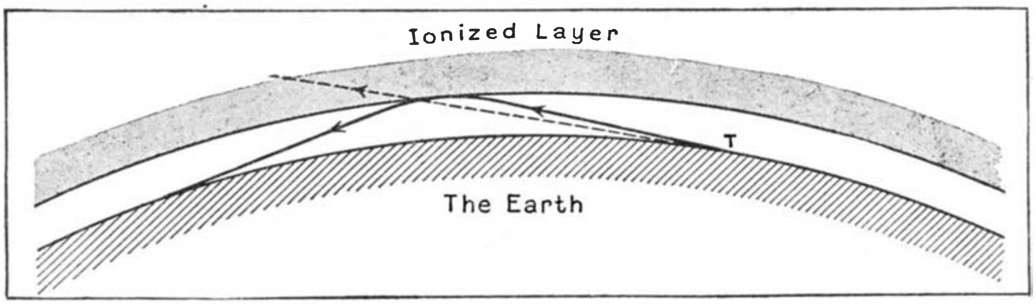


Figure 2: **The solid line indicates the path of a reflected radio wave from a transmitter located at T. A beam parallel to the horizon is shown by the dotted line**

Now that we have considered the various aspects of the problem, we ought to be in a position to say whether the possibility of communicating with our neighboring planets comes into the realm of practical experiment. With regard to our means of sending a message, we have seen that we can hardly be sure that we possess the necessary equipment for making the attempt. On the other hand, researches at present in progress on the electrical structure of the upper atmosphere ought to provide the knowledge of refraction and absorption of short Hertzian waves which we require.

ASSUMING that we can send the signal, whether it will be received or not is a matter of speculation, but we can at least be certain that there is no *a priori* reason why it should not. In any case, the only messages which we can send with a reasonable expectation of their conveying the impression of being signals from the earth are of a very simple and uninteresting nature. Yet the possibility can not be dismissed as a scientific fancy. It lies on that borderline of the practicable which so many of our most important inventions and discoveries have but recently crossed.

¶ *An interesting Hertzian wave phenomenon was reported in 1928 by the Norwegian physicist Stormer. The radio echo around the earth is a commonplace and requires one seventh of a second, but new echoes, delayed 3 to 15 full seconds, were heard. Possible explanations were: the retardation of velocity either in the Heaviside layer or in the earth; or the reflection of the waves from the moon, from the region of the zodiacal light, or from another and a more distant "Heaviside layer."*—THE EDITOR.

Scientific Criminology

How Bullets and Firearms Are Matched for Identification

By STANLEY F. GORMAN

Lecturer on Bullet and Firearm Identification, Police College, City of New York

The author at work with the comparison microscope examining bullets in the holders

THE most important types of cases a detective has to deal with are homicides, suspicious suicides by means of firearms, suspicious accidental shootings, and assaults by means of firearms during the commission of a crime.

We are all familiar with the fact that, since the war and prohibition, there have been more homicides committed throughout the country by means of firearms than ever before, and it is usual that attempts are made to mislead the detective, either by the perpetrator or witnesses or both, as to the truth regarding the occurrence. It is his duty, however, to obtain facts, present them properly and intelligently, and also to be able to furnish proof of guilt or innocence.

Since the establishment of the New York City Police College by Ex-Police Commissioner Grover A. Whalen, Deputy Chief Inspector John J. O'Connell, the Dean of the Institution, has included a course of instruction in the scientific identification of firearms, shells, and bullets, which, today, is as important as the study of fingerprints. The results of this method of identification are definite and conclusive.

At the scene of a homicide, a suspicious suicide, or an accident where a firearm has been used, the detective is interested in the perpetrator, the witnesses, the surrounding circumstances, finger prints, the fatal bullet, the suspected weapon, and the discharged shell or shells found at the scene of the crime.

It is obvious, of course, that unless a suspected firearm is found, no comparison can be conducted except as pertains to the ammunition. However, with the suspected arm located and the fatal bullet recovered, a comparison microscopic examination and test can be conducted. The results obtained will prove whether or not the fatal bullet issued from the suspected weapon. It must be realized, however, that no identification is possible if the bullet, while passing through the body, comes in contact with bones that cause cuts, grooves, furrows, and so forth, on it, distorting it so completely as to destroy minute important characteristic marks. On the other hand, even if considerable distortion is so caused, but a small side area remains unmutilated, identification can be made. This same condition applies to a bullet which has passed through the victim and has come in contact thereafter with some surface hard enough to mushroom it completely, leaving no portion of the side available for study. If the bullet simply ricochets, however, and only a portion of its surface is flattened or distorted, there will remain sufficient area by which a comparison may be made.

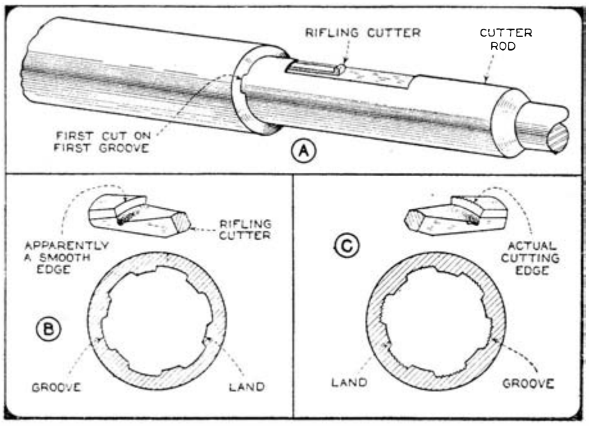
Guns of gangland. ***Top:*** **A Thompson sub-machine gun.** ***Center:*** **A sawed-off shotgun.** ***Bottom:*** **An automatic pistol equipped with a highly effective silencer**

In order to make clear the fundamental principles by which the expert in firearm identification is guided, it will be necessary first to explain in brief the process of gun-barrel manufacture. Here are born the tell-tale marks that are subsequently imprinted on the bullet when it passes through the gun barrel at the time of discharge. These minute marks give to each gun barrel a personality all its own.

In the manufacture of revolver, pistol, and rifle barrels, the first process is stamping out, by the drop-forge system, the gun-barrel "blank," cut off at the desired length. This "blank" is then bored lengthwise with a drill and finished to the proper size with a series of cutters and reamers. The resulting surface is known as the bore.

THE next manufacturing step is to create what is known as the rifling. This is a series of spiral grooves cut in the surface of the bore from end to end of the barrel. These grooves cause the bullet to spin around its longitudinal axis when fired from the gun. This rotating moment serves to make the bullet stable, so that while in flight it will travel nose first. The grooves grip the bullet at the instant of discharge and spin it as the cord spins a top. Just as the top is rendered stable by its spinning action, so is the bullet. In the latter case, however, a forward movement is imparted simultaneously with the start of the spin.

After these grooves have been cut, those sections of the original bore surface that remain between them are known as the lands. The manufacturers, because of their own patterns for this work, will be found to produce arms which differ in widths of lands and grooves. Some have narrow lands and wide grooves, some the opposite, and some have them equal. It will therefore be found that, in guns of a given make, the patterns of land and groove marks made on bullets fired through them will always be the same, and the same marks or patterns will not occur on a bullet fired from a weapon of any other make. In this way we are able to determine, by examination of a fired bullet, the make and type of arm from which it issued. It should be noted here that the lands or high parts of the bore, cut grooves or low marks on the bullet as it passes through. Thus, on a fired bullet, the low marks are made by the lands, while the high marks or rifling pattern are left by the grooves.



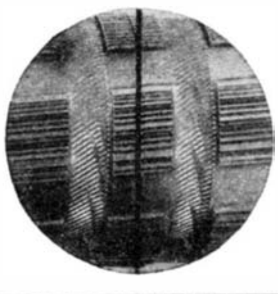
A: **A rifling cutter starting on the second groove. *B:* How the rifling cutter and rifling should look. *C:* How they are in actuality. All these drawings are exaggerated for clarity**

Every manufacturer or ballistic engineer has his own pattern and formula for the depth and width of the rifling, as well as for the rate or degree of pitch. Different manufacturers use different numbers of grooves; some five and others six. The Colt company uses six, while Smith and Wesson use five grooves in all their arms except their .22 caliber, the automatic, and the .45-1917 model revolver, where they use six. The direction of the rifling in the Smith and Wesson arms runs from left to right and the lands and grooves are of nearly equal width. In the Colt guns the rifling is from right to left; the lands are narrow and the grooves wide. All other domestic manufacturers use five grooves and generally run to the right. In foreign guns will be found a mixture of from four to seven grooves running in either direction, frequently in arms of one make.

WHEN considering in detail the rifling or spiral grooves on the inner surface of the barrel, it must be remembered that the physical structure of any piece of metal is not the same throughout. The consistency of the metal varies at intervals; therefore it will be found that in no two gun barrels will the physical structure be identical throughout the bore. This fact has considerable effect on the tool which cuts the grooves, known as the "rifling cutter." These implements are made of the hardest of tool steel, in two styles. One is made in the form of a hook and is known as a "hook cutter." The other is made in a drawn out S shape and is known as a "scrape cutter."

The cutting edge of one of these tools, when it starts its first groove, is as sharp as a razor. To continue with this analogy: It is well known that after having shaved one side of the face with a razor, it frequently is necessary to strop the blade before shaving the other side. The blade has become dull, due to the action on the fine edge of the hair on the face. This action has in reality changed the shape of the edge. The microscope discloses the fact that a razor edge has teeth similar to that of a saw, although they are invisible to the naked eye. Stropping lines up these "teeth," while use forces them out of alignment: a dull blade results.

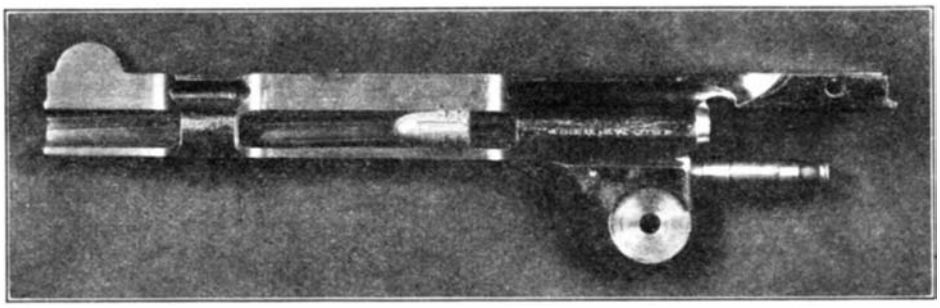
The action on a rifling cutter edge is similar. One can appreciate, then, as the rifling cutter is drawn through the barrel, while the barrel is rotated to give a spiral path to the groove, with the cutter so regulated as to cut $^1/_3$ of $^1/_{1000}$ of an inch from the interior of the bore surface on the first draw, that, considering the hard fine steel edge cutting away a hard steel surface, there is considerable wearing of the cutter edge in one stroke, during which it cannot be "stropped." So the rifling cutter edge is continuously changing its shape and, therefore, the pattern of scratches it leaves behind. The minute teeth on the fine edge are wearing down, chipping off in places, and the edge is scratching its ever changing pattern on the inner surface of the steel barrel.


How two bullets look when viewed through the comparison microscope. The markings on the fatal and test bullets correspond

Another source of tell-tale bore markings is to be found in the slivers of steel that have been removed by the cutter and are constantly twirling around ahead of the cutter within the barrel. They not only create their scratch marks, but they also leave behind marks of "fractures" at the point where the steel sliver breaks from the interior barrel surface. Here another analogy may be drawn. When planing a piece of wood, a thin sliver is removed by the blade of the plane. This sliver eventually breaks from the wood body and leaves a plainly visible scar or "fracture" mark. A similar action takes place within the gun barrel. Considering all these facts, it can readily be appreciated how accurate it is to say that no two gun barrels are alike; and furthermore, that no two groove marks are identically the same in any one gun barrel.

TO the naked eye the interior surface of a gun barrel appears smooth, but by examination with the microscope it is possible to detect, examine, and compare these minute tell-tale marks which have been passed on to the surface of the bullet as it is being forced through the barrel under a pressure of from 8000 to 16,000 pounds to the square inch. This tremendous pressure behind the bullet expands it, pressing it against the inner barrel surface, so that it takes on every minute scratch mark of that surface. Some of these scratch marks, seen under the microscope, are more pronounced than others; one line may be faint at one end and come up stronger at the other; the more the gun is used the more pronounced the scratches become.

If any particular minute defect exists in the barrel or any rust marks are present, the gun's individuality becomes more pronounced and the marks of identification on the

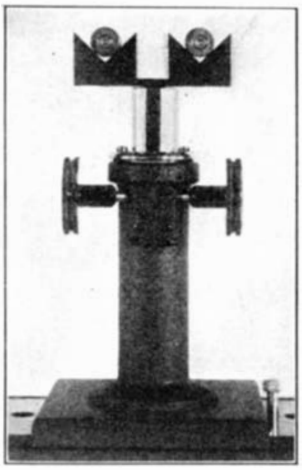

Cut-away view of a revolver barrel, showing rifling. In the barrel has been placed a bullet, on which are seen the "finger prints" made by the bore

bullet become more positive. It will be noted that those marks imprinted on the bullet as it enters the barrel at the breech end are changed as the bullet progresses through, and it is the marks that are imprinted on the bullet by the last few millimeters of the barrel that serve as the identification card of the gun.

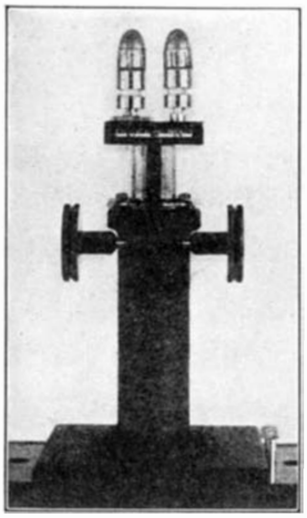
In the case of shell-head identification, the marks made by the firing pin and breech face are the "finger-prints" which must be followed. In the manufacture of the component parts of guns, the same change in the conditions of tools mentioned above gives a starting point for an identification method. If a series of seemingly identical parts, delivered consecutively from the same machine, are examined under the microscope, it will be found that each one differs in some respect from all of the others. The constantly changing tool marks or scratches on the firing pin and breech face are imprinted on the primer as it rebounds at discharge. It is possible to make identification of shell-heads in shot-gun cases in this manner, but because of the smooth bore of the barrel, nothing can be done with the pellets of shot discharged from this type of gun.

IN cases where automatic pistols are used, comparisons can be made of extractor hook marks and ejector rod marks, as well as the breech face marks on shell heads. This same method is used in determining what type of gun discharged a .45 caliber automatic cartridge, which could have been used in a 1917 model Smith and Wesson revolver, a Colt automatic pistol, or a Thompson sub-machine gun.

The method of identification consists of comparing the minute characteristic markings on the questioned or fatal bullet or shell with the markings on a test bullet or shell fired through or by the suspected gun. The bullet fired through a suspected weapon is caught in cotton waste so as not to distort it or cause any foreign marks to be imprinted on it other than those caused by the condition of the interior of the gun barrel.



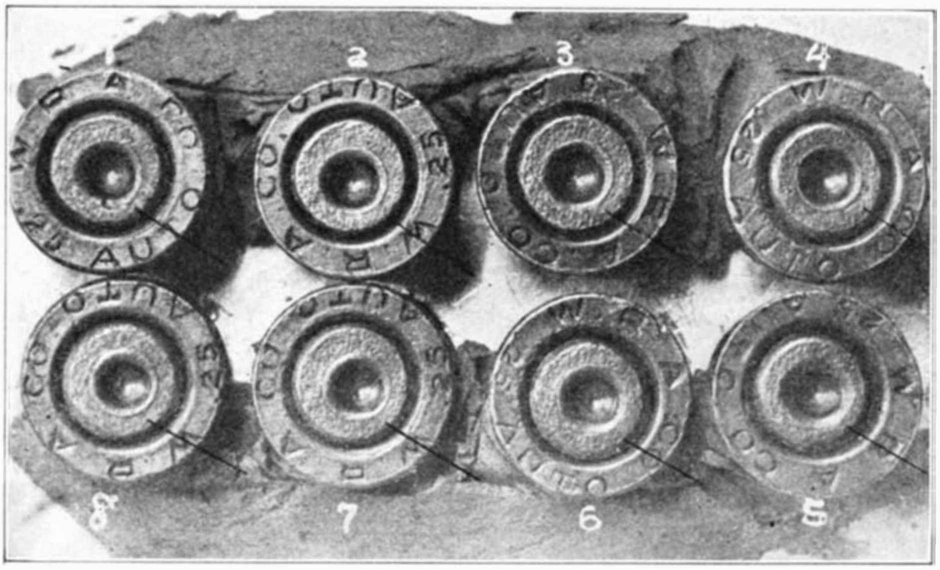
A new instrument designed by the author for holding and manipulating bullets and shells while being photographed. The views show the two different stages that are used



There are today a few experts who make identification in a logical and precise manner but there are also many so-called experts who recognize no limitations, no standards, and no equipment as essential in this field.

In the examination and comparison of fatal bullets and shells fired from suspected weapons, the most important instrument, which is today generally recognized as essential for satisfactory work in this field, is the "comparison microscope" which may be described as a specially designed compound microscope fitted with a comparison eyepiece, in which two bullets or shells can be examined at the same time. With such a microscope the fatal bullet and a test bullet fired from the suspected barrel are placed under the lens systems as shown in the photograph. Their images are fused into one by the arrangement of prisms in the comparison eyepiece. The result is a composite image, one half of which is contributed by the fatal bullet and one half by the test bullet. When the bullets are set in the microscope, they can be rotated independently or simultaneously by means of the mechanical stage.

One bullet is now held stationary, while the other is rotated so as to make various areas of its surface join against the area of the bullet which remains fixed in view. If both bullets are from arms of the same caliber and make, each land and groove mark on the rotating bullet, as it passes a land or groove mark on the non-rotating bullet, will fuse with it as to width and angle of pitch. If the bullets be from the same arm, not only will land and groove edges fuse, and angles be identical, but certain finer scratches from the lands and grooves, mentioned above, will, in some one given position, fuse also. Having located this position, the two bullets are revolved together, whereupon fusion of these fine lines, as well as of groove edges, will take place all around the circumference. Shell-heads are examined in the same way for tool scratch marks left by the breech block as above mentioned.



A row of fatal shells and a row of test shells placed side by side in an accurately bored steel block for purposes of comparison and photography

THE bullets having been examined microscopically and found to match, pictures are taken of both test and fatal specimens. These pictures are so arranged as to enable court and jury clearly to comprehend the result.

There are three pictures taken of the fatal bullet and two of the test bullet. These are arranged side by side in folder form, pasted together on the reverse side, in the following manner. From left to right, number one and two are pictures of fatal and test bullets, respectively; number three and four are pictures of the fatal bullet. The other picture of the test bullet is cut through the short diameter. The lower half is superimposed over the lower half of picture number three, of the fatal bullet, and the upper half over the upper half of picture number four, also of the fatal bullet. The fine lines or striations will match and prove identification.

My Experience in Amateur Telescope Making

By CLYDE W. TOMBAUGH

CLYDE W. TOMBAUGH, author of the accompanying account and the immediate discoverer of Pluto the new planet, "graduated" into professional astronomical work from amateur telescope making, as have several others up to the present time. Until he won a position at Lowell Observatory, Tombaugh was an obscure amateur, one of the 6500 of our readers who have gone in for this fascinating scientific hobby. For some reason he previously had not sent to this magazine a description of the failures and successes in his telescope building, and therefore was wholly unknown to the editors. Acting on a "hunch," when the newspapers stated that Tombaugh "had made telescopes," we found his name in the 1926 records as a purchaser of the SCIENTIFIC AMERICAN instruction book, "Amateur Telescope Making," and invited him to describe his efforts for publication.

Tombaugh's success is a refutation of the assertion, sometimes made, that the layman's worthy work stands little chance of notice by professional men of science. Here we have a plain young man, a farmer, without scientific connection. He makes several telescopes, studies, and wins a position at a noted astronomical institution—all without the least "pull" or preferment. Within three months his name is on every press wire, every cable. If that isn't romance, what is?

IN February, 1926, I began work on my first telescope, an eight-inch reflector, as that was the only way for one of very limited means to possess an instrument of moderate power. The work was new and unfamiliar and mistakes were made; for example, cementing a disk of wood of equal size to the back of the speculum. Another mistake was the flimsy equatorial mounting constructed, which teetered violently with the least wind. The tube was a square box seven feet long, made of four boards nailed together. The telescope was kept out-of-doors and these boards warped sadly in spite of their previous treatment with hot linseed oil and paint. Figuring the mirror was unsuccessful, also the silvering. The return of farm work forbade any further work on the mirror that season.

ABOUT this time, April, 1926, I learned that the SCIENTIFIC AMERICAN had published the book "Amateur Telescope Making," and immediately sent for a copy with the intention of "trying it again" the next winter. The eight-inch telescope was used occasionally during the summer and autumn, though its performance was disappointing. It would stand only the magnification of a two-inch eyepiece, 42 diameters.

A concrete cave (outside cellar) was built on the farm in the late autumn and this was seen to be a fine place to make mirrors because the temperature would remain constant. Work was kept up feverishly to doctor the figure on the eight-inch so that Mars could be observed while near the earth. Nothing but failure resulted, due to the fact that the glass disk was too thin. It showed signs of flexure.

A relative now wanted me to make a seven-inch reflector for him. Here was an opportunity to try fresh glass and to profit from the mistakes made on the eight-inch. Armed now with the book "Amateur Telescope Making," the second project bid fair to be a success, but the first disk cracked while heating it to cement a handle on the back. Another disk was ordered immediately.

The grinding proceeded very satisfactorily and soon was done. The mirror was ground to a focus of 58½ inches. Some scratching was encountered in the polishing, and fine grinding again was resorted to twice to remove the scratches. Upon investigation, the source of the mischief was found to be some grit which had become mixed in the rouge. Polishing was resumed, followed by figuring. "Hyperbolae," "turned-down edge," and "zones" gave trouble and several laps were made in correcting these errors. Finally the mirror was parabolized successfully, placed in the tube and tried on celestial objects for several nights. Views of the moon with a quarter-inch eyepiece were good—much to my joy. Accordingly the mirror was sent away for silvering.

THE tube of the telescope was made of number 22-gage galvanized iron, reinforced by a ring of strap iron at each end, riveted on the inside. A one-inch right-angled prism was used for a diagonal. The telescope was finished just in time, before the annual return of farm work intervened.

In May, 1927, I set out to enjoy the fruits of my labor. The telescope outstripped anything I had previously looked through. Views of the moon and planets with high powers were splendid. With low powers star fields and clusters were most beautiful. From time to time neighbors came to enjoy a look.

One rainy day in August the telescope was packed and shipped to my uncle. I had become so attached to the instrument that I felt the loss keenly.

Soon afterward I ordered disks of glass to build a nine-inch reflector for myself. During a rainy spell in September the rough grinding was done and several weeks later the subsequent work was resumed. A total of 24 hours were required for the grinding process, including careful washing of stand and tools between grades. An 80-inch focal length was aimed at, which later was found to be three-fourths of an inch less. All the grinding and polishing were done by hand. I did not have the time, money, nor inclination to build a machine for these operations. No wooden handle was ever cemented to the back of the speculum.

MY five-year-old brother took keen interest in the project and begged to help. I let him renew the charges of carborundum and water. This saved me the trouble of laying the speculum down and picking it up each time. His enthusiasm and willingness were a source of great joy and inspiration to his big brother.

My father assisted me most generously with the mounting. Ingeniously he fashioned a neat and sturdy one according to my plans from parts of old farm machinery, using only the

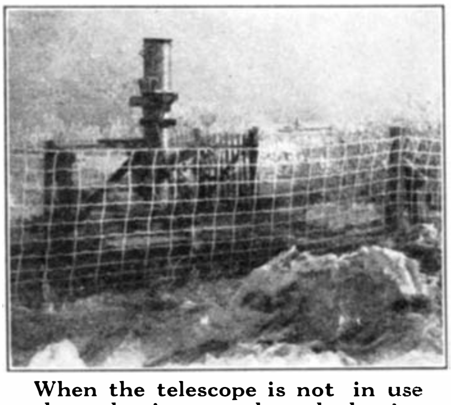
The author standing beside his nine-inch home-made reflecting telescope described in this article

tools found in the average farmer's repair shop. Later the performance of the mounting was found to be most gratifying, even when using a power of 400 diameters. The worm-screw slow motion in right ascension, and the turning of the polar axis in its bearings, were uniform and smooth.

The declination axis was cut from one-inch shafting taken from an old straw-spreader. A hardened steel shaft from an old Buick car served for the polar axis. The worm-wheel was made from a spark lever arc of an old car, by carefully filing the notches until they became teeth. The worm-wheel arc is readily clamped to the polar axis for slow motion.

The mounting is of the German type. My father and I forged the yoke from tough, heavy wrought iron. The upper end of the polar axis was threaded and screwed tightly into the yoke. Great pains were taken to fix the polar axis at exact right angles to the declination bearings, the latter being cleanly bored with a hand drill-press, and then treated with fine emery cloth. The polar axis bearings likewise were made with especial care. One could not ask for smoother motion. The polar axis bearings are fastened to the base of an old cream separator whose metal base in turn was bolted to a pier of reinforced concrete.

THE telescope tube, seven feet long and 11 inches in diameter, was made of 20-gage galvanized iron, at a tinner's shop, for a sum of six dollars. Later, at home, two strong bands, one at either end, were riveted by my father on the inside of the tube, giving added rigidity and strength. He also



When the telescope is not in use the tube is capped and the instrument is left out of doors in the snow and rain without injury

made a cell support in the tube and fitted the back of the cell with three adjusting screws for "squaring on" the speculum.

The nine-inch mirror rests on a ten-inch disk of walnut two inches thick, and the wood in turn is joined to a fixed metal disk base by the three adjusting screws. This metal disk fits snugly between a tube reinforcing ring in front and three equidistant arcs of strap iron behind. Three evenly spaced gaps were cut on the circumference of the metal disk. By turning the metal disk so that the three gaps come into a congruous position with the three arcs of support the entire cell with mirror slips out of the lower end of the tube. This arrangement allows quick removal and replacement of the cell with its mirror. Dead-black slate cloth was glued to the inside of the tube with shellac to prevent internal reflection of light.

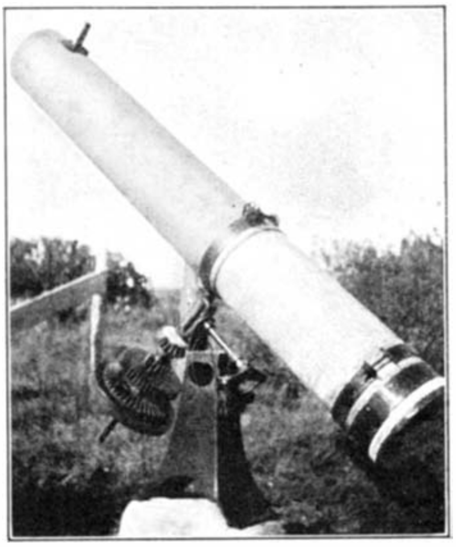
The arrangement used for fastening the telescope tube onto the declination axis will be quite well understood from the photograph. An iron band two inches wide and one quarter inch thick acts as a slip ring. The grip on the tube may be loosened by the handwheel and the tube rotated into any desired position. An iron block tapering off at either end was riveted to this ring. A hole was bored in the block and tapped, and the end of the declination axis was threaded and screwed tightly into this block. This arrangement proved to be quite rigid as well as convenient.

A SMALL optical flat, three eighths of an inch thick and 1½ by 2 inches, intercepts the light and directs it to the eyepiece. It was mounted so as to permit adjustment, and supported by a thin strip of strap iron extending diametrically across the tube.

Considerable trouble was experienced in figuring the mirror, because of the use of too many long strokes in shaping the first polishing lap which was slow in hardening. The first knife-edge test showed the r^2/R value to be one half inch! Serious complications followed in reducing this, and several laps were made and cut up while correcting various errors. The work, consequently, was greatly prolonged. At last the mirror was parabolized to two thirds the theoretical value, in order to compensate for the rapid fall of temperature at night, which is typical of western Kansas in seasons of good seeing.

The optical performance of the telescope is most gratifying. The "double-double" system of *Epsilon Lyrae* is a favorite test for light-grasp, resolving power, and seeing. The components of the two doubles are $2''.3$ and $3''.0$ apart, respectively. During good seeing these doubles are thrown wide apart, and each spurious disk is very small and clean-cut when using a one fifth inch Ramsden (positive) eyepiece. During moments of extra good seeing arcs of the first diffraction ring are observable, using the full 9-inch aperture. Between E_1 and E_2 are several faint stars. The two stars marked 12.0 and 12.5 magnitudes in Webb's "Celestial Objects for Common Telescopes" were conspicuous. Two fainter stars marked 13.8 and 13.9 magnitudes were just seen and held under favorable conditions. In addition I have seen many very delicate rills and countless craterlets on the Moon. In the autumn of 1928 I was able to observe seasonal changes on Mars and saw a few canals.

The making and use of my nine-



Detail of the mounting, made from parts of an old straw spreader, a Buick shaft, cream separator, and several other pick-me-ups

inch telescope has been a source of great pleasure to me, and the entire cost in money, excepting for the eyepieces, amounted to 36 dollars.

The entire telescope, excepting the eyepieces, is left out-of-doors in my "telescope garden." When not in use the tube is held in a vertical position, a tin cap is placed over the end, and a solid dummy eyepiece is substituted for the eyepiece. Thus closed, the tube is practically air-tight. The telescope has withstood the onslaughts of blizzards, driving rains, hail, and dust-storms without the slightest damage. Yet it can be set in operation in two minutes and closed up in five minutes, thus greatly encouraging observation.

A five-inch single-lens non-achromatic refractor of 6½ feet focal length was also made in the early part of 1928. Of course the color is bad and the definition poor due to diffusion. With a two-inch eyepiece it is fairly satisfactory, however.

The following autumn (1928) a Cassegrainian mirror was ground for the nine-inch. Two five-inch specula with focal lengths of 20 and 75 inches, respectively, were also under construction at that time, but early in January of 1929 I was granted work at the Lowell Observatory, and a little later was assigned to the new 13-inch Lawrence Lowell Telescope to search for "Planet X" (Pluto). Consequently my mirror work came to a close, and these mirrors still are unfinished.

Experiments With "Wonder Creatures"

By FRANK E. LUTZ, A.M., Ph.D.
Curator of Insect Life, American Museum of Natural History

ON inviting questions at the end of his first American lecture on the "Mechanism of the Muscle," A. V. Hill was indignantly asked by an elderly gentleman, of what use were all the investigations which he had been describing. For a moment Doctor Hill tried stumblingly to explain what practical consequences might be expected to follow from a knowledge of how muscles work. Realizing suddenly how thankless a task it was to prove to his indignant questioner that the work he was doing was useful, Doctor Hill turned to him with a smile, and finished,

"To tell you the truth, we don't do it because it is useful, but because it is amusing."

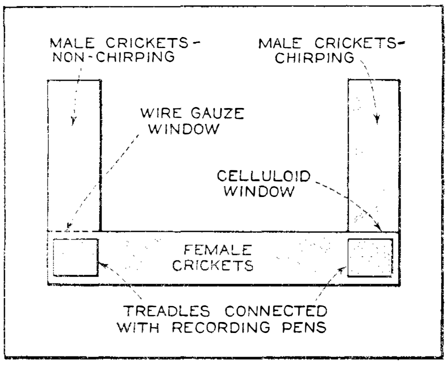
"And if that is not the best reason why a scientist should do his work," says Doctor Hill, "I want to know what is. Would it be any good to ask a mother what practical use her baby is?"

This article is to give you a peep at some of our "babies," glimpses of some of the experiments we have been trying at the American Museum's Station for the Study of Insects in the Harriman State Park and at the private laboratory of Alfred L. Loomis in Tuxedo. They are "babies" in the additional sense that none of them have gone far enough to mature into a definite scientific report.

MOST of the more than half a million different kinds of insects live their lives without a sound that we can hear. A few, however, such as the crickets, katydids, and their relatives, with an originality that is the more striking as we consider the multitude of conservatives, have developed not only rather complicated sound-producing organs, but also apparently satisfactory ears. As is characteristic of insects, they have gone about certain functions in a way and with structures that seem to us strange. An interesting essay could be written on this latter point, telling about such things as that insects take air directly to the blood instead of the rather clumsy human method of taking the blood to inhaled air; and not the least interesting thing about it is that the insects' way seems to work better than our way. An intimation of their success will be found in the last of the experiments discussed in this article.

Several years ago, in reviewing work on insect sounds, I confessed considerable skepticism concerning the utility of these sounds to the sound producers; but the chirping of crickets gave me considerable trouble both then and after the paper was published. The chirping is done by rubbing together highly modified structures on the front wings which seem "made for that purpose." Furthermore, crickets have ears on their front legs, and definite ears are unusual among insects. Since only males chirp (although both sexes have ears) the conclusion has been that the chirping is a sex call.

Having somewhat questioned that



The plan of the "automatic eavesdropper" described in the text

conclusion, it seemed only fair that I should test the matter; but watching a female cricket to see if she goes to a chirping male is a time-consuming business and, so, it seemed desirable to invent a machine that would do the job as well or better than we could. Consequently we made an automatic "eavesdropper." It will have to be improved and its first reports are not to be taken too seriously.

A box was made to contain the females. There was a window at each end where two other compartments joined it and here was food and shelter. Each window communicated with separate boxes containing males. One window was covered tightly with thin celluloid that let through the chirps but kept back odors. (Remember that insects have a keen sense of smell and many clearly find their mates by this sense.) The other window was covered with wire gauze that let through the odors and would have let through the chirps also if there had been any in the box with which it communicated. But there were no chirps in that box, because a simple surgical operation on the wings of the males there had completely "dechirped" them without hurting them more than a girl is hurt by having her hair bobbed—and the effect was much the same in so far as they were made more like the opposite sex. The females in the central box could wander about and go to either window. Would they go more often to the one where there were male chirps but no odor, or to the one where there presumably was male odor but certainly no chirps? This is where the automatic eavesdropper comes in.

On the floor of the females' box, just below each window, was a very delicate treadle. When a female came to either window, she stepped on the treadle there and, her weight depressing it, closed an electric switch that completed the circuit through an electromagnet. The magnet drew aside a pen that was otherwise tracing a perfectly straight line on a paper tape moving at a known speed. Each treadle moved its own separate pen. Clearly, all we needed to do was to examine the tape at our leisure and we could tell not only which window was visited but how often the female came, when she came, and how long she stayed.

IN "chirp but no odor *versus* possible odor but no chirp" the females visited the chirp window 290 times and the no-chirp window 307 times. There is practical equality here. When offered a choice between a blank window and one where there were males that could not chirp the score was 170 to 166. Again equality. "Chirp but no odor" won out over "blank" by 63 to 24, but the numbers are rather small and "blank" scored 65 against 48 for a window where there was *both* chirp and possible odor. Males which were offered several of the same choices paid 86 visits to "chirp but no odor" and only 40 to "possible odor but no chirp"; also 80 to "possible odor but no chirp" as contrasted with 44 to a blank window. It seems as though males are more consistently interested in both male chirp and odor than are females, the latter wandering about more or less at random; but that may be a too hasty conclusion.

A few experiments were tried with unmated females whose presumed ears had been removed by the simple expedient of cutting off their front legs. There were 27 visits by these virgins to a window where there were both male chirps and possible male odor and none

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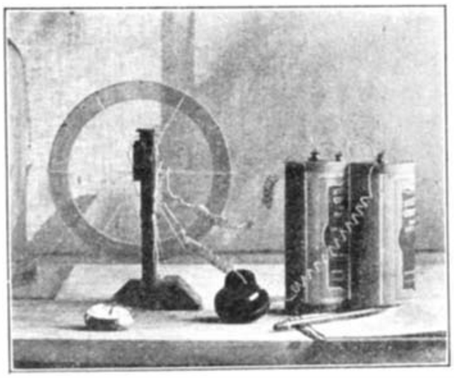
to the other window where there were no males. In another short series of trials where possible odor but no chirps was opposed to chirps but no odor the score was 14 to 11 in favor of odor, but the numbers are too small to be significant. On the other hand, possible odor but no chirps won out over a rival blank window by the rather startling total of 106 to 1.

One of two conclusions is fairly certain: either female crickets do not get wildly excited over the music of possible mates or there is something wrong with the apparatus.

THERE is a very different sort of problem which has greatly interested some physiologists and which may strike rather deeply into the mysteries of animal activities, either muscular or nervous, we are not sure which. For example, Harlow Shapley, an astronomer apparently desirous of improving daylight hours when he could not look at stars, watched ants and noted the speed with which they walked along a path at various temperatures. The warmer it was, the faster they went. A curious thing is that the relation between speed (S_1) at a given temperature (T_1) and the speed (S_2) at another temperature (T_2) closely accords with a complicated formula which represents the speeds of certain chemical reactions at various temperatures:

$$S_2 = S_1 e^{A\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

where e is 2.7183, the base of "natural logarithms," temperatures are measured on the "absolute centigrade" scale ("absolute zero" being about —273° C. or about —459° F.) and A is a constant that is characteristic of the reaction.



Treadmill operated by a cricket. A photo-electric cell recorded the revolutions made by the pedestrian

Some physiologists think that, by a comparison of the "temperature characteristics" of various animal activities (as shown by a curve representing the speeds of these activities at various temperatures) with the "characteristics" of various chemical reactions, we can discover what chemical reactions control these activities. Possibly we can but, at any rate, it is interesting to find out a little more concerning the influence upon insect activities of all the environmental factors, and this seemed to require a new type of apparatus in which the insect could walk straight ahead indefinitely without coming to a wall and in which the environment could be controlled.

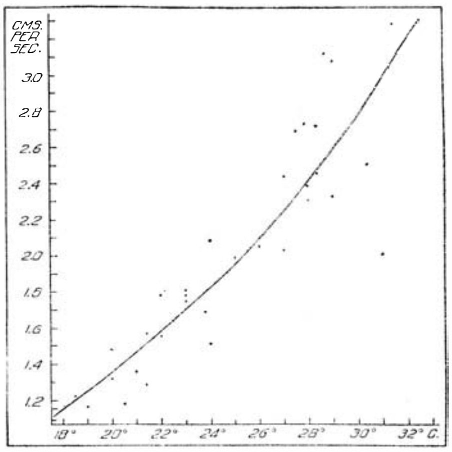
A device something like the wheel in an old-fashioned squirrel cage seemed to be what we wanted, but we wished it to be so delicately balanced and so frictionless that even a tiny fruit-fly would easily turn it. However, if we did away entirely, or almost entirely, with friction, the wheel, once it got started, would go on and on even after the insect had stopped walking. Furthermore, while we were at it, we wanted things fixed so that the wheel would automatically record both the speed and the direction of its turning. As I look back, I do not wonder at the kind, solicitous inquiries of friends concerning the "fly-wheel," and I even forgive the less kind intimations as to "wheels" in my head. The list of failures is a long one, but here is what worked and it is quite simple.

The track where the insect walks is something like an automobile tire with the insect inside of it. It is made of exceedingly thin, transparent celluloid, the "valve" being a tiny, sliding celluloid door for getting the animal in and out. The spokes of the wheel are fine silk threads; the axle, depending on the size of the wheel, is either a needle or the shaft of an almost obsolete thing, a hat pin. Over each end of the axle is an electro-magnet whose strength can be quickly and accurately varied by a rheostat conveniently located in the circuit.

NOW: An insect is put into the wheel, just enough electricity is sent through the magnets to take practically all the weight off of the bearings (a trick suggested to me by Professor R. W. Wood), and the insect can go as rapidly as it pleases but, like Alice and the Red Queen, it never gets anywhere. If it decides to stop, we can decrease the strength of the electric current; this lets the weight press on the bearings and friction stops the wheel.

Since an observer is usually on hand when the apparatus is being used, there really was not much point in having it self-recording but, compared with getting the wheel to work, that was easy, and there is some satisfaction in finishing what one starts out to do. Accordingly, a disk of opaque paper was fitted to the wheel and a series of openings was made in the disk. A photo-electric cell was put back of the disk and a beam of light was directed against its front. Every time an opening passed the beam of light, as the wheel turned, an electric impulse went through the photo-electric cell and worked a pen on a recording tape much as did the cricket treadle already described. The openings were so arranged that the turning wheel "telegraphed" a code message that told exactly what it was doing.

Having the apparatus, there was an obligation to use it and, I confess, this was more like work, although



The higher the temperature the faster the milliped walked. "What it all means is another question"

interesting. Not every insect is fit to go in such a wheel. Some sat calmly, as though thinking about something. Others had the will to walk but got tired, for the inside of a freely turning wheel is a trail that has no end. Thus, a yellow-jacket wasp that, in ordinary life, flies much but walks little, started off with an evident intention of getting somewhere in a hurry. For the first 20 minutes it kept steadily going at an average speed of about 9.5 centimeters per second. Then, temperature, light, humidity, and barometric pressure remaining the same, it began slowing up, its average speed in successive five-minute intervals being 8.3; 7.7; 7.4; 7.3; and 6.2 centimeters per second. At the end of the three hours and a half it was still at it but going only 3.9 centimeters per second, having had the longest walk of its life—about two thirds of a mile.

GROUND beetles (Carabidæ) are much more used to walking than are wasps. In fact, they rarely fly. A specimen which Richard Iverson timed for two hours with the wheel in the open laboratory started off with a speed of 5.3 centimeters per second. Its average speeds in 19 of the 20 five-minute intervals for the last hour of the run were: 5.4; 5.3; 5.1; 4.9; 4.8; 5.9; 6.0; 5.9; (Dick took a five-minute rest); 6.0; 6.2; 5.8; 5.7; 6.2; 6.1; 5.5; 5.6; 6.0; 5.2; and 4.3. Apparently it could keep that up longer than we cared to watch and record. Our automatic disk contraption would have been handy in this case.

The creature that best served our purpose was not, strictly speaking, an insect but *Spirobolus marginatus*, the large brown milliped ("thousand-legger") of the late-summer woods. It is heavy enough to turn the wheel without the help of magnets; it is a consistent walker; and there is an absolute fascination in watching the perfect rhythm of those many legs hour after hour. Let us examine the effect of two environmental factors upon its speed of locomotion.

A *Spirobolus* was started off at a temperature of 32.5° C. (90.5°F.); then the box which contained the wheel was gradually cooled to 18° C. (64.4° F.); and finally warmed again to 30° C. This took about four hours and a half, the creature walking most of the time. Distance traveled, together with elapsed time, was electrically recorded on a rapidly moving tape. If you are used to reading graphs, the one on page 271 will clearly tell the story. The dots on the graph indicate the average speed of walking (see left-hand margin) at various temperatures (see bottom margin) and the slightly curved line is that given by the formula noted above when the constants are speed of walking (centimeters per second) equals

$$2.238\, e^{6351 \frac{(\text{Temp.}-300)}{(300\times\text{Temp.})}}$$

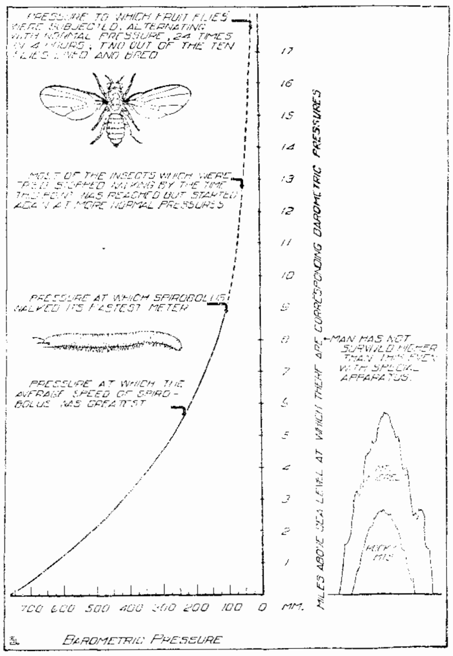
when temperature is given on the "absolute" centigrade scale. It is quite evident that "the warmer, the faster." What it all means is another question.

RATHER more startling experiments, perhaps largely because they were in an almost unexplored field, were the effect of changed air pressures, and this requires a bit of comment on the side. At sea level the air above us weighs so much that it balances the weight of a column of mercury about 760 millimeters high; in other words, the barometric pressure is about 760 millimeters at sea level. As we go up in a balloon (mountains are not high enough for present purposes) the pressure decreases, but not in simple proportion to the altitude. "Sounding balloons," carrying recording barometers but not a human being, have attained about 19 miles above sea level. But even that is not high enough for our present purposes. Since we do not know what the air pressure is 30 miles above sea level, about the best we can do is to take a very simple formula which seems to be "in the direction of the truth" even though it is known to be inaccurate. It is that altitude in miles about equals

$$10.33 \log_{10}\left(\frac{760 \text{ mm.}}{\text{Observed Pressure}}\right)$$

It may be simpler to look at the curve in the drawing above which gives, on the bases of known facts and of this formula, altitudes in miles for various barometric pressures.

For this experiment *Spirobolus* was put in a wheel; the wheel was put in a bell-jar; and air was pumped out of or let into the jar according to whether we wished to decrease or increase the atmospheric pressure. It was absurdly easy to give the creature all of the air-pressure thrills of a super-balloon ride to, say, 15 miles above sea level (air pressure of about 27 millimeters) and return in less than three minutes. Of course, since it is well to investigate one factor at a time, temperature, light, and humidity were



The effect of decreased barometric pressure on several animals tested. The vertical column of numerals has reference to miles above sea level at which there are corresponding barometric pressures. The insect is a much "tougher" organism than the mammalian primate known as *Homo sapiens*

kept as nearly constant as possible, and for that reason we can speak here of only the effects of air pressure and decreased oxygen supply.

Suppose a man were being treated in this way. Even if the change were made slowly, his gait would be wobbly and his breathing very labored at a pressure of 400 millimeters of mercury, and the aviator Gray died, whether accidentally or not, when it was about 150 millimeters.

Since we wished to time the speed of walking at various pressures, *Spirobolus* was subjected to graded series of them. Observations were made during the first hour at 740, 500, 400, 300, 250, 200, 150, 100, 75, 50, 40, 30, and about 22 millimeters pressure in succession. In order to have a constant degree of humidity and also to prevent drying of the milliped by excessive evaporation, we had water in the jar and, since the vapor pressure of water at ordinary summer temperature is about 22 millimeters, that was as far as we went, and it seemed far enough for the present. At that, there was practically no air left in the jar. Then we came by rather short stages back to normal; then went to 100 and back to normal; and repeated this "round trip" three more times—all in two hours and a half.

Instead of walking more slowly as the air became rarer, *Spirobolus* increased its speed, all of its many legs functioning in absolute rhythm. This increase kept up on the average until the air was about two thirds gone, corresponding to pressures at an altitude of, say, six or seven miles; then it began to slow on the average and stopped (but not for good) when there was practically no pressure left except that of water-vapor. As a matter of fact, however, the fastest one-meter dash that it did was at an air-pressure of only 105 millimeters (representing, say, an altitude of about nine miles), making the meter in 59 seconds or a rate of about 1.7 centimeters per second. Of what stuff are these creatures made, at any rate?

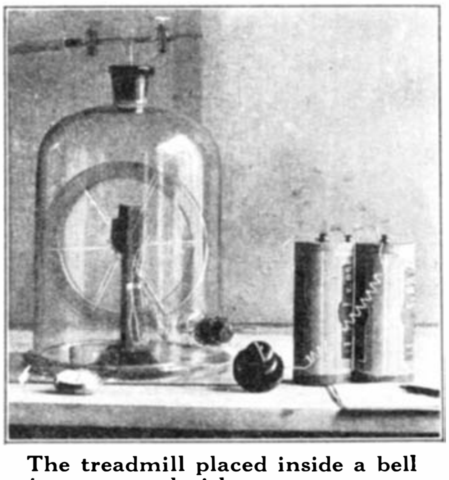
WE are all familiar with the tiny, red-eyed fruit-flies that come about over-ripe bananas and the like. Ten of these flies were put in a bell-jar with water and the air exhausted to the vapor-pressure of water in 90 seconds. The flies stopped moving. Valves in the apparatus were then opened wide and the pressure almost instantly returned to normal. Within four minutes all ten were walking about as though nothing had happened. The same procedure was repeated again and again. After the eighth trial one fly did not walk within seven minutes and I did not wait for him but went on with the one- to three-minute swings from normal to "none" and back again. After the 20th trial only six of the ten stalwarts were walking and I took time out for tea.

After tea we (the flies and I) made four more round trips and then only a male and a female of the original ten were still alive. There seemed no point in pushing the experiment to their death and, besides, I wanted to see if they were really as well and hearty as they seemed to be. So, I put them in a cage with a nice ripe banana, where they started breeding the next day. Careful microscopic examination of their children, grandchildren, and great-grandchildren failed to reveal indications that anything unusual in fruit-fly affairs had happened.

Human endurance would fall so far below that of insects in such a test that no comparison can be made. An express elevator in the Woolworth Building or the dropping of a cage in a deep mine are slow coaches going a short block compared to the ride these flies took 24 times in four hours, but in what follows we tried to reach the limit of even insect endurance—and failed as far as air-pressure is concerned.

It is well known that, in order to produce X rays, the air is almost completely removed from the X-ray tube and then an electric discharge of very high voltage is made to jump the gap between two electrodes in this "vacuum." But the so-called vacuum, while nearly complete, is not entirely so; there are still enough ions left to carry the electricity from one electrode to the other. Furthermore, it is possible, by means of a pump which Mr. Alfred L. Loomis has in his bio-physical laboratory at Tuxedo, to exhaust the tube so completely that the X ray dies out and even 30,000 volts will not force a discharge across the gap. Instead of an air-pressure of about 760 millimeters of mercury, as we have in normal atmosphere at sea level, the pressure now in the tube is of the order of one 10,000th of one millimeter. It is probably lower than the vacuum of interstellar space. What would happen to a "frail" butterfly or bee if subjected to such a vacuum and then suddenly brought back to normal pressures?

THE answer is complicated by a factor already mentioned, one which we found was more important than sudden and great changes in air pressure. This factor is that the pump which removes the air also removes the moisture; and insects which are kept in a pressure much less than the vapor pressure of water would quickly dry up and die of desiccation. Water can not be supplied to them in this apparatus, because some of it would evaporate so quickly that what remains would be frozen to solid ice and, in fact, part of the slowing effect of high vacuum on insects may be due to a marked lowering of their temperature caused by evaporation from their bodies. However, let us see what happened.



The treadmill placed inside a bell jar connected with a vacuum pump

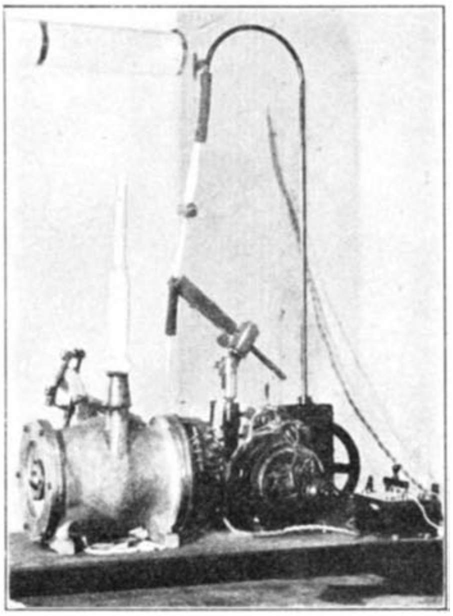
Three small bees belonging to two genera of the sort that live a solitary life, instead of in colonies, two mound-building ants, a beetle related to fireflies, and an immature grasshopper, were put in a tube and the ends of the tube were melted so that it was welded into the apparatus. (Ordinary joints would not hold.) Since moisture would ruin the pump and since moisture was sure to come from the insects, that part of the tube between the insects and the pump was packed in a mixture of solid carbon dioxide and acetone in order to freeze the water out of the air while on its way to the pump.

The pump was started and the next three minutes were busy ones. First the vacuum-tube glow appeared, but before the end of the second minute it had died out, showing that a non-conducting vacuum had been reached. This was held for 60 seconds, a rapidly growing pile of snow in the chilled connection being the moisture sucked out of these "frail" creatures, and then the glass tube was broken at one blow and the insects were returned to normal conditions from their journey into a "complete vacuum." Not one moved then, but two hours later all were active and apparently normal. A little later one of the ants showed some signs of trouble but whether it was due to the vacuum, the drying, or to some more natural cause I do not know. The next day that ant was dead but, when released, the other ant and all of its companions each according to its kind flew, hopped, or walked away.

THE same experiment was tried with a bumble-bee and two kinds of butterflies, except that the insects were in a vacuum of less than one millimeter pressure for four minutes and the extreme of 1/10,000 millimeter was kept up for 90 seconds. In about ten minutes after the tube was broken, instantaneously returning them to normal pressures, the bee and one of the butterflies began to show signs of life. Five minutes later both were walking and the other butterfly was feebly moving its legs and mouth-parts. By the next day the bumble-bee was active as ever but the butterflies had died. Possibly they were unable to withstand the conditions of the experiment, including the excessive drying, and possibly they died from other, more natural causes, but it did not seem necessary to try the experiment again.

There was no longer room for doubt that insects and their near relatives are creatures that can not only exercise vigorously at air-pressures which no man nor any of the animals related to him could survive; creatures that can not only completely recover within a few minutes from sudden and rapidly repeated transfers from normal pressures to almost none and back again; but they are creatures that can survive the most complete vacuum that man can produce with exceptionally perfect apparatus. How do they do it; why can they do it?

All that we can say is that insects seem to be better made than we are. They have invaded almost every bit of the livable world, including hot springs



The high vacuum pump at the Loomis Laboratory. See the text

and the highest mountains, the Arctic and the tropics, in water and on water, underground and above ground, in plants and animals and on them. Only the ocean is avoided by them. Their structure and mode of living have stood the test of time practically unchanged since the Carboniferous period. Possibly Maeterlinck was right when he called them "beings so imcomparably better armed and endowed than ourselves, concentrations of energy and activity in which we divine our most mysterious foes, the rivals of our last hours and perhaps our successors." On the other hand, as has been pointed out in "The Friendly Insects" (*Natural History*, Vol. XXVI, p. 147), relatively few kinds of insects seriously injure us and we owe much to many kinds. Possibly, with increased knowledge of insect habits, we may be able to swing the balance still more in our favor.

WHAT good are such experiments as these? Possibly collecting interesting information about the masterpieces of Creation is of no greater value than collecting human masterpieces of art; and possibly writing about Nature is no more useful than writing music; but, until some one is wise enough to be able to predict the worth of any bit of pure (as contrasted with "applied") science, we can at least say that it "amuses" those who do it and interests many who read about it. "Pure" science is science which has not yet been applied.

The Largest American-Made Telescope Mirror

READERS who are devoted to to science and the arts doubtless will recall that, in January, 1928, much publicity was accorded by the scientific and daily press to the successful casting of a two-ton disk of optical glass at the United States Bureau of Standards in Washington.

This disk, 71 inches in diameter and 12½ inches thick, had been poured in May of the previous year. The glass reached the mold at 2500 degrees Fahrenheit, was securely covered (the mold itself was in an insulated pit beneath the floor) and permitted to cool within a week to 1100 degrees Fahrenheit. It was held at that temperature four days, then cooled 4½ degrees per day until it reached 860 degrees, was held at constant temperature 45 days for annealing, and then allowed very gradually to cool to outside temperature, which required 130 days.

Only then might the covering be removed to ascertain whether the disk were broken and worthless or perfect. Dramatic moment! Some wag said that, as the decisive time approached, some of the anxious spectators nearly died of heart failure, but the disk came out uncracked. This was the first large American telescope disk ever cast and its successful completion rightly put a feather in the cap of the Bureau of Standards, particularly of Dr. A. N. Finn, the glass technologist at the Bureau. Optical tests for strains and symmetry of annealing indicated that the disk was optically as well as physically a success, and the whole proceeding thus constituted the beginning of a sort of declaration of American optical independence.

The disk was shipped to J. W. Fecker of Pittsburgh, the successor to the late John A. Brashear whose fame as a maker of large telescope mirrors is a tradition. The sequence of six recent progress photographs reproduced in the present pages was kindly furnished by Mr. Fecker, who with his men has done the further work which they show.

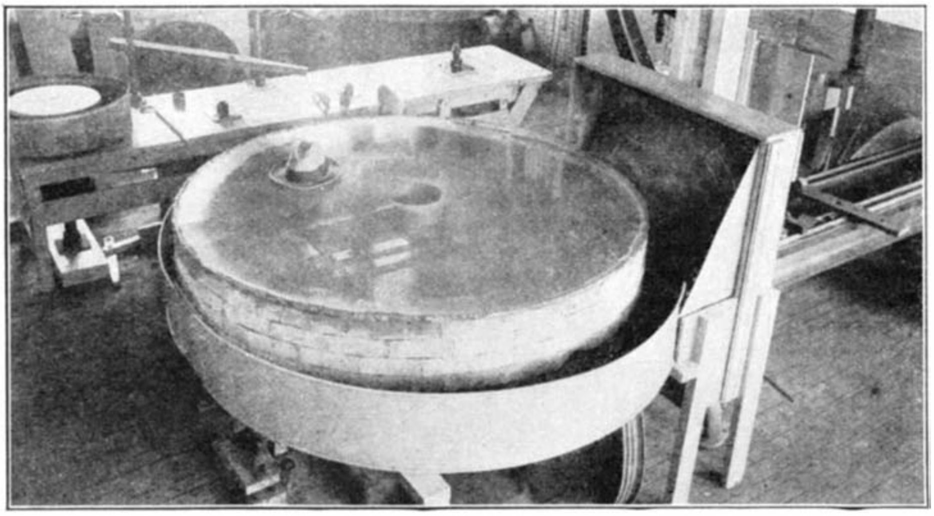


Figure 1, Above: **The raw glass disk of the 69-inch mirror. The geometrical pattern on its edge is due to the bricks of the underground mold**

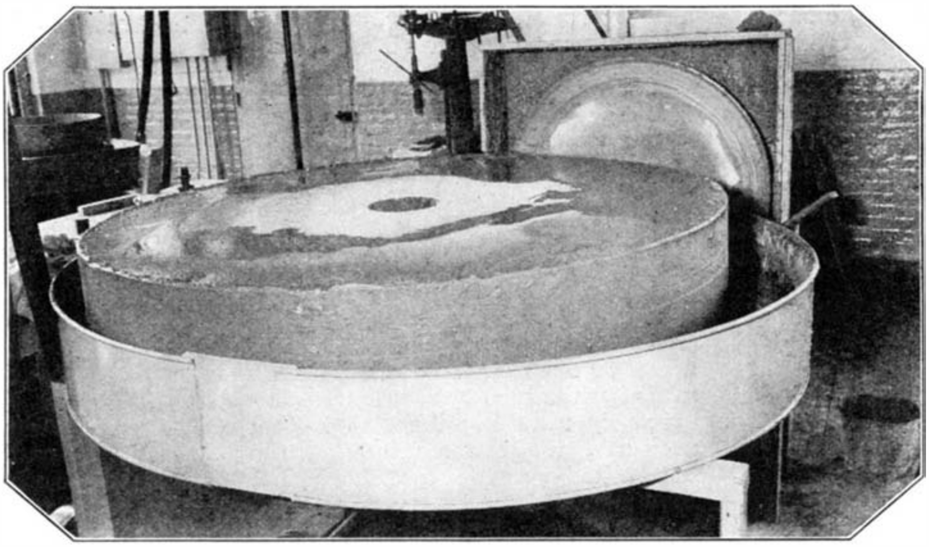
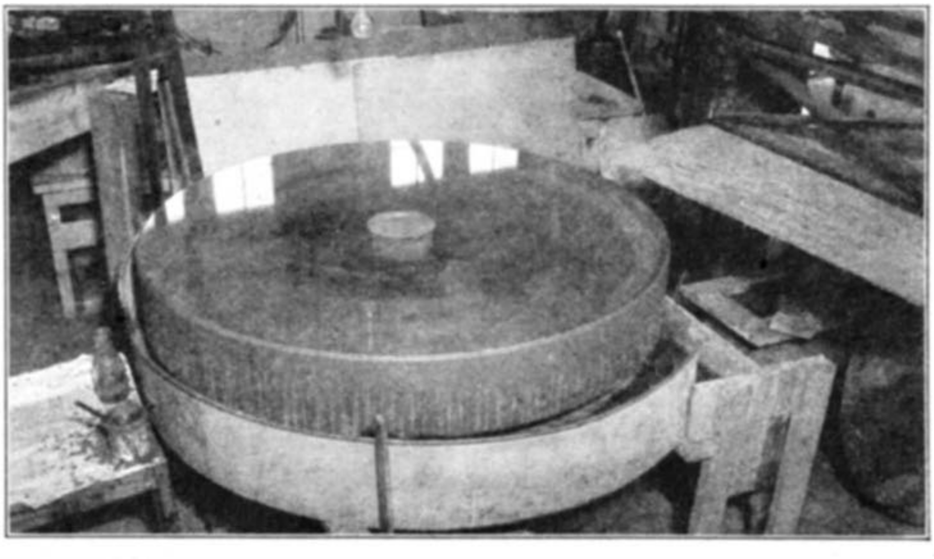


Figure 2, Right: **Rough grinding the edge with water and emery (note pot at right, on the floor) as the disk is slowly revolved**

Figure 3, Below: **The edge has been ground and the back surface ground and polished approximately flat. The disk is ready to be turned over and ground to thickness, preparatory to grinding the concave curve in the reverse side**



In Figure 2 the glass is slowly revolving while a disk of iron bears steadily against its edge, with wet abrasive doing the work of removing the irregularities. Figures 3 and 4 are sufficiently explained in the legends. In Figure 5 the disk, now reduced to $9^5/_{16}$ inches thick, has been ground to a concave (approximately spherical) curve having a depth of 0.95 inch, and less than one thousandth of an inch will be removed in all subsequent operations.

Apparently, then, the job is about complete. But is it? "In its present state," Mr. Fecker writes, "the mirror is about 20 percent completed." It is this last thousandth of an inch which contains most of the real grief in making a telescope mirror.

Even a thousandth of an inch is an extremely rough, coarse measurement in this work and a millionth of an inch is much closer to Mr. Fecker's final

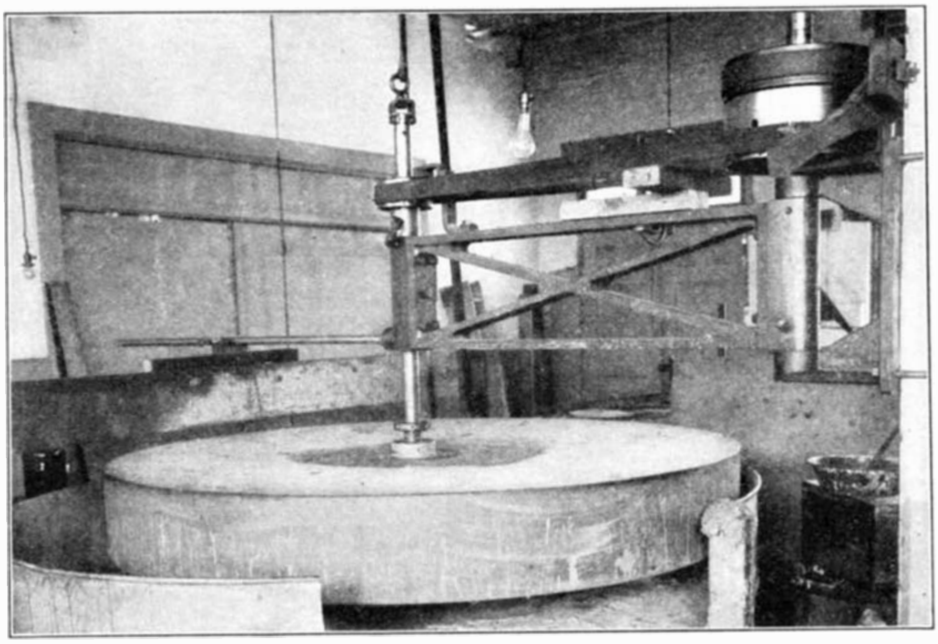


Figure 4, Above: **Grinding the hole true and concentric with the periphery of the mirror. As the disk slowly rotates the vertical, adjustable (note arm), revolving tool, belt driven, enlarges the hole**

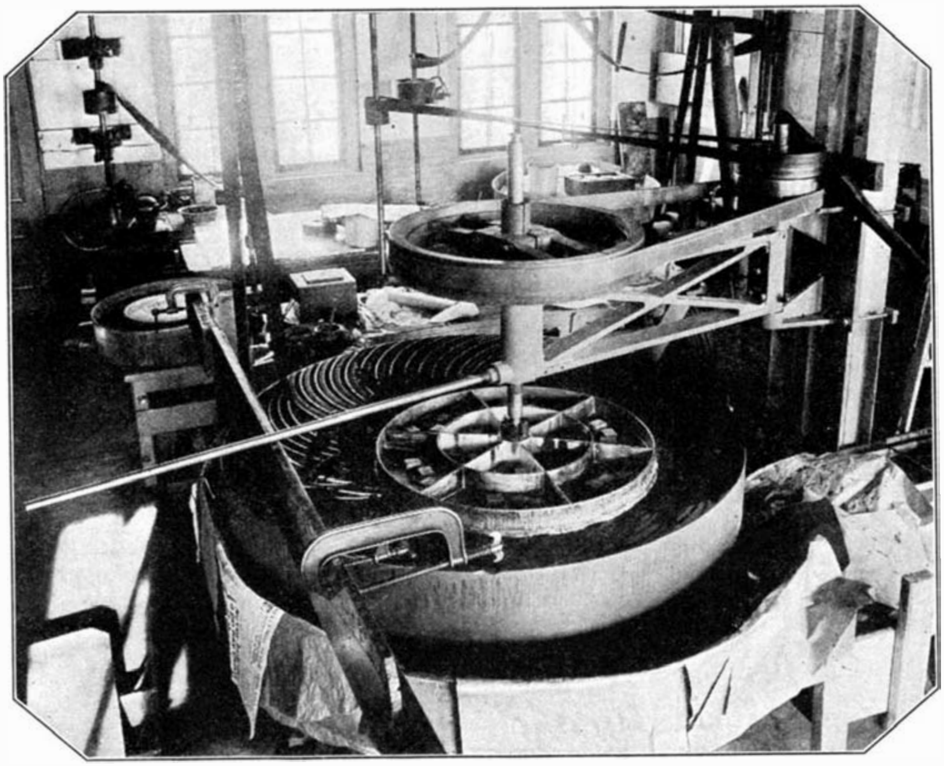
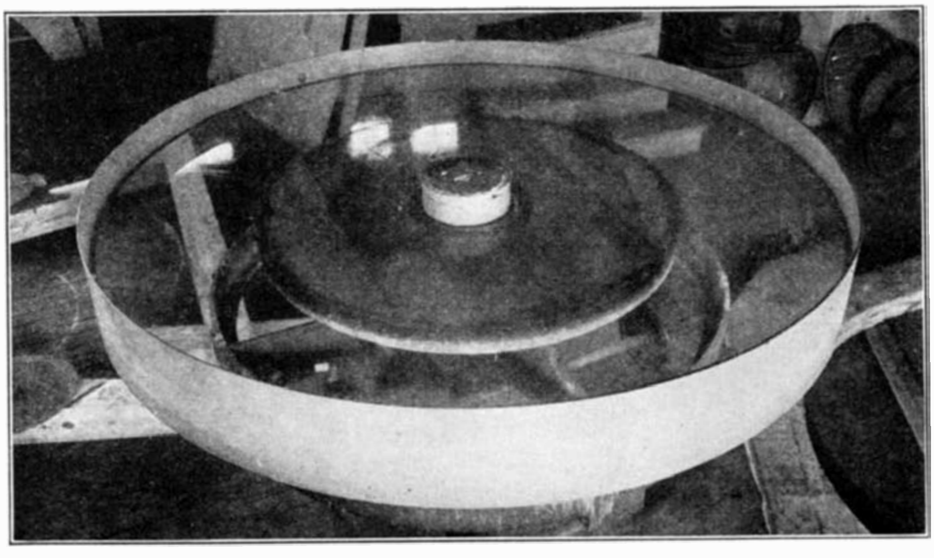


Figure 5, Left: **Polishing the concave surface of the mirror, using a pitch polisher and rouge abrasive. This brings the mirror to approximate spherical form ready for final delicate correction**

Figure 6, Below: **Ground and polished on both sides, ready to be put into its metal backing or "cell," removed to another machine in the constant temperature room underground and given final correction or "figuring"**



criterion of perfection. The degree of accuracy required by the purchaser in this case was one tenth of a wavelength of yellow light, or one 500,000th of an inch. In large work of this kind it is the practice to work within a specified tolerance, such as this, but Mr. Fecker carries the refinement to a still higher degree of accuracy. This final process, call "figuring," usually requires endless hours of the most skilled retouching, all performed underground in a constant temperature.

It is hoped that some time in 1931 the finished mirror will be functioning in the large telescope at Ohio Wesleyan University, which was made possible by the life savings of the late Hiram Mills Perkins and his wife Caroline Barkdal Perkins, the donors.—*A. G. I.*

View of St. Helens, at left, showing a group of mid-stream diversion dykes which formed a deep-water channel at St. Helens where once broad marshes prevented ships from landing

The Development of the Columbia River

By CHARLES F. A. MANN

AFTER over a half century of incessant effort by the citizens of Multnomah County and Portland, Oregon, assisted by United States Army Engineers, toward the establishment of a deep channel in the 110-mile stretch of the Columbia River that lies between Oregon's famous port and the Pacific at Astoria, the final and most important chapter of all is about to be written down—that of scraping off the last five feet of river bottom in the present 30 by 300-foot channel, in order that a deep-water canal 35 feet deep and 500 feet wide will be a stable part of the Columbia River.

Word reached residents along the lower Columbia late in 1929 that the Board of Army Engineers had approved and recommended the project to Congress, involving an initial expenditure of only 1,366,000 dollars with an annual maintenance charge of 665,000 dollars. Five feet does not seem much, but when one realizes that 85 percent of all imports of the Pacific Coast ports move in ships of greater draft than can be cared for in the present 30-foot channel, the importance is at once appreciated. Portland, together with its neighboring Columbia River ports of Vancouver, Washington; St. Helens and Rainier, Oregon; Kalama and Longview, Washington, draining vast quantities of lumber, paper, pulp, and fruit into the markets of the world—presents the paradox of a great seaport being able to export but do little importing.

THE Columbia River ranks as one of the great rivers of the world, draining some 300,000 square miles of territory in seven states and British Columbia, which is a region of heavy precipitation. It flows from glacial headwaters in the remote Columbia ice fields in north central British Columbia for 1200 miles to the Pacific.

Because of its gigantic proportions, the development of the Columbia for power and navigation, and use of its waters for irrigation, has been very slow. The great interior stretches of the river flow through vast, sparsely inhabited arid plains and past weird rocky cliffs where once countless lava flows and uplifts tore gashes and even changed the course of the river entirely. There is approximately 8,000,000 horsepower of primary and double that amount of secondary, or summer hydroelectric power available in the Columbia River. Only in the fall of 1929 were plans made for the first power plant ever to be placed on the river. It will be a 100,000 horsepower plant at Priest Rapids, in central Washington.

Because of its glacial origin, the Columbia carries vast quantities of sharp sand in its waters. In addition to this, when the hot summer sun melts the glaciers in the Columbia ice fields each year, the river floods with unusual rapidity, raising the level from 20 to 75 feet in various parts of its course. With a normal flow of about 70,000 cubic feet per second the river rises at certain times to a maximum of 1,400,000 cubic feet per second. Thus two great problems confront engineers who set out to conquer the river: silting and flooding in peculiar combination.

Scarcely 30 miles above Portland—140 miles inland from the ocean—the Columbia takes its last plunge over the Bridge of the Gods practically to tidewater. From there on, the river, known as the Lower Columbia, changes its character. It becomes wide, often sluggish, with shifting channels and innumerable sandbars. Rolling, green hills and fertile river plains in the wide lower river valley form the banks. It is in these quiet waters that the people of Portland and the lesser ports are directly interested.

Long ago navigation on the upper river, above Portland, gave way to the parallel railroad tracks on each bank, which are not affected by floods or silt and need fear no rapids, yet are able to take advantage of the matchless grade through the mountains that never is greater than 0.2 percent all the way from Spokane to Portland. This factor, together with the limitless possibilities of growth in the tributary area of Portland, long ago made one vital factor of great importance to the citizens of Oregon's metropolis: to make the Columbia River into a navigable channel. In final terms their problem was about as follows:

1. To get a deepwater channel to the Pacific.
2. To create a deep harbor in the shallow Willamette River, on the banks of which the city of Portland rises, 12 miles in from the Willamette's confluence with the Columbia.
3. To build two jetties at the mouth of the Columbia in order that the river might carry its silt far to sea, leaving ample depths over the bar at all tides.
4. To keep all bridges high above the Portland harbor and permit nothing but suspension spans with at least 200 feet clearance over the Columbia.

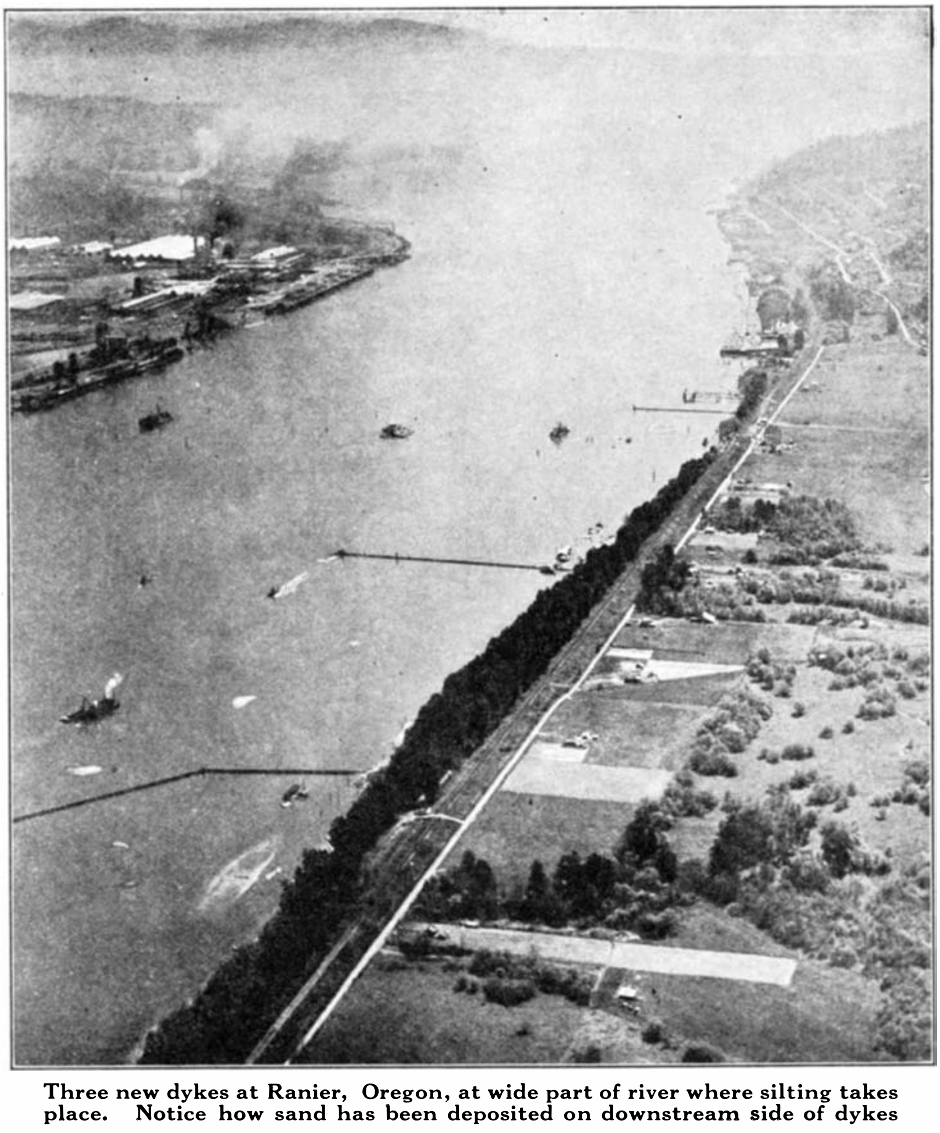
FIRST efforts by Portland citizens to get a deep channel in the Columbia began more than half a century ago. In order to clarify the method of carrying out the long series of river improvements, it is well to divide it into sections. The first section concerns the work of the Engineer Corps, United States Army, which has complete charge of the Columbia from its mouth to its confluence with the Willamette River. The second concerns the work of the citizens of Portland and Multnomah County, that of developing Portland Harbor without financial assistance from the Government through the Port of Portland Commission, and the development of public terminals through the Portland Commission of Public Docks. To the end of 1928, the United States Government had spent about 16,000,000 dollars on the two jetties at the Columbia's mouth, and 11,000,000 dollars on the 100-mile stretch of the Columbia River; the city of Portland had spent approximately 25,000,000 dollars divided about equally between harbor development and a public terminals system.

In the original state of the river, a minimum depth of about 15 feet was found, and around 20 feet at the Columbia Bar at the river's mouth. When work was first started by the Government a half century ago, the first problem to be solved was that of making the river scour its own bed free over the bar. The original plan for these jetties was first approved by the Government in 1884, but it was not until a quarter of a century later that they were finished. The south jetty is seven miles long and the north jetty two and a half. These have effectively changed the channel over the bar to a depth of 46 feet for a width of about 2500 feet and 40 feet for about 7000 feet width at mean low water. The original depths of the river were from 19 to 21 feet over a width of six miles.

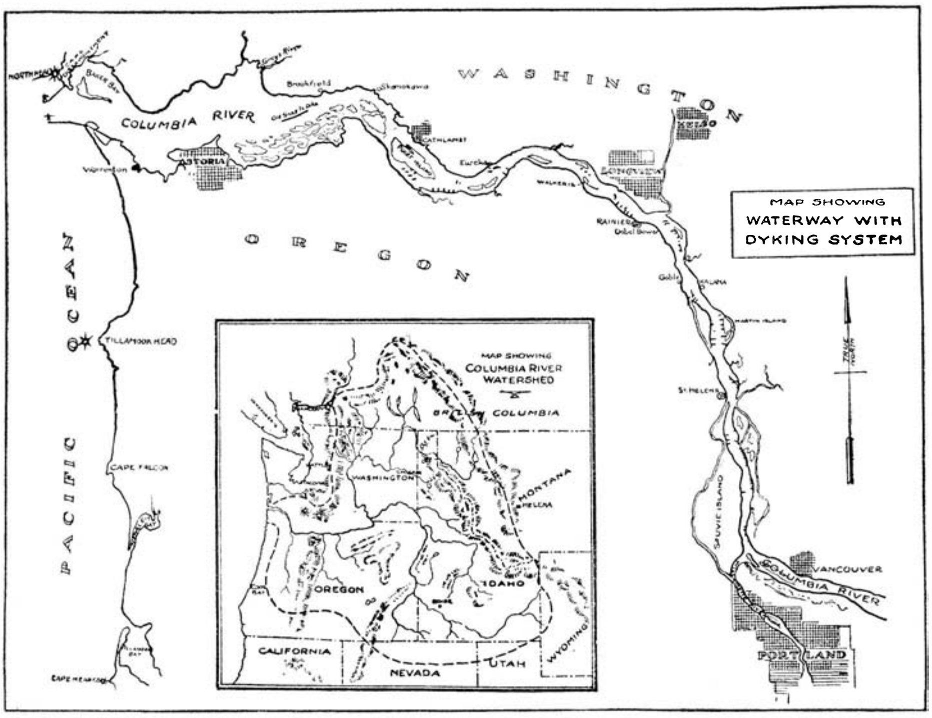
In the 100-mile stretch from Portland to Astoria, the Columbia develops shoals in about 25 places after the annual freshet in June. These are known as bars and, between them, deep pockets of safe water are found. So regular are these bars that year after year they are found in exactly the same places and after being measured are attacked by dredges and pumped away.

Ever since the long line of surveys was begun on the lower Columbia in 1878, the plan has been to make the river scour its own bars free of silt, the deposit of which varies from three to twelve feet each season, in exactly the same way as the big jetties at the mouth do. Accordingly, the primary problems of the Army engineers were reduced to two: dyke construction and supplementary dredging where dykes would not do the job.

BY watching the river closely after each flood, they have found where the shoaling takes place. As a result of this, more than 70 dykes projecting into the river at various angles have been built, which act as a contraction to the stream flow and keep the mass of mud and silt moving along the bottom. Supplementing this, after each flood from June to October, a fleet of dredges attacks the bars and brings them back to normal depth. The Portland Port Commission lends the War Department two dredges for a period of three months each year, the government paying nothing but operating expenses, to assist the regular Army dredges in speedily bringing back the proper depths before the



Three new dykes at Ranier, Oregon, at wide part of river where silting takes place. Notice how sand has been deposited on downstream side of dykes



deep-draft grain ships begin to move in October. This accounts for the abnormal rush to bring the channel back to proper depths that takes place each summer. The Willamette River does not silt in summer, but during heavy rains, it floods vast quantities of mud down from its valleys, which must be removed. Silting in the Columbia amounts to about 5,000,000 cubic yards per year.

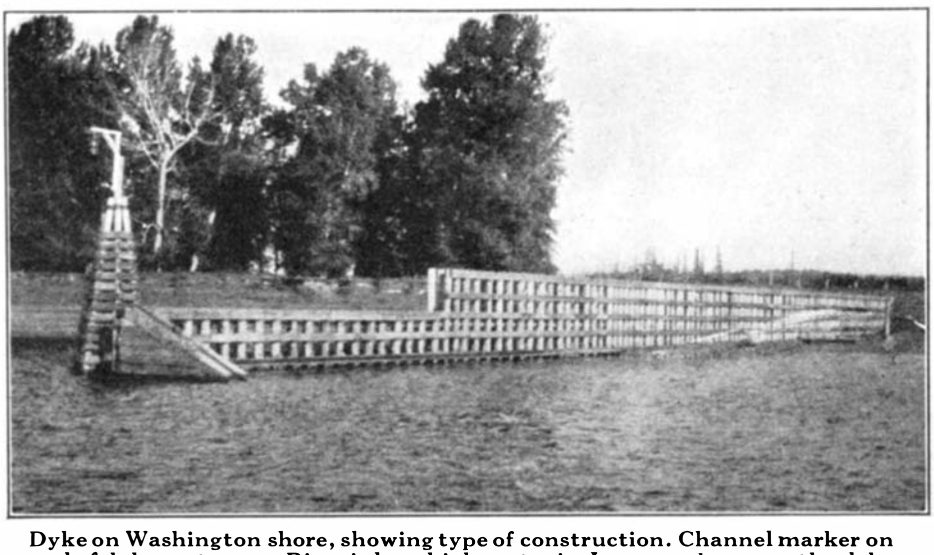
AFTER years of effort, the effect of the permeable dykes has become apparent. The channel is now stabilized and the success of the timber and rock wing dyking system has been proved. The entire project is a part of successive projects for 20, 25, and 30-foot depths approved by Congress in acts of 1892, 1902, 1905, 1913, and the foundation work of the 35-foot depth project about to be started, in 1919. With faster and deeper ships, increased dyking has had to be done to compensate for the increased cross-sectioned flow incident to dyke construction of earlier dates which deepened the channel.

In order to execute the 35-foot project, about 18,000,000 cubic yards of silt will have to be removed. In addition, 18 new dykes will have to be built and 28 extended farther into the river, amounting to 44.7 miles of Columbia channel and 11.5 miles in the Willamette. The annual appropriation of 665,000 dollars will serve to dredge away 7,000,000 cubic yards of silt and to repair dykes.

At Portland, we find the oldest quasi-public organization in the northwest, the Port of Portland Commission, at work with a fleet of four dredges, moving millions of yards of mud out of the Willamette, building its famous Swan Island Airport in the middle of its harbor out of waste silt from its dredges, filling in valuable real estate areas in the harbor, operating drydocks and towboats, and in sole charge of the entire harbor, without governmental aid in any form. Organized in 1891, the Port Commission began dredging away on its harbor, then mainly a muddy puddle between the two halves of the city. One old steam pipeline dredge—the famous *Portland*—worked 30 years at the task. Four others, ending with the 2000 horsepower twin-turbine steam dredge *Tualatin* and the giant *Clackamas*, a 3400 horsepower Diesel-electric dredge of tremendous capacity, were built. The *Clackamas* was the last dredge built by the Commission and, at the time of her building in 1925, was the most powerful in the world. She is capable of moving 20,000 cubic yards per day at a cost of about three cents per yard, and cost 850,000 dollars to build. During the two years in which the Swan Island Channel was changed to the west side of Swan Island and the famous airport built out of the waste from the dredges, the Port Commission dredges moved 39,000,000 cubic yards of material with an over-all cost of about 2,500,000 dollars. The real estate obtained by filling tide lands reduced the net cost of the entire project and gave the Commission an airport, a yacht harbor, and a new channel, all for less than 800,000 dollars! This still ranks as one of the most important dredging projects in the world.

WITH the last and most important step of all about to be taken, that of the 35 by 500 foot channel to the sea, the efforts of 50 years will at last bear their best fruits. Probably no more important piece of engineering has been done in this country than the building of a fine inland seaport on the erratic Columbia. With the hinterland yet comparatively untouched, and an enthusiastic group of boosters besieging Congress for 350,000,000 dollars to irrigate 2,000,000 acres of the Columbia Basin, the waterway will grow in importance as the years pass. Credit for the two big divisions of Columbia River development goes to Colonel G. R. Lukesh, of the Army Engineers at Portland, and James H. Pohlemus, Manager and Chief Engineer of Portland's famous Port Commission.

Another phase of the work, although not immediately concerned with channel development, is the vital problem of bridges in which approximately 50,000,000 dollars have been invested. Eight large spans cross the Willamette and two cross the Columbia carrying rail and highway traffic northward from Portland into Washington. A 6,000,000-dollar cantilever span across the Columbia between Longview and Ranier was opened in January, 1930; and a 5,000,000-dollar suspension span has been planned to cross Portland Harbor at St. Johns.

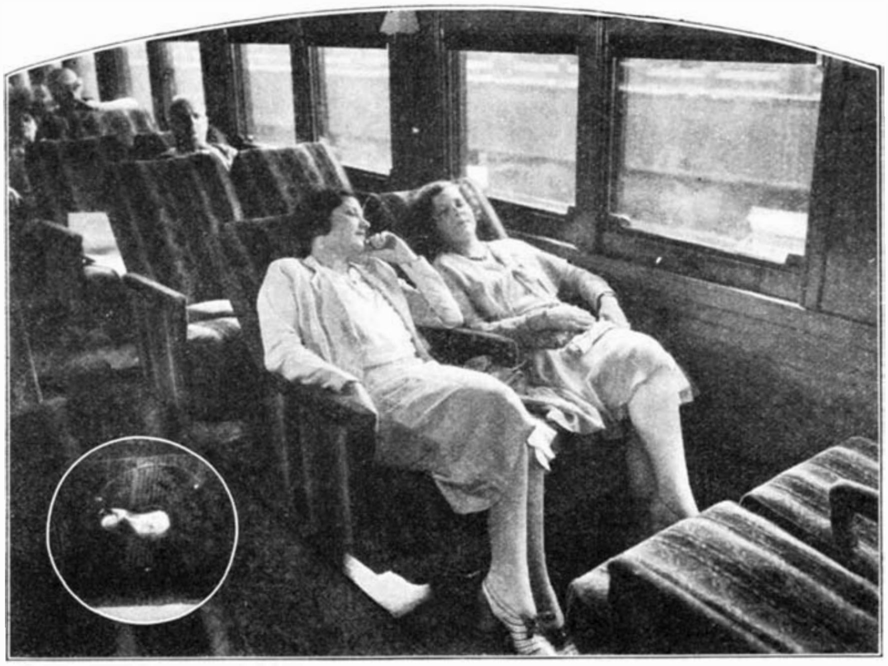


Dyke on Washington shore, showing type of construction. Channel marker on end of dyke on tower. River is low; high-water in June nearly covers the dyke

A Reclining Chair Night Coach

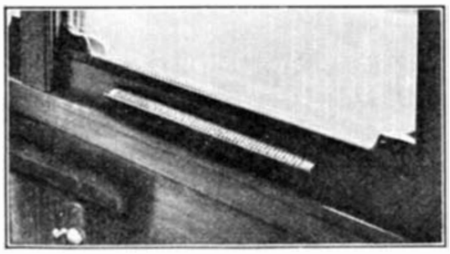
WHEN a person has to travel only part of the night, it hardly pays to take a berth in a sleeping car; some travelers cannot afford even the luxury of an upper berth. To all such, a new type of car has been introduced by the Baltimore & Ohio Railroad Company for their night trains between New York and Washington. These cars were built in the Mount Clare shops, Baltimore, Maryland. "Twin seats" in day coaches are in use on other railroads, but these new cars have many points of novelty.

THE exterior of the car shows no change, but in the interior there are many departures from normal practice. By means of cranks, each seat can be inclined independently. The arm-rests of the reclining seats are of sponge rubber composition, soft and comfortable. The middle armrests are collapsible and disappearing so they can be removed if desired, to allow children to lie down. Foot-rests are also provided, adjusted to the proper angle so that when the seats are in a reclining position, the posture of the occupant is conducive to rest. Thermostatic control is provided on each side of the car to insure even temperature throughout, and in addition there are ceiling and window ventilators. The decorations are plain and the car is finished in "living-room" style. In addition to ceiling lights, small individual night lights are provided so that those who wish to read may do so. There are separate smoking rooms for men and women, with comfortable arm chairs. The great novelty is the lunch room at one end, where simple refreshments can be obtained at all times during the long and wearisome night.

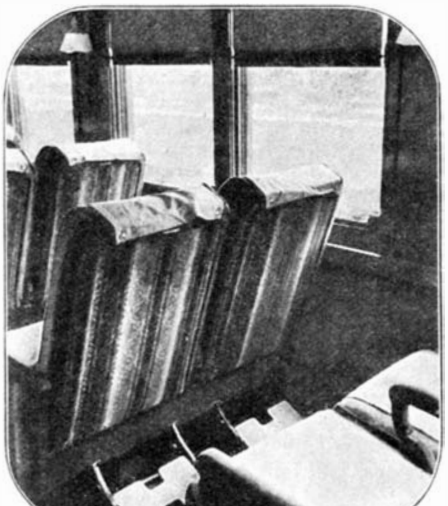


All photos courtesy Baltimore and Ohio Railroad

Each seat can be inclined independently by manipulating the cranks (insert). Windows have ventilators and a night light is on the side wall over every other seat



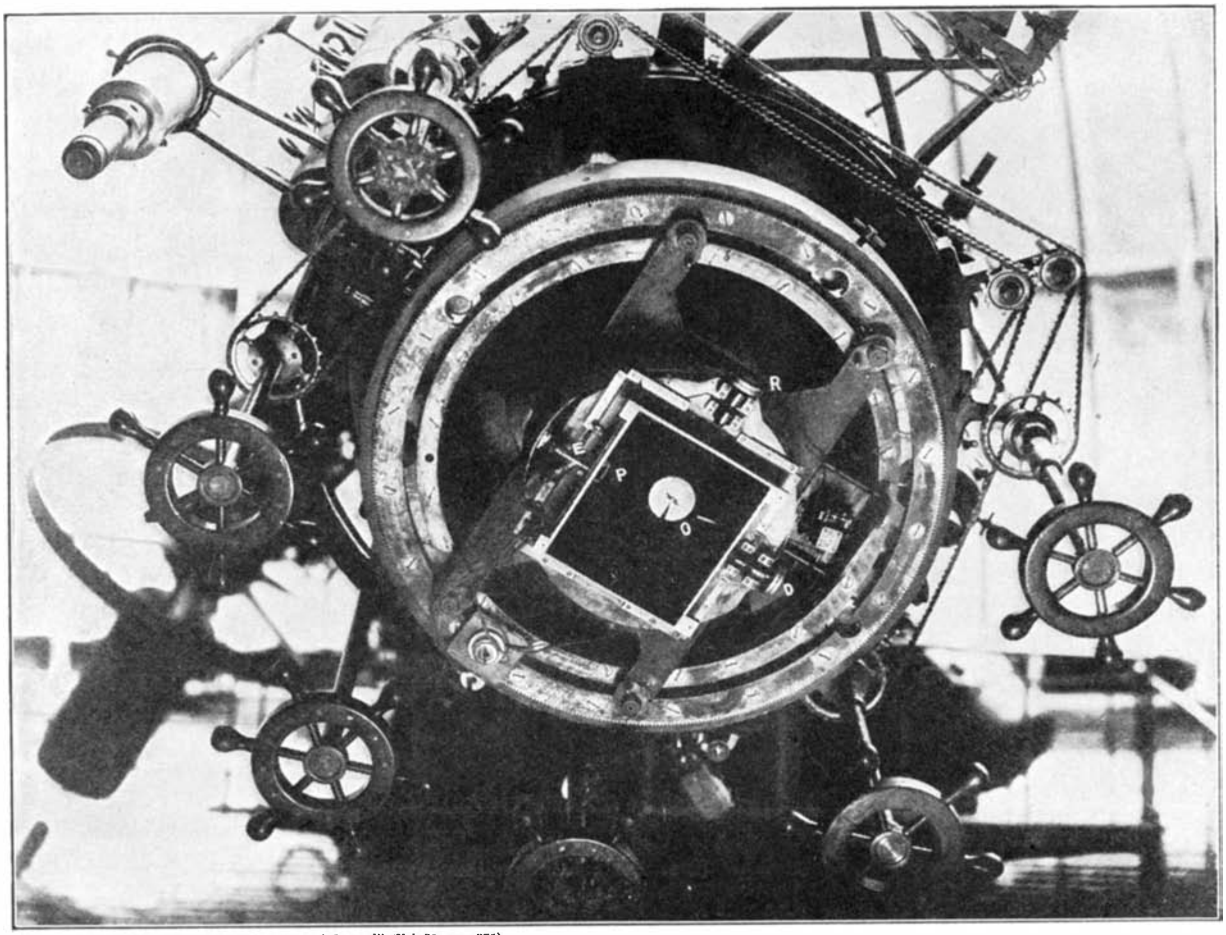
The window ventilator is a novelty. The air filters in through screens which arrest the cinders. Car windows are notoriously obstinate and here is the solution. The chair position crank is seen below



***Above:* The foot rests are adjusted to the proper angle so that when the seats are in a reclining position the posture is most rest producing**

***Left:* Women need no longer "bootleg" smokes, for a comfortable compartment with real chairs is provided for their use**

***Right:* This is not a "diner" or a "broiler" but it is a real lunch counter, where beverages, fruit, and sandwiches can be obtained**



Courtesy Yerkes Observatory; also "Astrophysical Journal" (Vol. 32 page 375)

Figure 1: **Professor Schlesinger's occulting disk or rotating sector invention attached to the 40-inch Yerkes refractor, for use in star distance measurement. The nearly square central object is the 8 by 10 photographic plate holder. O is the disk adjusted to a V-shaped opening (small object at center of disk is an adjusting wingnut.) P is the prism described in the text, and E the guiding eyepiece with crossed spider webs inside. R and D are the two guiding screws**

Measuring the Distance to the Stars

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

SIR ROBERT BALL, who illuminated his admirable lectures with recurrent flashes of his native Irish wit, used sometimes to say, "Astronomy consists of sitting up all night and doing arithmetic all day." No truer picture of the life of the working astronomer was ever compressed into a sentence. All that need be said in addition is that some astronomers specialize in the sitting up, some on the arithmetic, while some divide their energy between the two.

An excellent example of the third sort of work is found in the measurement of the distances of the stars. This has become in recent times distinctly an American field of work and may well claim our attention for a few moments. The principle involved is the simplest. Look out across the room through a window at the world without, then move your head a few inches from side to side. As you do so the window bars will seem to shift to the right as you move to the left, and *vice versa*. It is exactly such a shift of nearer objects, compared with those at a distance, which we use to measure the distances of the planets and the stars, only we call it by the Greek name of "parallax." Obviously, the nearer one sits to the window the more the window bars will seem to move across the landscape (for the same motion of one's head) and, if one can measure the apparent shift, the simplest sort of geometry gives their distance. Exactly the same principle is used in the range finders which are so important in military and naval gunnery.

TO apply this principle astronomically we must have two things: a shifting base moving by known distances, and a distant background against which we can measure the parallactic shift. When we are working on the moon or the nearer planets we change our base simply by making observations from different parts of the earth, or by the cheaper process of letting the rotation of our planet carry us around it. When we must deal with the stars we need a far longer base line. Fortunately we have one, provided by the earth's motion in its orbit, which takes us alternately 93,000,000 miles on one side of the sun and on the other, and so gives us a base of double this length. Even with this long base the parallactic shift is measureable only for a small minority of the stars. The rest are so far distant that their displacement is imperceptible.

This is no unmixed evil, for we may employ the multitude of faint stars which cloud the heavens as the background, the standard of reference; which is the other prime necessity of the method. Theoretically it is not quite an ideal standard, for even these remote stars must show a small parallactic shift compared with an absolutely fixed background. But, practically, this makes no trouble, for we have means, based largely on the sun's motion in space, of finding the average amount of this tiny shift and can then allow for it.

When it comes to the application of these principles to the actual measurement of star distances we meet with various difficulties. The first is that the stars do not stay still to exhibit their annual shift, but move across the heavens. By extending our observations over two or three years, however, we can easily find out the rate of this "proper motion" for each star and allow for it. More serious is the fact that the shift due to parallax is very small, so that our observations must be extremely accurate. This difficulty again has been fairly well overcome by the use of large telescopes and, above all, by the photographic method of observation.

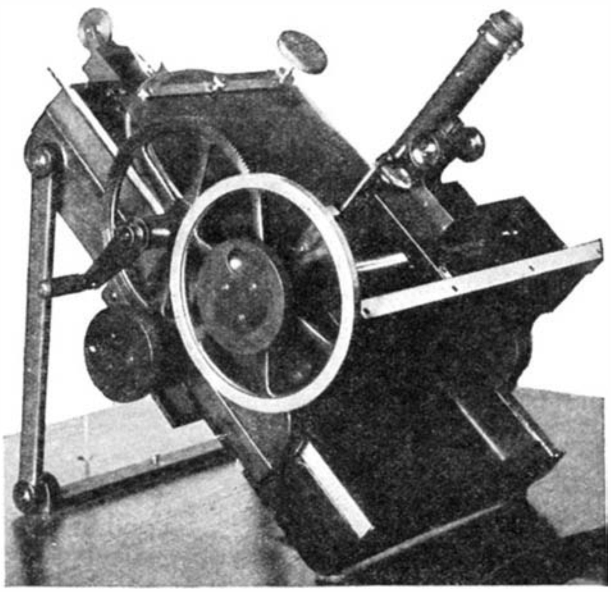
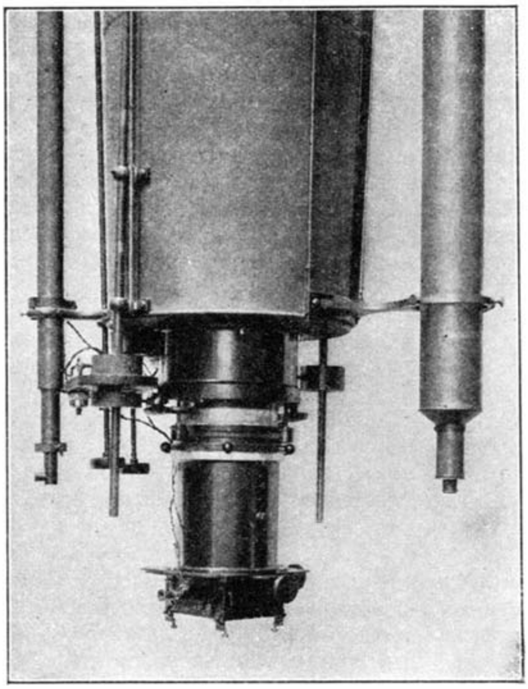


Figure 2, Right: **Gaertner machine for measuring parallex plates. A microscope, movably mounted above the plate on a very accurate, horizontal low-pitch screw, is spotted over the star's image, with the aid of its cross hairs. The accurately divided index head at end of screw facilitates measurement to 1/25,000 inch**

Courtesy Yerkes Observatory

Figure 3, Below: **Double slide plate holder of the 26-inch refractor at Leander McCormick Observatory with which Professor Mitchell's work was performed. Note small guiding eyepiece at left and guiding screws at right**

Courtesy Prof. S. A. Mitchell



ONE of the most unexpected discoveries of modern precise astronomy was that it is possible to make more accurate observations with a given telescope by photographing the stars and measuring the positions of their images on the plates than by measuring the stars directly with a micrometer attached to the telescope. Until the thing was actually tried no one had any idea how precisely the photographic film preserves the record of the position of the images which impress themselves upon it. In ordinary modern practice the average error of position of a single star image is less than a 10,000th part of an inch. Considering the vicissitudes through which the gelatine film has gone during the processes of development, fixation, and drying, this is really extraordinary.

However accurately the plate records the positions of the star images, it must be measured under the microscope, employing some form of micrometric device (for example, as in Figure 2), and it may still seem strange that this two-stage process yields better results than does the micrometer directly applied to the telescope. The most probable explanation is that, owing to the irregularities of atmospheric refraction, the star images in the telescope are continually oscillating and dancing about. In visual observation the observer sets his spider thread on the images and catches them at some one moment. The plate automatically averages the effect of the oscillations of the image during the whole length of the exposure (usually several minutes) and thus gains a considerable advantage. When it comes to measuring the positions of several stars in the same field the photograph has the still greater advantage that its record is simultaneous for all, while the visual observations must be successive and are subject to different errors in each case.

Photographs, therefore, have quite ousted all other methods in parallax work, but the observer is only at the beginning of his troubles when he has set up his telescope and got his lenses into proper adjustment. In the first place his instrument should follow the diurnal motion of the stars in the heavens so perfectly that the image of a given star throughout the whole time of the exposure falls exactly on the same spot upon the plate. Even the best driving clocks do not quite meet this severe requirement, and of course they can not follow at all the irregular motions of the images caused by refraction. To meet this need the parallax observer has the plate holder mounted on the telescope in such a way that it can be moved up and down or right and left by two delicate screws. (Figure 1 at D and R; also Figure 3.) Just outside the plate holder and clamped to it is an eyepiece (E, Figure 1), adjustable in such a fashion that the observer may bring into it the image of some faint star. Before he begins his exposure he brings this star on the cross hairs of the eyepiece. Then, watching with the eye of a hawk, he notes the slightest deviation of this image and brings it back by turning one or both of the screws which move plate holder and eyepiece together. An experienced observer in this way may get rid of most of the "errors of guiding" which otherwise might vitiate the positions of his star images. As a result of this care the images will all be small, clean and round. If by any mishap they are not, the plate will be rejected and not measured.

TO get good images, however, we need not only careful guiding but correct exposure. Under-exposed images are gray and diffuse; over-exposed large, fuzzy, and ill-defined—and neither sort can be measured accurately. When the star whose parallax we are seeking is faint, this causes no extra trouble. A trial plate or two shows what length of exposure is necessary to get good images of this "parallax star," and among the other stars which appear on the plate it is practically always possible to find enough of about the same brightness to serve as the "comparison stars" which furnish the requisite background.

But the parallax star may be a bright one—perhaps even Sirius itself—while the only available comparison stars are a hundred or even a thousand

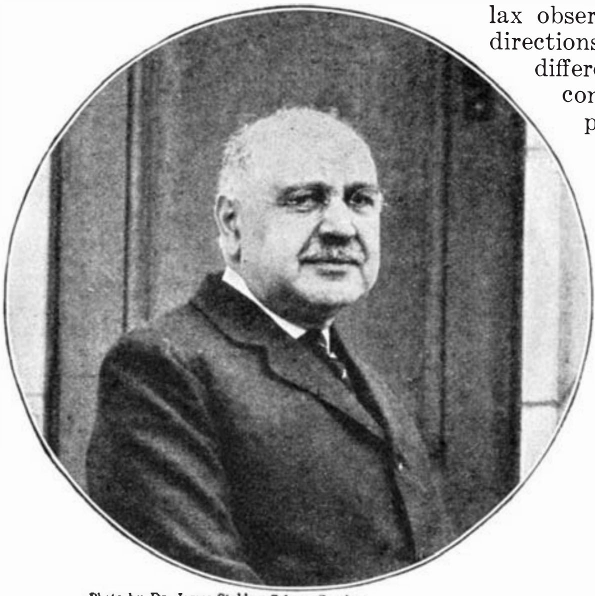


Photo by Dr. James Stokley, Science Service

Professor Frank Schlesinger, Director of Yale Observatory, whose parallax work was done at Yerkes and Allegheny Observatories

times fainter. Obviously, some means must be found to cut down the light of the one without obscuring the others. This is usually done by the aid of an "occulting disk" an inch or so in diameter (Figure 1, O). This consists of two parts which can be set so as to leave a narrow open sector of any desired width from 1 degree to 180, while blocking out the rest of the circumference. This disk is mounted close to the front of the part of the plate where the image of the parallax star falls and is rotated rapidly by a tiny motor or by clockwork. If the opening in the sector covers only 1/50th of the circumference, the parallax star will be given intermittent exposures which will total 1/50th that given the fainter comparison stars which receive a continuous exposure.

WITH this apparatus the image of even a very bright star may be reduced to apparent equality with those of its faint neighbors without losing the advantage resulting from the averaging effect of a large number of exposures under different conditions of trembling of the images. This method has been completely successful, with the result that observations of stars as bright as Sirius made with its aid are found to be as accurate as those of faint stars which do not need it.

Still another danger, and the most subtle, remains. The images of the stars are raised in the heavens by refraction, and more for white stars than for red ones (by the same influence which produces the "green flash" at sunset). If our parallax star and comparison stars are not of the same color (as very often happens) this will shift the one relatively to the other. So long as this spurious shift is always in the same direction and of the same amount it will not trouble the parallax observer, but if it is in different directions at the same time of his different observations it may become confused with the true parallactic shift in such a way as to vitiate his results. To be safe, therefore, he must observe any given star always when it is in the same position in the sky, preferably on the meridian, so that the error due to refraction may always be the same.

When all these precautions are taken, a set of from 12 to 20 photographs made at the proper times during an interval of two or three years, will give a determination of the parallax with the probable error less than $0''.01$, which exceeds in precision any other angular measurement.

Parallax work is a strenuous occupation. To get the shift in one direction the stars must be photographed in the evening as soon as it is really dark—which is easy; but every such plate must be matched with one showing the opposite shift taken at some other time of the year and in the morning hours just before dawn. To carry on the careful work of precise "guiding" without a moment's relaxation of the tension through these weary hours is "sitting up" with a vengeance, even if the observer has left the instrument to another worker during the middle of the night and sought a well deserved rest—and it is rarely that the size of an observatory staff permits such a relief.

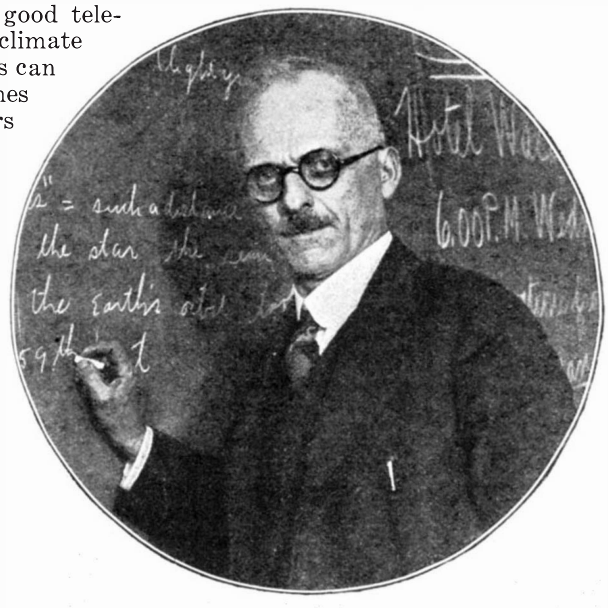
Measuring the plates, after they have been developed and passed as fit for it, is a job for the daytime and for a good light, and consumes a great deal of time. Indeed, one good telescope in a fairly favorable climate and with assiduous observers can secure plates two or three times as fast as these observers could work them up. Fortunately the measurement, like most routine work, can be entrusted to assistants and this is true *a fortiori* of the computations, which are simple but interminable when thousands of plates have to be discussed.

The pioneer of this photographic method was the great Dutch astronomer Kapteyn, who first pointed out the importance of accurate guiding and the way to avoid the errors due to refraction. The methods which are at present employed are mainly due to Schlesinger of Yale, who first used the rotating disk upon bright stars and devised the very convenient methods of calculation which are now employed by almost all workers in the field.

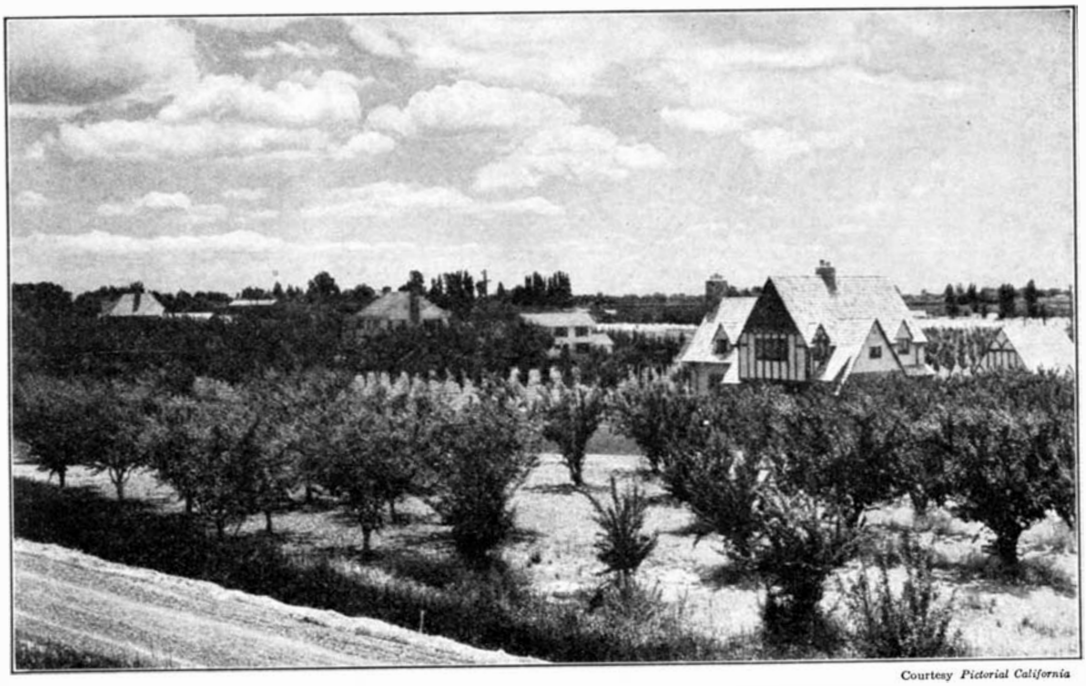
Most of these workers are Americans. First in productivity is Professor Mitchell, Director of the Leander McCormick Observatory of the University of Virginia, who recently has been the guest of his colleagues at other observatories in celebration of his completion of determinations of parallax for no less than a thousand stars! (See page 247.) This record is the more noteworthy since it comes from an observatory possessing a telescope of moderate size, as great instruments now go, and very modest resources. Moreover, the telescope is a visual one and therefore slow in photographic work. Only the persistent devotion for a long term of years of the director and a loyal corps of colleagues could have secured this remarkable result.

NEXT in order comes the Allegheny Observatory where, at first under Professor Schlesinger and later under Professor Curtis, more than 850 parallaxes have been determined. Smaller but very considerable lists, each about 300, have been observed at Mount Wilson, Yerkes, Greenwich, and the Sproul Observatory of Swarthmore College. The promising and almost untouched field of the southern hemisphere is now being worked both at the South African station established for the purpose by Yale under the direction of the veteran Schlesinger and at the Cape Observatory.

Arduous as the work is, and dull as some parts of it may seem to one who merely reads about them, it has a curious fascination.—*At anchor, off Mitylene.*



Dr. H. D. Curtis, Director of Allegheny Observatory at Pittsburgh, who also has measured many star distances and made inventions


Courtesy *Pictorial California*

Where once were the worthless tule marshes along the Sacramento River, are now found prosperous farms, luxuriant orchards, and beautiful homes—wealth for everybody everywhere

Marsh Delta Lands Become Rich Farms

Gyp corn, a dwarf type, grows to nearly double height—seven feet

ONE of the most fertile regions in California is the Delta area (usually called the "Delta lands") in northern California, just a few miles west of Sacramento, the capital city. The tule marshes along the Sacramento River were long considered worthless but have been developed in recent years into most fertile farm and orchard land. Until the engineers constructed levees, drainage canals, pumping plants, and other flood protection, the Sacramento and San Joaquin Rivers spread out over the entire area during annual spring floods, depositing new layers of silt. Water for irrigation now comes from the rivers and the surplus water is drained and pumped back into them. Soil rich with the humus of centuries, abundant water, and a splendid climate all unite to make this one of the most fertile spots in the United States. The crops are very diversified and include asparagus (a 10,000,000 dollar crop). The rivers and paved highways serve to bring all the crops to market or to the great canneries at strategic points.

Asparagus is a splendid crop in Delta lands, worth $10,000,000

Celery is grown on seven thousand acres in the Delta lands and much of it is crated in the field itself

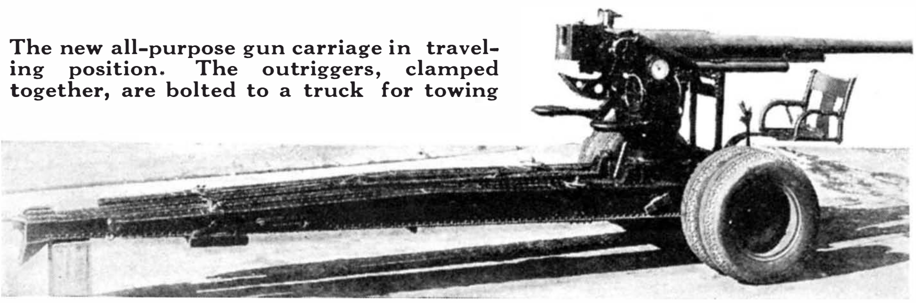
Cutting asparagus in the irrigated fields. Much of our best canned asparagus comes from this locality

Our Army's New Super-Weapon*

By MAJOR G. M. BARNES
Chief, Design Section, Watertown Arsenal, Watertown, Massachusetts

DEVELOPMENTS during and since the war are tending to render the existing field artillery matériel obsolete. It is a well known fact that new field guns and carriages of the division, corps, and army types have been built since the war which are greatly superior to the war types in that the guns give greater ranges. However, the matter is more serious than that, since none of the war types and few of the post-war types of artillery will meet the new demands which will be required of them in future wars.

High-speed targets in various forms are gradually entering the field of fire of all types of field guns, such as the new high-speed trucks used as prime movers for artillery and for carrying infantry, and tanks having cross-country mobility and speeds heretofore unthought of. But even more menacing than the high-speed tanks and trucks are the many types of aircraft, carrying bombs and machine guns, which may swoop down upon the infantry or artillery without warning.



The new all-purpose gun carriage in traveling position. The outriggers, clamped together, are bolted to a truck for towing

It is well known to all field artillery officers and other officers, and civilians as well, who have given thought to the problem, that the present types of field artillery, as exemplified, for example, by the famous French 75-millimeter gun, are wholly incapable of dealing with these high-speed targets. Few of the carriages for these guns permit sufficient elevation for firing at aerial targets, or have sufficient speed in traversing or elevating.

Unfortunately, not only the guns and the carriages but also the fire-control instruments which have been developed for use of field artillery, are wholly unsuitable for use against high-speed moving targets. The fire-control instruments used by a field artillery battery have been developed on the principle of keeping this equipment as light and as simple as possible. Practically all firing data must be computed slowly and laboriously by the personnel of the battery. It will be at once evident that such methods are found lacking when attempting to fire guns continuously at moving targets.

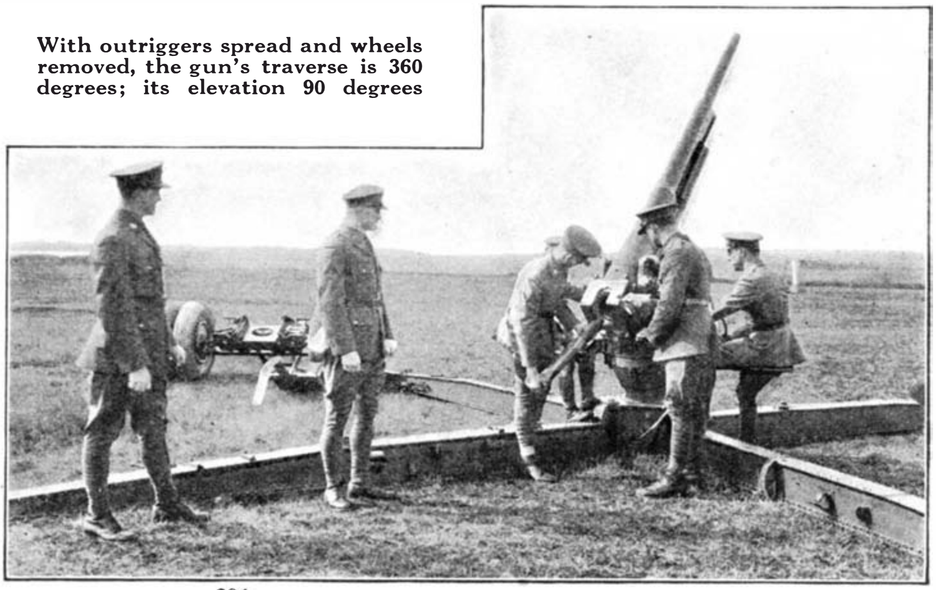
With luck, a battery of divisional guns might destroy a high-speed tank, but there could be no assurance of the same result using the present types of field carriages and fire control. It would be absolutely impossible to bring effective fire upon an airplane traveling at a speed of 100 miles per hour or more, and to attempt it would be purely a waste of ammunition. The present methods of fire control are being adhered to although the increased ranges of the post-war guns necessitate refinements in fire-control instruments and methods.

Furthermore, practically all existing field artillery carriages, up to this time, are defective from the standpoint of modern high-speed transportation in that they cannot be hauled at speeds greater than about 15 miles per hour without seriously damaging the gun carriages and their mechanisms. All the artillery of the World War period was limited in this respect since it had been designed with the idea of using horses or the slow-speed tractors available at that time for tractive forces. Since the war, trucks have been built which are capable of hauling gun carriages at high speed. Commercial development makes it imperative that gun carriages of the future be so constructed that these high speeds can be taken advantage of, not only on good roads, but when the gun carriages are trailed across country.

THESE new conditions, thus briefly outlined, call for field artillery of a new type. The present ideas concerning fire control must be revised and the fire-control equipment of the battery must be augmented so that these batteries can bring effective fire against stationary ground targets, and can also be used effectively both against rapidly moving ground targets and, with equal accuracy and facility, against high-speed targets in the air.

A new type of field-gun carriage which has been developed with the idea of meeting the new requirements referred to above, was completed recently at Watertown Arsenal. This carriage mounts the high velocity 75-millimeter gun (muzzle velocity 2175 foot-seconds) which gives a maximum range of 15,000 yards with a 15-pound

With outriggers spread and wheels removed, the gun's traverse is 360 degrees; its elevation 90 degrees



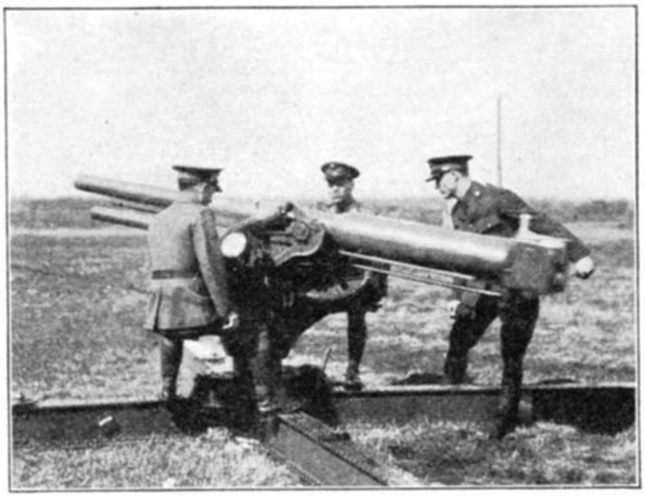
*Reprinted through the courtesy of *Army Ordnance* projectile for high or low altitude.

The new carriage has been equipped with wheels mounting balloon tires and having roller bearings at the hubs. The design is such that either single or dual tires can be mounted. The newly developed puncture-proof inner tubes are used. While the dual wheels and tires increase the weight of the gun carriage about 400 pounds, it is believed that tests will show the advantages of having the additional tire contact area. Furthermore, the two additional wheels and tires may be considered as spares, in which case, if one of the tires were punctured, the vehicle would not have to stop. The increased ground contact area will make it possible for the vehicle to pass through sand and soft mud. The construction is such that the gun carriage proper is carried on the wheels and axle as a spring load.

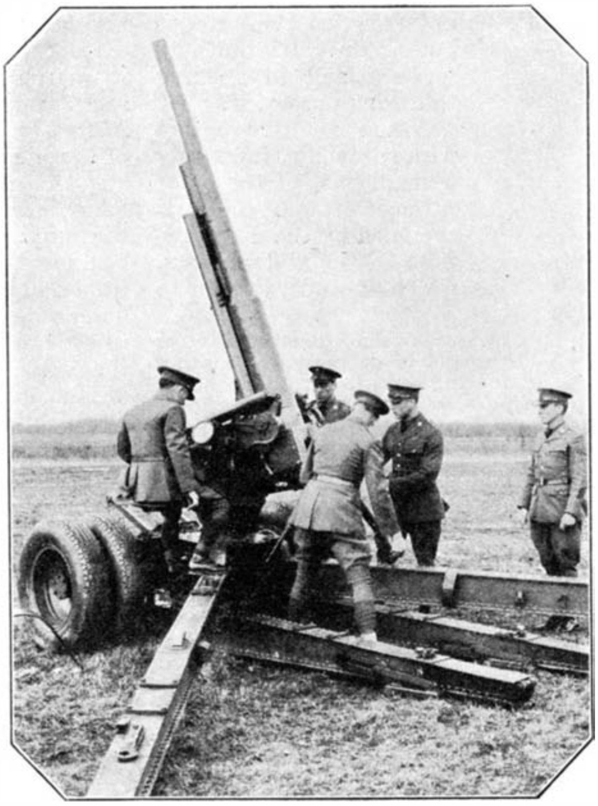
The gun can be fired by opening out the rear trails and supporting the front part of the carriage by means of the two spare trails. Two outriggers with built-in screw jacks are placed on the ground under the carriage pedestal.

WHEN in place, the screw jacks are tightened against the bottom of the carriage; thus the vertical component of the firing load enters the ground through these two outriggers which serve to protect the balloon tires, roller bearings, and the spring suspension from the firing load. The gun can be fired in this manner through an angle of traverse of 90 degrees and at elevations from 0 degrees to plus 80 degrees.

If all-around fire is desired, the carriage can be put in a second firing position. In this case, the two outriggers are used as levers for raising and lowering the carriage. The wheel and axle assembly can be removed quickly from the pedestal of the gun carriage and the latter lowered to the ground. The two spare outriggers are then put into place to complete the base for the carriage. In this position, the gun can be fired through 360 degrees of traverse and at angles of elevation from 0 degrees to plus 80 degrees.

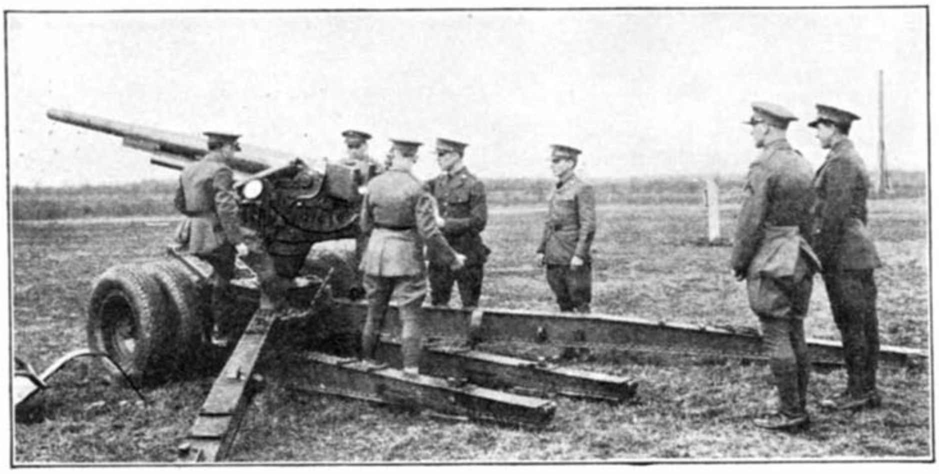


Firing position of the 75-millimeter gun, 360-degree traverse and 15-degree elevation, in full recoil



In arsenal trials, using untrained men, the carriage was put in the first firing position (for 90 degrees traverse) from the traveling position in one minute, and in the second firing position (for 360 degrees traverse) from the traveling position in four minutes.

It is believed that such a gun carriage fully meets the requirements which were outlined at the beginning of this article. The weight of the gun and carriage in the firing position is 5800 pounds, or nearly twice that of the low-velocity 75-millimeter gun carriage of the World War type. However, assuming a four-inch penetration of the tires into the ground, the area of the tires in contact with the ground is 832 square inches as compared with 194.6 square inches for the French 75-millimeter field gun, M 1897, equipped with steel tires, and the ground pressure is 6.9 pounds per square inch as compared with 13.7 pounds per square inch for the French gun. Thus it will be seen that the new carriage will undoubtedly possess greater cross-country mobility than the lighter carriage.



In center of page the mount is arranged for 90-degree traverse and 60-degree elevation for anti-aircraft firing. At bottom of page, the gun has a 90-degree traverse and an elevation of 15 degrees for firing at speedy land targets. In both cases, the balloon tires, the roller bearings, and the springs are protected against shock of recoil by the special type of construction

THIS low weight for a high velocity, all-around-fire carriage with dual balloon tires, brakes, and spring suspension, is made possible by taking advantage of steels of high physical qualities, of a new welding process which has been developed at Watertown Arsenal, and by making parts of the carriage, where possible, of strong aluminium alloys having one third the weight of steel. This carriage is equipped with the anti-aircraft type of elevating and traversing mechanisms, employing roller bearings throughout. All blacklash is eliminated, making it possible to lay the gun with an accuracy of ½ mil on either elevation or azimuth.

Fitting of fire control equipment to this new gun mount is still in the experimental stage and somewhat too technical for discussion here.

Basic Patents in Evolution—III

By WILLIAM K. GREGORY

Professor of Vertebrate Paleontology, Columbia University. Curator, Departments of Anatomy and Ichthyology, American Museum of Natural History. Member of the National Academy of Sciences

(*Concluded from September*)

TURNING now to the history of the pelvis and hind limbs, we have already noted that in many respects their origin was similar to that of the pectoral limbs, that is, they first appeared as keels or ridges supported by basal rods and operated by extensions of the segmental muscles of the body-wall (Figure 13). Much later they became paddle-like and finally when bent downward (Figure 14) were able to support the weight of the body and to co-operate with the pectoral limbs in pushing the body forward. But the pelvic limbs and the pelvis itself differed widely in their functional associations with surrounding parts and consequently they acquired conspicuous anatomical differences from the pectoral limbs. In the first place, the pelvis corresponds only to the inner or primary shoulder-girdle and it never had any system of sheathing plates attached to it. Secondly, the pelvis was associated with the lower ends of the digestive tract and of the tubes that discharged either eggs or living young in the female or the sperm of the male (Figure 13).

THUS the pelvis arose around the cloaca or common opening of the digestive and reproductive tubes and served as a base or platform of the following sets of muscles: first, those that ran forward along the lower surface of the abdomen; second, those that ran backward along the outer and under sides of the tail (Figure 15); third, for a cone-shaped mass of muscles based on the pelvis and converging outward and downward to form the thigh muscles.

The ilium, or upper branch of the pelvis, at first grew upward between the muscles of the back in front and the tail muscles behind. As it grew upward it passed to the outer sides of the ribs, which were at first entirely free from it. Gradually, however, certain of the ribs became tied by connective tissue and ligament to the inner side of the ilium and when this happened an indirect connection was established between the hind limbs and the backbone. Thus the hind limbs soon acquired great importance both in thrusting the body forward and in steering the front part of it.

In the primitive reptiles with sprawling limbs only a small part of the outer surface of the ilium is occupied by the deep portions of the gluteal mass, which ran outward on to the top of the femur. But when the limbs were drawn in toward the sides of the body in the primitive mammals, the gluteal muscles acquired great importance in holding the body upon the femur when the opposite leg was lifted off the ground. Hence, that part of the outer surface of the ilium which gave rise to these muscles became enlarged in accordance with their increasing importance (Figure 14, D, F, G, H, I).

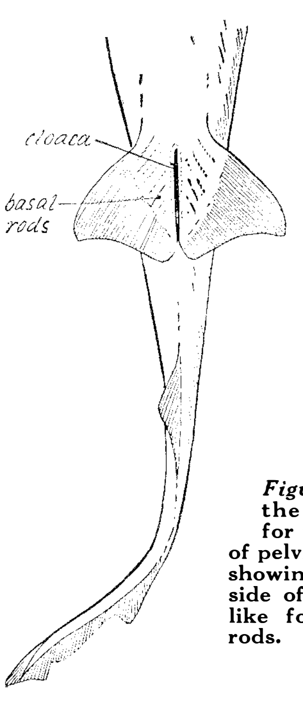


Figure 13: **The basic invention of the pelvis or bony foundation for the hind limbs. Under side of pelvic region of primitive shark, showing the pelvic fins on either side of the cloaca; they are keel-like folds supported by skeletal rods. Drawing from specimen**

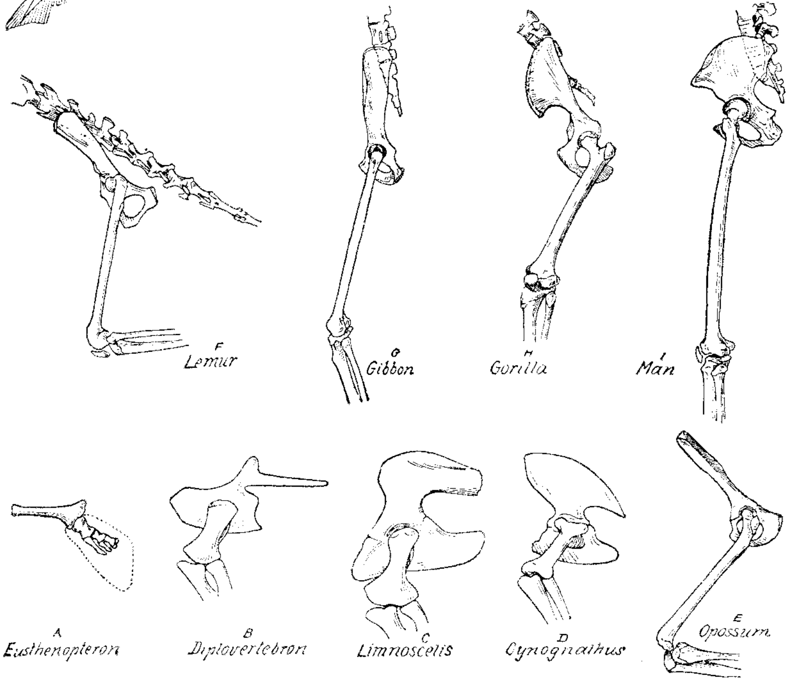


Figure 14: **Series showing progressive outward growth of ilium from fish to man. (A) Lobe-finned ganoid (*Eusthenopteron*) of the Devonian period; (B) *Diplovertebron*, early tetrapod; (C) primitive reptile (*Captorhinus*); (D) advanced mammal-like reptile (*Cynognathus*); (E) primitive mammal (opposum); (F) primitive primate (lemur); (G) gibbon; (H) gorilla; (I) man. This series of drawings was made chiefly from models and specimens in the American Museum of Natural History at New York**

In the early mammals when the knees were drawn forward the ilium also grew forward almost parallel with the backbone (Figure 14, E), to which it was now attached by means of the sacral vertebrae and their ligaments. At first in the mammals the upper part of the ilium was trihedral, that is, triangular in cross-section, its three surfaces being occupied respectively by the muscles of the upper side of the backbone, by the iliacus muscles in front and by the gluteal muscles on the outer side. When the primates began to sit upright (Figure 14, G), resting themselves on their folded-up legs and on the lower ends of the pelvis, the iliac muscles served to check them from falling backward, while the gluteal muscles prevented them from falling forward. Hence with the increased size of these two sets of muscles the blade of the ilium began to grow outward in a transverse plane, the chief successive steps in this broadening process being recorded in the lemurs, monkeys, apes and man (Figure 14, F, G, H, I).

In the first section of this article we saw that in a primitive quadruped the body is slung between two suspension towers, which are the pectoral and pelvic girdles. The gibbon of the East Indies (Figure 16) has succeeded in turning this suspension bridge up at right angles to its original horizontal position and in balancing it on its rear tower, represented by the pelvic girdle. In other words, in the gibbon Nature has already worked out the basic invention for upright or bipedal progression on the ground. This great step in advance is seen first in its viscera, which approach the human type in a number of ways, and, secondly, in the details of construction of its pelvis.

But how did the gibbon learn thus to run on its hind legs? The answer of comparative anatomists is that the first step was the habit of sitting upright and the second was the habit of brachiating, or climbing with the arms raised above the head and the body suspended beneath the branches. The habit of sitting upright, as we have seen, conditioned the first steps in the remodelling of the pelvis, especially the flattening of the ilium in the transverse plane. The habit of brachiating conditioned the extension to and upon the upper border of the ilium of certain muscles of the loins and abdomen, which thus found themselves in a better position to support the viscera, pelvis, and hind limbs when the body was suspended from the arms. But the gibbon is no longer content merely to climb deliberately with his forearms; he makes enormous leaps from one branch to another one in the distance, and in taking off for the leap he can extend his thighs backward so that they may be nearly parallel with the backbone; whereas in a quadruped, with its backbone in the horizontal position, the thigh is but rarely extended so far backward. The result of this habit of the gibbon is that when it comes down on the ground to walk it has no difficulty in extending the thighs downward parallel to the backbone.

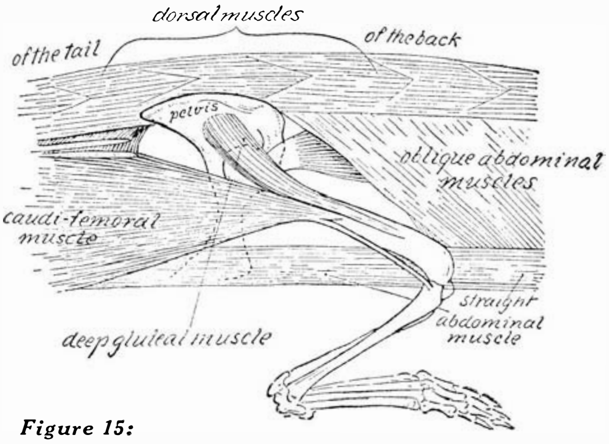
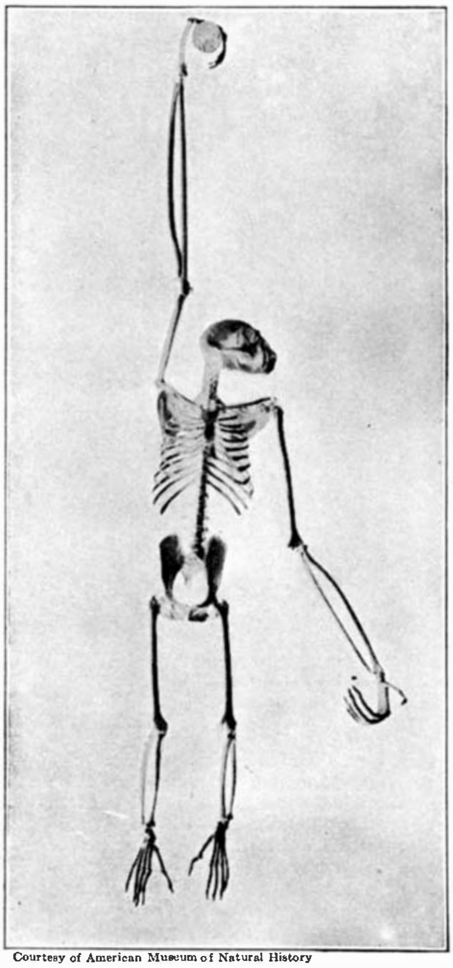


Figure 15:
Pelvic musculature of a crocodile. After Romer, 1923



Courtesy of American Museum of Natural History

Figure 16: **The ape that solved the problem of walking upright. Skeleton of gibbon from the East Indies**

But is there any reason to suppose that our own remote ancestors, which from all the evidence of comparative anatomy were admittedly related to the anthropoid stock, learned to walk upright on the ground only after a long course of instruction in brachiating in the trees? The answer is, yes, since the human skeletal and muscular systems, as well as the brain and viscera, still retain abundant traces of a brachiating, arboreal stage that immediately preceded the stage of upright walking on the ground.

IN the first place, the entire shoulder-girdle, arm, and hand of man are far more nearly approached by those of the brachiating anthropoid apes than by those of any other known animals living or extinct, and the same is true when we compare the pelvis and hind limbs of the two groups. It is truly surprising that, although the pectoral limb of the anthropoids is chiefly an organ of locomotion, while that of man is used almost exclusively for carrying or manipulating objects, in spite of this great functional difference the anatomical resemblances between the forearm of man and those of the gorilla and the chimpanzee are such as to amount almost to identity, while the differences are limited chiefly to differences in the lengths of the corresponding segments of the hand and arm. Thus the hand of the chimpanzee, for example, is much longer than that of man, at least in proportion to the body size, while its thumb is notably degenerate in size; yet the humerus, radius, and ulna closely resemble those of man and the same is true of the bones and muscles of the hand. These fundamental resemblances between man and anthropoid are well brought out in Figures 17 and 18.

Objection to the derivation of man from brachiating ancestors has been made on the ground that the habit of brachiating in the anthropoids has led to the use of the hands merely as hooks and to the consequent degeneration of the thumb; also that the mobile hand of man with its well developed thumb could never have been derived from a brachiating type. The answer to this line of argument may be sketched* as follows: first, that it is not necessary to attribute to the common ancestors of man and the anthropoids the extreme specializations of either of their descendants—and indeed all the available evidence indicates that while the thumb of the chimpanzee has been reduced, that of man is a progressive structure which has experienced an increase in adjustment with its increased functional importance. Secondly, the evidences of both hand (Figure 17) and foot (Figure 18) indicate that the remote ancestors of man were primates of arboreal habits, with hands and feet more like those of the gorilla and the chimpanzee than like those of ordinary monkeys; also, these are the only known kinds of hands and feet that would work well with the particular forms of shoulder-girdle, arm, pelvis, and hind limb, which upon quite other grounds there is good reason to attribute to the common ancestors of the anthropoids and man.

In short, from the point of view of comparative anatomy, these and many other resemblances between man and the anthropoids are due neither to chance nor to "convergent evolution," because they are too numerous and too detailed. They can mean only that both man and anthropoid have descended from a common ancestral stock which was already brachiating, yet was perhaps somewhat less specialized in this way of climbing than is the chimpanzee.

IN conclusion, the chief "basic patents" in the locomotor apparatus in the long ascent from fish to man appear to have been as follows:

(1) The appearance of the striped muscle fiber, under the control of the nervous system. This is the stage attained by many invertebrates.

(2) The building up of these muscle fibers into zigzag muscle segments separated by tough partitions of connective tissue. This is the stage attained by *Amphioxus*.

(3) The assumption of a stream-line body-form, propelled by lateral undulations caused by the rhythmic

* For a fuller presentation of the evidence, see the author's papers in the Proceeding of the American Philosophical Society, 1926, Vol. LXVI, pp. 439-463; 1928. Vol. LXVII, No. 2. pp. 129-150; No. 4. pp. 339-376.

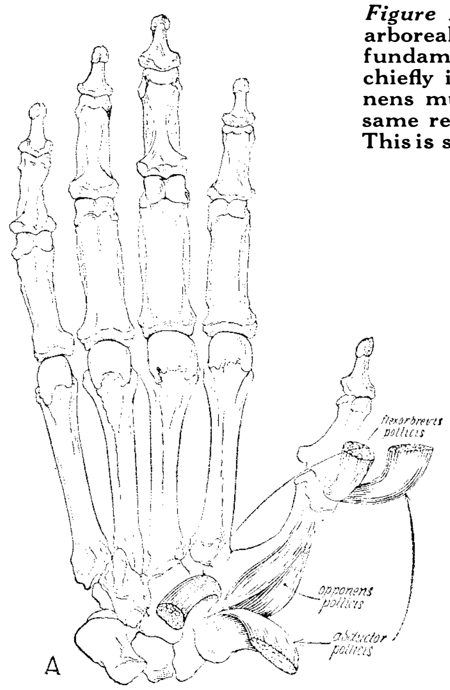
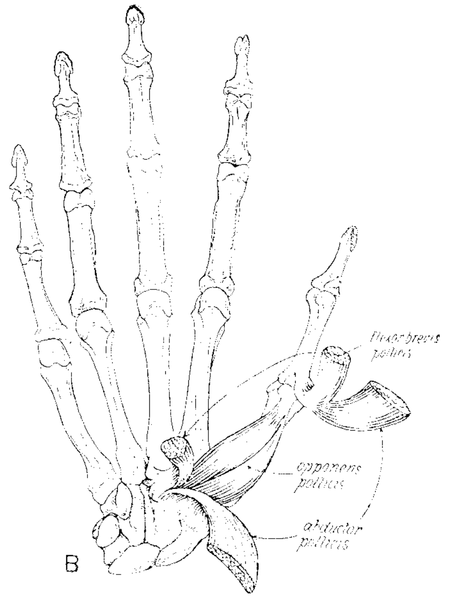


Figure 17: **The testimony of man's hand as to his arboreal origin. Man's thumb, it will be seen, is fundamentally similar to that of the gorilla, differing chiefly in its relatively greater length. The opponens muscle is present in the gorilla and has the same relations to surrounding muscles as in man. This is shown in the drawings. (From Gregory, 1928)**



contraction of the muscle segments. This is the stage attained by *Amphioxus* and the oldest ostracoderms.

(4) The development of an axial skeletal system laid down at the points of greatest stress at the intersection of the primary and secondary septa, between the muscle masses. This is the stage attained by the shark.

(5) The development of an appendicular skeletal system, beginning in the form of keel-like projections of the body-wall, supported by segmental cartilaginous rods, as in the oldest sharks; from these rods evolve gradually the skeleton of the paired fins, the shoulder-girdle, and the pelvis, successive stages being seen in the different sharks.

(6) The operation of the paired fins by muscles that were originally derived from the segmental muscles of the body-wall but which soon became organized into a definite system consisting of a dorso-medial group above and behind the pectoral paddle, and a ventro-lateral group below and in front of the paddle. A similar system develops simultaneously in the pelvic fins. Different stages in this development may be observed in the sharks, lobe-finned fishes and early amphibians.

(7) The development of freely movable paired paddles with a fan-shaped skeleton from the keel-like ridges already mentioned. Stages of this development are observable in sharks and lobe-finned fishes.

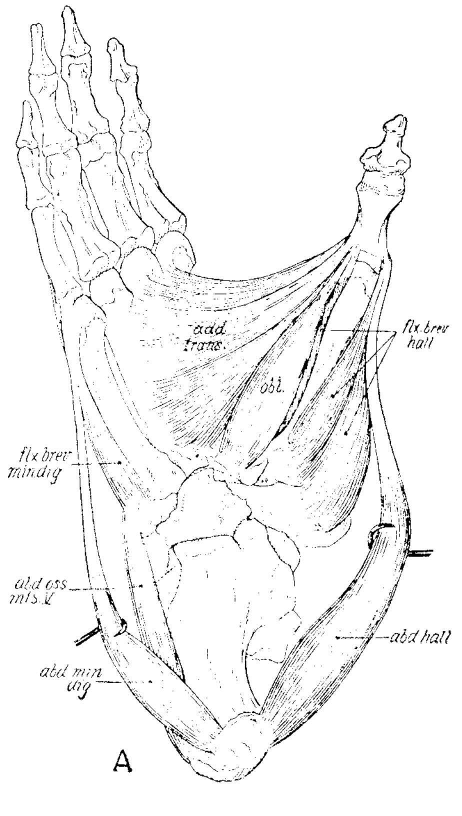
(8) The remodeling of the paired fins and shoulder-girdle of some early lobe-finned fishes after they had "learned" to turn the fins downward and to use them to assist in wriggling along on land.

(9) The development of the "double suspension bridge," by which the weight of the body was supported between one U-shaped and one V-shaped sling made from the pectoral and pelvic girdles respectively. This is the stage of the oldest known tetrapods.

(10) The development of a connection between the V-shaped pelvis and the backbone. This stage was attained by later tetrapods.

(11) The raising of the body off the ground and the drawing inward of the feet, elbows and knees. This stage was initiated in the mammal-like reptiles, perfected in the mammals.

(12) The invasion of the trees and the establishment of the habit of sitting upright. This stage is observable in the lemurs and monkeys.



(13) The development of the habit of brachiating, or climbing with the arms extended above the head and the body suspended from the arms, by which were acquired very many prerequisites for erect, bipedal progression on the ground. This stage is seen in the gibbon.

(14) A marked increase in size of body, which became too heavy for comfortable climbing in the trees, and the gradual abandonment of tree-living in favor of upright, bipedal progression on the ground. This stage is today observable in the gorilla and was with high probability passed through by our own ancestors. The gorilla, however, is now becoming secondarily quadrupedal.

(15) A profound readjustment of the viscera and of many parts of the skeleton to secure more favorable arrangements for supporting the body in the upright position. The early stages in this transformation have already been passed by the gibbon, chimpanzee, and gorilla. The later stages are now observable in man.

Although many details as to the "basic patents" that led up to man's present locomotor apparatus remain to be worked out, it is unlikely that we can be very far off in the foregoing sketch of the main stages, because much consistent evidence of the evolution of the jaws, teeth, skull, brain, and so forth is already on record.

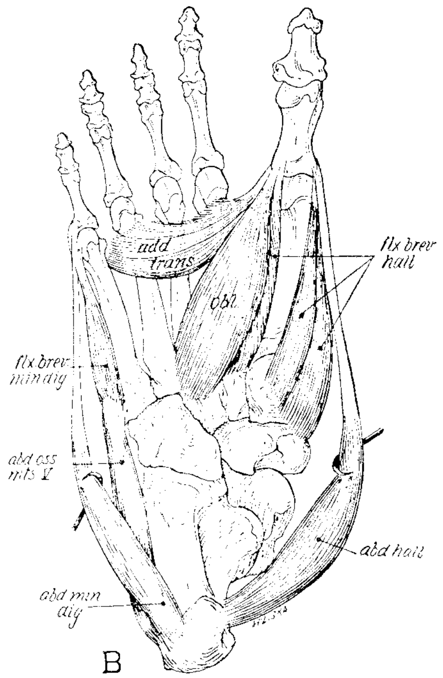
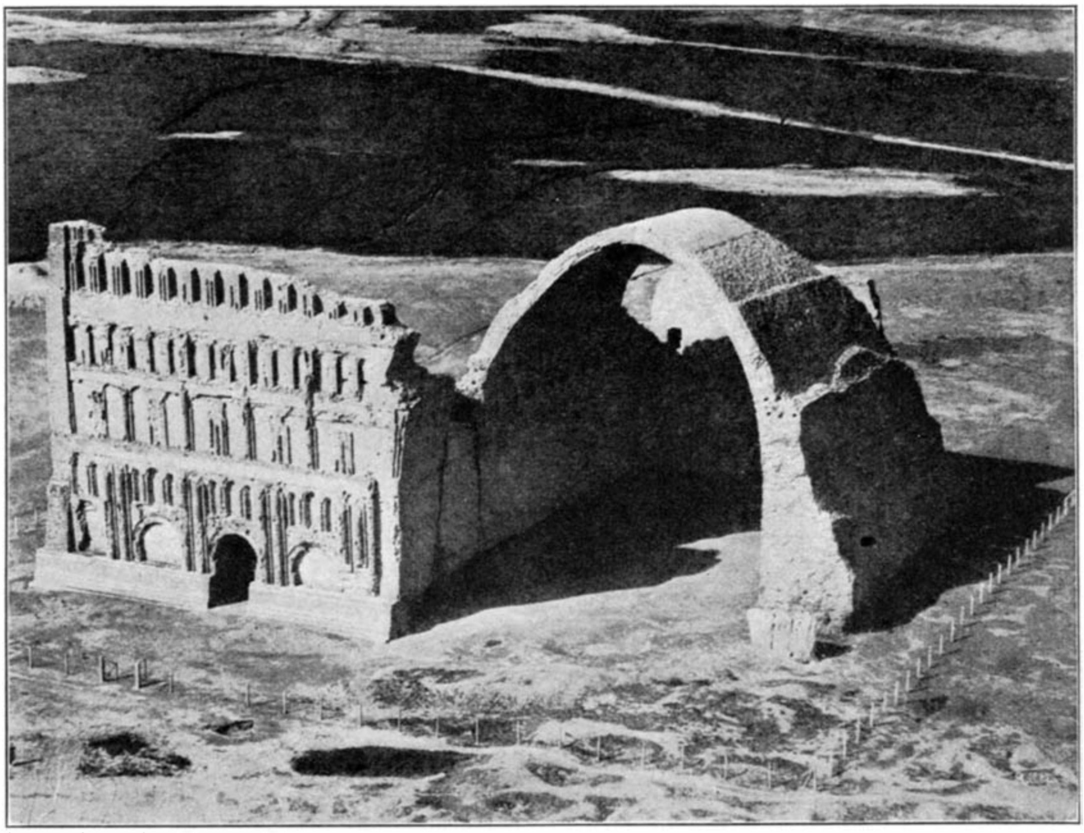


Figure 18: **The testimony of man's foot as to his arboreal origin. Externally the sole of a human foot superficially resembles that of a bear, but internally its construction is an evident modification of the "biramous" type, with a grasping great toe. In spite of the almost exclusive use of the human foot for walking on the ground, the great toe is operated by muscles that evidently correspond closely with those of the gorilla foot, as is shown. (From Gregory, 1928)**



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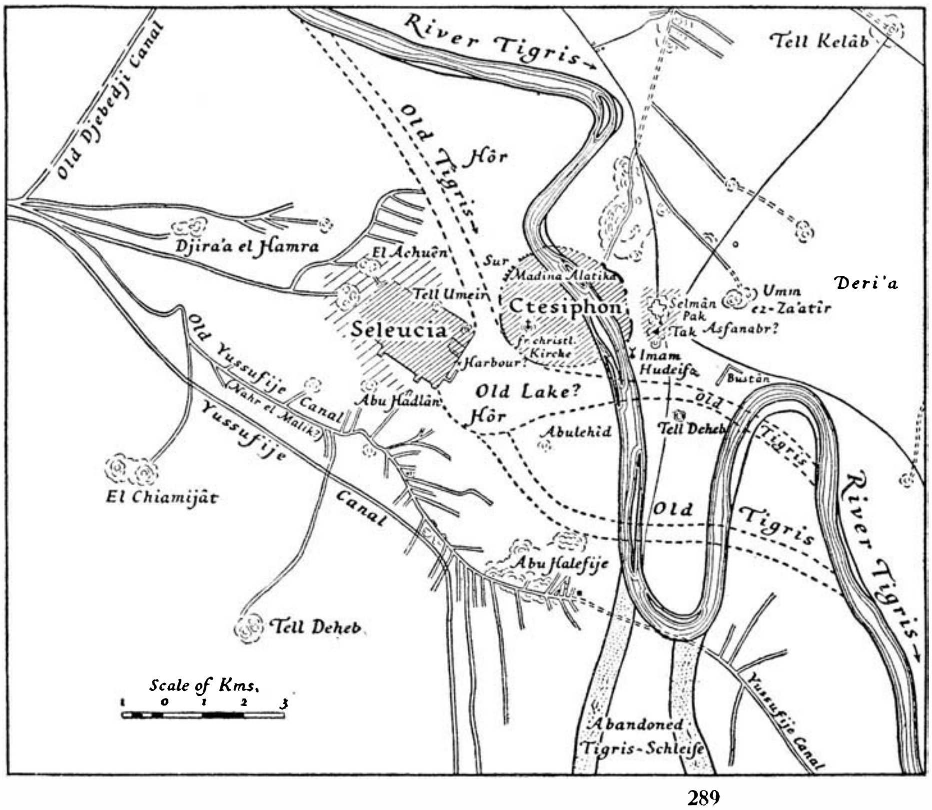
Ctesiphon was an ancient city of Mesopotamia, about 25 miles southeast of Bagdad. The principal remains are a magnificent arch of the Sassanian period. The Neo-Persian Empire was founded in A.D. 226 and was destroyed by Arabs in 637. A tremendous battle was fought here on November 21, 1915

Ctesiphon, A Magnificent Fragment

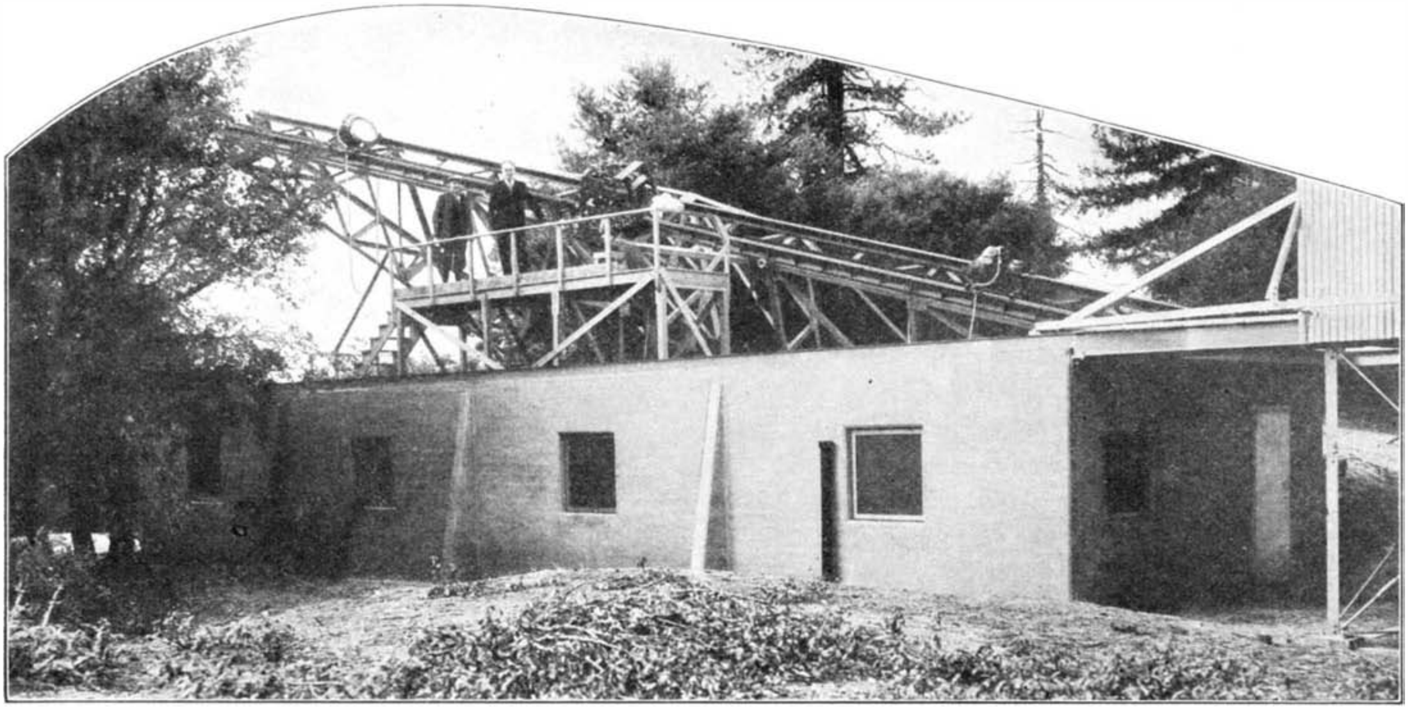
IN the autumn of 1928 a German archeological expedition began to excavate the site of Ctesiphon, the capital of the Sassanid Empire. Here was a great battleground where the conflict raged on the Euphrates and Tigris between East and West, between the Orient and Hellenism. For a thousand years Seleucia was an outpost of conquering Greece in the East while Ctesiphon was the center of Sassanian royal power. Both were symbolic of the two conflicting worlds. Our esteemed contemporary *Antiquity* publishes an interesting account of the painstaking excavations and the results thus far obtained. Our readers probably will be most interested in the gigantic barrel-vaulted hall of the royal palace of Ctesiphon. The date is probably somewhere between 531 and 579 A.D.

The main front of the edifice is 312 feet long, the height is 115 feet and the depth is 175 feet. The great hall has an elliptical barrel vault 86 feet wide and 163 feet long and is open in front. The springing of the vault is 40 feet from the ground. The brick courses are horizontal and project inwards as they rise, so that the actual width of the vault portion is only about 71 feet. The crown of the vault is nine feet thick. It was probably built with centering. Being located on an alluvial plain no stone was available so brick was employed.

The best view of the noble ruin is from the air and now that the authorities of Iraq permit archeological investigations and air flights we may look for further discoveries made by means of aerial photographs.



Map of the district around the rival cities Ctesiphon and Seleucia. The former was the center of Sassanian power, the latter an outpost of conquering Greece in the East. In time, both cities fell



The new 50-foot interferometer tipped about one hour east. The outer diagonal flat mirrors stand about 35 feet apart. The lower half of the housing is of concrete, the upper half is a metal shed (see page 293)

The New Fifty-foot Stellar Interferometer

By F. G. PEASE
Mount Wilson Observatory

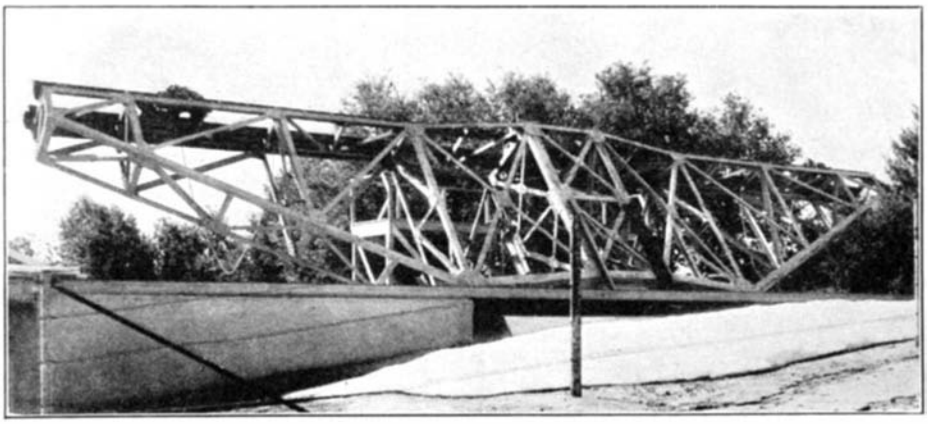
THE star image formed at the focus of a telescope is not a point but consists of a bright central disk surrounded by several dark and bright rings known as the diffraction disk. No known star except the sun has an angular diameter large enough to appear as a real image in existing telescopes, that is, its actual disk can not be seen, consequently one can not measure its diameter with an ordinary micrometer.

Fizeau pointed out that it might be possible to measure the true angular diameter of stars with a stellar interferometer. This instrument utilizes the principle of interference long familiar to physicists wherein two pencils of light radiating from the same small source are brought together again, forming a series of bright and dark bands called "interference fringes."

In the stellar interferometer the star image has the same appearance as it does in an ordinary telescope except that it is crossed by a series of parallel dark bands, that is, the interference fringes. Each point in a star produces one of these interference patterns. If the star is very small in angular size the fringe patterns all lie directly on top of one another and are clear and sharp. If a star of larger angular diameter is chosen each point in it produces a pattern which is displaced a little with respect to the original one, thereby reducing the clearness or visibility of the fringes. A still larger star may be selected in which there may be so many overlapping patterns that all the dark bands disappear and just the ordinary image remains. Two radio sets receiving from the same studio will blend well, but two sets receiving from adjoining studios emitting different modulations, even though the wavelength be the same for both, will not blend but will have only sound as a result.

IN the stellar interferometer we take advantage of the disappearance of the fringes to measure the star's diameter. Mathematicians have computed that when this occurs $a = 1.22\frac{\lambda}{D}$ where a is the angular diameter of the star in radians and λ the wavelength of the light and D the separation of the centers of the two pencils of light.

Since no existing telescope was large enough to give complete disappearance of the fringes Michelson devised a periscopic attachment consisting of four plane mirrors mounted on a stiff frame which is placed on the end of the telescope. Two outer mirrors inclined at 45° face upward, and throw the light to two inner mirrors which are inclined at 45° facing downward, directing the light into the telescope. The outer mirrors move simultaneously on slides to equal distances from the axis of the telescope.



The bridge of the new nine-ton instrument from the north side

The distance to the star from the focus of the telescope over the two paths must be the same to within a very few wavelengths of light, otherwise the fringes will not appear at all. Owing to flexure of the telescope, atmospheric variations, and slight errors in setting the mirrors it is convenient to use an optical compensator just in front of the eyepiece, with which the distance may be equalized.

As an illustration of the practical application of the interferometer method let us turn the 100-inch telescope with its full aperture on Rigel and no interferometer attached to it. We see in the eyepiece a bright image without surrounding rings, since the atmosphere rarely permits their presence in the 100-inch. Placing a canvas over the end of the tube and cutting a hole in it seven inches in diameter whose center lies 47 inches from the axis we see an image very much fainter but larger in size showing diffraction rings.

READERS who keep up with science doubtless will recall the striking confirmation, made in 1920 by means of the Michelson-Pease interferometer, then new, of the prediction that many of the stars were immense beyond conception. The giant star Antares, for example, was found to be 400,000,000 miles in diameter and Betelgeuse 250,000,000 miles. The brilliant work was what might fairly be called a legitimate scientific sensation.

What the interferometer really did was to measure the diameter of a star, not in miles, but in fractional degrees of arc. The diameter in miles was then derivable from this by trigonometry, since the distance to the chosen stars ("parallax") already were known. How the interferometer actually measures the angular diameter of a star can not be explained here. The interested reader is requested to see Russell, Dugan and Stewart's "Astronomy," pages 740-748, which covers it adequately and understandably in theory and practice.

To measure more stars a larger instrument has been needed. Now, ten years later, it has been built and Dr. Pease, who had much to do with its design and construction, was invited to describe it for our readers.

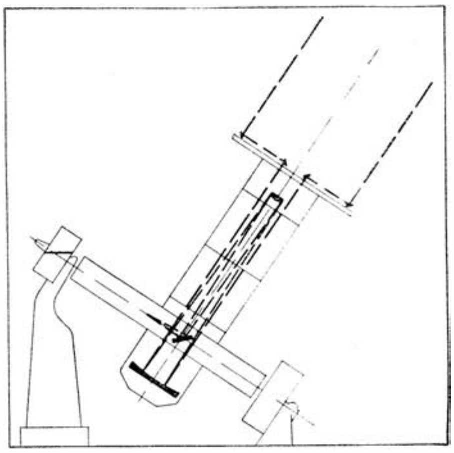
—*The Editor.*

CUTTING a similar hole in the canvas diametrically opposite, that is, with centers of the openings 94 inches apart, we see an image twice as bright crossed with parallel dark bands. With good atmospheric conditions the image appears single but if the seeing is poor the two images vibrate about a common center. Let us now turn to Betelgeuse. To our surprise we see the bright diffraction image but the fringes are not sharp and distinct. Covering these last two openings and cutting in their stead two others 45 inches apart the fringes become almost as prominent as on Rigel.

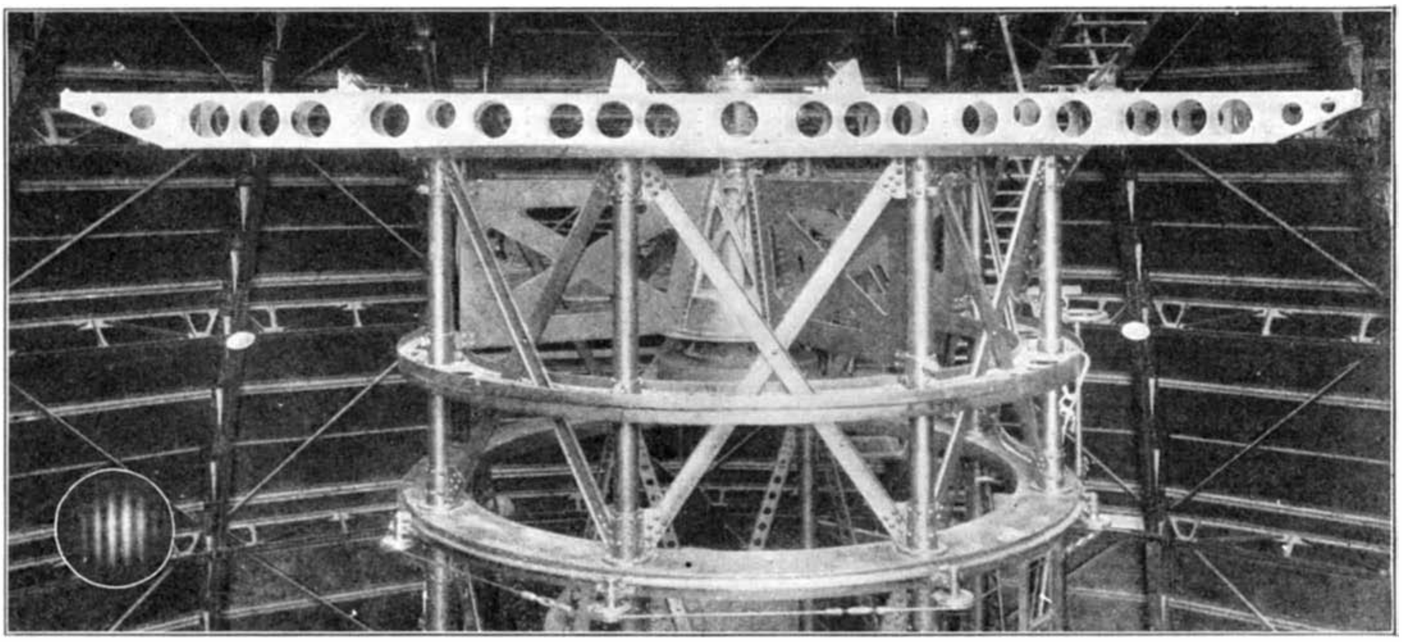
We next place the large steel beam carrying the four diagonal plane mirrors on the end of the 100-inch tube, using the crane, since it weighs about 800 pounds. The canvas will be left over the end of the tube, as the light from the inner mirrors will pass through the openings 45 inches apart. We next set the outer mirrors 110 inches apart and turning to Betelgeuse again, we adjust the compensator until the fringes appear. We have to look very carefully for them because when they do appear they are very weak, the dark spaces having almost disappeared. Shifting the outer mirrors to 120 inches we are unable to see any fringes regardless of how long we search for them. Turning the telescope to Rigel the fringes are found almost immediately and appear as crisp as they did when the apertures were closer together.

Taking the separation of the mirrors D as 120 inches, or 305 cm, and λ as 5.75×10^{-5} cm, we find that a equals 2.3×10^{-7} radian or 0.″047 arc, the angular diameter of the star. The angular diameter of Betelgeuse appears to vary irregularly; there are days when the mirrors must be moved 14 feet apart in order to cause disappearance of the fringes.

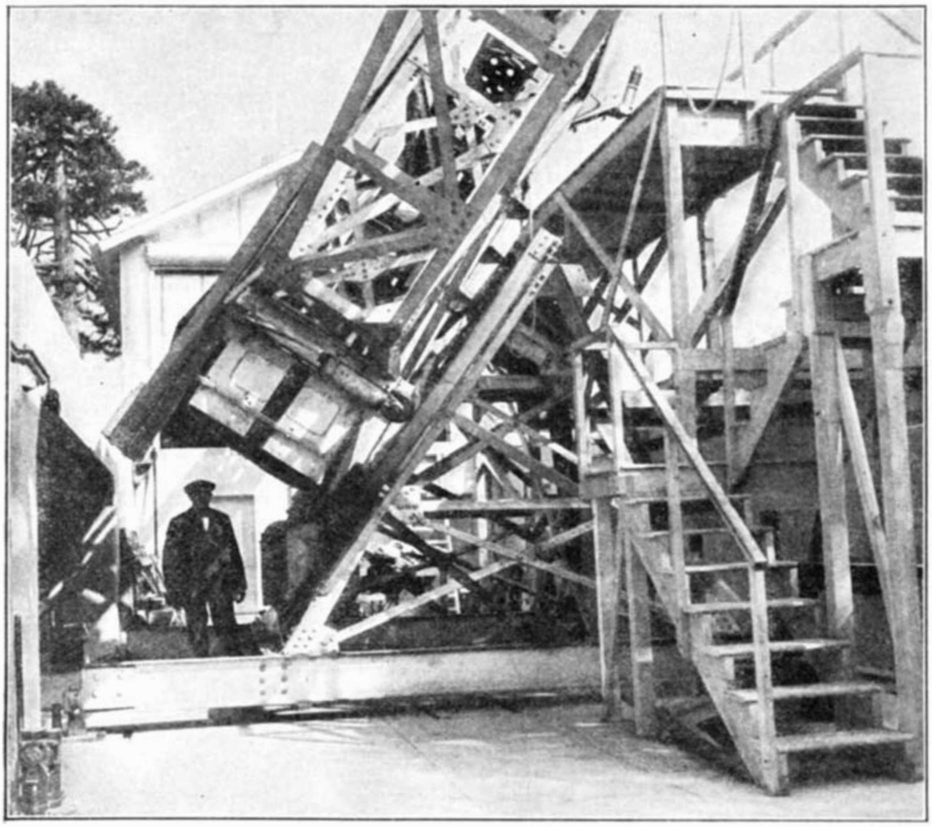
The minimum angular diameter measurable with the 20-foot interferom-



How the earlier, 20-foot interferometer was employed—attached to the 100-inch telescope. Two pairs of diagonal flat mirrors gave it, in effect, a spread or aperture of 20 feet, instead of the 100 inches of the telescope. The diagram shows the light path of two rays



The old 20-foot interferometer beam bolted to the end of the tube of the 100 inch reflector. The two inner mirrors remained fixed but the outer pair could be moved inward or outward. The circular holes in the bar were merely to save weight. *Insert, lower left:* Typical appearance of the interference fringes, a series of bright and dark bands



Pedestal and lower part of the "bridge." The 40-inch main mirror in its cell is above the man's head (Ladd, machinist). Opposite his shoulder is the worm and sector drive. One of the rollers is visible higher up. The slanting polar axis shows beneath the peak of the main supporting A-frame

eter is 0.″024. The diameters of Arcturus and β *Pegasi*, which are slightly smaller than this, were found by plotting the visibility curve for various mirror separations and determining D from the extrapolated curves for zero visibility.

The diameters of stars measured with the 20-foot instrument were of the same order as those found by indirect methods. All of the stars measured were "late" type stars.

In order to measure stars of "earlier" types which have smaller angular diameters it is necessary to have a larger interferometer. Accordingly the new 50-foot interferometer has just been built at the Mount Wilson Observatory, in which the apertures are larger and can be placed 50 feet apart. This instrument will measure a star diameter as small as 1/100 second of arc, about corresponding to that of a cent piece at a distance of 250 miles.

The 20-foot instrument was of such a size that the steel frame carrying the periscopic mirrors was placed on the upper end of the 100-inch Hooker reflecting telescope, the optical system of the telescope itself being utilized in forming the star images. But a 50-foot beam would be too large to place upon the 100-inch. So the new instrument is a unit in itself and is housed in a separate building, whose upper half is a metal shed which moves to the east on a trestle, leaving the interferometer standing in the open air. The building is 60 feet long, 20 feet wide and 26 feet high. The shed is moved by rack and pinion.

The interferometer consists of a large skeleton frame which we call the "bridge," mounted in cantilever fashion on the north end of a short ball-bearing polar axis. A structural steel pedestal supports the whole and carries the mounting for the worm that meshes into a sector on the bottom of the bridge. The bridge lies in an inclined plane parallel to the equator and carries the periscopic mirrors on its upper surface and the image-forming mirror at its lower end.

The bridge is a latticed steel frame 54 feet 5½ inches long. The structural members are all angle iron and vary in size from 6 x 6 x ⅜ inches to 3 x 3 x ¼ inches. The estimated weight of the bridge itself is 8000 pounds and the total load on the axis including the mirror mountings, tracks, and so on, is about 18,000 pounds.

The polar axis is of 0.50 carbon steel with an elastic limit of 80,000 pounds per square inch. It is forged and heat treated and drawn so hard that it was machined with difficulty. Each of its bearings is composed of two S K F annular bearings. To guide the bridge and prevent its vibrating in the wind two rollers nine inches in diameter with spring cylinders behind them are fastened to the bridge and travel on a circular track fastened to the north face of the pedestal.

The driving sector is a large iron casting bolted to the bottom and south sides of the bridge. It is 100.2671 inches pitch radius and has 1440 teeth. The worm is 4½ inches pitch diameter, 0.4375 circular pitch, left hand, single thread. It runs on S K F self-aligning bearings and continually dips into a bath of clock oil which is free from acids and gumming properties.

The driving clock is of the typical weight-driven conical governor type and is self winding. It stands just east of the pedestal and transmits power to the worm through a gear box. Slow motion in right ascension is by means of a motor mounted directly on the planetary gearing in the gear box. The instrument works in right ascension from 2 hours east to 2 hours west.

One of the illustrations shows an outline of the optical path of the interferometer. Two outer plane mirrors AA inclined at an angle of 45° receive the parallel beams of star light and reflect them to two similar mirrors BB inclined also at 45° which direct them downward to the large concave mirror C. The converging beams are then returned upward to a 45° plane mirror D, thence southward to a second plane mirror E and upward through the compensator to the eyepiece.

The flats AA, BB, and D are of Pyrex, 15 inches in diameter, D being cut away at the sides to clear BB. E is a glass mirror five inches in diameter mounted with a self-aligning mechanism which directs the beams constantly into the eyepiece tube which may be moved into various convenient positions for observing.

The concave mirror C is of Saint Gobain glass, 40 inches in diameter, 18 feet focus and lies at the bottom

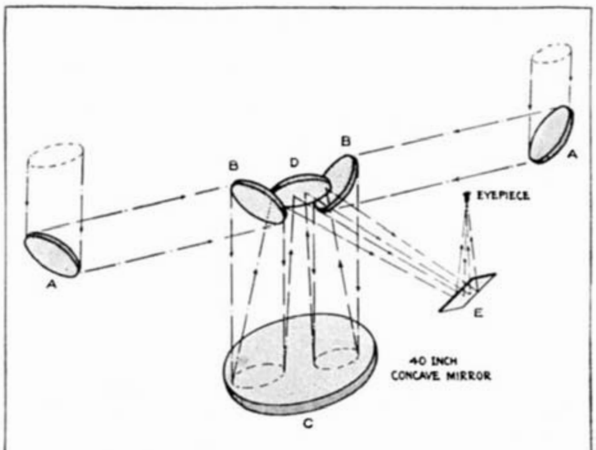
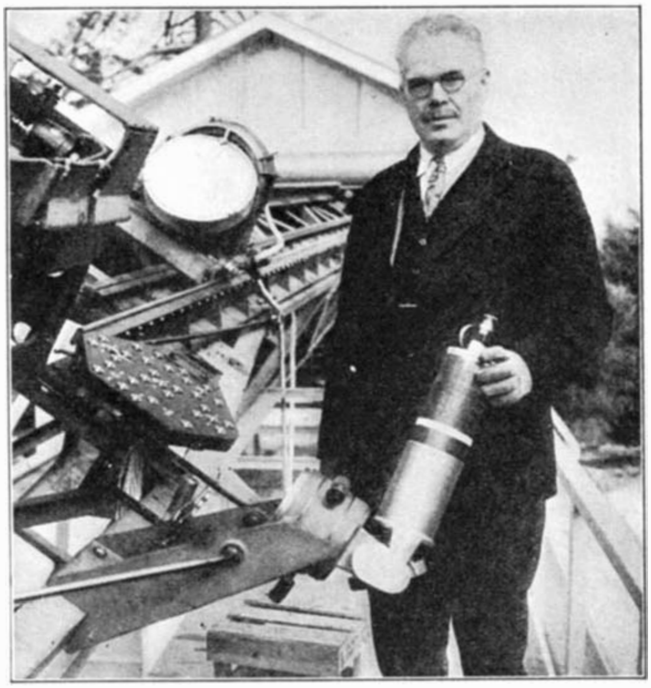


DIAGRAM OF LIGHT PATH IN 50 FOOT INTERFEROMETER
MOUNT WILSON OBSERVATORY
PASADENA CALIFORNIA

of the bridge in an iron cell insulated with corkboard. It is supported on its back by three fixed plates and one central counter-weighted plate and on its edge by four pivoted arcs.

The outer mirrors are mounted on V-wheeled carriages which are moved by motor through a herringbone rack and pinion along tracks placed on the top surface of the bridge. For the tracks heavy machined iron castings of inverted "T" section are bolted to the top of the bridge. To these are fastened steel bars bevelled on both their narrow edges. The upper edges receive the fixed V rollers of the carriages while the lower edges receive similar V wheels mounted on spring counter-weighted arms which always keep the carriages in contact with the tracks.

The carriages may be moved from 6 to 50 feet apart and their positions are read by pointers on scales graduated directly on the tracks. Positions are read through a system of mirrors by a telescope located near the eyepiece tube.



The "business" part of the bridge. The author's hand is on the eyepiece, and at his right are the control buttons. The east diagonal 15-inch flat mirror with its track and rack is visible. When the photograph was made the special mirrors and "telescope" for reading the scales and circles, described in the accompanying text, were not attached

THE outer mirrors rotate for declination about centers passing through a common axis parallel to the top of the bridge. Both fast and slow motions are provided. Readings by circle and vernier are made through a system of mirrors with the same telescope used for reading the mirror separation.

The three central plane mirrors are mounted on a cast iron frame which stands on the top surface of the bridge directly above the large mirror. The central mirror is fixed; the other two can be tilted for slow motion about axes parallel to the polar axis. The east mirror is mounted on a slide capable of micrometric motion along the beam and furnishes an additional means of compensating the optical path length for variations due to flexure, differential expansion, and atmosphere.

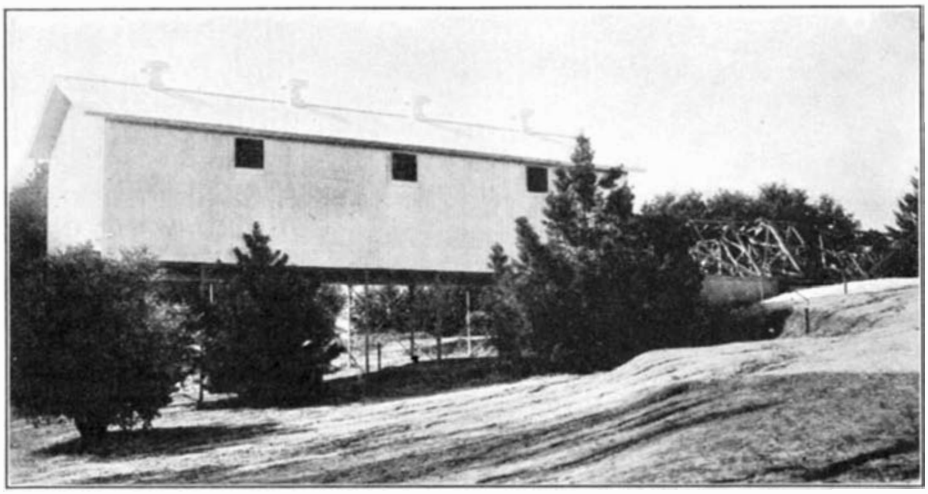
Observations are made from a platform located south of the bridge above the polar axis. Here are placed the eyepiece, the control buttons, circle and scale lamp switches, and the telescopes for reading the circles and scales. All motions in the instrument are motor driven and are operated through relays. An eyepiece of one-eighth-inch focus is necessary to view the fringes conveniently.

The alignment of the instrument during construction was made by squaring the pedestal with the house and checking the polar axis for azimuth on the 60-inch reflector axis with level and gage. When the instrument was about finished the alignment was checked on Polaris by means of a rod carrying cross wires clamped to the bridge. Final adjustment was made by taking drift curves of equatorial stars directly reflected from an uncovered portion of the large concave mirror, computing the error and adjusting the screws at the base of the pedestal.

Drift curves were next taken of the images from the flat mirrors which were found to shift in opposite directions along the declination cross wires. Eight and ten foot straightedges were clamped in various positions about the beam and the shifts measured after moving the instrument into various positions. The addition of several ties has practically eliminated this drift.

The first experiment made with the interferometer was to see whether fringes would show at distances greater than 20 feet. Experimental curves obtained with the 20-foot instrument showing decrease in visibility for a drop in the seeing had been plotted for stars of small angular diameter. Extrapolation of these curves indicated that for "seeing" even as low as 1 on a scale of 10, fringes should appear for distances much greater than 20 feet. At the time the 50-foot interferometer was tried out the seeing varied from 1 to 2 and it was noted with feelings of great pleasure that at the distances of 25 feet and 34 feet at which it was tried the readings coincided with points on the curves. Visibility curves of Betelgeuse and Arcturus made during seeing 1 to 2 also coincided with those made with the 20-foot beam, indicating that measures of star diameters made with the two instruments are alike.

IT is estimated that stars as faint as fourth magnitude can be measured and that complete disappearance of the fringes will take place for about 25 stars. Others whose diameters are still smaller can be estimated by plotting the visibility curve. The appearance and amplitude of vibration of the image given by the two mirrors appeared to be the same regardless of their separation, thereby giving evidence of atmospheric conditions favorable to telescopes of large apertures.



The housing or shed of metal rolled off to the east on its trestle

Nothing but toys are made here. Interior view of a large plant which manufactures toy aircraft. Large supplies of raw materials are in the foreground, and the lines of presses for stamping out parts are visible at the left

The Juvenile Aircraft Industry

By G. ANDERSON ORB

A SMALL boy, eight or ten years of age, was convalescing in a New York hospital. A friend brought him a demountable toy airplane to pass the time away. Looking it over carefully, the boy gave a grunt of disapproval as he said, "Huh! The chap who made that doesn't know much about airplanes—propeller's set at the wrong angle!" And that evening a scribbled note went out to the manufacturer calling his attention to the incorrect part.

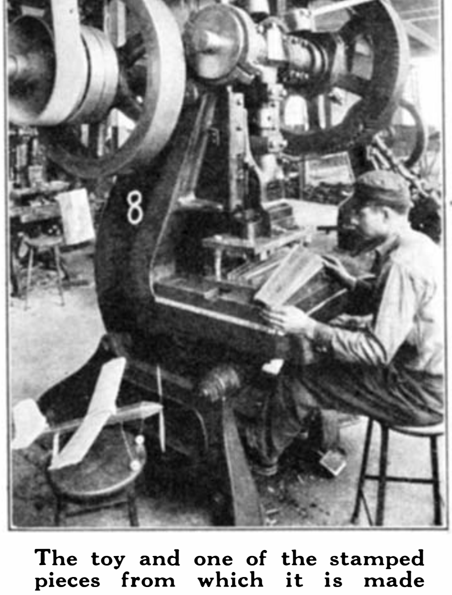
Now, the significant thing about the above incident is the fact that that boy is just the average boy of today! He is just one of thousands! And these same boys are setting the pace for the aircraft of tomorrow.

THERE is no one to whom the romance of aviation makes more of an appeal than it does to the boy between seven and 15 years of age, and these boys are building model aircraft by the millions—of every kind.

Perhaps no better measure of the significance of an industry is to be had than in the size, type, and value of the plants that cater to its needs.

While there are perhaps 2000 manufacturers in the field who are catering to the juvenile aircraft demand, there is one firm, the Metalcraft Corporation of St. Louis, which is far and away the leader, with a production in last October alone amounting to more than 140,000 dollars, sold for double that amount over the counters of toy aircraft retailers. Three of Lindbergh's original backers, Knight, Bixby, and Dysart, are financially interested in this company.

Metal aircraft construction sets are manufactured which can be taken apart and re-assembled to form actual replicas of well known ships, such as the *Spirit of St. Louis;* the *Bremen,* the *America,* a tri-motored Fokker; a Waco one-motor bi-plane; a monoplane; in fact, some 500 planes can be built from one set. There are also blimp sets and a model *Graf Zeppelin,* with a complete line of airplane equipment, including airports, hangars, beacon lights, mooring masts, and landing field.



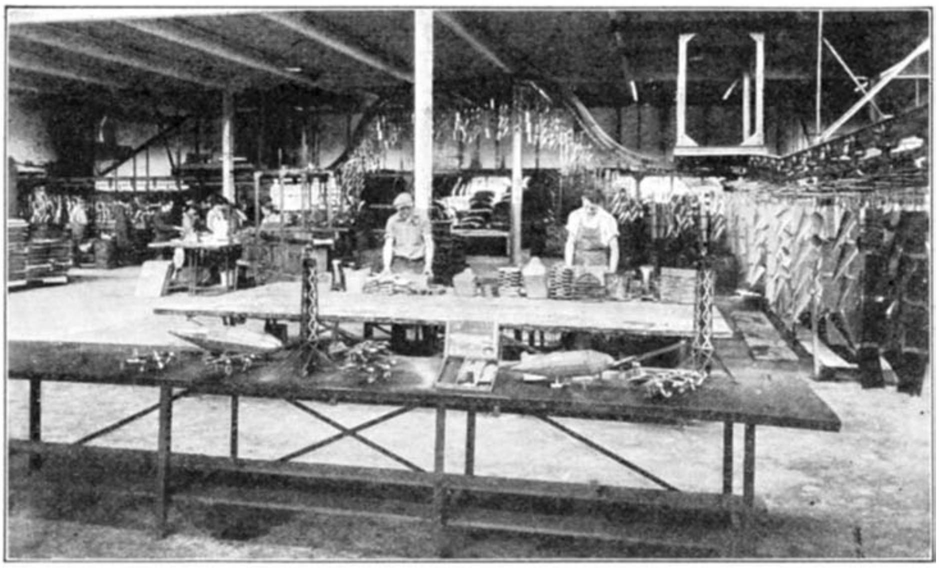
The toy and one of the stamped pieces from which it is made

The factory is completely electrified and the processes of manufacture rival full size production. Dies have been perfected for use in punch presses which stamp out every kind of part required in the construction of any type. When rigidity is desired, spot and butt welders come into use. A plating room has complete equipment for chromium-plating all metal pieces except those to bear a color.

A MOTOR-DRIVEN continuous conveyor, holding racks upon which various parts in process of manufacture are hung, carries them through the enamel vats and on into a long oven where the color is baked on, and thence out to the packing tables. This conveyor has a capacity of 40,000 pieces per hour when running under high-speed production. Belt conveyors of a different kind expedite both assembling and packing of the various construction sets.

A national organization, the Lyonsport Aero Club, composed of boys owning sets manufactured in this particular plant, is equipped with aviation uniforms and winged pins which admit them free of charge to view certain war films, and also entitle them to a ground course in one of the St. Louis air colleges with a proficiency certificate of the same nature as that for adults.

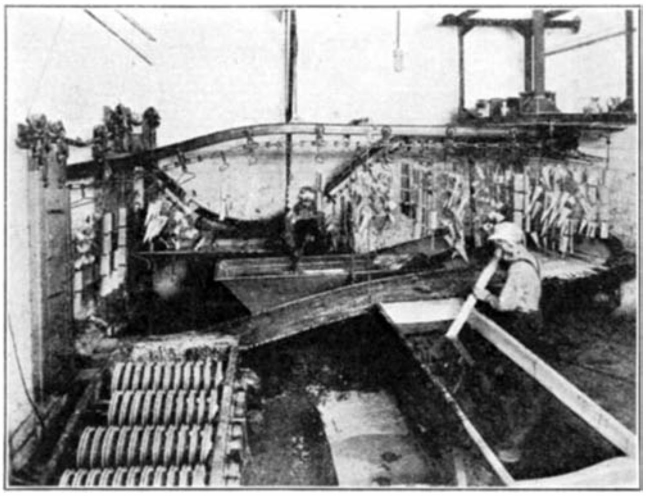
THIS Lyonsport Aero Club, commanded by Captain Jack Bursey, has juvenile pilots all over the world. National advertising over one of the big radio chains carries the stories of adventure to this juvenile audience of aviation enthusiasts, and spurs them on to greater work and a broader aircraft education.



A section of the electrically-operated carrier system on which metal parts are carried through enameling vats and bake oven, thence to the loading table

It was about 1911 that the Illinois Model Air Club was organized among Chicago high school boys. Then came the war and interest was directed elsewhere.

Then Lindbergh's epochal flight in May, 1927, and overnight America became air-minded. Prior to this time, the toy aircraft industry had been very small indeed, but in the next three months it jumped to a quarter of a million dollars retail. By the end of 1928 it had climbed close to the 2,000,000 dollar mark, wholesale, while the Metalcraft Corporation, in October, 1929, wholesaled some 140,000 dollars, as has been noted, in demountable aluminum and sheet-steel aircraft parts for toy models.



The paint room. The carrier dips low so that the toy airplane parts are immersed in the paint

Meantime the Playground and Recreation Association of America got behind a movement to arouse juvenile interest in aircraft construction, sponsoring miniature aircraft tournaments all over the country, with a National Tournament held in Memphis, Tennessee, in October, 1927. The vocational departments of many public schools had already adopted a definite program of model airplane construction, with classes, contests, and the like.

Nor has this work been confined to any one type of plane. Flying stick types, scale models of famous ships, hydroplanes that will rise off the water, and racing planes driven by four propellers and capable of running 50 miles per hour, have been constructed.

The National Aeronautical Association has recognized two of these contests, held annually: the Mulvihill for outdoor models, and the William B. Stout for indoor models—named after the donors of the trophies.

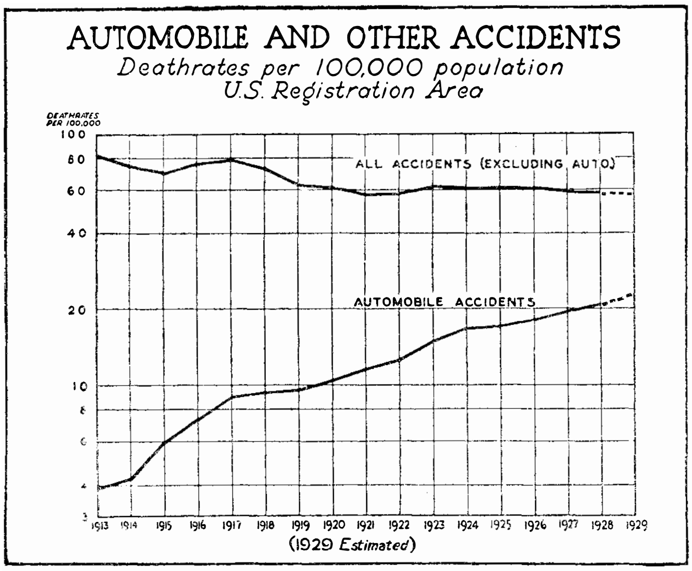
Illustrations courtesy The Metalcraft Corporation

Assembling and packing the finished parts in construction sets. The purchaser does the final assembling himself, from the parts supplied in the kit

IN June, 1928, the National Indoor Meet was held in Detroit, with boys from all over the country competing for the Stout trophy and some 500 dollars in prizes. It is significant to note that during the World's Air Fair Week, held in the St. Louis Arena during the middle of last February, a National Junior Indoor Model Airplane Contest was held; also, steps were taken for the organization of the first Junior Aircraft Convention, at which time technical subjects as applied to model airplane construction will be up for discussion.

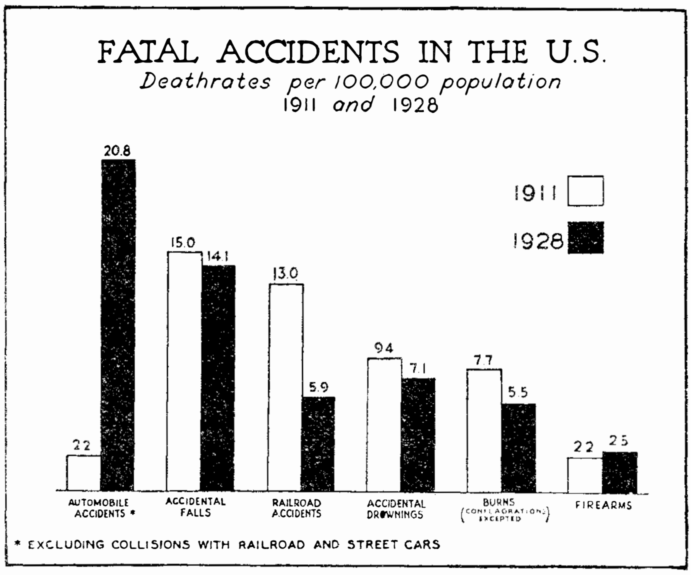
From Florida to Newfoundland, and from New York to Seattle, these model airplane contests are being held. They are being fostered everywhere; special junior technical aircraft magazines—featuring model drawings to scale, for the boy to use in his construction work—have made their appearance.

And the whole of it points directly toward a highly specialized aircraft education for boys—not just haphazard play! The results are bound to be far-reaching in the extreme in their effects upon the aviation of tomorrow.

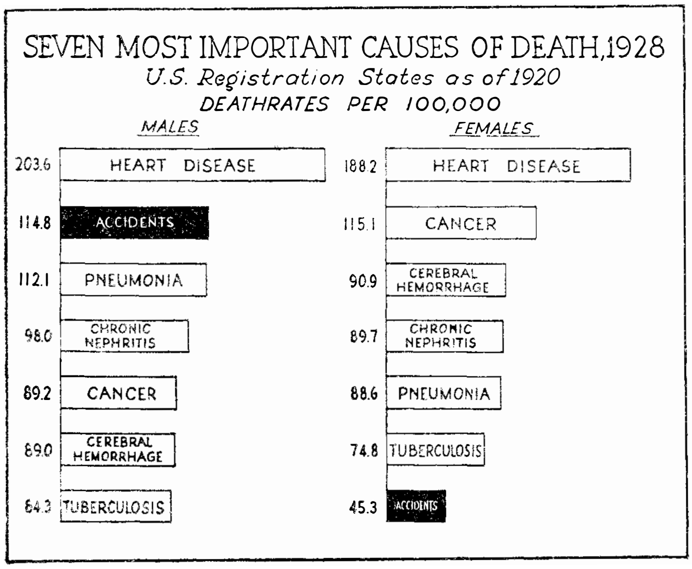


Al diagrams courtesy of National Safety Council

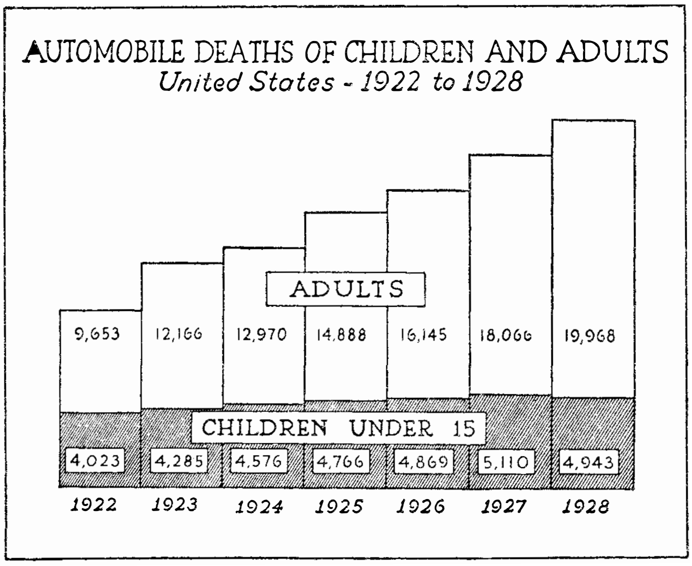
While automobile accidents soar, the death rate for non-automobile accidents is 30 percent below 1913



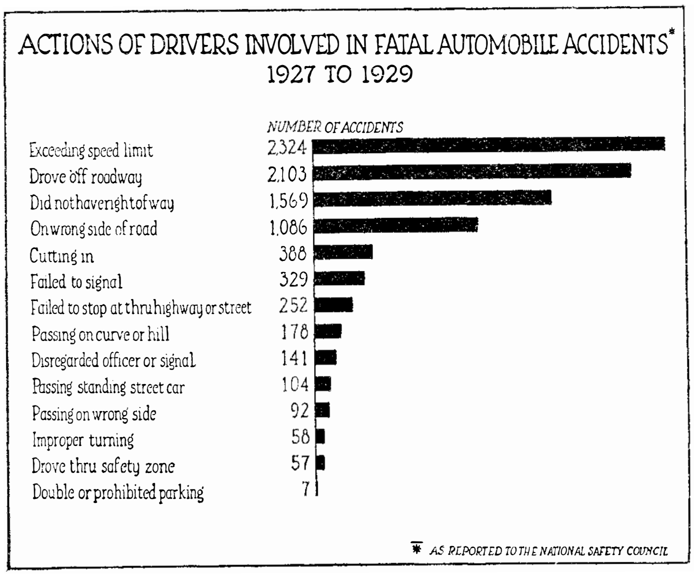
Various types of accidental death, showing a decrease during 17 years except for automobiles and firearms



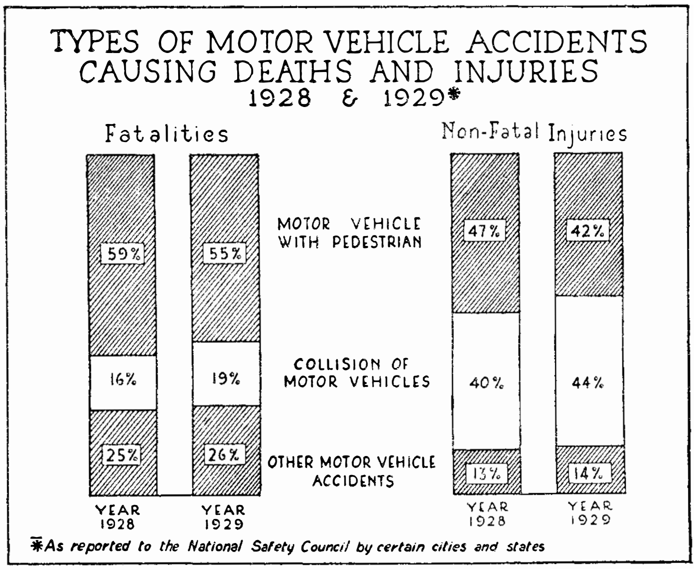
Fewer women than men suffer accidents. Accident death rates compare unfavorably with those of disease



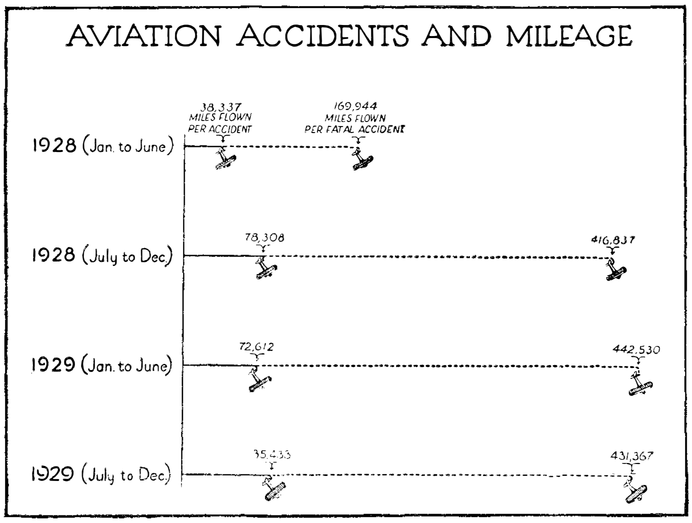
Motor vehicle deaths among persons over fifteen years old are increasing more rapidly than among children



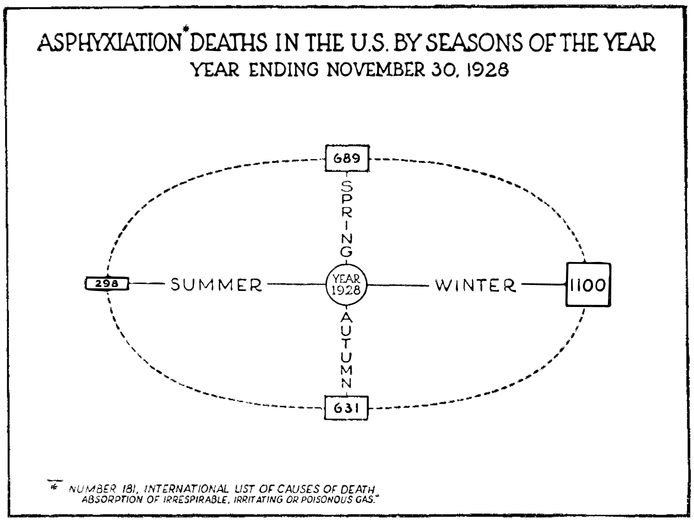
The cause of automobile accidents is worth studying. Speeding tops the list but even parking adds its quota



This interesting diagram shows that the automobile kills 13 percent oftener than it injures the pedestrian



Aviation accidents are on the increase as is described in the text. Four hundred and ninety-six deaths occurred in the year 1928 by airplane and balloon



The third largest cause of home fatalities is asphyxiation; 40 percent of such deaths occur in the winter months. The number is far smaller in the summer

The Penalty of Carelessness

AN unprecedented increase in motor vehicle fatalities overbalanced the decreases in all other walks of life last year and America's accidental death toll rose to a new high total of 97,000. The private automobile driver is responsible for most of this increase and he must be curbed before a definite reduction can be realized in the national accident picture. The 1929 total for all accidents has just been made public by the National Safety Council on completion of its accident analysis for the past year. The accident fatalities for 1928 were 95,086. While total fatalities in 1929 were slightly less than 2000 more than in 1928, automobile casualties alone reached 31,000, an increase of 3000 over the previous year. These figures tend to show that motor vehicle fatalities alone are on the increase and that other types of accidental deaths are on the gradual decline.

Accidents to children are increasing far less rapidly than to older persons. In the seven-year period from 1922 to 1928, fatalities to persons of all ages increased almost 25 percent. In the same period accidental deaths of children under 15 increased less than one tenth of 1 percent. If accident prevention work among adults had been as successful as among children, approximately 20,000 lives would have been saved during the past year.

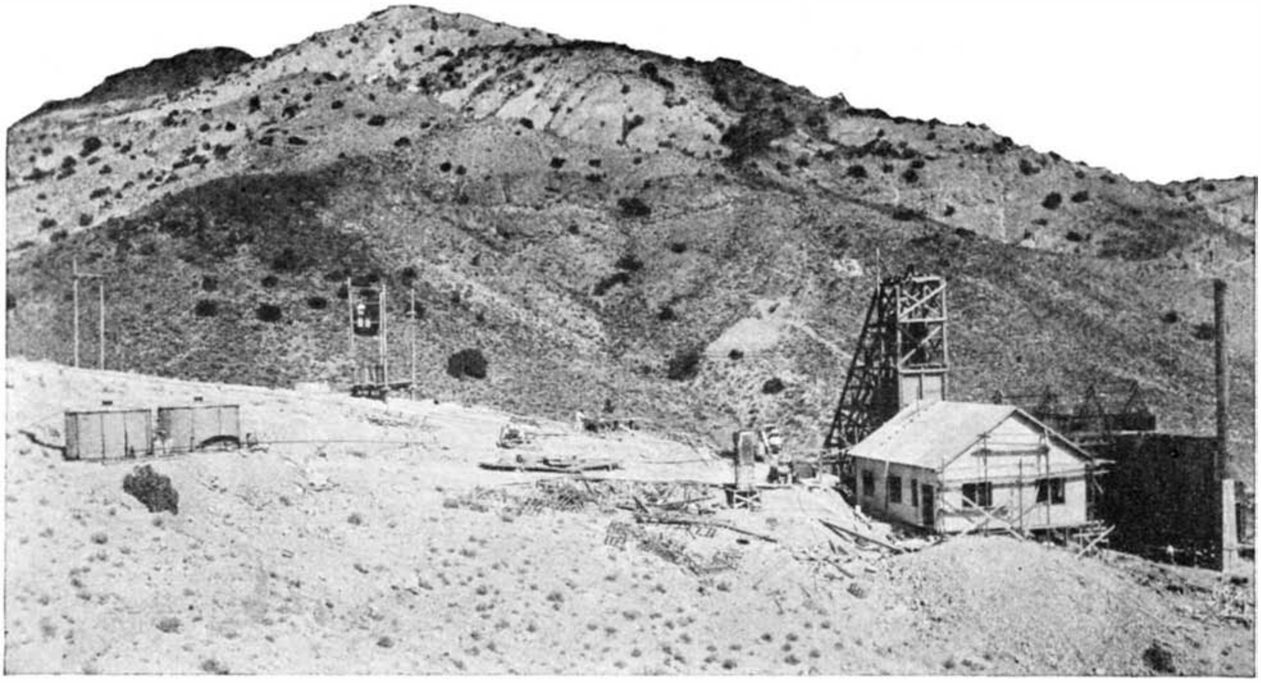
There was very little change in the railroad-automobile fatalities during 1929 and there was an improvement in the accident situation among commercial vehicle drivers. A large part of the increase therefore can be charged indirectly to careless owners of private automobiles.

The 97,000 death toll for 1929 included 23,000 fatalities in or about American homes; 23,000 fatal accidents in industry; and still another 20,000 persons who lost their lives in public accidents not involving the use of a motor vehicle. The principal cause of home accidents was falls, 9200 persons losing their lives in this manner. Burns, scalds, and explosions accounted for the next largest number of home fatalities. Asphyxiation and suffocation were the third most important causes. Carbon monoxide poisoning in closed garages was an important contributing factor. About 200 non-fatal accidents occurred in American homes for every fatal accident, it is estimated.

IN addition to the annual study of accident statistics of the United States for the past year the National Safety Council conducted an interesting survey. Inquiries were sent to all governors, to the mayor of every large city, and to numerous other officials and civic leaders, asking their opinions as to the reason for increases or decreases in last year's accidents. Personal studies were made in 12 leading cities. This survey brings out some interesting facts: The states which have rigid drivers' license requirements continue to make better records, in relation to their own past experience, than the states where licenses are not required. Speed is a major consideration in the opinion of quite a number of the state and city officials and other experts. Intoxication is partly responsible for the "obsession to speed," according to the reports. Inadequate enforcement is blamed by many authorities.

There is one hopeful sign brought out in the analysis of the accident experience for 1929. If we could ignore the annual toll from motor vehicle accidents, our national experience would show that the national death rate from all other accidents had been reduced more than 30 percent since 1913.

The number of airplane and balloon fatalities in the United States has increased from 182 in 1920 to 496 in 1928. These are the Census Bureau figures. The Aeronautics Branch of the United States Department of Commerce recorded a total for the year of 485 fatalities in civil aviation. Schedule flying has the best record with a total of only 41 fatalities, or 8.5 percent of the total. According to other reports of the Aeronautics Branch, this type of aviation accounted for over 25,000,000 miles flown out of a total for all types of 79,000,000, or 31.6 percent of the total mileage. Miscellaneous pleasure flying resulted in 277 fatalities, or 57 percent of the total for all types. Of the total fatalities 227 were pilots and 258 passengers. The average mileage flown per accident and separately, per accidental fatality, is shown in our diagram. After extended and careful investigation the Aeronautics Branch announces that in 1929 about 57 percent of all accidents were due to errors of personnel; 18 percent to power-plant failures and 10 percent to some failure in the machine apart from the power-plant. Less than 5 percent were attributed to weather conditions. There was a sharp increase in deaths in airplane accidents in 1927 and a still greater advance in 1928, the latter being over 100 percent.



A quicksilver, or mercury, mine located in the hills of Nevada

The Reviving Liquid-Metal Industry

By J. K. NOVINS

IMAGINE a radio set without a vacuum tube, Milady's vanity dresser without its vermillion cosmetic, the bathroom chest without its reserve of mercury bichloride to guard against fleshy infection, the sick room without a thermometer, and your hunting ammunition unequipped with precussion caps. All of these utilize quicksilver, or mercury, in various quantities. Yet the average man or woman knows little of the origin of this liquid metal or of the methods through which it is extracted from sandstone and poured into flasks, ready for the many uses that man's scientific ingenuity has devised.

Still less do we know of the potential uses of this fluid-metal which touches the life of every man, woman, and child in that it brings freedom from agonizing pain, makes possible home comforts, kills crop-destroying insects, prevents the fouling of ship bottoms, and is used extensively to roughen the hairs of felt products.

Of the two and a quarter million pounds of mercury utilized in this country, only 10 percent enters into the manufacture of electrical apparatus. Yet here is a field that promises unprecedented demand for the metal and is responsible for the present revival in mercury mining. Few know that mercury is essential in the manufacture of neon lights which are now used for display sign purposes. The blue color produced by the neon sign is caused by the presence in the tube of metallic mercury which acts with the neon gas. The green color is produced by mercury without the aid of any other gas or chemical, but the glass tube is tinted.

Of greater importance still is the promised use of mercury in power generation. Experiments conducted by the General Electric Company have demonstrated that mercury turbines have a heat efficiency of 85 percent, as compared to the 25 percent or lower heat efficiency of steam electric plants. If applied generally, anywhere from 11,000,000 to 17,000,000 pounds of mercury would be required to take care of the annual increase in generator capacity. This amount of mercury is more than the entire world now produces annually.

THE experimental installation consists of a mercury boiler and mercury-vapor driven turbine, as well as steam boiler and steam-driven turbine. After passing through the vapor-driven turbine, the mercury vapor is condensed. Steam is generated in this condenser by the heat delivered in the condensation of the exhaust mercury-vapor. The condensed mercury is then drained and returned to the mercury boiler. In this manner mercury can be utilized with very little loss.

Only 2.4 percent of the mercury used in this country enters into the manufacture of scientific instruments, such as thermometers and barometers. By far the largest amount—to be exact 32.2 percent—is required by the drug and chemical industries. The largest single use is for fulminate, an explosive, and next in order, for vermillion and oxide. Only a little over 3 percent is used for gold and silver milling, although during the bonanza days in gold mining very large quantities of mercury were needed to amalgamate gold and silver from the metallic ores. In the heyday of gold mining, California, which is our largest mercury producing state, enjoyed a record annual production amounting to 4,000,000 dollars, but now the production has fallen to less than a million. For many years the domestic mercury industry was practically at a standstill, only to be revived recently by increasing demands in industry.

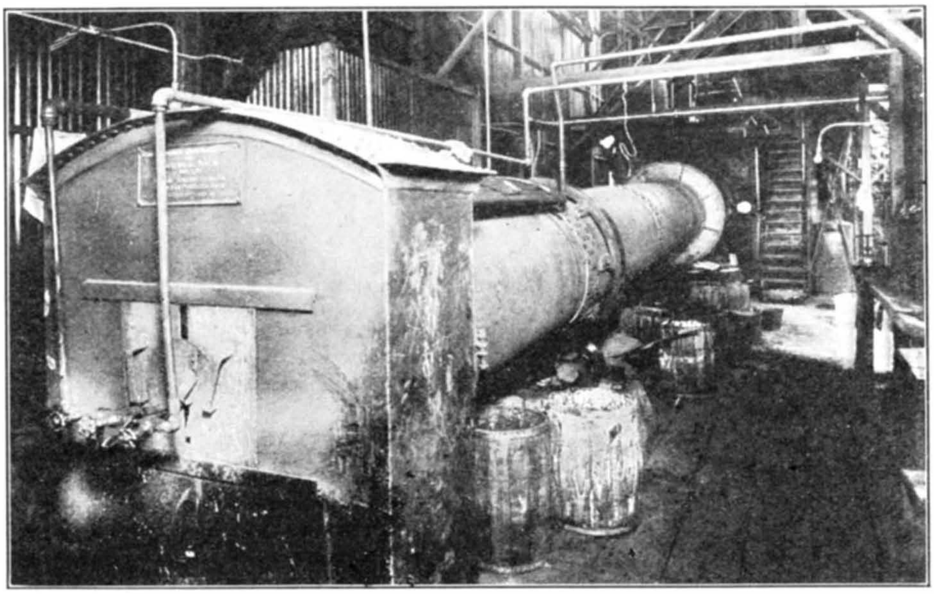
A NUMBER of the old mercury mines in California, which have been idle for years, are now thriving with renewed activity. The Oat Hill Mine, which the writer visited recently, again began to produce the metal from low-grade ore only a few months ago, after it had been abandoned for four or five years. Low prices, substitution of cyanide for gold and silver extraction, and the competition of foreign mines, were responsible for almost a dead stop in domestic production. No other metal has suffered as much from the inroads of substitution. It was formerly used in large quantities to "silver" mirrors, but is now almost entirely replaced by a silver nitrate process. Even as a fulminate, other substitutes have been found, in which lead and silver form the principal products. Now that mercury has been demonstrated as an efficient power generation agent, research has revealed a suitable substitute for it in the form of diphenyl oxide, which is a by-product in the manufacture of carbon tetrachloride and chloroform.

YET, despite its age-long battle with substitutes, mercury has persisted as a separate mining industry since the Phoenicians first began to work the famous Almaden Mine 27 centuries ago. Today this mine, operated by the Spanish government, produces more than one third of the world's supply of mercury, and shows no signs of depletion. Last year this mine produced half of the world's supply. Italy was the next largest producer, and the United States came third in the production of this metal.

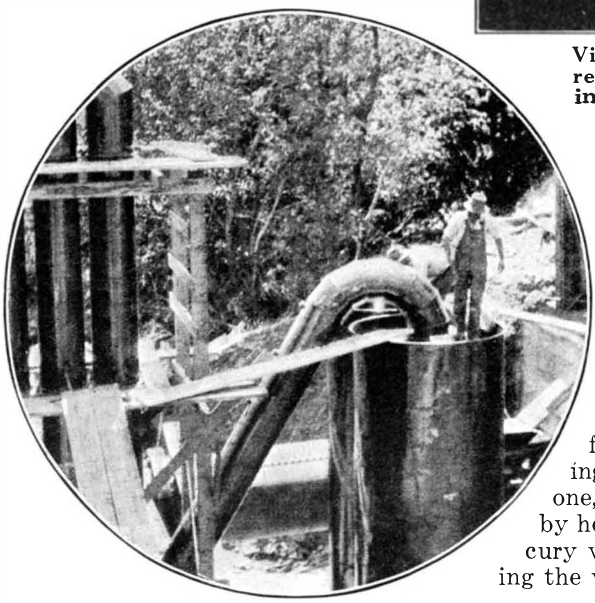
The principal mercury mines in California are located without exception in the coast range, where the ore has been lifted toward the surface by volcanic action. The mines are usually located in the vicinity of hot springs. Due to the surface operations, mercury mining in California has not been marked by the hazards of fissure digging in the Almaden deposits, where men have gone to depths of several thousand feet. Due to the greater heat at 2000 and 3000 feet below the surface, mercury has been known to run down the stope walls as so much liquid, thereby subjecting the miners to the danger of mercurial poisoning. Surface mining, confined largely to depths of several hundred feet, have tended to reduce hazards, and the danger of poisoning by contact with vapor has been largely eliminated by the use of modern furnace and condensing equipment to be found in the California mines.

At the Oat Hill Mine, tunnels are bored into the hillside and the ore removed to the surface on a narrow-gage roadway. The ore is a sandstone dotted with red, and is known technically as cinnabar. This heavy, vermillion-colored mineral is composed largely of mercury and a smaller amount of sulfur. The process of extracting the mercury is a simple one, the metal being distilled by heating the ore until the mercury vaporizes and then condensing the vapor into a liquid. This is followed by a purification process to get rid of the sulfur, as well as of carbon monoxide gas and other dangerous fumes. The final process is to "hoe" the mercury from its slimy blanket of soot. The refining process is accomplished entirely at the mine, and takes place within a few minutes after delivery of the crushed ore to the furnace.

In mercury mining, a tunnel is driven to as great a depth as 750 feet. There are innumerable tunnels to be found in the vicinity of the Oat Hill Mine, and it is estimated that in the 60 years that this mine has been producing the metal no less than 24 miles of tunnel have been driven. During that time the Oat Hill Mine has produced some 19,000,000 dollars worth of the widely used liquid metal.



View of a Gould rotary furnace, a type now used extensively for the refining of mercury. Its rotating action helps volatilize the mercury in the ore. Its construction and operation are described below

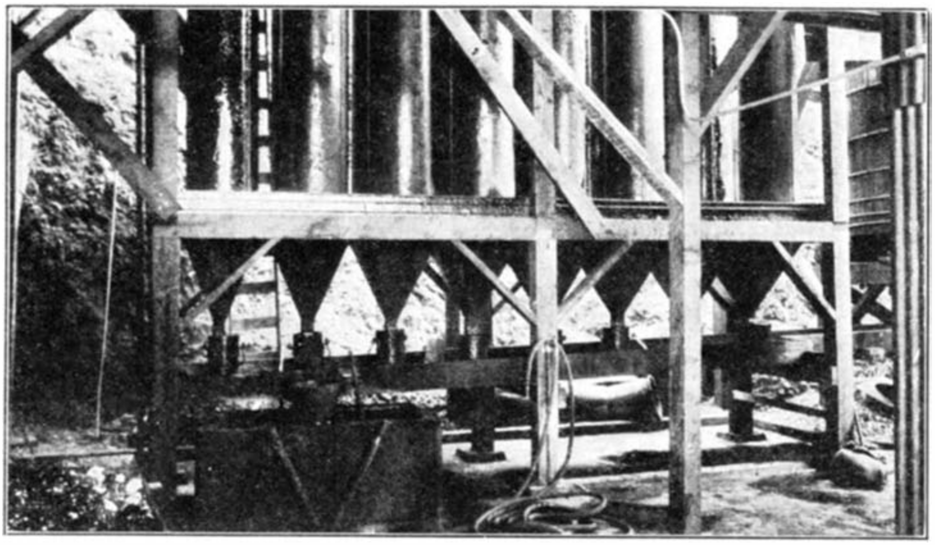


From the cyclone tank, on which stands a man, mercury vapors are piped into condensers

From the mouth of the tunnel, the ore rock is conveyed to the gravity sorting bin by a three-ton motor truck. After a perilous mile and a half trip over a one-way mountain road, the truck is backed up onto a loading platform, from which the rock is catapulted several hundred feet to the storage bin below. Yet this truckload of rock will produce only 12 or 18 pounds of mercury, figured at from four to six pounds of the metal to the ton of ore. At present prices—and they are high—a pound will bring less than two dollars, or more than double the production cost. The present price is treble the average price of mercury in the United States during the past 40 years, while production cost has been reduced by utilizing more efficient production methods.

BEFORE the ore is fed to the furnace, it must be crushed and sorted. An automatic feeder introduces the ore particles into the rotary furnace at the rate of 10 pounds every minute. The feeder can be adjusted to feed the ore in various quantities and in different sizes, depending on both the type of ore and the roasting conditions. The "feed" then has to go through the 60-foot rotary furnace, which slowly revolves in order to facilitate volatilization of the mercury from the ore. At the point that the ore enters the furnace a temperature of 1800 degrees, Fahrenheit, is maintained, this being decreased to 450 degrees at the mouth of the furnace.

The rotary furnace turns three fourths of a revolution per minute and inclines at three fourths of an inch to the foot. At the same time that the vapor rises from the ore, the revolving action raises the dust as the rock proceeds downward. A powerful fan in



Mercury condensing system. The vapor travels through these condensing tanks and is deposited as a sort of sludge or slime in the hoppers below

the dust chamber at the head of the furnace sucks the vapor and dust into two cyclone tanks, in which the dust settles and the mercury vapor is made to proceed to the series of 12 condensers. The first cyclone tank is smallest and collects most of the dust. As the dust and vapor enter the cyclone they are driven by centrifugal action from the center to the metallic walls, with the result that the dust, being heavier, will settle, while the vapor, combined with smaller quantities of dust, will undergo further separation in the second, and larger cyclone. The light gaseous vapor naturally rises to the top of the tank directly into pipes which lead to the series of condensers.

The condensers are 16 feet long and 19 inches in diameter. At the bottom of each condenser unit is a cone-shaped outlet. The hot gas enters directly into this lower cone, where it deposits some of its dust, and then travels through a circular pipe to the height of the condenser. The vapor condenses into the familiar liquid against the cool walls, and this liquid metal drops to the cone-shaped hopper, or outlet.

A CERTAIN amount of the condensed mercury will adhere to the wall and can be removed into the hopper below by unscrewing the clean-out hole at the top of the condenser and flushing the walls with water. Even at this stage the mercury can be removed from the hopper in the first condenser in the form of a whitish slime from which the quicksilver must be hoed out.

A certain proportion of the mercury vapor will fail to condense in the first condenser, and will therefore circulate through the other condensers in the series. Experience has shown that most of the mercury will be deposited in the second and third hoppers. The complete series of 12 condensers is needed in order to catch every minute globule of mercury before the sulfur and other gases are afforded an escape to the purifying tanks.

The three purifying tanks are connected by a small pipe. Thus by a process of compression, when the gases enter the pipes, and by expansion during the journey in the tanks, considerable heat is generated, propelling the sulfur and carbon monoxide gases to the stack, from which they are vented into the air.

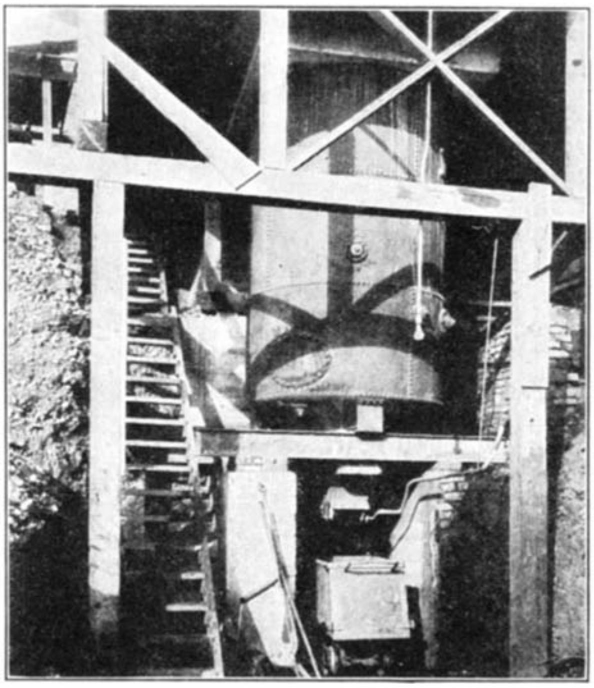
The whitish slime gathered from the hoppers is dumped on a round table. A man with a hoe separates small quantities of the slime, and as he does so, small streams of mercury globules are seen to flow to the opening on the lower end of the table and into a metallic flask which normally holds 76 pounds of mercury. Properly sealed, this flask is ready for the market.

The hoeing process is a survival of ancient times. The minute globules of mercury present in the slime are practically invisible to the naked eye. The action of the hoe loosens the slime in small quantities, making it possible for the small globules to seek each other out, much as drops of water coalesce into a small stream. It is the simplest, yet most interesting process of mercury refining—and the most hazardous.

The hoeing action must be slow; otherwise it will raise little eddies of dust, which if swallowed, even in minute particles, is sure to cause mercurial poisoning. The first symptom of the poisoning is loosening of the teeth, followed by disruption of the digestive system. If the poisoning is not arrested, the operator will suffer an attack of nerves. Leaky pipes in the roasting and condensing system are now the chief cause of poisoning. In the ancient Almaden mines there were so many cases of poisoning that the occupation was considered too dangerous for a free man; therefore convict labor was extensively employed.

H. W. GOULD, a San Francisco mining engineer, recently perfected a mechanical hoeing device which it is expected will eliminate the inefficiency and the hazards of hand hoeing. This device is equipped with mechanical rabble arms to separate the slime and afford free movement for the mercury globules. Mr. Gould is also the inventor of the rotary furnace which is now used extensively in American mercury mines, and is gradually replacing the older methods employed in foreign operations. It is especially adapted for low-grade ores which formerly could not be worked at a profit. At the Oat Hill Mine the rotary converts 80 tons of ore every 24 hours. This ore has less than 0.25 percent of quicksilver. At the Spanish mines the ore has about 8 percent of mercury and can, therefore, be mined economically with the older methods of refining. Although these mines have been worked since 800 B.C., richer ore is now being extracted from great depths.

Paul M. Tyler, of the Federal Bureau of Mines, says that "in many lines, substitutes for mercury are employed; but in other lines there is a constant ebb and flow as consumers experiment with first one and then another, only to return to mercury. . . . To have faith in the future of modern industry is to have confidence in the future of mercury."



Waste ore from the furnace is deposited in a retort and is removed in carts to the rock dump

PROHIBITION
and the Physiological Effects of Alcohol

By H. H. MITCHELL
Professor of Animal Nutrition, College of Agriculture, University of Illinois

THE most acute political question of this generation is at the present time being debated largely on the basis of uncertain statistics, and interpretations of them biased by inflexible opinions in regard to moral standards or personal liberty. It should be obvious to those who approach the question of the advisability of national prohibition with an open mind that reliable statistics on the success of prohibition enforcement are not at hand. The interpretation of trends in penal, industrial, and other social statistics that are at hand, in terms of assumed trends in the consumption of alcoholic liquors nevertheless is the stock in trade of the political prohibitionist and the political anti-prohibitionist. After reading the propaganda put out by both sides of the argument, one can agree wholeheartedly with Josh Billings, when he said that it is better not to know so much than to know so many things that aren't so.

THE enactment of legislation aiming at the restriction of the sale of alcoholic liquors can be justified only on the basis of the harmful effects of alcohol on the human body and on human behavior. The extent to which the consumption of liquor should be restricted depends upon how harmful alcohol is and in what dilution its effects become inappreciable. Few would doubt the wisdom of governmental restriction of the sale of the alkaloidal narcotics. The question with respect to alcohol may and should be argued on the same basis, though the answer need not be the same because there are certain compensations in the use of alcoholic beverages that do not pertain to the use of the more powerful narcotic drugs. Without minimizing the importance of the purely practical problems of the probable effectiveness of the machinery for the enforcement of liquor legislation and of the expense involved, it appears to be no exaggeration to say that the purpose and the form of such legislation should be determined largely on the basis of scientific data in regard to the physiological and psychological effects of alcohol.

How does the human body dispose of the alcohol contained in consumed liquor? Requiring no digestion and being readily soluble in water and readily diffusible, it is rapidly absorbed from the digestive tract. In fact, absorption may start in the stomach, from which practically no absorption of the ordinary food nutrients occurs. The absorbed alcohol is taken up by the blood stream and carried to all the tissues of the body. Its ready diffusibility in aqueous media accounts for its penetration into all organs, and after a time it may be present in the brain, liver, kidneys, spleen, heart, and lungs in concentrations approximating that in the blood. Even after moderate doses of alcohol, it may be detected in the expired air, in the urine, and, with nursing women, in the milk secreted.

OF heated articles about prohibition there already have been no end. It may be stated with fair confidence that 90 percent of the general public is thoroughly and heartily sick and tired of them. It is getting so that many people, when they sense the approach, say at dinner, of an oral tilt about this threadbare subject, let out a groan of despair and slide into oblivion under the table. At least they feel like doing so.

Is it not possible that this widespread reaction to the prohibition question is due partly to the fact that one so seldom reads an article or listens to an argument on prohibition that seems really calm and unbiased? But we publish Professor Mitchell's article because we believe it is just that—calm and unbiased. If as a result of its publication we receive a half bushel of letters saying it leans toward the "Demon Rum," and another half bushel saying it leans equally in the opposite direction, our own belief — that it does not lean at all —will be flattered.—*The Editor.*

But the body does not dispose of ingested alcohol to any great extent by excretion from lungs or kidneys. Only five percent or less is gotten rid of in this way. Alcohol is combustible in the body, and is very readily burned to carbonic acid and water, as are sugars and fats. The energy thus liberated may be used by the body in the same way and for much the same purposes as the energy produced from the burning of sugars and fats. But it has not been shown that alcohol can be transformed to sugars or fats and stored in the body.

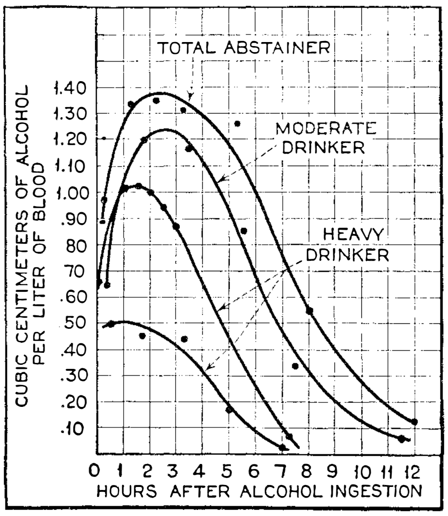
Hence, after a drink of alcoholic liquor the concentration of alcohol in the blood and tissues will rapidly rise to a maximum in the course of one to two hours, depending on the concentration in the liquor consumed, but then it will gradually decrease until after a variable period of time the body will be alcohol-free or practically so. It has been estimated by Mellanby in England, that an average man can burn only from 7 to 10 cubic centimeters of alcohol per hour, so that the time required for the body to rid itself of this substance will be directly dependent upon the amount consumed. A moderate dosage of alcohol, for example, 30 cubic centimeters or approximately one fluid ounce, contained in a pint of fairly heavy beer, would be disposed of in three to four hours or so, but an intoxicating dose may take from 10 to 20 hours for complete combustion.

THE physiological and psychological effects of alcohol have been shown to vary in intensity with the concentration of alcohol in the blood. When the blood contains no more than 0.1 percent of alcohol there are no obvious signs of intoxication. A concentration of .15 percent of alcohol, following the consumption of about 100 cubic centimeters of alcohol (4 pints of beer or 7 to 8 ounces of whisky) on an empty stomach, is associated with a moderate state of intoxication. With increasing consumption of alcohol the maximum concentration in the blood will increase to 0.5 percent, which may be associated with stupor. When a concentration of 0.6 percent is reached, life itself is endangered. Some recent German investigations, in which more recent methods for the analysis of blood for alcohol were used, would indicate that these values may all be low, but the fact remains that alcoholic effects are correlated with alcohol concentrations in the blood, and that the lethal concentration is uncomfortably close to that associated with alcoholic stupor.

It is well known that the effects of a given dose of alcohol depend upon its dilution as consumed. More alcohol may be consumed in dilute solution than in concentrated solution in producing a given physiological effect, because the time of absorption is extended. In agreement with this fact, it has been found that the more concentrated the solution of alcohol consumed, the greater the blood concentration attained and the quicker the maximum concentration is reached. Vernon has shown, in illustration of the same relation, that amounts of alcohol may be consumed in small hourly doses without physiological effect, which in the aggregate would produce intoxication.

IT is also well-known that the consumption of alcoholic liquor during or immediately after a meal produces a much smaller psychic effect than consumption on an empty stomach, for example, three hours or more after a meal. A number of investigations agree in showing that the alcoholic content of the blood is less if a given dose of liquor is drunk immediately after a meal than three or more hours after. The consumed alcohol mixes with the food in the stomach and is diluted by it, so that the rate of absorption in considerably less. Fatty foods are particularly effective in this respect.

Again, it is a matter of common experience that a person not accustomed to alcoholic liquor is more readily affected by it than is a habitual user. And again the blood picture offers an explanation. Thus, Schweisheimer showed that if total abstainers, moderate drinkers, and heavy drinkers imbibe the same quantity of alcohol under the same conditions of dilution and time after the last meal, the resulting concentration of alcohol in the blood is highest for the abstainer and lowest for the habitual heavy drinker. Furthermore, the observed differences were considerable. Possibly the habitual consumption of alcoholic liquors impairs the absorptive powers of the digestive apparatus, or possibly some obscure protective mechanism is developed.



From W. Schweisheimer in Deutsches Archiv fur Klinische Medizin 1912-13

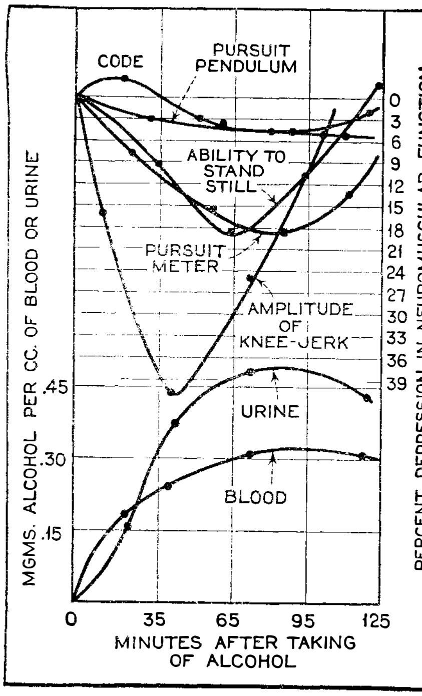
The effect of habituation to alcohol on the concentration of alcohol in the blood after the ingestion of 1.57 cc. per kilogram of body weight (corresponding to about four ounces for a 150-pound man)

It is true that alcohol is a food in the sense that it is easily oxidized in the body, but unlike the ordinary nutrients it is toxic when it attains even a moderate concentration in the blood and tissues. Also unlike ordinary nutrients, the body has no effective means of regulating its concentration in the blood. When a healthy normal person consumes sugar or starch, even in large amounts, the concentration of sugar in the blood will rise rapidly, but when the rate of absorption exceeds the rate of oxidation and sugar begins to accumulate in the blood, it is withdrawn from the blood by the liver and the muscles, converted into glycogen or fat and stored for future use. The concentration of sugar in the blood will for this reason rarely exceed 0.15 percent. But in the diabetic, who has lost the power to oxidize sugar or to store it in any considerable amount, the consumption of sugars and starches will increase the concentration of sugar in the blood to 0.30 percent or more, and the accumulated sugar clogs the physiological machinery, so that diabetic coma and even death may result.

THERE is thus a similarity between the effects of sugars and starches on persons afflicted with diabetes and the effect of alcohol on normal persons. The diabetic can dispose of absorbed sugar only (or mainly) by way of the kidneys; the normal individual can dispose of alcohol only (or mainly) by way of oxidation, but in both cases the mechanism of disposal is effective only to a certain limit of consumption, beyond which increasingly disastrous effects will ensue, even to the point of death. Thus, regulation of the composition of the blood in neither case is a physiological one, but is largely a matter of voluntary control. However, the diabetic is aware of his condition and of his own peculiar dietetic dangers, and trains himself under medical guidance to limit his consumption of dangerous foods to his own particular tolerance for them. Can the same be said of the habitual drinker?

The outward symptoms of alcoholism are familiar to all, but it is of interest to quote a precise description of them as analyzed by a noted English physiologist, the late Professor E. H. Starling:

"The effects of acute alcoholic poisoning may be described as a continuous and progressive impairment and abolition of the functions of the brain, starting at the highest evolutionary level and progressing downwards. The stage in which there is lessened self-criticism, greater freedom of utterance, and diminished self-control is succeeded by a phase in which there is interference with the social habits of the individual, while the co-ordination of muscular movements becomes more and more imperfect. This gives place to a condition of stupor or drunken sleep in which the individual may persist for many hours until the greater part of the alcohol has been oxidized in the tissues and its concentration sinks once more below the poisonous level. In the drunken sleep the noisy, labored breathing often shows the beginning of interference with the innervation of the respiratory muscles, and if the dose has been sufficiently large this may lead to death from paralysis of respiration. . . . In some cases the result may be a profound shock from the direct irritant effects of the strong alcohol on the stomach, and heart failure may be associated with the gradual failure of respiration."



Data from Miles, Alcohol and Human Efficiency

Effect of a small dose (27.5 grams—about an ounce) of alcohol in dilute solution (2.75 percent) on selected neuromuscular responses and the alcohol content of blood and urine. The curves represent averages from eight subjects. The neuromuscular responses may be described briefly as follows: Efficiency of eye-hand co-ordination was tested by the "pursuit pendulum," with which the subject catches in a small cup as much as possible of a stream of water flowing from the lower end of a moving hollow pendulum. Continuous eye-hand co-ordination was measured by the pursuit meter, an electrical instrument of some complexity—the subject, by manipulating a rheostat, endeavors constantly to keep a wattmeter needle on the zero-mark in spite of fluctuations in the electric circuit automatically induced by a disturbing device which remains beyond his control

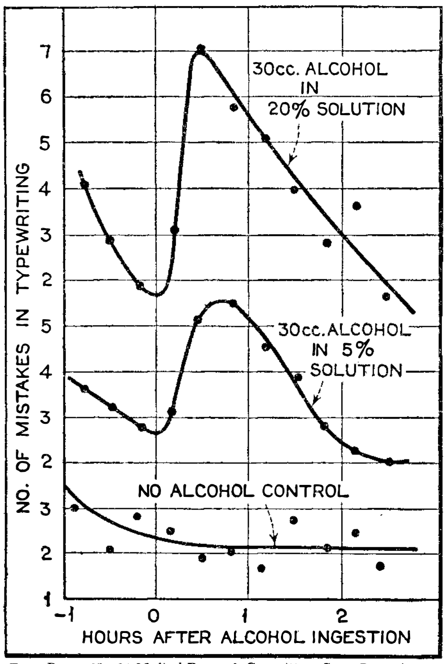
Popular opinion throughout the

civilized world favors some type of governmental action to decrease the likelihood of alcoholic intoxication, a condition which is disgusting to see and degrading to its victims. The pleasing effects of alcohol are, however, realized long before this condition is reached. The temperate use of alcoholic liquors induces a condition that has been sympathetically described, also by Starling. Picturing a man who is attending a feast of which alcoholic drinks form an integral part, Starling says:

"A man may go to such a dinner full of the cares and work of the day, with little or no interest in those he has to meet, whose occupations may be very diverse from his own, nervous of making any remarks to his neighbors for fear of making himself ridiculous or saying something in which they are not interested. After the first glass of champagne we notice the conversation, instead of being spasmodic and forced, becomes general and free; the self-consciousness and preoccupation of each man with his own affairs become lessened. He is more receptive of the moods and interests of his companions. His emotional responses are more readily aroused; the solemn man unbends, the critical becomes charitable and sympathetic, the silent man more loquacious. Each man thus not only reveals himself more to his fellows, but is more ready to appreciate the merits and conversation of those around him. In a word, the use of alcohol in moderation promotes good fellowship. With this greater freedom of interchange of ideas there is less restraint of gesture; facial expressions become more animated; ideas in every man seem to flow more freely and speech becomes more ready."

EVEN though at such a feast, a second or a third glass of champagne may change the conversation from witty repartee to boresome anecdotes and maudlin expansiveness, there is surely no occasion for the interference of organized society. But when the party breaks up and its members enter their various automobiles for the trip home, possibly through congested traffic, have their psychological reactions and their muscular co-ordinations been so adversely affected that as motorists they are to some degree menaces to public safety? Or if it is a midday meal, and they have an afternoon of work in office, shop, or factory before them, have their physical and mental efficiencies been impaired by this convivial feast?

Unfortunately these questions must be answered in the affirmative. Many physiological laboratories throughout the world, particularly the Nutrition Laboratory of the Carnegie Institution at Boston, have demonstrated beyond reasonable doubt that the consumption of even moderate amounts of alcohol, in dilutions of 10 percent to as low as 2.75 percent, depresses the function of the nervous system generally and in many respects to an appreciable and even a considerable extent. It is true that much of this work relates to drinking between meals rather than at meals, but the results are applicable, if in less degree, to the case in point. Furthermore, it may be supposed that wherever the desirable psychic effects of alcohol are observed, the depressant effects are invariable accompaniments, since both must result from an increased concentration of alcohol in blood and tissues.



From Report No. 34 Medical Research Committee (Great Britain)

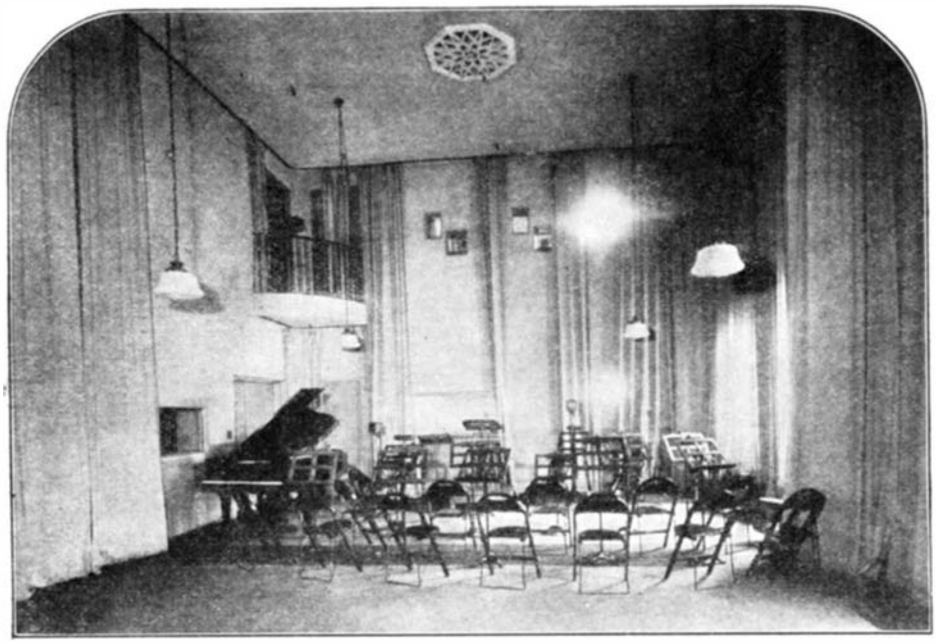
The effect of 30 cc. (about an ounce) of alcohol, taken in dilutions of 5 and 20 percent, on the accuracy of typing a memorized short passage, which required a maximum of two minutes to type

If a participant of Starling's feast attempts to stand perfectly still, the swaying of his body may be greater by almost one fourth than it was before the feast; if he attempts to follow with his eye a quickly moving object, or if he attempts to adjust some instrument with his hand according to the guidance of his eye, his performance will be definitely subnormal. His visual acuity has been decreased and the amplitude of his knee jerk (patellar reflex) has been depressed. If he is a skilled typist, his speed in typewriting will be to some extent lowered and the number of errors perpetrated will be greatly increased. In the case of a woman, her speed in threading needles will be much less than normal. In these and many other ways, it has been shown that alcohol in very moderate doses is a depressant, though the imbiber will have the subjective impression that he is performing faster and better than normal. The more skilled the task, the greater is the depression in efficiency.

It is very doubtful whether alcohol ever exerts even a small initial stimulating effect on the nervous system, as has been maintained in the past. The change in point of view has resulted from improved methods of study. It is now recognized that many physiological processes are normally kept slowed down by higher controlling centers. When these centers are depressed by alcohol, or ether, or chloroform, the lower mechanisms are released with some of the signs of stimulation, such as an increased pulse, or a flushing of the surface capillaries with an increased flow of blood. The effect resembles that following releasing the brakes of an automobile, as contrasted with increasing the pressure on the accelerator. A British scientific board has summed up the evidence in the statement that "the direct effect of alcohol upon the nervous system is, in all stages and upon all parts of the system, to depress or suspend its functions; that it is, in short, from first to last, a narcotic drug."

THESE scientific findings render superfluous any statistical inquiry of the effects of alcohol consumption on industrial efficiency. A depression of efficiency of some degree is almost an inevitable consequence of even the moderate use of alcohol. The effect upon criminal tendencies can not be so clearly deduced, but the common association of liquor with crime, even before the prohibition regime, must be something more than an accidental one. In so far as the criminal is a psychopath, with an inherited tendency to mental and nervous instability, he is, according to Starling, an especially susceptible victim of alcoholic poisoning.

The facts discussed in this article are not presented as the sole evidence upon which the wisdom of prohibition should be decided. But it may be contended that they should form an important part of that evidence. The basis of discussion of this question should be shifted from the grounds of morality, social reform, and personal liberty, which possess merely a sentimental appeal, to the sounder basis of the control of the sale of alcohol as a narcotic drug. Its potency is much less than that of other drugs long known to be narcotics, but the much more prevalent use of alcohol in much greater amounts will of necessity occasion more misery, ill-health, and inefficiency. However, the use of alcoholic liquors by a large proportion of the population is a striking testimonial to its contribution to the pleasures of life and to conviviality. The solution of the question of liquor control should possibly be a compromise between these opposing arguments.



One of the studios where recorded radio programs are made. Two microphones are visible, one on each side of the window in the background

Recorded Radio Programs

By A. J. KENDRICK

President, Sound Studios of New York, Inc.

IN England the broadcast program is paid for by the public, which is taxed, the money collected being turned over to the radio stations to defray the expenses of broadcasting. The sponsored program does not exist.

In this country, however, business interests, awake to the good-will that may be created for their products and services via the air, pay the stations for the privilege of broadcasting programs. The sponsor also pays for the programs, which entertain the radio public and create good-will for the sponsor. This American system of broadcasting, which makes of radio a business asset, has also introduced a new industry to take the place of that older one which has found the going hard in the face of radio competition. The old industry to which we refer is that of making phonograph records. The new one is the recording of broadcast programs.

It might appear that these two industries are quite alike. They are—in outward respects. The new one has grown from the older. But the new one has progressed to that point where a person familiar only with the old method of phonographic recording would be lost in the new science of recording radio programs. On the other hand, those who would do fine work in the new industry should have at their command experience in the phonograph field, should have grown up hand in hand with recording, from its primitive days to the present time.

It was with the basic idea of creating an organization based on quality that Sound Studios of New York was founded. With Gustave Haenschen and Frank Black, well known in the phonograph and radio worlds, as Vice Presidents and directors of music, we were assured of artistic programs that would please the audience and gain good-will for the sponsors. With C. Lauda, Jr., an authority on acoustics, as Chief Engineer, we were well taken care of on the technical end, especially since he immediately surrounded himself with experts to handle every phase of recording.

THEN we procured studios and equipment of the latest type. Desiring to have full responsibility over every step in the making of recordings, we acquired turntables and recorders, microphones and studios, galvano baths and presses, shaving machines and buffing machines—every item for making disks. With a most complete plant and equipment, with a musical library as fine as any anywhere, with experts along every step of the way from business men and executives, through musical directors, talent, technicians, and workers, we felt ready to proceed.

We formulated ideals and we have stuck to them, without trying to discredit other firms or individuals who are doing a good job. We will rent our studios and equipment and the services of our technicians for recording programs not prepared by us. But we insist that they be of high quality, for we cannot afford to have poor programs recorded in our plant. Nor do we allow the release of programs prepared and recorded by us to stations not properly equipped to broadcast them. The results of these ideals, equipment, and personnel have been the recognition on the part of sponsors and stations that recorded programs have a definite place in the radio field if done properly, and the building of a clientele of the foremost sponsors.

RECENTLY, the Western Electric Company, having developed recording and broadcasting apparatus to a point hitherto unreached, equipped a number of broadcasting stations for operation from disk recordings. Others are being equipped every day. Looking about for a recording company whose work and personnel merited the installation of recording apparatus, Sound Studios of New York was chosen as the recipient of the first Western Electric license for the recording of broadcast programs. An entirely new set of equipment is now being installed in our studios, covering every feature of recording.

Recording broadcast programs involves a combination of artistry and engineering. The artistry lies in the preparation of the program, which should reflect the character, mood, tempo, and atmosphere of the sponsor and his product, appeal to the audience whom he wishes to address, and please that audience, making the listener desire to purchase the sponsored product.

The program having been prepared, the musicians and vocalists rehearsed, and the program given over the network, let us suppose that the sponsor wishes to get the full benefit of this fine program. He desires to use it for "spot" broadcasting from independent stations.

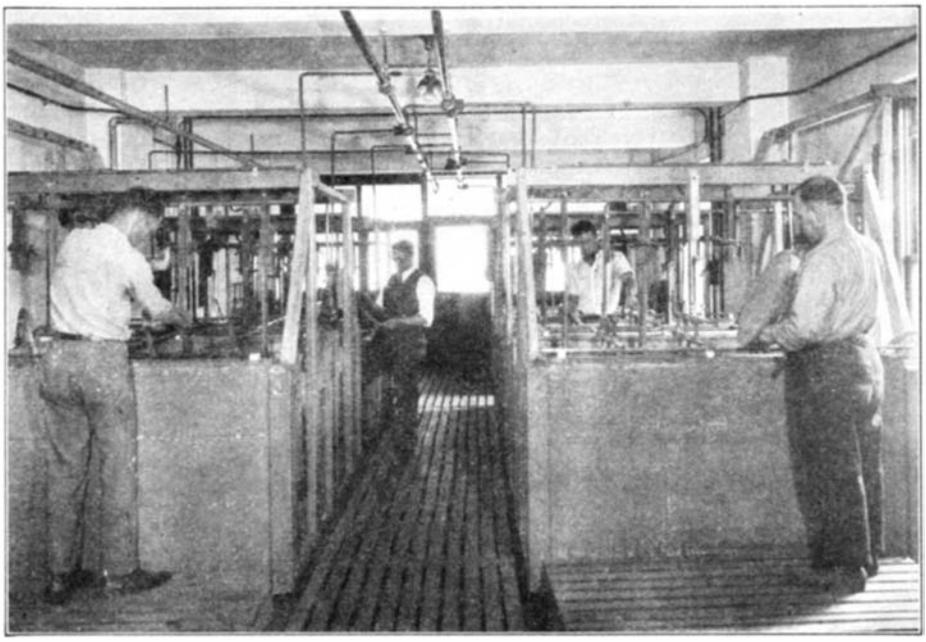
The recording studio is prepared. This room looks very much like any fine broadcasting studio, with soundproof walls and ceiling, ventilator to keep the room at constant temperature, control room looking upon the studio through a glass window in the wall, microphones, and so forth. In addition, there are the turntables, both for the small 10- or 12-inch records which revolve at 78 revolutions per minute and play about $4^1/_2$ minutes, and for the large 16-inch disks which revolve at $33^1/_3$ revolutions per minute and play for 10 minutes.

These turntables are powered by synchronous motors, which maintain a constant speed in spite of voltage fluctuations or other factors. The turntables are equipped with faders, by means of which one turntable may be faded off and another faded on, causing no break in the performance when it is desired to play two disks without interruption.

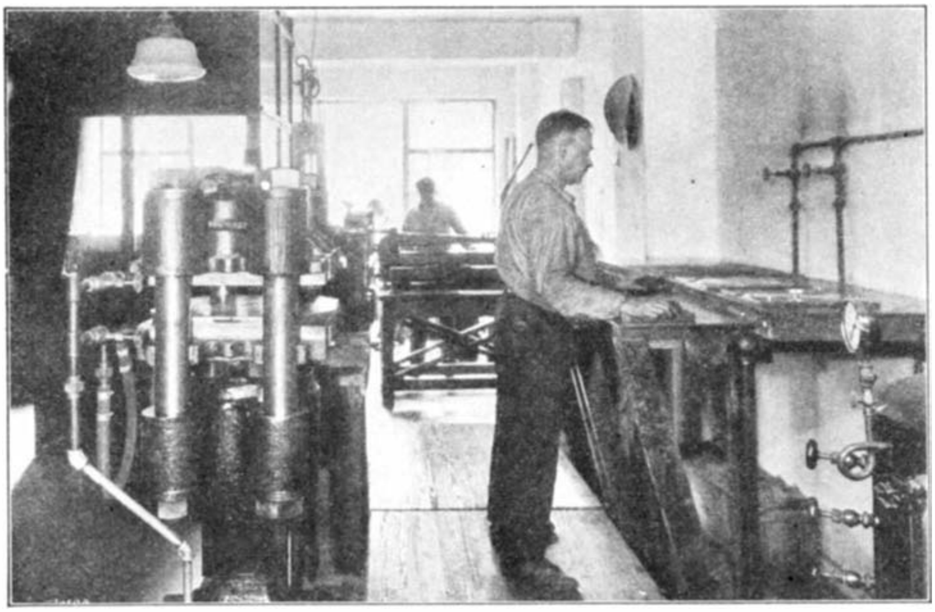
LET us suppose that a program is to be recorded on a 16-inch disk. Disks for broadcast recording, by the way, play from the center toward the rim, the reverse order of the usual commercial records. They are of the lateral cut type, the grooves being of constant depth and the stylus cutting the walls of the grooves; as contrasted to the "hill and dale" type, the name of which describes its principle. The wax—which is really made of soap material—is placed on the turntable, the motor set and the microphones properly placed in the recording studio. Then the program is begun. The man in the control room lowers or raises the volume of each microphone independently. So it is that the soloist is heard above the orchestra even though in the recording studio she cannot be heard above the roar of the drums and the horns as she barely whispers into the microphone which is before her. Sometimes as many as four "mikes" are used at once.

The performance over, the wax, now referred to as having been "cut," is placed in the galvano bath. Swishing back and forth on the end of a long rod in the bath, the cut side of the wax is electroplated, after which the resultant copper "master" is stripped off. This, of course, is a negative of the wax, its marks being raised above the surface whereas in the wax they were indented. The "master" is then taken to the pressing room where two test pressings are made from it. The test pressings are composed of a combination earth-shellac material, identical with the material of the final pressings. This substance is heated, then placed in the press with the "master" and, under enormous pressure and heat, baked. The test pressings are then played for the approval of all the parties concerned. The musical director looks for faults, the sponsor listens closely, the technicians try to find something amiss. If everything is perfect, performance and recording, the technicians, musical director, and sponsor O.K. the pressing. Perchance a certain selection was not as good as it might be. It is performed over again and recorded. Then the first record is played again and recorded on a clean wax, the re-recorded selection being "dubbed" in at the proper time, in much the manner as a movie strip is inserted in the final film. Another "master" is made, and test pressings approved.

Were the final disks pressed from the "master," there would be no impression of the performance should the "master" be injured in the pressing, for the wax has already been shaved for future use. So the "master" is in turn electroplated and the resultant "mother" taken from it. The "master" is then filed away for safe keeping or use for subsequent orders for more pressings of that performance. But the "mother" has its lines indented. It cannot be used to press the final disks. So it too is plated and the "stamper" coming therefrom used to make the final pressings, which are then ready for the broadcasting stations, where they are transmitted by the use of apparatus similar to that on which they were recorded. In this manner is a radio broadcast program recorded.



Left: Adjusting one of the rods which move the waxes in the plating baths. _Center_: Examining a copper "master." _Right_: A wax ready for plating



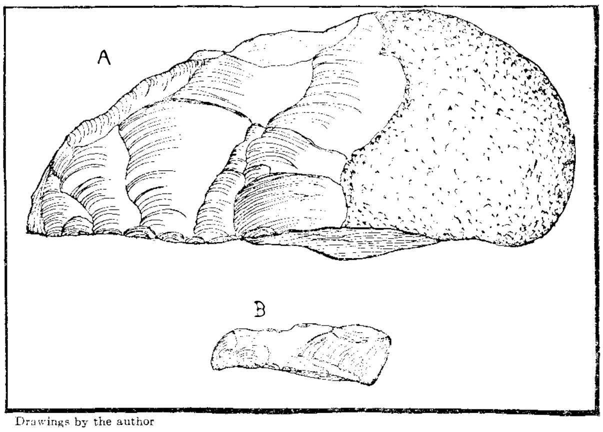
Making test pressings. The earth-shellac compound is being heated at the right to the consistency of dough. _Left_: One of the disk-baking presses

The uses of the recorded program are many and varied. It enables the independent station far from sources of entertainment talent to broadcast programs equal in quality to the finest network offerings, thereby enhancing its reputation and increasing its value to the sponsor. It enables the sponsor to reach his country-wide audience at the same hour despite time differences between the east and the west. It permits the use of radio by sponsors unable to book time on the networks; and for those already using the chain, makes possible the fullest use of their fine network programs. The cost of recording being divided between all the performances given by the disks, the individual programs are low in price, without loss of quality. The recorded program permits of editing, taking the finest portions of several performances, whereas in the direct program any slip passes directly to the audience and cannot be recalled.

FLINT IMPLEMENTS
Great and Small

By J. REID MOIR

As we all know, certain kinds of reptiles of the remote geologic past started their careers when they were of very small size and finished their earthly course when they had developed to gigantic and preposterous dimensions. In fact, so unwieldly and immense did some of them become that it has been supposed their disappearance was due to their great increase in size which made it impossible for them to adapt themselves to their environment. Whether, however, this theory is correct or otherwise, it is of considerable interest and, strange to say, has some kind of bearing upon certain problems which students of early man find themselves called upon to solve.



Drawings by the author

Figure 1: ***A* is a massive rostro-carinate from beneath the very ancient Red Crag of Suffolk. *B* is a diminutive rostro-carinate from the much later, second interglacial age in Suffolk**

Thanks to the researches which in recent years have been carried out in deposits containing the earliest flint implements, it is possible, and of much importance, to trace what may perhaps be termed the career of any particular type of artifact from its first appearance until it passed out of use. When this is done it is realized that in most cases flint implements, unlike ancient reptiles, first appear of a very large size, and dwindle finally to minute, and as it would seem, to almost useless proportions. It must of course be clearly understood that the earliest examples of any particular type of flint implement are not all of great size. But although this is the case, it remains true that the majority of these examples are of massive porportions.

The reasons for this largeness are by no means easy of explanation. It is probable that the size of the raw material played an important part in the dimensions of the resulting implements, but this reason must not be over-stressed. For, although it would not be possible to make large implements from small nodules of flint, it would be quite easy to manufacture small artifacts from masses of flint, however big. Again it may be imagined that the earliest men were of great muscular strength, possessing hands much larger than those of their descendants, and this may be regarded as a probable explanation of our problem, as certain very ancient flint implements which have been found are provided with what appear to be carefully prepared hand grips which were evidently not meant for hands of the span of those of today.

Whatever may have been the cause, a survey of the flint implements made by prehistoric man will show that, generally speaking, the more ancient these specimens are, the bigger will be their size. There is a difference of the same order to be observed in the flaking as, in the older implements, the flake-scars are large and caused evidently by powerful blows, and this peculiarity becomes progressively less marked as the specimens of later cultures are examined. It must not, however, be imagined that the fact of an implement being coarsely flaked points to a lack of knowledge of flint flaking on the part of its maker. In fact, in my experiments I have actually found it more difficult to produce say, a hand axe, solely by the removal of large flakes than by the detachment of smaller ones. It is, of course, true that the later implements exhibit a more delicate outline, or form, than the earlier, but this does not in every case mean that the former are more skilfully made than the latter. For instance, it would not be correct to claim that a Mousterian *racloir* exhibits more skill in flint flaking than does an early Chellean hand axe, and of the two types I would regard the Mousterian specimen as being much more easily produced.

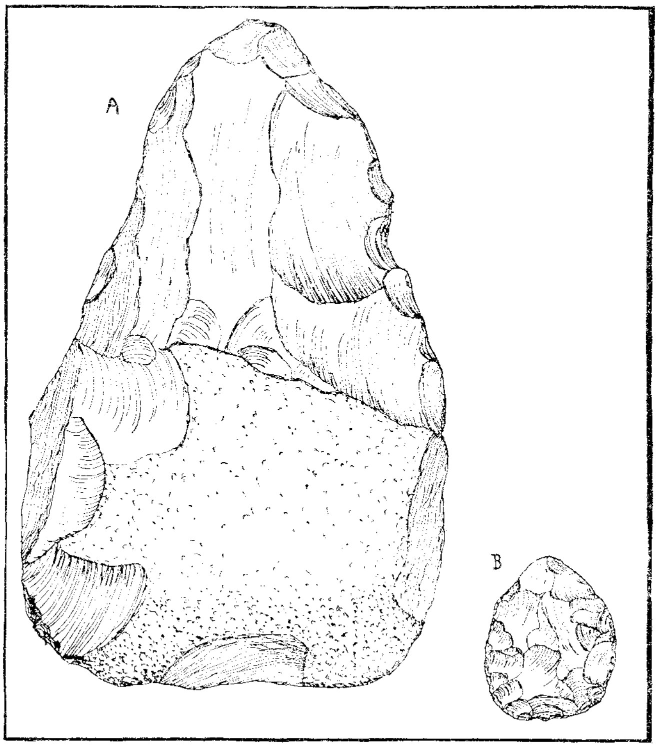


Figure 2: **Another contrast. *A* is a huge seven-pound hand axe and *B* is a diminutive hand axe**

Although up to a point it is legitimate to compare the invention, age, long use, and gradual discarding of any particular type of flint implement with the appearance, existence, and final disappearance of some form of life, yet I know of no particular form of artifact which, like certain animals, became actually extinct, and left no descendants. Even in Neolithic times the most primordial types of implements, the eoliths and rostro-carinates, appear occasionally; and other forms, clearly related to earlier artifacts, occur at that epoch. Neither is it possible to hold that such and such an implement appears first at a certain period and, as it were, to claim a "special creation" for it at that time; for a careful collecting and examination of the flaked flints of earlier epochs, will usually reveal forms clearly ancestral to that under discussion. As an example of this, mention may be made of the *tranchet* axe found particularly in the shell mounds of Denmark which are of early Neolithic Age. It is not long since this type of implement was regarded as making its first appearance at this epoch but recent researches

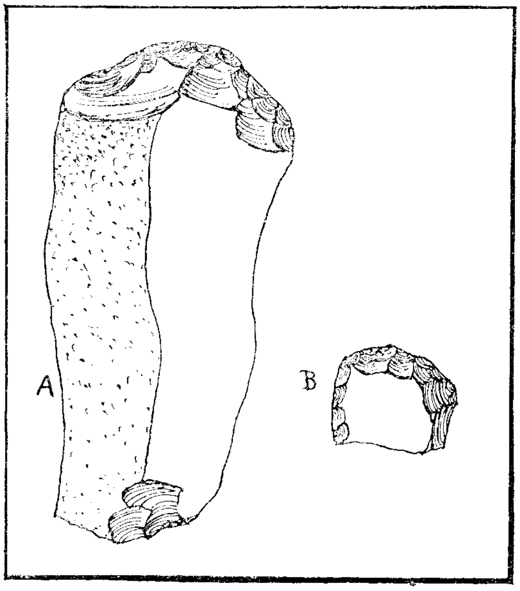


Figure 3: **Contrast *A*, a seven-inch Mousterian (Neandertal) scraper, with *B* of Bronze Age from burial in Suffolk**

have shown it to occur in the lower Paleolithic cultures of South Africa, at the lower level at Le Moustier in France, while I have found an example in a "floor" of early Mousterian Age in Suffolk.

It becomes clear, therefore, that modern work in archeology is demonstrating that no prehistoric culture can be regarded as in a "water-tight" compartment, but each is indissolubly related to that which goes before and to that which comes after. But at certain epochs particular types of implements made occasionally in earlier times, suddenly, for some unknown reason, sprang into favor and these types became the dominating artifacts of those epochs.

THE problem of the implement of minute size is by no means easily solved. In Figure 1 are shown two rostro-carinate specimens, the larger found beneath the very ancient Red Crag of Suffolk, and of several pounds in weight, while the smaller, found in beds of second inter-glacial age near Ipswich, is a true rostro-carinate but of very small size. There is no difficulty in realizing the uses, such as chopping and picking, to which the larger of these two specimens could be put, but to what useful purpose can the smaller be referred? Again, in Figure 2, a huge hand-axe from the Cromer Forest Bed of Norfolk is illustrated beside a very small example of the same type of implement found in a floor of Upper Paleolithic age at Ipswich, Suffolk. Here the same difficulty of assigning a use for the smaller artifact arises, as it does also in the case of the scrapers (Figure 3) and *tranchet* axes (Figure 4).

I have sometimes wondered whether these very small implements of certain types were ever made for any utilitarian purpose but represent, rather, "models" of artifacts, the forms of which had been handed down by tradition. We know that in the Bronze Age flint scrapers, for example, were occasionally scattered over the burial sites of that period, thus showing that these specimens had acquired some magical value. It seems possible, therefore, that in the Stone Age some ancient types of implements were made also for the same occult reason and this may explain the minute artifacts to which attention is drawn in this article.

But while this may be the case, such an explanation can not apply to the widespread "pigmy" culture which marks the closing phases of the Stone Age. At this epoch, from the Vindhya Hills in India right across to western Europe and Britain, a remarkable flint industry is found in which many of the implements are literally of microscopic size. Some of them are as small as a grain of rice and exhibit edge flaking which is so minute that a strong lens has to be used in order to see it satisfactorily.

THERE is, of course, no doubt that these specimens are the work of man but it is also evident that their makers must have been possessed of eyesight much keener than the average person of today, who, with unaided vision could not flake flints in such a manner. Some of the specimens assume geometrical forms and are believed to have been inserted in pieces of wood as harpoon barbs. But this explanation does not cover all the types of pigmy flints, and the uses to which many of them were put remain obscure.

Associated with these very small artifacts and obviously of the same age are numerous implements of much larger size, thus showing that the smaller were made for some specific purpose. The notion was at one time put forward that these microscopic implements were made by a race of very small people, of about three feet in height. But this view was soon demolished by some one who pointed out that if a flaked flint one eighth of an inch in length pointed to its maker standing only three feet, then by the same reasoning a specimen 10 inches long must have been produced by a super giant. When, as in very ancient specimens, definite hand grips are found to have been produced upon implements, it is possible to come to a conclusion as to the size of the hands of those days, but to judge of the height of past races of mankind by the length of the implements they made is patently absurd, for this would connote the previous existence of numerous races of true story-book giants, and we are sure there were none.

The fact of the matter is that our knowledge of the uses to which many stone implements were put is almost negligible. We have at present reached the stage when it is possible to claim on scientific grounds that certain examples exhibiting flaking have been shaped by man. Further, we can with equal certitude state that these specimens were weapons, implements of one kind or another.

BUT it is not possible for us, and it may never be, to assert that these artifacts were put to this or that particular use. It is clear, however, that the great majority of the humanly-flaked flints which are discovered are merely tools with which other things of wood, ivory, and bone were made. But, except in a very few cases where conditions have been favorable to the preservation of such specimens, they have failed to survive the vicissitudes of the past. This fact should always be kept in mind when attempting to reach a conclusion as to the state of culture existing among any prehistoric people, as the flint implements they made are only the indestructible residue of their industry, and to judge of their condition of advancement merely by taking into account this residue, must clearly be entirely misleading.

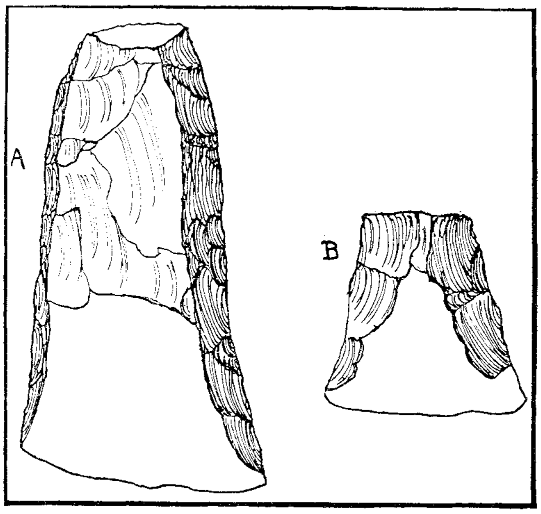
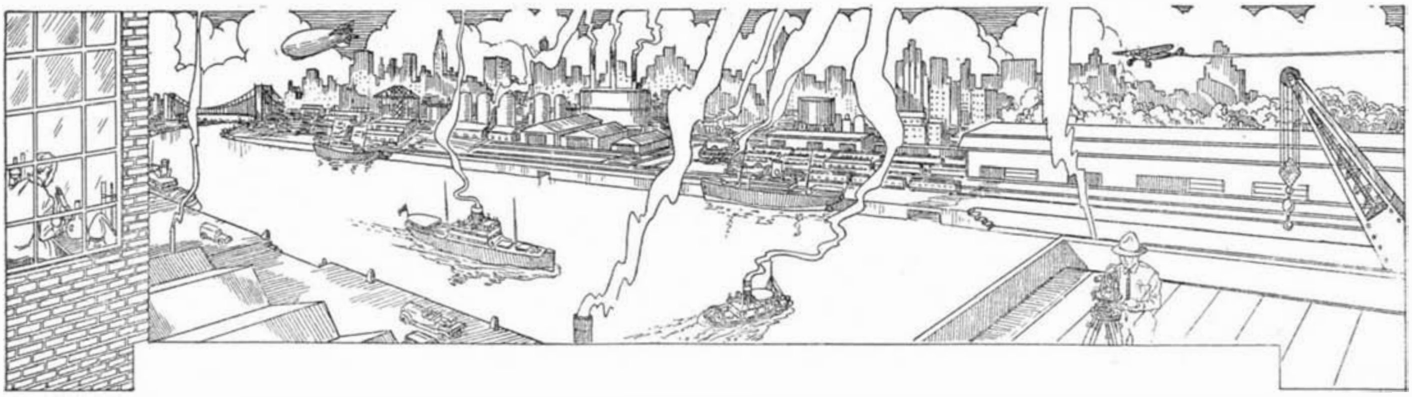


Figure 4: Tranchet **axes great and small. *A* is from Paleolithic deposits in South Africa and *B* is from much more recent beds near Ipswich, Suffolk**



The Scientific American Digest

Conducted by F. D. McHUGH

Index Globe for Study of Geography

THE self-pronouncing dictionary now has a rival in geography in the form of a unique globe which was shown at the American Library Association conference in Los Angeles recently. The globe was invented by Charles M. Williams, a resident of Los Angeles for 40 years.

By means of paper rolls inside the globe, the location of more than 43,000 towns, mountains, rivers, and bays is indicated automatically through a small window when a handle at the bottom of the globe is turned. When the location is noted from the inner index, the globe may be turned, and the place found immediately by means of a special finder scale. If the globe is turned farther, a description of the country, a list of its products, its climate, and photographs of scenes in the country may be seen through a second small window on the side opposite the first. This globe also shows the point in the world where any constellation of stars will be visible at a specific time, and the point on the earth where, on any particular date, the sun will be directly overhead.

Courtesy *Los Angeles Herald*

As the handle is turned, the index gives the information desired

Hudson River Bridge Cables Completed

THE spinning of the last wire for the last cable of the Hudson River Bridge at New York, took place shortly before noon on August 7, thus marking the completion of a major and probably the most spectacular phase of the building of the structure. The occasion was informally observed at the Jersey end of the span. Commissioners of the Port of New York Authority, which is constructing the bridge, and a number of other interested persons assembled on the Palisades as the last wire, to which was attached a small American flag, came across the river from the Manhattan side.

The spinning of the four enormous cables was completed in less than 10 months, the first permanent cable wire having been strung on Friday, October 18, 1929. The number of men engaged in the spinning operation was approximately 400. One man was killed at the New York anchorage while setting up spinning equipment, but none was seriously injured or killed during the spinning operation. Only about 27 days were lost due to inclement weather conditions.

Complete details of the cables and the methods of spinning were given in an article in the January, 1930, issue of SCIENTIFIC AMERICAN.

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Illegal Guns Slaughter Waterfowl

DESPITE the fact that both federal and state laws prohibit the use of guns larger than 10-gage in taking waterfowl, game wardens from time to time discover elaborately built "artillery" used for this purpose. Every person, whether he be a sportsman or not, should assist the authorities in wiping out this illegal method of hunting and use every effort to assist in securing conviction of the violators.

In the accompanying photograph are shown three illegal guns captured by game wardens in Maryland. The one in the center was captured last January by Aleck Tyler on Fox Island, which lies along the Maryland-Virginia boundary line. It consists of four barrels, each of a different length and having muzzles one inch in diameter, all bound to a large oak block by means of an iron band. The total weight is 125 pounds. Carved in the wood at the base of the barrels is a groove for powder which is ignited by means of a percussion cap fired by a hammer on the right hand barrel. This arrangement causes firing of the four barrels in rapid succession.

The two long guns, one eight feet and one nine feet long, and weighing 90 and 100 pounds respectively, were confiscated by Warden Tyler, together with two Deputy Wardens and Orin D. Steele, United States Deputy Game Protector. These guns are made of two-inch galvanized piping with one end brazed to form a chamber, mounted on home-made stocks. The charge for one of these guns consists of about one fourth of a pound of powder and one pound of shot.

Such guns are used by violators of wild fowl laws for hunting wild fowl at night. The large single barrel guns are usually locked to a skiff, the barrel projecting over the bow and the breech supported by some object at the butt and fastened in such a manner as to take up the recoil. The battery type is usually mounted on a swivel. These guns are very destructive and will kill at one firing from 100 to 150 birds and cripple many more.

The hunter who follows this method of

Deadly guns for slaughtering waterfowl, confiscated in Maryland

shooting wild fowl is very hard to apprehend since he uses a small skiff with a short paddle, sneaking at night into large rafts of waterfowl on their feeding grounds. Since the water is shoal on these grounds, it is very easy for the pot-hunter to get within range of the birds before they become suspicious.

Entoptical Effects—Can You See Them?

MR. L. F. CULVER of Gautier, Mississippi, one of our readers, sends us the following note concerning a peculiar effect in the realm of physiological optics. He describes phenomena which other readers may be able to duplicate.

"Many times," Mr. Culver writes, "while lying on the ground with a straw hat over my face I noted that for each tiny opening through which light came I saw a round light spot about one fourth inch in diameter and with a dark center. At length I saw that these light spots were all of the same size, and I also observed that the dark centers were of irregular form, but all exactly alike in detail, except that the spot seen by one eye was totally different in form and detail from that seen by the other eye.

"Then I noticed on successive days that these dark spots always looked exactly as at first. As their form was not at all dependent on the form of the openings in the hat through which the light came, I concluded that what I was seeing was within the eye itself and must be the blind spots on the retina, that I had learned of in my school days.

"I tried other ways of seeing them and discovered much that was unexpected and very interesting and beautiful. This, I found, required considerable patience and perseverance, but the reward was ample. I think it best, however, first to try the method described above.

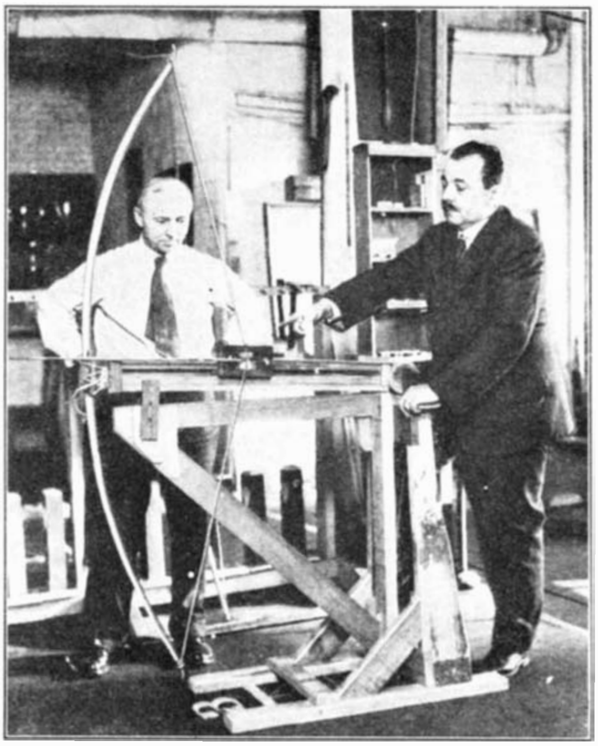
"At night sit with the side of the head toward the source of light and facing a darkened part of the room or a door opening into a dark room. Hold about one inch from the eye farthest from the light some small, polished, spherical surface of one-eighth inch or less in diameter to reflect the light into the eye. This illuminates a part of the retina. Near the center of the illuminated part will be seen the blind spot. The dark nucleus of the spot evidently is bordered by a row of highly sensitive nerve filaments which appear like a row of brilliant bright dots close together. In my left eye there are three small blind spots outside of the main spot. The borders of these also are studded with bright points. The group reminds one of a group of sun spots seen through a telescope. Under stronger illumination, as with direct sunlight, bright points appear, sparsely scattered over the entire blind area, and much new detail is seen. Whatever the reflecting surface used, these spots change their form. The amount of detail seen varies greatly with the degree of illumination."

These phenomena are known as "entoptical" effects and are described in works on physiological optics, most comprehensive of which is the famous "Treatise on Physiological Optics" by the great German authority Helmholtz. This three-volume work of 1700 pages is an old standby to all physicists and opticians. Recently it has been translated, and thus made easily available to English speaking readers, by Professor James P. C. Southall of the Department of Physics at Columbia University, author of "Mirrors, Prisms and Lenses," himself an authority on optics.

"Under suitable conditions," says Helmholtz, "light falling on the eye may render visible certain objects within the eye itself. These perceptions are called entoptical. . . . There are some objects in the eye, particularly the blood vessels of the retina, which fulfill the latter condition by being very close to the sensitive membrane and therefore in position to cast shadows on the retina." Fully to describe these and a wider variety of entoptical effects would, however, demand as much space as is devoted to them in Helmholtz' treatise.

While Mr. Culver's discovery is not new to science, he made it independently. When his note, as reproduced above, was submitted to Professor Southall for opinion, the latter commented, "I think Mr. Culver deserves much credit for having made these experiments for himself."

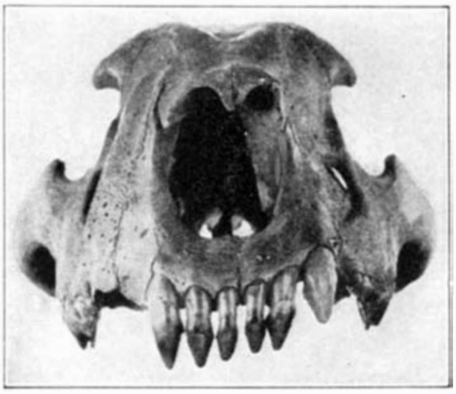
Perhaps others of our readers can duplicate these effects.



As the age-old sport of archery takes a new hold on the interest of thousands, problems of constructing bows and arrows have had to be solved anew. Much success has attended the efforts of the manufacturers, but there is still much to learn. The illustration shows a new machine displayed some time ago by the archery club of Seattle, Washington, for testing the accuracy of arrows. With this home-made contraption, arrows can be tested so that their feathers may be trimmed, thus making possible the shooting of an entire quiver of arrows under any given set of conditions

When the Tiger Lost a Saber

IT is said that Mrs. Paleolith would quiet her young Paleoliths by saying she would call Old Saber-Tooth; and these giant long-toothed cats were indeed fearful-looking



When this tiger lost one of its saber teeth at an early age, its jaw grew asymmetrical, one-sided

creatures. Once in a while saber-tooth skulls from which a saber 10 inches long had been lost, are seen, but the animal had survived the loss bravely. It is thought that these toothed cats used the long sabers for stabbing the prey in order to drink the blood, but it was possible, when a saber was lost, to survive by eating flesh. This particular tiger lost the saber when young, the saber-tooth being broken off far up in the socket. Its loss produced a curious asymmetry due to the necessity of filling in the large socket. In loosing a saber the great cat had had its face lifted. The front teeth in the tiger's left jaw are elevated and the bones reduced.

Chemistry and the Old Rag Man

RAYON has given us wonderful and beautiful varieties of cloth but, when the glossy fabric has served its purpose and found its way into the rag bag, it is not popular with the rag man. Before the advent of rayon, "old rags" were the raw material for the finest grades of writing paper. Recent tests by the United States Bureau of Standards disclose the fact that rayon rags are valueless for this purpose, and may actually be detrimental. Laboratory tests were conducted at the bureau to determine the paper-making quality of rayon when subjected to the same treatment as rags in the production of fine papers.

Cotton and linen fibers are commonly used for papers, such as bonds and ledgers, on account of their strength and durability. In addition to their value in these respects they are used in the manufacture of papeteries and other fine writing papers, as well as to impart softness and other desirable characteristics of surface and finish. The presence in rag stock of any fiber which would affect these qualities of paper is undesirable.

Samples representative of the four general processes of rayon manufacture—viscose, nitrocellulose, cuprammonium, and cellulose acetate—were included in the tests. The equipment employed in the preparation of the pulp and its subsequent conversion into paper was on a laboratory scale and is that used at the bureau for the preliminary tests of all paper-making materials under investigation. The caustic soda and lime processes were used in the cooking operation. Paper-making stock was prepared from the pulp, alone and in admixture with sulfite pulp, and converted into paper on a sheet mold.

Owing to loss of strength when wetted, the rayon filaments tended to break into short lengths during the preparation of the paper-making stock without the fibrillation and fraying necessary for good felting properties. As a consequence, the all-rayon sheets lacked the strength to withstand the handling necessary in the pressing and drying operations, and the pliability characteristic of rag papers. Likewise, sheets made of rayon in admixture with sulfite pulp were considerably weaker than those made from sulfite alone.

Since increasing amounts of rayon are being found in the rags and textile waste used in rag-paper manufacture the test data are believed to be of value to that industry.

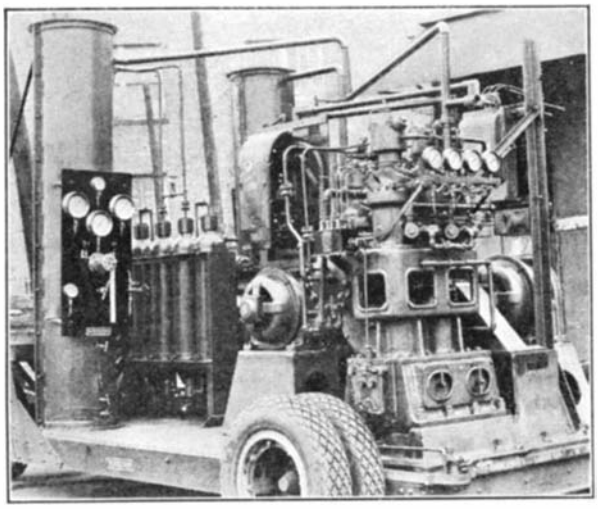
A Chemical Service Station for Dirigibles

In a few years, when air travel is as commonplace as railroad travel today, machines like that pictured here may become as familiar to travelers as the workman who taps the axles while the train is standing in the station. This trailer full of motors and compressors will draw up alongside your dirigible and will start to work, drawing the helium gas out of the balloonet, removing the air that has mixed with it, and returning it to the ship with its full lifting power restored.

The mobile helium re-purification plant was built for the Goodyear-Zeppelin Corporation, of Akron, Ohio, by the Helium Company of Louisville, Kentucky. The entire plant, with a capacity of 1500 cubic feet of gas per hour, is mounted on a pneumatic-tired trailer body and can traverse any terrain which a truck can negotiate.

The mobile plant consists essentially of two compressors, one handling air, the other helium. The air compressor supplies air at high pressure to an expansion column, which serves to liquefy a portion of the air, forming a cooling bath at a temperature of —170 degrees, Centigrade. The second compressor forces helium at 2000 pounds pressure through copper coils immersed in this liquid air, with consequent removal of impurities by liquefaction. The helium passes through nearly a half-mile of copper tubing, and is finally discharged at a purity of 98 to 99 percent to any desired point and at any pressure up to 2000 pounds per square inch. The loss in repurification is approximately 1 percent.

The mobile helium repurification plant was designed by R. R. Bottoms, director of research, and E. G. Luening, executive vice-president of the Girdler Corporation, which operates the Helium Company. These men were also responsible for the development of the special fuel gas used by the Graf Zeppelin on its first return trip to Friedrichshafen from the United States.—*A. E. B.*



When helium becomes diffused with ordinary air—a condition that might take place in a dirigible due to leakage of the gas envelope—its "lift" is decreased in proportion to the adulteration. Because of this fact, the mobile helium re-purifier shown here was built for the Goodyear-Zeppelin Corporation. It removes air and any other diffused gas from helium by the process of freezing out, as explained in the text

"Jake" Paralysis

During the past few months thousands of cases of paralysis from drinking bootleg Jamaica ginger have occurred, principally in the southwestern portion of the United States. Studies made by chemists indicate that the poisonous substance is a derivative of coal tar or phenol. Few of the patients have died, but practically all of them have developed forms of paralysis which seem to be fairly permanent. The nerves affected include those of both the arms and legs. The nerves conveying sense of pain, touch, and heat have not usually been disturbed, but in some cases the patients seems to lack also these sensations. In one instance in Oklahoma City a traveling man 66 years of age died following paralysis from drinking Jamaica ginger. Postmortem examination indicated that in some manner the poison had selected the nerve of motion in the arms and legs. The tissues of the brain were not apparently greatly influenced by the poison. Post mortem examination also revealed that death was apparently due to a previous kidney disease, complicated by his secondary illness, rather than to the Jamaica ginger.—*M. F.*

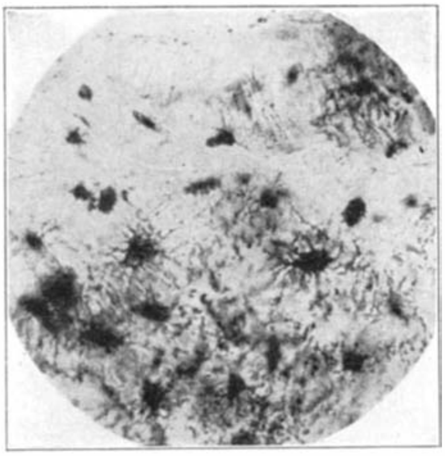
Ancient Bacteria Preserved in Fossil Bone

It has been a matter of surprise that such minute, delicate bits of protoplasm as bacteria should be found in thin sections of bone many thousands of years old. Yet in the bone of an ancient tiger, under the microscope, are found undoubted germs resembling some of the bacteria of today. The picture shows, at a magnification of 400 diameters, colonies of bacteria in the minute, thread-like canals leading out from the bone cells which appear in the picture as dark diamond-shaped bodies. It is not known whether or not these ancient germs brought on disease but it seems likely that they were the germs of decay.

Peculiar Aviation Inventions

We are constantly receiving suggestions for peculiar types of aircraft and aviation accessories, some provocative of thought, some merely of amusement. The inventors, however, are in dead earnest, and full of the desire to advance aviation. Here are extracts from an anonymous letter, with the envelope bearing a Canadian postmark. "Dear Sir. I am quite unknown to you and you are to me. However I do not hesitate to address you this letter; for if the idea that it contains is good it matters little to know whence it comes but it matters only to use it. So I desire to remain unknown but I desire also an experiment to be done, that, in my opinion will give the best results . . . The motor of the plane works in the air by means of the propeller. But the propeller with two blades is an instrument with which the motor can work but little in the air in one turn . . . however let us consider that to the two blades of the propeller, one can add 16 other blades on the same circumference. That makes a propeller with 18 blades; it is the American Wheel. . . . To be used for speed it is necessary for a motor to make much work during a turn."

The suggestion is a typical one. Such inventions always come down to a question of arithmetic. It seems at first sight plausible that with only two propeller blades on a shaft, the intervening air is not worked upon properly. But when the suggestion is examined technically, it is found that two propeller blades already take up the entire power of the engine, and that the efficiency of the two-bladed propeller in producing thrust may be as high as 85 percent and as nearly the theoretical values attainable as will ever be practicable. When a multiplicity of blades is used, the interference between them is such that the efficiency is greatly reduced instead of being improved.



Fossil bacteria in fossil bone

In almost all the suggestions received, the same question of arithmetic is neglected. Dozens of plausible helicopters are suggested, with some screws for lifting, some for propulsion, and so on. There is nothing theoretically wrong in such helicopters, but when the invention is examined it is found that the inefficiency of the various elements, the complication of the mechanism, and failure to consider certain factors of stability and control make the idea quite impracticable. There appears to be in the United States an inexhaustible fund of inventiveness and courage. The prime necessity is to add to mechanical instinct at least a modicum of analysis with reference to air forces and efficiency. At the same time, one dare not predict that some instinctive mechanic will not yet contribute to our knowledge without such basic analysis!—*A. K.*

A Chemical Paradox

NOTABLE among the triumphs of industrial chemistry during the past decade has been the development of commercial processes for the synthetic manufacture of ammonia and nitric acid. Because of the efficiency of these new methods, ammonia is being sold at prices which make it attractive in many new industrial roles, some of which were described in an outstanding paper presented by Jasper E. Crane, of the duPont company, at a recent meeting of the Manufacturing Chemists' Association.

Among the most attractive of the newer uses for ammonia is its application as a source of hydrogen, particularly for welding. It seems, offhand, to be paradoxical to state that it is economical to combine hydrogen with nitrogen to form ammonia, then to separate the two gases again in order to obtain the hydrogen. The answer to the paradox lies in the fact that one cylinder of ammonia, when "cracked" is equivalent to about 17 cylinders of hydrogen. As the principal part of the cost to the user of hydrogen is the cost of the cylinder, he finds that he saves about one-half by buying 17 times the volume of hydrogen in a single cylinder. Simple, inexpensive apparatus has been developed for cracking the gas by use of an electrically heated catalyst.

An even more striking reduction in cost is that of nitrogen made by the cracking process. The cracked gases are burned in air, producing water and nitrogen. One cylinder of ammonia, in this case, is equivalent to about 36 cylinders of nitrogen at one ninth the cost.

Other better-known uses, of course, are much more important as tonnage markets for ammonia. These include the production of synthetic organic chemicals in great variety; nitric acid and synthetic sodium nitrate; fertilizers; nitrided metal products; and its uses as a cheap alkali.—*A. E. B.*

An Interesting Light Plane

THE popular interest in gliders has been followed by enthusiasm for the light plane. One of the most successful of these small planes, with success measured not only by flying ability, but by large sales also, is the *Aeronca* built by the Aeronautical Corporation of America. This plane is equipped with a relatively small engine of the two-cylinder opposed type, 4⅛-inch bore and 4-inch stroke, rated at 30 horsepower at 2500 revolutions per minute. The weight empty is 385 pounds, the disposable load (with one occupant) 315 pounds; thus the total or gross weight is only 700 pounds. The span is 36 feet and the wing area 144 square feet. The top speed is given as 85 miles per hour, the landing speed as 31 miles per hour, and the initial climb as 550 feet per minute. Such performance is quite adequate for private flying, except for cross-country work under adverse wind conditions.

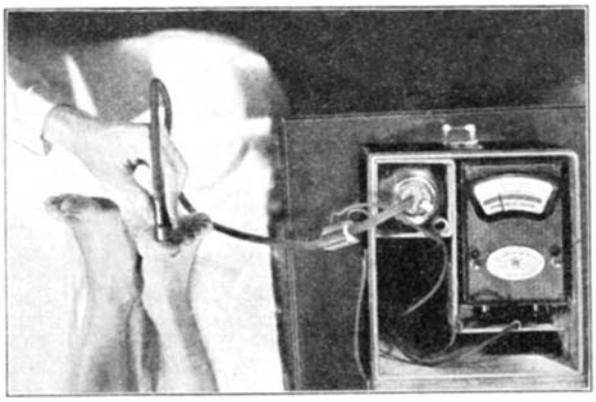
Quite adequate for private flying, this plane, empty, weighs 385 pounds

The main interest of the *Aeronca* from a flying point of view is in the low wing loading, the use of relatively large control surfaces, and of large dihedral and vertical fin areas.

The low wing loading, 4.8 pounds per square foot of wing area, means low landing speed, quick getaway, and short pull up. This makes for safety and for the possibility of using small fields.

The large dihedral (raising of the wing tips relative to the center) makes for stability in a side slip. The large vertical tail surfaces give weather-cock stability, the plane swinging into a side wind instead of swinging dangerously away from it. The large control surfaces, on the other hand, make for ease of control in spite of the inherent stability. The aerodynamic conception, although not exactly novel, makes for ease in flying. Machines of equal stability and the reasons for such stability have been known since 1910 or thereabouts. But it is gratifying to see designers take perfect stability as their objective again. If there is to be private flying, machines must nearly fly themselves. There is but one serious disadvantage to such a lightly loaded plane: gusty weather is apt to result in difficulties near the ground and considerable bumpiness aloft.—*A. K.*

Most of us are familiar with the clinical thermometer but few, among laymen, realize the necessity for taking temperatures on the surface of the body. The illustration shows an improved electrothermal instrument for measuring body surface temperature and the text herewith explains the need for it



Body Temperature Measurement

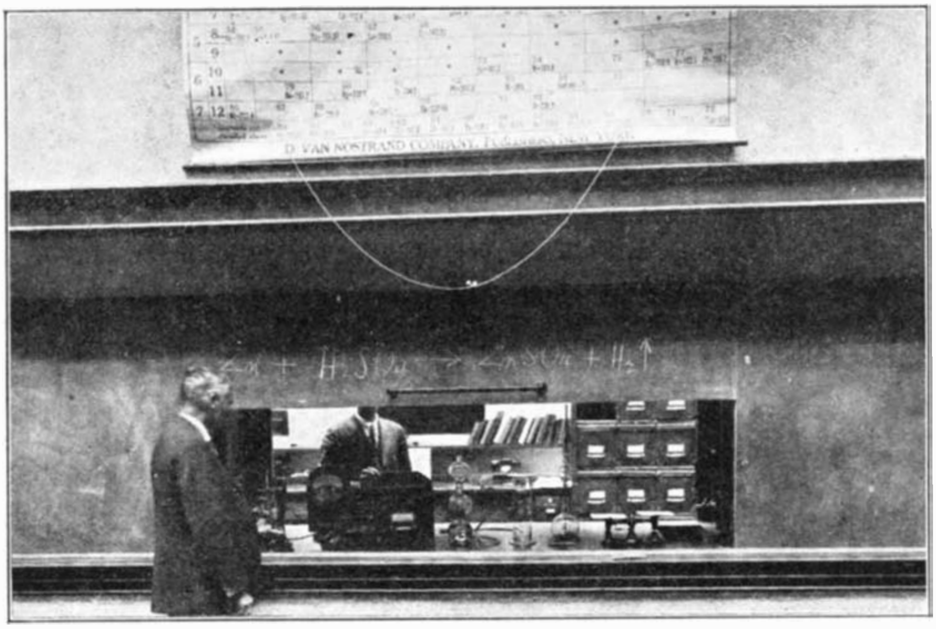
THE measurement of the temperature of the human body on the surface and at various points represents one of the most important observations made by the physician in the diagnosis of disease. It has been recognized for years that infection produces congestion and fever. There is increased flow of blood to the part involved which is responsible for the changes that occur.

Investigators in the Mayo Clinic have recently developed an electrothermal instrument for measuring surface temperature and also for measuring temperatures of various organs at any given time. In case the temperature of an organ or of the spinal fluid or of the brain is to be determined, a needle is introduced and by means of the thermocouple method the temperature at the point of the needle can be ascertained. The sensitivity of the electrothermal junctions is increased by putting four couples in series; the galvanometer is calibrated in degrees Centigrade. Thus it is possible to measure the temperature at any point in the body in 10 seconds, absolutely accurately, and within a fraction of a degree.—*M. F.*

Lightning and the Airplane

WALTER E. BURTON, writing in *Aviation*, describes some interesting experiments now being conducted by the Ohio Insulator Company on the effects of lightning on the airplane.

In a thunderstorm, lightning is more feared, but wind is much more dangerous.



In the new chemistry classrooms at Princeton, the apparatus needed during a lecture is kept behind this blackboard which slides up like a window. Thus while the professor lectures, attention-distracting equipment is kept hidden from the students although it is set up ready for instant use when needed

Nevertheless the effects and dangers of lightning are well worth investigating.

The lightning laboratory of the Ohio Insulating Company is unique. With new equipment being installed, the laboratory will be capable of producing a spark at more than 3,000,000 volts pressure, nearly 30 feet long. In an open-air laboratory three transformers, the largest ever built, are used to produce the huge spark. The units are arranged in steps on a special porcelain tile base; the highest stands 50 feet above the ground. A number of oscillators are available to produce a continuous spark discharge. A camera with a shutter operating at 1/50th of a second is used for photographic studies of the flash.

At one end of the open air laboratory, a system of poles, guys, and insulators will allow the suspension of airplanes as large as a Ford tri-motor for experimental purposes. Because wind may blow discharges to one side, the airplane is in a field which is sheltered by groves of trees. So far experiments have been made only on airplane models. Later a full-size plane will be suspended with every part complete, the gasoline tanks full, and the engine running. It is not yet certain, however, whether the experiments with gas aboard and engine running will be possible without undue danger.

One problem has already been solved: a plane can be struck, can deflect a lightning discharge and become part of its path as it travels from cloud to cloud, or from cloud to ground. Among the many other problems to be investigated systematically are:

If a plane is struck, what is the probable effect on pilot and passengers?

If a lightning discharge takes place near a plane without actually striking it, will the pilot receive so large a shock as to lose control temporarily?

How vulnerable is the ignition system?

Do the exhaust gases, because of their ionizing effects, create a path for, and attract the lightning?

What is the fire hazard for tanks, fabric covering, and so forth?

What happens when metal parts are not completely bonded? Will sudden currents of several hundred thousand amperes passing through imperfectly bonded joints fuse the metal parts instantaneously?

We shall await with great interest the results of the experiments.—A. K.

Germans Isolate Ethyl Radical

POLITICIANS have definite, though varying, ideas of what a "radical" is, but when the chemist refers to a "radical" he means something quite different. In chemical parlance, a radical is a certain definite combination of atoms which stick together persistently and act, chemically, as a single atom. Thus, the two elements sulfur and oxygen are prone to link together as the radical SO_4 and to retain the identity of their union in compounds such as sulfuric acid, (H_2SO_4), calcium sulfate, ($CaSO_4$), and so on.

Now these radicals have been assumed to exist for years, although no one has ever seen any SO_4—it doesn't exist alone. Neither had anyone ever seen the important radical C_2H_5 which is part of the molecule of ethyl alcohol, (C_2H_5OH), until recently. Now, however, two German chemists report that they have isolated the radical C_2H_5—an announcement which to a chemist is about as startling as saying that a soul has been separated from a man and put in a glass case for observation.

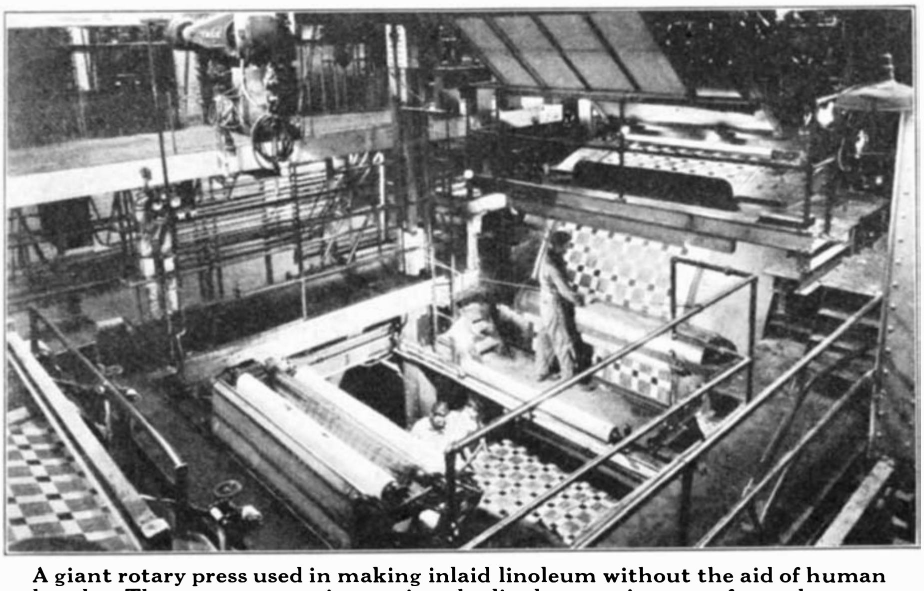
Professor Paneth and W. Lautsch have succeeded in producing the radical ethyl in a free form by the thermal decomposition of the vapors of lead tetraethyl in a current of hydrogen under diminished pressure. The ethyl radical is just as aggressive as the methyl recently isolated by Paneth and Hofeditz. Free ethyl converts such metals as lead, zinc, antimony, and cadmium into volatile compounds, which are clear as water at room temperature and 760 millimeters pressure. —*A. E. B.*

An Industry That Grew from a Paint-Pot

A PAINT pot, accidentally left uncovered, furnished the clue to several great industries that have grown up since Frederick Walton found his paint covered with the tough skin of dried oil. In his efforts to make something useful out of that film, Walton eventually laid the foundations for the linoleum business, for he discovered that the dried oil could be ground up, mixed with granulated cork, and made to adhere to a canvas or burlap foundation. The inventor died recently at the age of 94, having lived to see a giant industry arise from his early experiments.

Although modern linoleum is characterized by a beauty and durability undreamed of in the early days of its manufacture, the process of manufacture is fundamentally the same as described in Walton's original patents. Linseed oil, pressed from flaxseed, is boiled to the consistency of molasses so that it will oxidize or dry out quickly. This same boiling process is the beginning of patent leather manufacture and that brings us to the place where our chemist friend, Professor J. S. Long, of Lehigh University, comes into the story.

Several years ago, a certain manufacturer of patent leather asked Dr. Long to tell him why the patent leather surface of shoes cracked when the shoes were worn. Dr. Long found that the boiling of the linseed oil was done in an empirical manner, the operator simply continuing the cooking until the oil felt about the right consistency,



A giant rotary press used in making inlaid linoleum without the aid of human hands. The operators are inspecting the linoleum as it comes from the press when rubbed between the fingers. The chemist, knowing the fallibility of human judgement, began to investigate the reason why linseed oil "thickens" on cooking. He soon confirmed his suspicion that the change was due to an increase in the molecular weight of the oil. From there it was easy to develop a simple method of determining the molecular weight of the oil as the "cook" progressed, and to stop at exactly the right point. Thus, perfect uniformity of product is obtained, and the patent leather manufacturer is no longer subject to the troubles that were his lot when he depended on the guess of his workmen. This piece of research work was the starting point for a series of investigations at Lehigh University that have almost as much significance for the users of linseed oil as Walton's curiosity about the film in the paint pot.

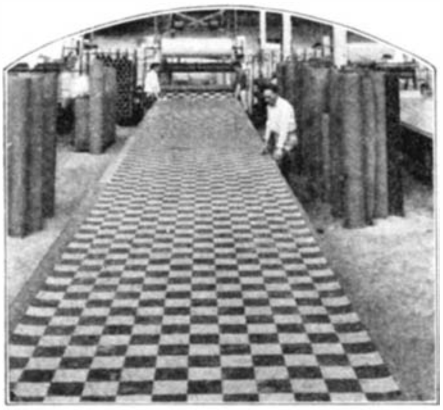
In the modern linoleum plant, the boiled linseed oil is run into a trough, from which it trickles down over sheets of scrim which hang from ceiling to floor of the oxidizing shed. The boiled oil oxidizes rapidly, forming the tough, elastic skin, which is ground up to a pulp and then mixed with rosin and other gums in large kettles. When the mixture cools, it is chopped up into convenient sized chunks and aged for several weeks before it is mixed with the finely ground cork. Color pigments are also added to the mix which is fed between huge steam heated rollers. The usual backing material is burlap. To obtain the many colorful designs which make printed linoleum such a popular floor covering, the plain material is run through massive printing presses, after which it is run into the "stoves" for drying and toughening. The more expensive grade, known as inlaid linoleum, is made by fitting vari-colored tiles of linoleum into a pleasing pattern, which is fused in position in hydraulic presses.—*A. E. B.*

"Sunshine" Lamps

THE tremendous vogue of the use of lamps producing ultra-violet rays has caused considerable consternation among physicians who realize the limitation of these lamps for health and also the fact that there are all sorts of peculiar devices offered to the public, in many instances without any certainty that the device will actually produce good results or that it will provide the ultra-violet that the person wants. In order to bring some control into the field, the Council on Physical Therapy of the American Medical Association has issued a manifesto to manufacturers, defining the limitation of such apparatus and the claims with which it may be sold.

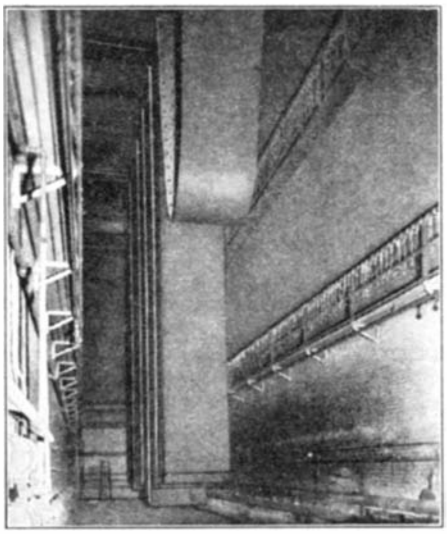
Because of the possible danger of lamps of high intensity, the Council has taken the stand that any "sunshine" lamp sold directly to the public should be so constructed that the radiant energy emitted shall not differ essentially from sunlight. In general, the Council believes that more conservative claims for the necessity of strong sunlight should be made by the manufacturers of lamps for home use, such statements being restricted to those which can be justified by conclusive scientific evidence. The Council is not convinced that human beings in good health require the great amount of ultra-violet energy which one is led to believe is the case from the advertising and descriptive matter pertaining to some of the so-called "sun-lamps" sold to the public.

A number of the more responsible manu-



Each roll of linoleum is inspected by experts but also is subjected to as many as 110 laboratory tests before it is ready for shipment

facturers have fully agreed with the opinion of the Council. The emission characteristics of their lamps are in essential agreement with the requirements established by the Council, and in their advertisements they carefully avoid making



One of the "stoves" in which printed linoleum is "festooned" for final toughening and aging

curative claims. Furthermore, in these advertisements attention is called to the advisability of consulting one's physician before exposing oneself to ultra-violet radiation.—*M. F.*

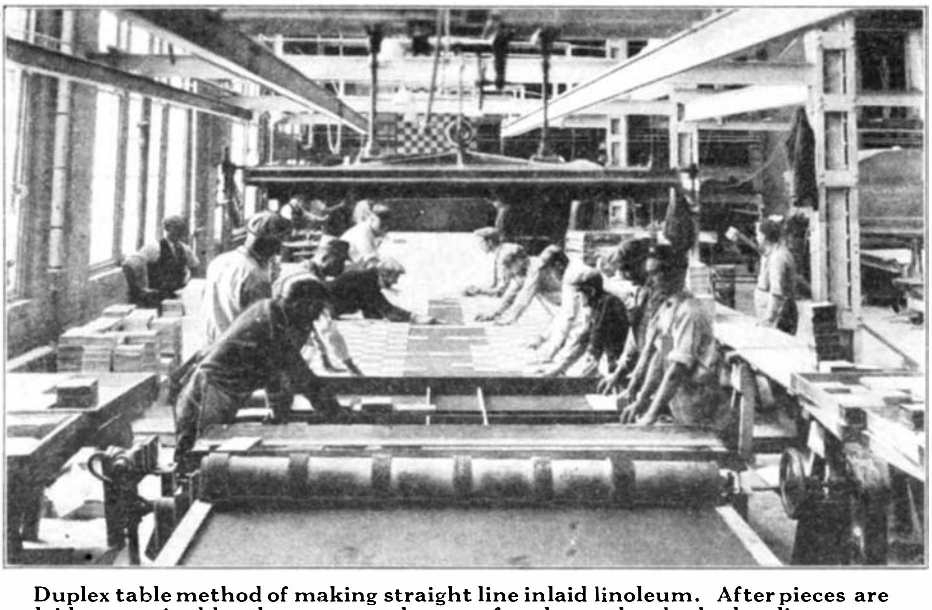
Reforestation in 1929

REFORESTATION in the United States last year restored to tree growth a total of 111,175 acres, the Forest Service of the United States Department of Agriculture reports. This included the planting of 31,430 acres by 21 states and two territories, 5920 acres by municipalities, 25,088 acres by industrial organizations, 539 acres by schools and colleges, and 1516 acres by other organizations. Farmers planted 24,825 acres to wind-breaks and woodlots, and other individuals planted 3650 acres. The Forest Service planted 18,207 acres of land on national forests last year.

The First International Air Safety Congress

THE First International Congress for Safety in Aeronautics will be held in Paris during December, 1930. It is being organized by the *Comite Francais de Propagande Aeronautique*, under the presidency of the French Air Minister. Aircraft safety is not a matter of a single invention, but a question of improvement along innumerable lines. Nothing illustrates this fact as much as the program of the Congress, to which eminent authorities from every civilized country will be asked to contribute memoirs and investigations for consideration by the delegates.

The Congress is divided into seven groups and six sections. Group A will deal with safety organization in various countries and with the statistics of accidents. Group B will cover the general problems of air safety, under the following six sections: Safety of Materials; Aerodynamic Safety; Engine Reliability; Aids to Navigation; Meteorology and Aerology; Navigational Instruments and Radio Communications. Group C will consider the application of the best safety methods to all branches of commercial aviation. Group D is concerned with the physiology of the pilot and other questions of a medical aspect. Group E is concerned with the training of flying and ground personnel. Group F will



Duplex table method of making straight line inlaid linoleum. After pieces are laid as required by the pattern, they are fused together by hydraulic presses

take up methods of protection such as parachutes, means of preventing or extinguishing fire, et cetera. Group G will be devoted to lighter-than-air craft.

Valuable results may be expected from this well organized international gathering.

Explosion of Anesthetics

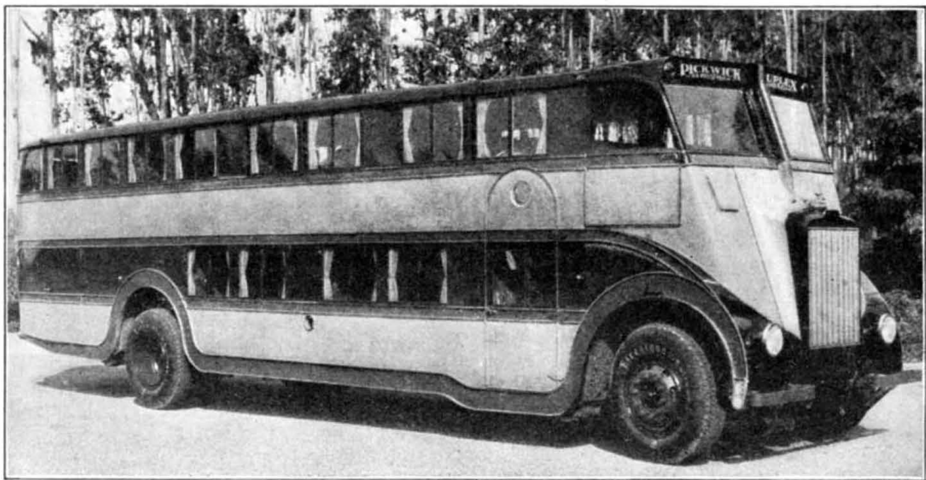
MIXTURES of air and ether, and of ethylene and air and of various other gases, occasionally explode. Obviously this constitutes a hazard in an operating room where a person is inhaling such a mixture of gases. It has long since been recognized that an open flame must not be kept near a source of ether vapor. The first explosion that ever occurred from ethylene was due to the fact that a cautery was brought into a room after the anesthesia apparatus had been removed but some of the gas was still in the atmosphere.

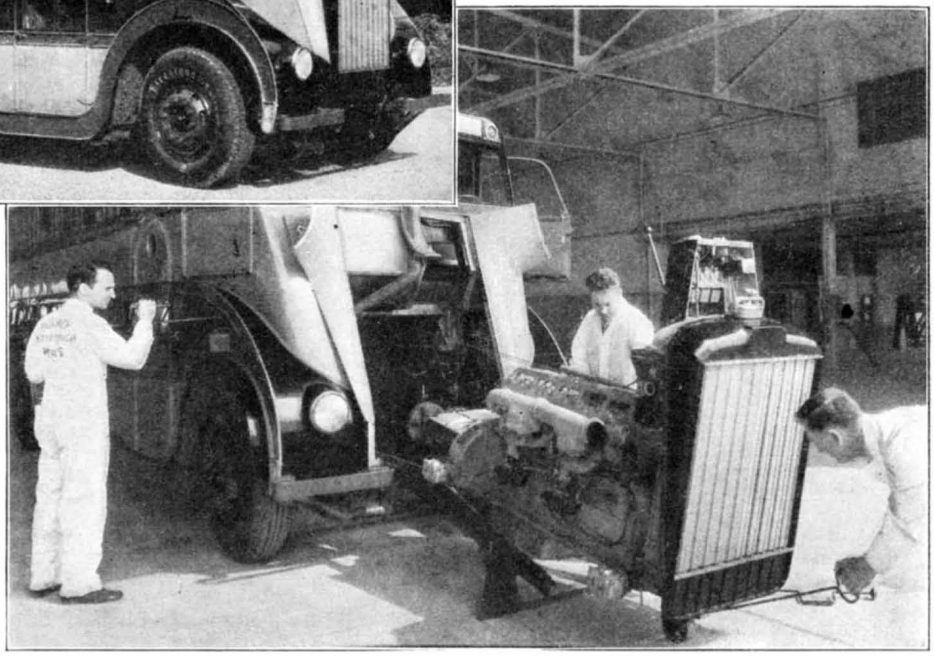
Recent studies indicate that electric sparks may be sufficient impulse to set off an explosion. The entire subject has been reviewed by Dr. H. B. Williams, who recommends the elimination of rubber from apparatus for giving anesthetics, making the equipment as far as possible conductive throughout. He also recommends metallic tubing and a general connection of the face piece to the tubing so that when removed from the face piece the upper part of the mask will remain in electrical connection with it. In this manner, the entire apparatus can be kept at a uniform electrical potential and no high voltage is likely to develop even if the apparatus is not grounded.

Among other precautions for preventing explosions are the following directions:

There should be provision for grounding the operating room personnel, to prevent sparks passing from their persons to the apparatus, which is more likely to occur in winter weather and in severe climates. If rubber soled shoes are worn, rivets of copper may be put through from inside to outside. Great care must be exercised in placing blankets removed from a warming closet on the patient. These, if very dry, may cause copious and intense sparks when unfolded or shaken. They might well be kept from becoming so dry. Blankets of wool may contain surprisingly large quantities of water without feeling damp; they may, in other words, be damp enough greatly to diminish the hazard of electric sparks without being in the condition popularly described as a "wet blanket."

Ethylene should under no circumstances be used in any operation in which an actual cautery or surgical diathermy apparatus is to be used, and ether should never be used in any throat operation in which a cautery or surgical diathermy or similar apparatus is required. Care should be taken, especially in very dry weather, not to comb or stroke the patient's hair until the ethylene has had time to become thoroughly dissipated. It would be well to wrap the hair in a linen binder during and immediately after the operation.—*M. F.*





The rapid increase of motor coach transportation in the last few years may be traced directly to great improvements in equipment. A striking example is the new Pickwick 53-passenger day coach illustrated above. It has a 246-inch wheelbase, and is 33 feet long, eight feet wide, and nine feet ten inches high. With a full passenger complement, it weighs 25,000 pounds. As shown at the right, the motor may be easily removed from the chassis, thus facilitating rapid repairs

"A Good Mixer" Welcomed in Industries

THE word "emulsion" always brings first to our mind a certain patent tonic which we were bribed and cajoled into taking before meals in the fast receding days of childhood. Emulsions, however, play a very important and ubiquitous part in a great many commercial products which are not related to medicine. The suspension and dispersion of fats, oils, and waxes in a liquid medium with which they are not naturally miscible is a basic step in the manufacture of a wide variety of useful substances. For this reason, the recent discovery that the compound, triethanolamine induces emulsification to an astonishing degree, is of prime importance.

Ordinarily, emulsification has been accomplished by slow mixing and vigorous stirring. In contrast, when an oil solution of a fatty acid is added to a water solution of triethanolamine, an emulsion tends to be formed spontaneously. This method, therefore, consists in simply dissolving in the oil approximately 6 to 20 percent of the fatty acid, which includes any free fatty acid naturally occurring in the oil, and mixing the solution with a 2 to 8 percent solution of triethanolamine in water. This method usually yields a spontaneous emulsion which is converted by moderate agitation into a product of satisfactory stability. If a minimum of the water solution is used, a concentrated emulsion results which is capable of storage indefinitely without separation, and which may be diluted readily with more water when desired for use.

Low-viscosity mineral oils not only can be emulsified by this method, but they can be made up as "soluble oils." There is a wide application for soluble mineral oils. They form the basis for machine cutting oils, for orchard sprays, for polishes, and for a number of textile oils.

The most interesting field for these oils, perhaps, is in the textile industry. Although mineral oils are theoretically best fitted for textile lubricants, they have hitherto been at a disadvantage due to the great difficulty experienced in removing them completely out of the finished cloth. Oils prepared with triethanolamine overcome this difficulty, and tests have shown that the above soluble oils, even after several weeks of aging in the cloth, are readily emulsified and removed with pure water.

The linseed-oil emulsions offer very interesting applications. Inasmuch as most boiled oils have an appreciable content of free fatty acid, emulsions may be made with the addition of only triethanolamine in the amount of 0.5 percent. Such emulsions, in the water phase, are used as the base for paints that are required to be of exceptionally low fire hazard, and for

paints, such as are used for lettering asphalt, which must have no solvent effect on the under-surface.

Wax emulsions are finding a growing use due to their increased cheapness and low fire hazard compared with hydrocarbon solutions, especially since coating and polishing operations can be performed practically as readily with either type of dilution. A paraffin emulsion has been applied successfully to the coating of paper, board, and window shades and a carnauba emulsion to leather and linoleum. Together with other constituents they have a wide variety of applications. As an example, the carnauba wax emulsion has been made up with turpentine and nigrosines to give an excellent shoe polish with cleaning, scouring, polishing, and blacking properties.

The kerosene emulsion is especially interesting as a tree-spraying material. It may be made in a very stable form with a concentration of kerosene up to 85 percent of the oil by volume and readily dilutable with water; in this respect, at least, it is far superior to the usual orchard sprays.

Further emulsions which have been made with triethanolamine confirm its general utility in this field. A number of edible oils, such as olive, castor, and refined oils, the palatability of which is greatly increased by emulsification, are readily emulsified with this base, although they may not be recommended for internal use until the physiological inertness of triethanolamine has been confirmed.—*A. E. B.*

Art as Sales Stimulant

THE growing importance of art in commerce as exemplified in the increasing attention on the part of manufacturers to improve the appearance of products was emphasized by the Secretary of Commerce, Robert P. Lamont, in an address before the annual convention of the American Federation of Arts in Washington.

Mr. Lamont said that more and more people are realizing the association of art to everyday life and that this association is manifesting itself in the minds of designers and producers of merchandise. The incorporation of beauty through color and form into the products of our industry should increase the market for our goods.

Measuring the Oilyness of Oil

THE accompanying illustration shows W. C. Wilharm, Research Laboratories, Westinghouse Electric and Manufacturing Company, demonstrating to a visitor the device he has developed for measuring the oilyness of oil.

The device consists of a weighted platform supported by three highly polished steel balls and resting on an equally highly polished steel plate which is covered with a film of oil. The steel balls cut through the fluid film and rest on the tightly absorbed film built up by certain molecules present in the lubricant. The plate is fastened to a hinged platform which is raised slowly by means of the crank which Mr. Wilharm is shown turning in the photograph.

Thus, the angle between the plate and the horizontal is increased gradually until the weighted platform supported by the steel balls moves, slipping over the absorbed film of molecules. The slightest movement of the platform is rendered perceptible by the action of a voltmeter connected in a circuit which is closed when the platform comes in contact with a needle after moving only .001 inch. The tangent of the angle between the plate and the horizontal attained when the platform begins to slide is the coefficient of friction.

Demonstrating a device designed to measure the oilyness of oil

In this way, the device, determining the angle at which the balls will slide over their absorbed film of lubricant molecules, measures the oilyness of the oil. Of course, the smaller this angle, the greater the oilyness and the better the oil for lubrication purposes.

Rural Radios

A RADIO in every country home is the wish of the Virginia commissioner of agriculture, George W. Koiner, as expressed in a statement just issued.

"It is stated that 35 percent of the farmers have radios," Mr. Koiner said. "In some sections there are more than in others. The radio is a great boon to the isolated country home. The best music in the great cities may be brought to the home which could never be heard otherwise. Also the important market news and the interesting sporting news for both the old and the young. We wish there could be a radio in every country home."

Is Private Flying Dangerous?

EARLE OVINGTON was the first airmail pilot (1911). He is President of the Early Birdmen, a semi-serious, semi-humorous secret society and he has kept up-to-date by recently securing a transport pilot's license. His views on private flying, as expressed before the Seattle Aeronautical Meeting of the American Society of Mechanical Engineers are therefore, though somewhat pessimistic, worthy of serious consideration.

Mr. Ovington asks "Why are there so few private owners of airplanes?" and continues: "I will answer this question by saying: because the airplane really suitable for the private owner, has yet to make its appearance." Perhaps the readers of these columns will disagree with Mr. Ovington—practical light planes are with us already, in the opinion of many observers.

His views on certain desirable characteristics of the light plane are far less open to controversy.

He would like to have:

Perfect visibility.

The pilot's seat as far as possible from the engine, to minimize crash hazard.

A smooth six-in-line, inverted, air-cooled engine.

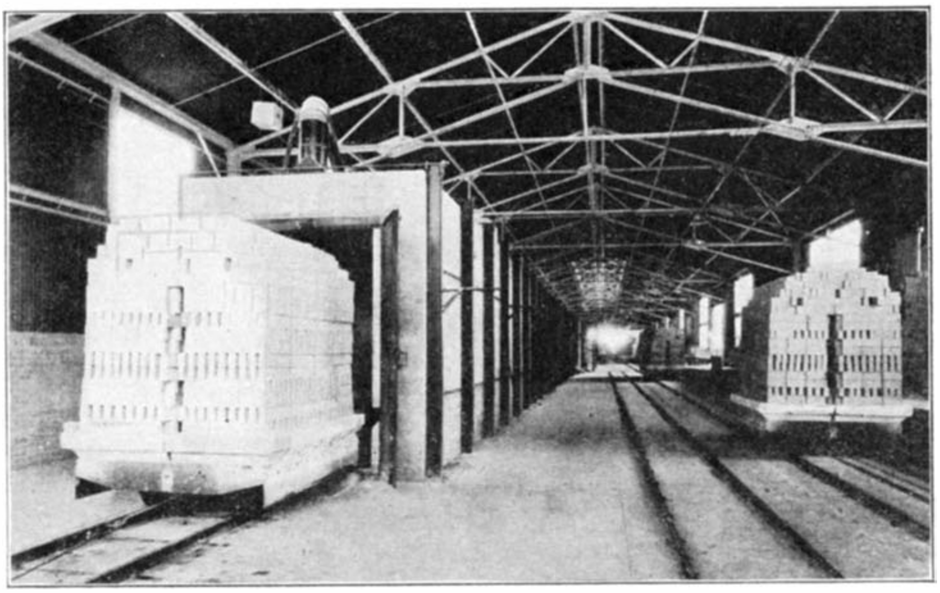
A landing speed far lower than that of the conventional airplane of today. A private plane should not land at the speed of an express train.

Perfect stability.

No dangerous stalling.

No noise.

He does not consider less cost im-



Only a few years ago, temperatures of 2800 degrees, Fahrenheit, were believed impossible for tunnel kiln operation in the manufacture of bricks. Progress in the ceramic art, however, has been so great that the gas-fired kiln, shown above, has been developed to a point where it operates continuously at the temperature mentioned, and turns out fire brick for furnace linings at the rate of 12,000 per day. The kiln is 325 feet long and a 100-ton hydraulic pusher moves the flat cars loaded with brick through it

portant. It is more safety that we want.

Mr. Ovington believes that the Curtiss *Tanager*, winner of the Guggenheim Safe-Aircraft competition is a step in the right direction, though far from being an ideal plane.

Comparing the safety of private flying with that of regular air-transport flying, Mr. Ovington gives the transport service the best of the argument:

Two complete sets of instruments and controls are mounted in the cockpits of this new sport trainer

"When you fly on a schedule airline, the circumstances usually are 'right.' The pilot is well trained; his experience has been extensive; the plane is the best obtainable; its mechanical condition is everything that could be desired; the airway is well known to the pilot; emergency landing fields and airports are usually frequent along the route; and undue risk is not usually taken on account of weather conditions.

"In private flying, the pilot often is not well trained; his experience is often inadequate in spite of the fact that he must pass the Department of Commerce tests in order to get his license; his ship, so far as design and construction is concerned, does not always compare favorably with the large air transports, and its mechanical condition is not always perfect; because the private owner does not, as a rule, follow an airway, landing fields and service stations are not always convenient. Only when it comes to weather conditions is the private owner better off than the air-transport pilot; the private owner is usually a fair-weather pilot and largely avoids weather risks."

On the other hand Mr. Ovington has quite a splendid time with his own plane. This veteran pilot paints a glowing and interesting picture, particularly for the man who is mechanically inclined. He does his own servicing, adjusting, and grooming. His airplane is a hobby with him. "I'm never happier than when I'm in my hangar, unless it be when flying my always well-groomed ship."—*A. K.*

Rheumatic Fever

RHEUMATIC fever is responsible for at least one half of all cases of heart disease and the death rate for heart disease in the United States is more than twice that of the second greatest cause of death. For this reason, research on heart disease is attracting more and more investigators throughout the world. Coombs, who has studied the disease extensively in England, is convinced that children acquire rheumatism because defects of inheritance and environment combine to permit invasion of the germs that takes place through the tonsils in at least one third of the cases. Miller of England places special emphasis on the living conditions, finding this disease particularly in poor and damp neighborhoods.

All authorities are agreed that the chief hope of control of these conditions is early recognition and considerable attention to such early signs as pains in the limbs known as "growing pains," slight rise in temperature, and fatigue. Whenever the tonsils are infected, the heart must be examined repeatedly to find out whether or not it is involved in the infection. Miller warns particularly about watching the pale, tired child with poor appetite, who looks feverish and sick and who has a little fever at night.

In view of the lack of knowledge as to the actual cause of this disease and of the way in which children are infected, it becomes obvious that the attack upon it must be made from every possible point of view. In modern research, biology, chemistry, bacteriology, pathology, and all of the other related fundamental medical sciences, are brought to bear in searching for the solution of any disease problem.—*M. F.*

A Neat Sport Trainer

THE aircraft industry is peculiar in that the training of students is one of its most important activities. But some day flying will become so easy to learn that airplane trainers will disappear. For the present, however, the number of training planes built per year equals, if it does not exceed, the number of all other airplane types. However, as flying becomes gradually a private owner's affair, the attempt is made by dsigners to combine the functions of a trainer with that of a sport machine. Hence the name "Sport Trainer" for the new two-seater biplane built by the Verville Aircraft Company. It is an excellent example of what our manufacturers can do at their best.

In the matter of equipment, for example, much more is available now than in the early days of cockpits empty of everything but seat, control wheel, and rudder bar.

The Sport Trainer calls for the following accessories: standard steel propeller; Heywood air starter; balloon wheels; dual A. P. C. brakes; oildraulic shock absorbers; fully casterable tail wheel; dual stick control; parachute seats; head-rest; two 3-piece safety glass windshields; gasoline gage; tool compartment and kit; air speed indicator; two tachometers; compass; two altimeters; two oil pressure-gages; navigation lights; dry battery; fire extinguisher; first aid kit; dual throttles; dual switches; dual stabilizer adjustment; and baggage compartment. The brakes can be controlled from either cockpit, separately or simultaneously.

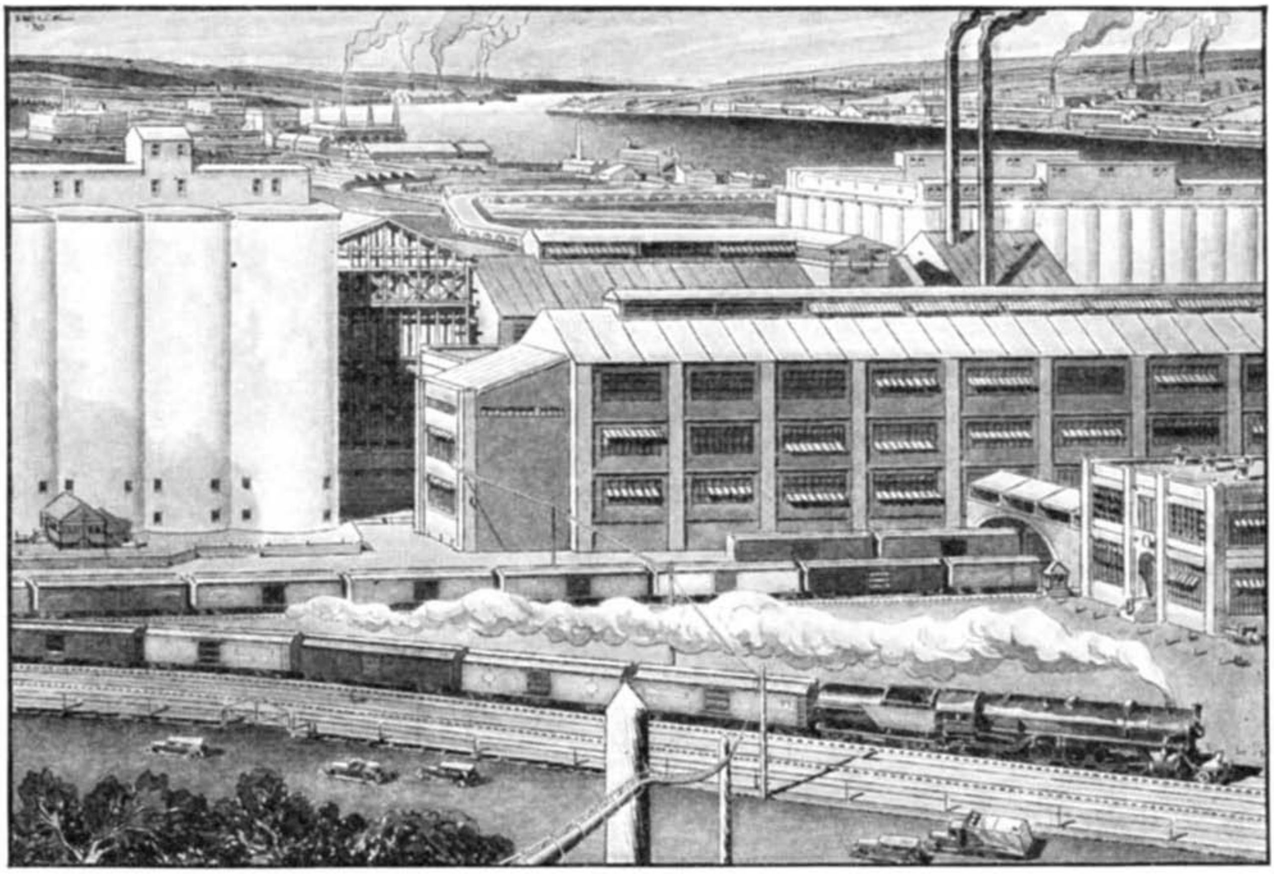
The reader will note the repetition of the word dual. For many years there was a controversy as to the installation of instruments in a training plane. Designers argued that the same instruments should be seen by both instructor and student, and that the student did not need to have all controls under his command at the start. This resulted in peculiar arrangements of the instrument board. So that both occupants could see them, they were sometimes mounted on the trailing edge of the upper wing, sometimes at the side of the fuselage, and in other unlikely locations. With improvement in instrument construction, so that two sets of instruments can be relied upon to read exactly alike, duality has apparently won out.

The specifications of the Trainer are as follows: Span, 31 feet; length over-all, 24 feet 3½ inches; height over-all, 8 feet 9 inches; power plant, Continental A-70, 165 horsepower at 2000 revolutions per minute; fuel capacity, 36 gallons: fuel consumption at crusing speed 9 gallons; normal range, 328 miles; wing loading, 9.27 pounds per square foot; power loading, 13.6 pounds per horsepower; pay load, 420 pounds; weight empty, 1562 pounds; gross weight, 2243 pounds; high speed, 115 miles per hour; climb, 900 feet per minute; cruising speed, 95 miles per hour.

The arrangement of the cockpits in a training plane is most important. There should be good vision forward and down. It should be easily possible to make a parachute jump from either cockpit. If our reader will imagine himself seated in either cockpit, he will see that both objectives are attained. There should be,

(*Please turn to page* 323)

A three-quarter front view of the Verville sport trainer



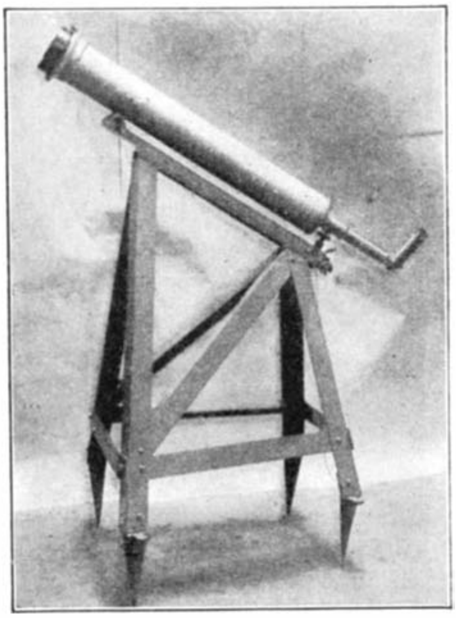
The Amateur Astronomer

Conducted by ALBERT G. INGALLS

JOHN M. PIERCE, President of the "Telescope Makers of Springfield" (Vermont) estimates that 2000 telescopes actually have been made since 1926 when this journal opened its amateur telescope making campaign. That figures about 30 percent of those who have obtained the SCIENTIFIC AMERICAN instruction book "Amateur Telescope Making" and is a good showing when the unusually exacting nature of this work is considered.

Telescope making is not a hobby which is likely to appeal to the masses; it is a little too stiff for them. It recently was tried on the readers of several newspapers, who were given a syndicated series of simple "how-to-make" instructions for a reflector. The results, to put it mildly, were nothing to shout about. (Recently, by the way, we stated in these columns that amateur telescope making was too stiff for boys as well as average newspaper readers and several of our readers took the word boys to connote all minors. Perhaps "kids" was the intended word. One might say the dividing line between the "too-stiff-fors" and the "not-too-stiff-fors" is plane geometry. If a lad has studied geometry, nothing in the amateur telescope making hobby should stump him, other things being equal—namely that he be fairly handy and a bit more "stick-to-it-ive" than the average lad.)

The Telescope Makers of Springfield erecting the new Porter turret telescope

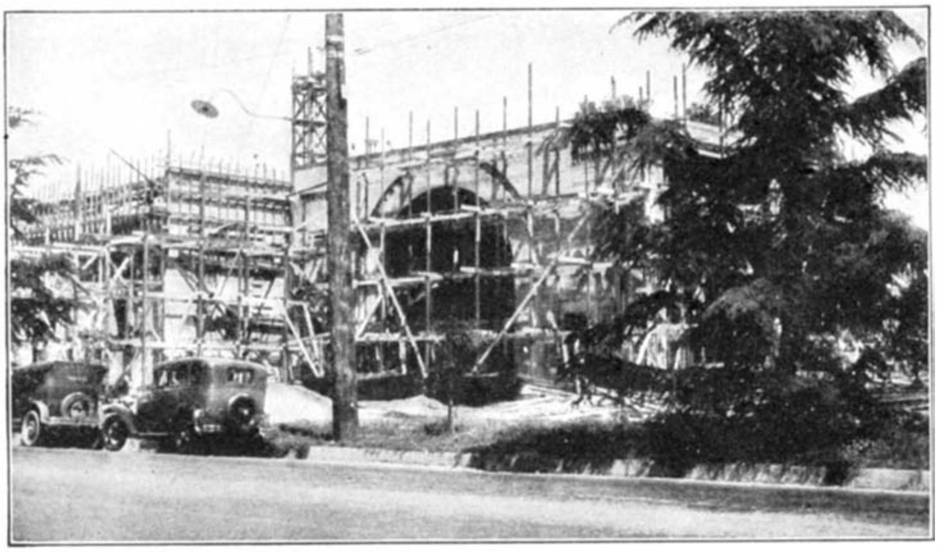


One of the four 4-inch refractors designed by Porter for use on *Polaris* to study "seeing" by Anderson's method at several sites in California and Arizona with a view to selecting a suitable location for the 200-inch telescope. Two larger telescopes will be used in the final tests at a later date

Another gratifying evidence of the consistent, even if not meteoric, spread of the amateur astronomical and telescope making hobby was the attendance at the yearly "get-together" of the worst addicts—the flea-bitten regulars who take telescope making instead of their meals—held last month at "Stellafane," near Springfield, in the hills of southeastern Vermont. As these words are written (in a jiggling Pullman berth) the fifth of these annual conclaves is just over and, despite the frowns of bad weather, more visiting fans from neighboring states attended than on any of the previous occasions. Running down the list of registrants one sees a well scattered following, as connoted by their home towns, Newport, New London, Boston, Pittsfield, Brookline—all places in nearby New England; also New York, Princeton, Philadelphia, Rochester, Pittsburgh, and Detroit. A special contingent came from Pittsburgh, representing the thriving association of amateur telescope makers recently organized there.

As usual there was a Saturday evening "feed," although the time-hallowed "piece of resistance," real beanhole beans, did not materialize. The evening meal stowed away, the assembled enthusiasts listened to a talk by Russell W. Porter, Associate in Optics and Instrument Design on the staff of the California Institute of Technology. Mr. Porter spoke on, or rather "around," the subject of the great 200-inch telescope. Nearly all the extant plans are tentative and therefore little of a definite nature may be told about them as yet. We reproduce two photographs showing the first tangible beginnings, but the mammoth telescope doubtless will be many years in the making.

The small testing telescope shown is equipped with gooseneck prism and an eyepiece which is essentially a compound microscope giving a magnification of 7500 diameters. The quality of seeing afforded at a number of sites which are under careful investigation is determined by ascertaining the number of diffraction rings visible around the central image of a star and how much the image of a star shifts, in terms of its diameter, when local atmospheric disturbances affect it. The



Through this large, arched portal adjoining the new instrument shop of the California Institute of Technology will go the 200-inch mirror blank to be ground and polished in the large optical shop to be built later to the right

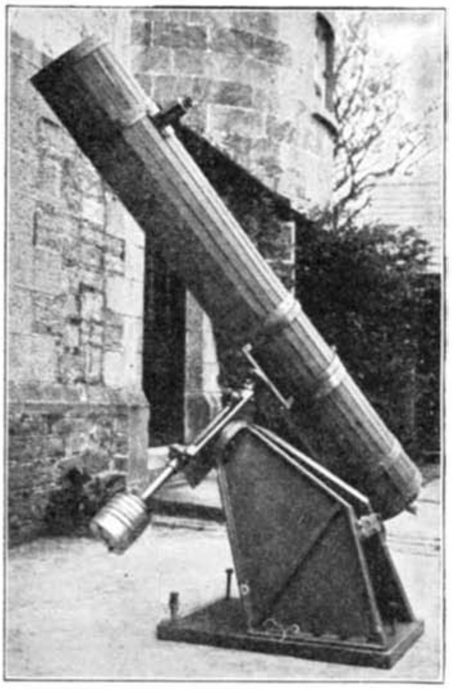
star *Polaris* is the test star. Any other star would suffice, but careful study of the picture will show that the telescopes were designed especially for use on *Polaris* because that star remains for all practical purposes at the same place all night—in other words the use of *Polaris* is a matter of convenience.

As other new facts concerning progress on the 200-inch telescope become available for publication this journal will endeavor to report them.

The telescope enthusiasts, convened at "Stellafane," obtained a glimpse of the new Porter turret telescope—"new" only because recently set up (see one of the illustrations, which shows the work in progress just before the meeting; also see "Amateur Telescope Making," second edition, page 51, illustration at VI). We hope to publish a picture in a later issue, showing the complete mounting.

The turret, made of concrete, will house two telescopes, the larger one a Porter combination having a 16-inch paraboloid and a 16-inch flat, focal ratio *f* 13; the smaller one a 12-inch Cassegrainian with *e. f. l.* of 4 on 4, or *f* 16. The rings of the turret are of iron and have an external diameter of seven feet; they show toward the lower right. In the foreground is the long arm, made of tubing, to carry the 16-inch paraboloidal mirror. It, with the iron ring, dome, and counterwieight, will weigh about 4000 pounds.

The picture shows "the boys" at work erecting the telescope. Porter, the gang boss, is the figure with the long stogie; the rest are working—especially Pierce, whose hat alone is visible (on the skyline) while he compacts the concrete in the forms with his feet. The photograph was taken by Oscar S. Marshall. In the background is Ascutney Mountain. Next year when you come to the Sixth Annual Astronomical Riot at "Stellafane" the new Porter turret telescope will be ready for you to use.



An 8½-inch reflector recently built for Senor Jose Fernandez of Argentina, by the Reverend Mr. W. A. Ellison of Armagh Observatory, who did not send further description. The roof of Ellison's stone workshop shows at right

Current Bulletin Briefs

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

BIBLIOGRAPHY OF AERONAUTICS, 1928, gives the information in dictionary form with author and subject entry and one alphabetical arrangement. Citations of the publications of all nations are included in the language in which these publications originally appeared. *Superintendent of Documents, Washington, D. C.—50 cents (money order).*

INSTRUCTIONS FOR INSTALLATION AND CARE OF BROWN ELECTRIC FLOW METERS (Instruction Book 214). The flow meter is an instrument of precision and must be treated as such; this book tells how. *The Brown Instrument Co. of Philadelphia, Pa.—Gratis.*

BEARING VALUE OF SOILS—FOUNDATION ENGINEERING deals with soil pressure, soil character, soils under load, soil tests, examples of failures, and so forth. The paper was prepared by C. C. Whittier. *Robert W. Hunt Company, 2200 Insurance Exchange, Chicago, Ill.—Gratis.*

EUROPEAN MOTION PICTURE INDUSTRY (Trade Information Bulletin No. 694, United States Department of Commerce) gives up-to-date information such as the fact that at the end of 1929 there were 1670 European motion-picture houses wired for sound films. Continental film leaders now regard the sound film as the entertainment of the future and the multilingual feature as a necessity for foreign trade. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE BOWIE METHOD OF TRIANGULATION ADJUSTMENT IN THE FIRST ORDER NET IN THE WESTERN PART OF THE UNITED STATES (Special Publication No. 159, Coast and Geodetic Survey, U. S. Department of Commerce) by Oscar S. Adams, Senior Mathematician. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

FERTILIZATION OF SHADE TREES (Bulletin No. 1, June 1930, Research Department, The Davy Tree Expert Co.) deals with the advisability of chemical fertilizers for conifers. *The Davy Tree Expert Company, Kent, Ohio.—Gratis.*

A NEW METHOD OF EVALUATING THE POTENCY OF ANTINEURITIC CONCENTRATES. (Reprint No. 1348 from the Public Health Reports), by Maurice I. Smith. A study in the chemistry of the antineuritic vitamin. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

PREVENTING CRACKS IN NEW WOOD FLOORS (Leaflet No. 56, U. S. Department of Agriculture) by L. V. Teesdale, Senior Engineer, Forest Products Laboratory, Madison, Wis., gives valuable information as to cause and prevention of floor cracks. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

SECTIONAL MAP INDICATING MAIN AUTOMOBILE ROADS BETWEEN CANADA AND THE UNITED STATES is divided into four sheets—Atlantic, Great Lakes, Middle West, and Pacific sheets. When ordering, indicate in which section you are interested. *Address F. C. C. Lynch, Director, Natural Resources Intelligence Service, Ottawa, Canada.—Gratis*

THE KILLIFER TILLAGE SYSTEM is a valuable, fully illustrated treatise on a system of soil tillage. *Killifer Manufacturing Co., 5525 Downey Road, Los Angeles, Cal.—Gratis.*

MUSEUMS, A MAGAZINE POPULARIZING MUSEUMS. Edited by Ralph Clifton Smith, *Editorial Office, 3732 Van Ness St., Washington, D. C. $3.00 a year, single numbers 25 cents.*

GEOLOGY OF THE EAGLE-CIRCLE DISTRICT, ALASKA (Geological Survey Bulletin 816, Department of the Interior) by J. B. Mertie, Jr. *Superintendent of Documents, Washington, D. C.—50 cents (money order).*

BORATE MINERAL FROM THE KRAMER DISTRICT MOHAVE DESERT, CALIFORNIA (Professional Paper 158-I., Geological Survey, Department of the Interior) by Waldemar T. Schaller. *Superintendent of Documents, Washington, D. C.—20 cents (coin or money order).*

REVIEW OF LEGAL EDUCATION IN THE UNITED STATES AND CANADA FOR THE YEAR 1929 by Alfred Z. Reed deals with the missing element in legal education, practical training, and ethical standards. *The Carnegie Foundation for the Advancement of Teaching, 522 Fifth Ave., New York City.—Gratis.*

BEGINNING THE SECOND CENTURY is a piece of institutional literature produced in celebration of the centennial anniversary of the invention of the platform scale by Thaddeus Fairbanks, and the founding of the company which bears his name. It is beautifully illustrated. *Fairbanks, Morse & Co., Publicity Department, 900 South Wabash Ave., Chicago, Ill.—Gratis.*

HICKORY GOLF SHAFTS (Commercial Standard CS18-29, Bureau of Standards, U. S. Department of Commerce) gives full diagrams. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

TRACTOR LUBRICATION is the title of a little monograph which shows that power economy is the ultimate objective in tractor lubrication.—*The Texas Company, 135 East 42nd St., New York City.—Gratis.*

PERSONNEL RESEARCH AGENCIES (Bulletin of the United States Bureau of Labor Statistics No. 518) has been prepared by Estelle M. Stewart of the United States Department of Labor. It is a most valuable pamphlet of over 200 pages dealing briefly with such subjects as employment management, industrial relations, employment, safety, hygiene, cost of living, et cetera. *Superintendent of Documents, Washington, D. C.—35 cents (money order).*

FOREIGN STUDENTS AND THE IMMIGRATION LAWS OF THE UNITED STATES. (Bulletin No. 1, Institute of International Education) by Ruth Crawford Mitchell is a monograph on a subject on which it is rather difficult to obtain dependable information. Two editions have been called for in 1930. *Institute of International Education, Inc., 2 West 45th St., New York City.—25 cents.*

ETHNOLOGY OF THE MAYAS OF SOUTHERN AND CENTRAL BRITISH HONDURAS (Publication 274, Anthropological Series, Vol. XVII. No. 2) by J. Eric Thompson, Assistant Curator of Central and South American Archelogy, Field Museum of Natural History. Here we have detailed anthropological studies of some of the living descendents of the ancient Mayas written in most interesting style. *Field Museum of Natural History, Chicago, Illinois.—$3.00 plus postage.*

DESIGN FOR KANSAS FARM HOMES (Kansas State Agricultural College Bulletin, Vol. XIII. No. 10) by H. E. Wichers, is a publication (Bulletin 23) of the Engineering Experiment Station. The 102 page pamphlet gives 38 designs for houses accompanied by floor plans. It is a valuable contribution to the small home literature.—*Engineering Experiment Station, Kansas State Agricultural College, Manhattan, Kansas.—Gratis.*

PRINCIPLES AND OPERATION OF PIONEER INSTRUMENTS is a pamphlet containing many diagrams and is sold either alone or with a set of enlarged diagrammatic drawings which are 17 x 22 inches and are suitable for classroom or lecture use. The "manual" contains reduced copies of the diagrammatic drawings with accompanying text. *Pioneer Instrument Company, 754 Lexington Ave., Brooklyn, N. Y.—Diagrammatic Drawings and the Manual $2.50; Diagrammatic drawings only, $2.00; Manual only 75 cents.*

The Scientific American Digest

(*Continued from page* 318)

and is, a neat, heavy cowling for the front end of the fuselage. The exhaust ring and the engine as a whole should blend gracefully into the fuselage, and they do. The landing gear should have a wide tread and be rugged, and it is. The landing gear should absorb shocks readily, and it does, since it is provided with both oildraulic shock absorbers and air wheels. It should be easy to take the upper wing down, and since it is in one piece, this is easily accomplished. There should be a handy catwalk on the lower wing on either side of the fuselage, and there is.—*A. K.*

New Fertilizer Reported

A NEW phospho-nitrogen fertilizer, obtained from a base of natural phosphates, is reported by the United States Assistant Trade Commissioner in Paris, to have been perfected by a French engineer, a technical director of one of the Algerian mining companies. Natural phosphates are treated with hydrochloric acid in the proportion of one to one. Ammonium sulfate is then added to the clear solution, the mixture filtered in order to eliminate the precipitated calcium sulfate, and calcium carbonate is then added to the filtrate. The fertilizer manufactured in this manner contains 18 percent phosphoric acid, soluble in citrate, and 14½ percent of ammoniacal nitrogen.—*A. E. B.*

Salt of the Earth Made to Fit Varied Needs

THERE is a silver thread of salt closely woven into the fabric of all human history, says Dorothy Robinson in a recent issue of *Food Industries*. It is doubtful if any commodity has had a greater effect upon the history and civilization of the peoples of the earth. Its value from ancient times is most clearly indicated, perhaps, by the prominence salt has occupied, not only in commerce but in religious and moral development. Invariably it was used in religious rites as a worthy offering, and every language has its common sayings concerning the welding of bonds of friendship through the eating of salt. Such a one is the Arab phrase "There is salt between us."

The modern salt plant, such as the one at Manistee, Michigan, described by Miss Robinson, is located over the vast underground deposits of rock salt. A pipe is sunk 2000 feet below ground and through it water is sent down to dissolve the salt. The salt solution is then pumped up into huge wooden settling tanks where some of the impurities settle out. The salt solution is then evaporated, either slowly in open vats called "grainers," or rapidly in steam heated vaccum pans. The product of the grainer is a flake salt whereas the vacuum pan produces a granular salt. The salt thus crystallized is dried and screened to obtain the many varied grades demanded by different users.

Butter makers must have a small, soft-flake salt of high purity; the cheese manufacturers desire a similar salt but of coarser grain; the canners demand a fine granulated salt to maintain color and freshness in their products; the flour manufacturers mix an exceptionally fine salt with prepared flour. The meat packers in Chicago alone, last year, used 500,000 tons of coarse flake salt in curing and preserving meat. In other words, each manufacturer must have a salt which is adapted for his purpose, and by varying treatment of brine, methods of manufacture, drying, and screening, all of these demands can be supplied.

Even the farmer has salt put up especially for his use. Fifty-pound lots of granulated salt are dried and pressed in a large hydraulic press at 1000 tons per square inch pressure into a salt block to be used as a salt lick for cattle. For table salt, 1 percent of filler is mixed with the salt to prevent absorption of moisture and consequent hardening. For the much-advertised iodized salt, 0.02 percent of potassium iodide is added, as iodine compounds are an aid to health in the prevention of goiter.—*A. E. B.*

Alcohol As Motor Fuel

EFFORTS of the Brazilian government to popularize use of alcohol motor fuel are meeting with success, according to reports to the Department of Commerce by Assistant Trade Commissioner J. Winsor Ives, Rio de Janeiro.

Official cars are required to use this fuel and 60 percent of all cars in Pernambuco are regular consumers.

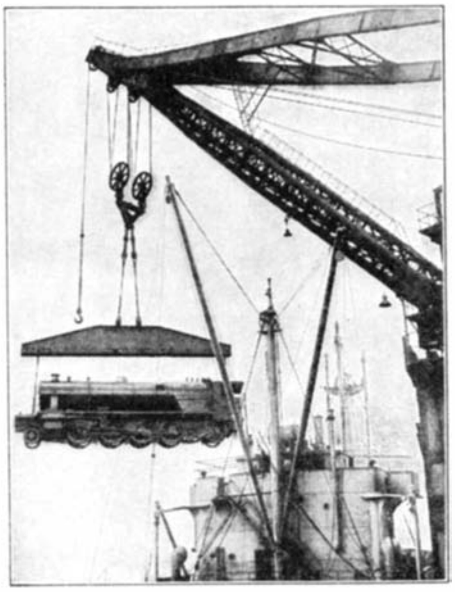
Petroleum companies maintaining branches in Pernambuco report reduced sales of gasoline due to the lower price of alcohol fuel. Alcohol motor fuel, which consists of a mixture of cane alcohol and ether, is selling from 500 to 700 reis (approximately six to eight cents) per liter, with gasoline approximately 18 cents.

Proprietary and Medicinal Foods

THE old time tonic and patent medicine has given way to the stimulating food. Years ago everyone who became depressed or fatigued or disabled in general, thought he ought to have something from a bottle to give him back the vim, vigor, and vitality that he had lost. The Food and Drugs Act and the publicity which followed its passage have made people realize the preposterousness of this belief. The newer knowledge of the vitamin has, however, brought into the situation the attempt to replace the old time products by new combinations of vitamin foods. The food faker, as has been pointed out by Dr. W. McKim Marriott, follows closely behind the investigator of nutrition, picks out an occasional truth, and distorts and broadcasts it to the unsuspecting public. Diabetic foods, pre-digested foods, and brain foods are sold with claims that are preposterous—are sold indeed with the impression that it is possible for the food to depart from the stomach and go immediately to the one portion of the body to which it may be aimed. All of the foods are reduced in the digestive tract to elemental substances, resynthesized into products that can be taken up by the blood and then distributed generally to the various parts of the body.

In addition to special foods for special portions of the body, there are products sold with a vaunting of the claims of calcium, iron, phosphorus, iodine, and all of the alphabetical vitamins. Claims are made again and again for special virtues associated with the use of certain food substances, before scientific research definitely has established the fact that the claims are warranted. Because a fresh product contains vitamins, it can not be assumed that the preserved product has retained the vitamins.

Perhaps one of the most significant phases of modern research in the canning field has been the attempt to substitute exact knowledge for guessing in the promotion of the canned food. Already it is known through research conducted in your own "laboratories" that the sun ripened tomato is much more likely to be an adequate source of vitamin C than the green product hastily ripened by artificial means. It is known that American canned tomatoes are likely to contain much more



Although it weighs 119 tons, this locomotive is lifted like a toy to the deck of the S. S. *Belhor* by a huge 150-ton crane. The engine is destined for a railroad in India

vitamins than English canned tomatoes. Because exposure to the sun's rays produce vitamin D in the body, it can not be assumed that exposure to the sun's rays or to artificial ultra-violet will produce vitamin D in every other living tissue. Unless a sufficient quantity of ergosterol, the precursor of vitamin D, is present in the tissue, exposure to ultra-violet rays will not produce the vitamin.

It is also important to remember that foods must be taken into the body primarily for growth and health and not primarily for the control of disease. True, the degenerative diseases which afflict mankind are the effects of wear and tear and may be minimized by suitable control of the diet; true, the diseases due to defects of nutrition and the lack of the necessary food substances may be controlled by the provision of the missing vitamins, but in the vast majority of cases mankind eats in order to provide his body with fuel for his energy consumption and to maintain his tissues in a state of health.

Hence the folly of claiming for various natural foods special contents of infinitesimal quantities of various mineral salts and vitamins must not be permitted to dominate the manufacture of millions of cans of staple foods, of millions of packages of cereals, and of millions of pounds of meat. The statement is particularly apropos in connection with recent campaigns asserting the special value of canned foods prepared from fruits and vegetables grown in soils especially rich in iodine or iron or other mineral salts. The quantity of iron or iodine or calcium or phosphorus required by the human body is now definitely known, and it is understood among scientific nutritionists that these quantities are to be had through a vast variety of foods and that a person who eats a well balanced diet is likely to get these quantities without paying special attention to any one of these particular salts. There is no necessity for limiting the output of canned fruits and vegetables to any particular portion of the United States. Wherever these products grow in quantities and in a quality suitable for preservation, they may well be packed for preserving as part of the American diet in a season and at a time when the fresh fruits are not generally available.—*M. F.*

New Finish for Aluminum

A NEW, simple, and cheap method of giving aluminum a dead white finish was described by Leon McCulloch, research chemist of the Westinghouse Electric and Manufacturing Company, in a report to the American Electro-chemical Society. The metal is boiled in milk of lime to which a little calcium sulfate is added. The new coating will be tested as a base upon which to apply paints and enamels to aluminum.—*Science Service.*

Sand as Source of Helium for Airships

MONAZITE sand, source of thoria from which gas mantles are made, may provide the lifting power for future British airships. Work at the Chemical Research Laboratory at Teddington by R. Taylor has shown that this sand is a possible source of helium, the non-inflammable gas that replaces hydrogen in American airships. The United States now has a practical monopoly of helium which is found in extractable quantities only in the natural gas of certain American gas wells. Large quantities of monazite sand are available in the British Empire, especially Ceylon and Travancore, India.

The natural gas from Texas contains about 1 percent of helium, while the monazite sand yields about one cubic centimeter of helium to every gram of sand. This means that to fill a ship of 5,000,000 cubic feet capacity, the size of the *R-100*, newest of British dirigibles, 150,000 tons of sand would have to be refined. The gas escapes from the sand on heating, so in treating it for the manufacture of thoria, large quantities of helium are wasted. In the process for its refinement worked out by Mr. Taylor, the gas is treated with heated magnesium metal which removes most of the nitrogen, and then final treatment with heated calcium removes the rest of the nitrogen and other gaseous impurities—*Science Service.*

Chemist Peers into Atoms With Aid of X Rays

IT is just 35 years since Roentgen discovered X rays. The application of his discovery during that time to medical diagnosis has been of inestimable value to mankind. But there is another, more recently discovered, field of usefulness for the X ray, namely the exploration of the atomic structure of matter. By the use of X rays, the scientist is permitted to "look" down into the fine structure of matter far beyond the power of any microscope. On the 35th anniversary of Roentgen's discovery, the foremost explorer of these hitherto hidden realms, Dr. George L. Clark of the University of Illinois, itemized, in *Chemical Markets*, some of the wonderful recent applications of the X ray diffraction method to industrial problems:

1: Numerous determinations of proper heat treatment of metals. In one case, the X-ray results showed that at the correct temperature for annealing of cast steel parts a better structure was obtained in 30 minutes than in the six hours previously taken.

2: An improvement in the transparency of waxed paper from 40 percent that of air to over 80 percent by a simple application of the diffraction results to influences affecting the crystallization of paraffin wax.

3: A genuine improvement in the quality of rayon by fundamentally showing the structural effect of every step in the process and of adapting these to produce the necessary ultimate structure, or diffraction pattern, essential for proper tensile strength, extensibility, gloss, and so forth.

4: A method of specification for asbestos (single pattern) by comparison with standard patterns associated with practical behavior.

5: Control of addition of dyes and other agents to rubber, and of the primary effects of various treatments on colloidal size—the only method of ascertaining true reproduction of natural rubber in synthetic rubbers.

6: Measurement of particle size in paint pigments, and control of production of carbon blacks.

7: The only exact method of analysis of any material to prove whether or not it is true cellulose.

8: Measurement of film thickness of every kind.

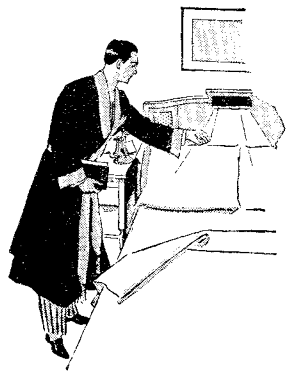
9: Determination of proper conditions for manufacture of best quality of ice-cream, as to size and distribution of ice crystals.

10: Classification and identification of precious and semi-precious stones and routine method of differentiation between fine and cultivated—containing mother-of-pearl center—pearls.

These are but a very few of the remarkable achievements of the X ray when used for the study of atomic structure. So delicate is the diffraction method that the mine from which a sample of asbestos was taken is established by its X-ray photograph, as is the exact age of a growing cotton fiber or the exact process by which a rayon thread had been manufactured.—*A. E. B.*

A Rigging Handbook

SAFETY in flying depends in a large measure on plane maintenance, and this in turn depends on the skill and knowledge of the airplane mechanic. Few American books have dealt especially with the subject of airplane rigging, and we therefore welcome the "Airplane Mechanics Rigging Handbook" by Lieutenant Colonel Rutherford S. Hartz and Lieutenant Elzor E. Hall. It covers the rigging of the modern airplane in clear and simple language, is splendidly illustrated, and is written by men thoroughly conversant with their subject. In addition to covering



rigging and inspection, the handbook provides a compendium of practical information on aircraft materials, wood and glue, metal airplane parts, wires, dopes, fabrics, and so forth. The care of parachutes forms a useful concluding chapter.—*A. K.*

Visualizing the Kidney

ONE of the most valuable procedures used in scientific medicine for the study of disease is the method known as "cystoscopy," whereby a tube is introduced into the bladder and the interior of the bladder studied thoroughly. In addition, it is possible to inject substances into the bladder which are opaque to the X ray and thereafter, by means of the X ray, to study the outlines of the organ.

A general examination of the kidneys is an exceedingly difficult matter. The kidneys are connected to the bladder by two tubes called the ureters and the introduction of catheters into the ureters and then to the kidney is an exceedingly painful and difficult task. It has also been necessary, if one wished to take suitable X-ray pictures of the kidneys, to inject a substance into the kidney by means of the tube introduced first into the bladder and then by the catheter into the ureter.

Several years ago Dr. Evarts Graham and his colleagues in Washington University, St. Louis, developed a dye substance which could be injected into a vein and which would then localize in the gall bladder. By this means it became possible by use of the X ray to visualize the appearance of the gall bladder. Attempts have been made over a number of years to develop a similar method for visualizing the kidney, but until recently without success. Such a method is now being discussed in medical periodicals and apparently the goal has been reached. The dye substance used is a derivative of iodine and pyrridone. The substance finally used has been developed after a dozen or more similar substances were used and discarded because of unfavorable side effects.

The final product, when injected into a vein, apparently is excreted in the kidney and an X-ray picture will reveal the outline of the organ. By its use in several hundreds of cases, it has been possible to diagnose the presence of cancers or tumors of the kidney, unusual formations of the kidney such as contractions or dilatations, or horseshoe shapes, and the presence of stones and other abnormalities. The method will, no doubt, make it possible, when it is fully developed, for the average practitioner to increase the certainty of his diagnosis. It will also be possible in many instances to avoid the necessity for the more complicated and difficult procedure known as cystoscopy and ureteral catheterization.—*M. F.*

Commercial and Financial Aspects of Aviation

AVIATION has gone through a tremendous boom and is now suffering an equally severe depression, at least from a financial point of view. The thousands of investors in aviation securities are seriously worried. Since knowledge is the best guide to investment or liquidation of investment, we recommend R. R. Bennett's book "Aviation, Its Commercial and Financial Aspects," to all those interested in these phases of this new industry. Published by the Ronald Press, New York City, and written by a man who has made his mark in newspaper writing on aviation, the book discusses the following subjects: The Present Status of Aviation; Safety and Dependability; Financial Aspects; Manufacture of Aircraft; Air Transportation; Airports; Aids to Navigation.—*A. K.*

Stiff Back in the Saber-tooth

THE saber-tooth, dreaded by our cave-dwelling forbears, had a stiff back as shown in the accompanying illustration of two backbone joints which are joined by a heavy bridge of bone brought on by disease or injury. Among the thousands of skeletons of the saber-tooth found in asphalt pits at Los Angeles, California, there are many which show the effects of disease, a study of which sheds light on the nature of ancient maladies. The one pictured here recalls a human disease in which the muscle of a part turns to bone, a disease which the doctors call *Myositis*. In some cases the backbone is completely solid for a distance of several inches.

The bridge of bone found on the backbone joints of a saber-tooth

Chemical Vapor Degreases Metals

AN apparatus for degreasing metal and other products prior to plating, enameling, or other finishing operations, has just been perfected as a result of the application of an ingenious chemical principle. In this process the material to be degreased is suspended in a bath of the vapor from one of a class of chlorinated solvents known under the trade name of Cecolene. The vapor, being much heavier than air, has no tendency to overflow but fills the container in which the parts to be cleaned are placed and condenses in contact with water-cooled condensers around the sides of the container and in contact with the cold objects being cleaned. It is claimed that the condensate carries all dirt and grease to the bottom of the tank where it remains in the liquid without danger of vaporization. The device is adaptable to gas, steam, or electric heating.—*A. E. B.*

British Fog Flying Experiments

SINCE England "enjoys" more fogs than any other country, the subject of fog flying is of real interest to the British Air Ministry. Its scientific staff has recently made some interesting and successful experiments in this direction, at the experimental station at Farnborough. The tests were made on a day of real fog, which extended 90 feet above the ground.

The apparatus used was simple in character. A small captive balloon was anchored 400 feet above the ground and about half a mile from the landing field. An airplane, an Avro biplane of standard make, carried a pitch, or fore-and-aft level, indicator and a turn indicator. A weight was suspended by a wire a few feet below the landing gear. The pilot left the landing field and flew above the fog, sighted the balloon and returned to the field at the appropriate gliding angle, by using his pitch indicator. When the suspended weight touched the ground, a red lamp gave him the signal for leveling out. Once the airplane left the ground it was not seen from the field until it had again landed. The experiment was repeated successfully five times and certainly adds to our knowledge of fog-flying technique.—*A. K.*

New Industries from Natural Gas

THE most remarkable development of industrial chemistry within the past decade has been the large-scale production of scores of entirely new chemicals from natural gas. Chemists have learned that they can juggle the constituents of natural gas around in a great variety of ways. The decomposition of natural gas (largely methane, ethane, and propane) at high temperatures is known as pyrolysis.

When methane is subjected to temperatures of 1800 to 2200 degrees, Fahrenheit, it breaks up, or "cracks." At slightly lower temperatures the parts reunite, but form new products as they combine. The higher hydrocarbon gases also break up and reunite to give various products different from the parent substances. At sufficiently high temperatures the gases will decompose to carbon and hydrogen.

In either type of cracking, hydrogen is always set free and by suitable means can be isolated and used commercially. Its major uses are as a reducing agent in the process industries; the hydrogenation of mineral and vegetable oils and coal; the synthetic production of ammonia and fertilizers; and as a refrigerant.

Other gasses formed in the pyrolysis of natural gas are acetylene, butadiene, ethylene, propylene, and butylene. Acetylene is used in welding and cutting metal, and may be used to prepare acetaldehyde, which is further used in silvering mirrors or in the preparation of medicinals such as chloral, a soporific. Butadiene, under proper treatment, condenses to form an artificial rubber having the same general composition as natural rubber. Ethylene has recently come into use in ripening fruits. It is also finding use as an anesthetic. However, its major use at present is the synthesis of ethylene glycol, an anti-freeze for water-cooled motors, and the basis for a series of important lacquer solvents. If desired, ethylene may be converted to ethyl alcohol, widely used as a solvent, and also in the preparation of other compounds such as ether. Again, by proper reaction with chlorine, ethylene chloride is formed. This is a valuable solvent, especially for fats and essential oils, and is also used as an anesthetic. Propylene finds use as an anesthetic, and also in the synthesis of iso-propyl alcohol, which is being substituted for ethyl alcohol with good results in certain instances. Butylene is also used in the preparation of certain butyl alcohols which are finding use as solvents in the chemical industries.

The principal liquids formed in the pyrolysis of hydrocarbon gases are benzene, toluene, and xylene. Benzene is a very valuable product and forms the basis of many chemical processes. Thus are obtained aniline and the entire series of aniline dyes, and many explosives, perfumes, and medicinals. In addition benzene is an excellent solvent and anti-knock motor fuel. Toluene is the basis of the familiar T. N. T. (trinitrotoluol), of dyes, and of saccharin, a sugar substitute 400 times as sweet as sugar. Xylene is similarly used in the synthesis of dyes and other products, and also to a large extent as a solvent.

The solids resulting from pyrolysis are chiefly naphthalene and anthracene. Naphthalene is well known as an insecticide in the form of moth balls. It is also the basis for the important indigo dyes. Anthracene is used in the synthesis of alizarin dyestuffs. Finally, under certain conditions of cracking, there is obtained carbon black, widely used in making ink, in compounding rubber, and as a pigment for paint.—*A. E. B.*

Electrocution

WHEN a human being is subjected for a brief period to a considerable amount of voltage of either continuous or alternating electric circuits, changes are produced in the cells of his body. An engineer, aged 60, depressed because of ill health, made contact with an alternating current at 2200 volts potential. The current passed from his left hand to his left foot, and he may have been in contact for 20 minutes. Physicians in Baltimore made an investigation of the conditions of the cells of his body six hours after death. They found that the cells of the brain were swollen and had been badly injured by the current.

A man, 24 years of age, electrocuted for murder, was submitted to a voltage of 2200 for two minutes. When his brain was examined after death the same type of changes were found.

Rats were then electrocuted and real injuries were found in the nerve cells of the brain and spinal cord. Some of the greatest changes took place in the nerve centers in that portion of the brain which controls the breathing. If the shock is slight, the interference with the breathing is temporary and it is possible by the use of artificial respiration to bring about recovery. If the shock is continued for a long period of time the changes that occur are so definite and prompt that recovery is not possible.—*M. F.*

Artificial Silk from Peanut Shells

RAYON from peanut shells is under investigation by the Farm Wastes Division of the Department of Agriculture at Arlington Farms, Virginia, with results which seem to promise a large raw-material supply for viscose producers. Over 70,000 tons of peanut hulls are collected annually in southern shelling plants, but little use is made of them except as fuel for plant power. The fact that the hulls are collected is a point in their favor, since many other types of waste which might be used could not be made available in bulk without heavy collection costs. Research shows that a product up to 90 percent alpha cellulose content can be derived from peanut shells, the requirement of good rayon material thus being satisfied. Experimental fibers have been produced.—*A. E. B.*

Yeast for Cows Instead of Cod-Liver Oil

YEAST, which has been exposed to ultra-violet rays, is better than cod-liver oil for increasing the rickets-preventing properties of cows' milk, Dr. Harry Steenbock, Flora Hanning, and E. B. Hart of the Wisconsin Agricultural Experiment Station at Madison, Wisconsin, have found.

These investigators have been trying for some time to find a way of increasing the anti-rachitic property of cows' milk. The majority of infants fed on it get rickets. Earlier observations showed that summer-time milk had slightly more vitamin D, the rickets-preventive, than milk produced in winter. Experiments showed, however, that it was not because the cows were getting more ultra-violet light in summer that their milk had more vitamin D in it.

Next, experiments with the cows' diet were made. Cod-liver oil, which prevents rickets in man, was not satisfactory when fed to the cows. Fed in large amounts, it lowered the secretion of butter fat. Fed in small amounts, it produced little, if any, effect of an anti-rachitic nature.

Excellent results were, however, obtained from irradiated yeast. Two hundred grams fed daily to cows producing from 30 to 40 pounds of milk increased the vitamin D content of the milk many fold. Even 50 grams furnished enough vitamin D to make the milk highly anti-rachitic.

Apparently by the use of irradiated yeast one of the most outstanding deficiencies of cows' milk can be corrected in a practical way. With the present cost of yeast production, it should be possible to give milk all the vitamin D required for normal nutrition at a cost of a fraction of a cent per quart.

The use of yeast has a further advantage in that the amount of vitamin in the milk can be controlled by the feeding of a standardized yeast preparation in amounts adjusted to the milk production.

The applicability of the use of irradiated yeast for the enrichment of human milk still remains to be worked out.—*Science Service.*

Cleansing Chemical Is "Safe" Alkali

UNTIL recently sodium metasilicate (Na_2SiO_3) had not been available commercially because of the difficulty of preparing the crystals from the sticky mother liquors and the consequent inability to prepare a granular product which would not adhere or form a hard cake on standing. Chemists have now succeeded in overcoming these commercial barriers and sodium metasilicate is available as a dry soluble powder, which keeps indefinitely in a tight container at temperatures below 60 degrees, centigrade.

Sodium metasilicate yields strictly alkaline solutions which remain effectively alkaline until they are almost completely neutralized. The solution is efficient as a cleansing agent without the disadvantages met in certain other solutions of the same high alkalinity. The material seems well adapted to cleaning all sorts of material, including glass, metals, and alloys. It also has interesting applications in the laundry. —*A. E. B.*

Shelled Nuts Form Soap Deposit in Glass Jars

THE mystery of the frostlike deposit frequently seen on the inside of glass jars containing shelled pecans, or other nuts, has been solved by E. K. Nelson and H. H. Mottern, chemists of the United States Department of Agriculture. The deposit is soap, the chemists say, and it is formed by the action of the acid fat of the nuts on the alkali of the glass. It causes considerable financial loss in the sale of the product.

The unexplained presence of the soapy deposit has long been a source of annoyance to packers of shelled nuts and to some housewives in the south who put up shelled pecans in glass jars when the nuts are plentiful and inexpensive. Although the soap does not impair the quality of the nuts, it presents an unsightly appearance and reacts against the sale of the product.

The chemists first thought that the acid fat of the nuts had come in contact with minute amounts of alkaline cleaner left in the jars but this theory proved incorrect.

Further investigation showed that shelled nuts packed in ordinary glass containers formed the white deposit, whereas nuts put up in hard-glass containers at the same time and under the same conditions formed no deposit. It was concluded, therefore, that the soap was formed by the action of the nut fat on the glass.

Our Point of View

(*Continued from page* 253)

in their vigorous attacks on the treaty. But most Americans felt that, taking all matters into consideration, it was a good treaty. We think they reconciled themselves to this treaty in the firm belief that President Hoover would put the whole force of the administration behind a building program that would give the nation the maximum navy it is entitled to have under the treaty. In as much as the ratification of this treaty is a personal triumph for Mr. Hoover, the vigorous prosecution of the building program becomes a personal obligation of the President and his administration.

CONGRESS AND PARLIAMENT CONGRESS and Parliament adjourned almost simultaneously and neither had succeeded in accomplishing its major objectives. Despite the earnest efforts of the Congressionally-created Farm Board, the price of wheat and cotton is lower than last autumn, and the Labor Government in Great Britain, although unhampered by either the Conservatives or Liberals, has not only entirely failed to reduce the number of unemployed but has seen them increase by over 200,000. These two failures should warn the peoples of both countries that there is definite limitation to the powers of government to interfere with economic laws. There is truth in the homely old adage that God helps those who help themselves, and nothing so becomes a nation as the sturdy self-reliance of its industrial citizens.

BRITISH EMPIRE FREE TRADE AMONG the panaceas urged for its commercial depression is a tariff wall for the British Empire. To avoid offending the Free-Traders, this new proposal for an empire preferential tariff is euphoniously called "Empire Free Trade," but the essence of the system is a tariff against the rest of the world. The difficulties in creating such a system can be estimated by recalling the difficulties encountered by the Republican leaders in passing the last tariff bill through our Congress. All the struggles between the industrial and agricultural parts of the United States are foreshadowed on a larger scale between the industrial United Kingdom and her agricultural dominions. To obtain a preferential market for the products of her factories in her dominions, the United Kingdom must give them a compensating preferential market for their agricultural products. This means a food tax. And neither the Labor nor the Liberal party is prepared for such a departure from traditional British policy.

Even if the United Kingdom were willing to submit to a food tax it is doubtful if the Dominions would be willing to give British factory products much preference, for Canada, Australasia, and the Union of South Africa are all seeking to protect and expand their own infant industries. A Canadian leader expressed this idea very vigorously when he said in substance "A factory in Montreal strengthens the British Empire as much as a factory in Manchester."

In spite of the difficulties to be encountered in establishing reciprocity throughout the British Empire, many British readers, mostly among the Conservatives, are convinced that it offers the only solution for British unemployment. Much will be heard on the subject in the near future. As Canada and the United Kingdom are among our leading customers, our interest in the outcome is apparent.

OCEAN LINER COMPETITION WHILE the Naval Conference has placed definite limitations on naval competition, the struggle between the leading merchant navies of the world is proceeding at a faster pace than ever. It is noteworthy that in every case the governments of the competing countries are solidly supporting the private companies building and operating merchant vessels. Great Britain, Germany, and Japan have long subsidized their merchant marines; more recently France has also. Italy and the United States have come to the assistance of their commercial fleets. At present the British Cunard line, especially aided by the government, is planning a vessel that will be speedier than the German *Bremen*, and the French Government recently increased its aid to the French company that is engaged in building a liner, especially designed to add new luster to the French Line.

These wonderful liners, the western terminal of which is and will be New York, directly and indirectly add to the commercial prestige of a state and, in time of war, can readily be converted into auxiliary cruisers, or in some instances into aircraft carriers. Small wonder then that, in these days when governments realize they must help their own citizens in the competition for world markets, they willingly assist their own merchant marine. Somewhat tardily we have realized that we must give governmental aid to our merchant marine; a determined continuation of this policy will do much to regain our long-lost position of sea-traders.

As a result of our government's assistance, American private enterprise, naturally chary of competing with foreign lines, with their cheaper built and operated vessels, are consolidating and enlarging their maritime interests, and while they will encounter stiff foreign competition, we believe they can succeed as did their forbears during a similar competition in the first half of the last century. Already in the Pacific, American vessels are holding their own against foreign vessels; we confidently expect a like result in the Atlantic.

THE CHAOS IN CHINA RECENTLY the U. S.S. *Palos*, a small river gunboat doing patrol duty in the Yangste River, was fired upon by one of the numerous insurgent armies now laying waste their unhappy country. This incident may focus the attention of Americans for a moment on China, and it would be decidedly to their interests to give that wretched country a brief thought. China takes a large part of our silver, some wheat, and some cotton goods. With Chinese trade demoralized, naturally the demand for these articles disappears. And by so much we suffer. When to the Chinese situation is added the unsettlement of India, the other large silver market, the present low price of silver is understandable. Most of the world's silver is produced in Canada, the United States, and Mexico, and when the price of silver falls, our own silver producers and those of our two nearest neighbors and excellent customers suffer, so commercially we lose three ways.

No one can offer an off-hand solution to the problem of China, but it is plainly obvious that there will be no miraculous remedy. If the Great Powers continue to stand aloof and let the Chinese brigands calling themselves Generals continue their indiscriminate fighting and unholy looting of their own country, poor China may stew in her own juice but the supineness of the Great Powers will be somewhat punished by their reduced Chinese trade.

In these post-war days it is the fashion to condemn everything connected with pre-war diplomacy, but the old European Concert of Powers would not have tolerated the conditions that have existed for almost a decade in China. Our responsibility in China should no longer be ignored; by our insistence on the Open Door policy, quite proper in itself, we have effectually discouraged any independent European or Japanese intervention in Chinese affairs. We should, therefore, take the lead in offering some form of outside help to this distracted country which so plainly can not extricate itself by its own efforts. Our previous record of refusing to seize Chinese territory or even to accept concessions, has given the Chinese people confidence in our good will, so that they will be more inclined to accept advice and help under our sponsorship. Certainly we should not continue to watch with folded hands the ghastly struggles of our tormented neighbor across the Pacific.

Books Selected by the Editors

AN INTRODUCTION TO THE STUDY OF WAVE MECHANICS—*By Louis de Broglie*

A COMPLETE account of the new wave mechanics, including the Heisenberg theory, written by the original theorist de Broglie (see SCIENTIFIC AMERICAN, March 1930, p. 183) who suggested the wave atom. This 246-page book, translated from the French, contains an unusually well rounded discussion of the subject, is not popular, but involves college mathematics throughout. $4.50 postpaid. —*A. G. I.*

THE FUNDAMENTAL THEORY OF ELECTRICAL ENGINEERING —*By A. L. Albert, Asst. Prof. E. E., Oregon State College*

BECAUSE of the recent developments in vacuum tubes, photoelectric cells, et cetera, a text of this kind was needed to cover completely present practice in fundamental electric phenomena. This presentation is equivalent to college or university courses and will be of value as a reference for non-electrical students. $3.40 postpaid.

FUNDAMENTALS OF ARCHITECTURAL DESIGN—*By W. W. Turner*

HERE is a dependable text and a ready reference for architects. It presents a concise treatment of all the fundamental principles of architectural design. The plates give both the module and part system of measurement. Dealing with five major fields of architectural design, each of which ordinarily commands a volume for itself, this text really comprises five books in one. The vital elements of each of these fields are presented along with well-rendered drawings and a full glossary of architectural terms. $6.20 postpaid.

INFALLIBILITY is not one of the characteristics of an editor, although many of our readers apparently compliment us with this attribute. No one person, in fact, no single editorial staff, can answer every one of the diversified group of questions that come in our mail. Usually we can give some authoritative reference; sometimes on minor, unimportant queries, we must simply say we have no information, but here is one which should have an answer: "What literature is available on the dynamics of small boat sailing?" Our own references failed us. We wrote to our good friend, the Editor of *Yachting* and he replied that the older texts we ourselves located were somewhat antiquated; that a revised edition of one of the standard works would appear shortly, but at present there was nothing but the older issues.

Have patience, therefore, if we cannot always serve you, but do not hesitate to send your book queries to L. S. Treadwell who edits these pages.

ENGLISH FOR ENGINEERS—*By C. A. Naether and G. F. Richardson*

THERE is without a doubt a strong trend in engineering and industrial circles to set higher standards in the use of characteristic English. The various colleges and universities, particularly in the large centers of population, are offering courses specially prepared for the adult student. Prominent engineers are using every effort and opportunity to advocate some sort of standardization. This work is ably conceived and most carefully executed. It is a broad course readily adapted to manufacturing business generally and postulates that accuracy in any line should extend to expression as much as it is essential to the subject matter. $3.20 postpaid.

INGENIOUS MECHANISMS—*By F. D. Jones, Editor*

ONE hundred and ten designers have contributed to this collection of the most ingenius mechanisms which are commercially practical. Designers and inventors will find the classification and description of this important work of 536 pages of invaluable aid in their work. As a reference it should be kept in every technical library. We quickly placed it on our shelves. For 15 years these devices have been collected, many of them having received prizes in competition. A needed and welcome work amply illustrated. $5.25 postpaid.

HOW TO BECOME A RADIO AMATEUR

A VERY complete little booklet of 30 pages describing in detail how anyone interested in radio can take an active part in the fascinating pastime of amateur radio communication. First, something is told of the ease of constructing amateur radio equipment. Then follows a short dissertation on learning the code. A very simple yet complete vacuum tube receiver and a low powered transmitter, both for use on the "80-meter" band, are described in minute detail so that the reader can at once start construction. The latter part of the booklet is devoted to telling how the interested person can pass the necessary examination for obtaining a first grade amateur's license. For this booklet write direct to the publishers, American Radio Relay League, Hartford, Conn.—10 cents—*A. P. P.*

SCIENCE IN SOVIET RUSSIA—*By J. G. Crowther*

THE author of the unusually interesting article "Super Magnetic Fields," in the June SCIENTIFIC AMERICAN, himself a scientific man, recently visited each of Soviet Russia's scientific research institutions, testing and other laboratories and institutes, and has given his readers a clear, graspable picture showing just what actually is going on—and there really is quite a little—in science pure and applied in that strange civilization. $3.00 postpaid—*A. G. I.*

THE SKELETAL REMAINS OF EARLY MAN—*By Dr. Ales Hrdlicka, U. S. National Museum*

A NEW and noteworthy scientific treatise containing lengthy detailed descriptions of all the famous finds of ancient man: Foxhall, *Pithecanthropus*, Piltdown man, Heidelberg man, Rhodesian man, all the Neandertal skeletons, and others, by a famous authority. Suitable for the general reader. Because of its origin with the Smithsonian Institution, the volume is priced about at cost, $2.25 (unbound), otherwise it would be at least a five-dollar book. It is suggested that purchasers order it direct from the Smithsonian Institution, Washington, D. C.—*A. G. I.*

SOUND PICTURES—*By J. R. Cameron and J. F. Rider*

"THE purpose of this book is to acquaint those coming in contact with sound equipment with sufficient fundamentals pertaining to sound motion picture equipment involved at the recording and reproducing end, to enable them to assume freely the responsibilities of operation and maintainance"—so runs the foreword. It contains 1074 pages, abundantly illustrated, starting with the structure of matter and proceeding through the whole field to the very latest adjuncts and accessories. There was real need for such a work and one will quickly realize that it has been amply met here. Both authors are experts and authorities and yet the treatment is so clear and comprehen-

From Recent Publications

sive one can readily assimilate the technicalities by a little application. A most creditable accomplishment. $7.70 postpaid.

THE CONDENSED CHEMICAL DICTIONARY—*Thomas C. Gregory, Editor*

A SPLENDID reference for people not educated along chemical lines but who seek information regarding chemicals and other substance used in manufacturing and laboratory work. This second edition is completely revised, reset, and enlarged and gives a surprising amount of information in most condensed form. Many useful tables comprise the appendix. $10.20 postpaid.

READINGS IN PSYCHOLOGY—*By R. H. Wheeler, Univ. of Kan.*

CAREFULLY selected passages written for the purpose of giving student beginners access to experimental investigation, selected first by what seems to be the dominant interest in psychology, and second by accessibility for publication. This is a sort of laboratory manual, with editorial notes, glossary, and index. There are seven groups in all, with a total of 28 readings. 568 pages of text. $3.95 postpaid.

WHEN I WAS A GIRL—*By Helen Ferris*

WELL told short biographies of Schumann-Heink, Janet Scudder, Marie Curie, Jane Addams, and Etsu Sugimoto, all of whom achieved success in spite of almost insurmountable obstacles, in the fields of music, art and social service, or science. Inspirational and most readable. $2.65 postpaid.

EVOLUTION OF THE FLYING MACHINE, BALLOON, AIRSHIP, AND AEROPLANE—*By Harry Harper*

WITH the background of 25 years of flying, giving as it did unusual facilities for acquiring material of special interest, the author has assembled more incidents of early flight than we have yet seen under one cover. English and Continental flying is particularly well covered and a most complete chronology, especially of early attempts at flight, casualties, et cetera, completes a thorough work. $5.20 postpaid.

TWENTY THOUSAND MILES IN A FLYING BOAT—*By Sir Allan Cobham*

THE very entertaining and sometimes thrilling experiences of this celebrated pilot during his circuit of Africa in a large seaplane. As a messenger of goodwill, he did much to open up many hitherto inaccessible places. $2.65 postpaid.

MANUAL OF FLIGHT—*By Ienar E. Elm, Capt. U. S. A. (Ret.)*

KNOWN as the author of several successful technical books, here he has recorded the fundamental knowledge that should be part of the equipment of every man or woman who intends to fly. Elementary and advanced maneuvers are covered in detail and the actual hazards and safety of air travel are judiciously set forth. Emergencies are considered together with the best means of escape. An intimate and accurate outline of the art is given in most workmanlike fashion. A very practical and conclusive manual. $3.20 postpaid.

PRACTICAL NAVIGATION—*By Charles H. Cugle*

"THERE are many excellent books on the theory of navigation, but very few that the ordinary man can understand and this book has been published with theory eliminated entirely,"—so runs the preface. Practically everything that is needed at sea is included in this most excellent text of 574 pages—innumerable examples of calculations as well as rules, deck information, examinations, stowage of cargo, et cetera. No short cuts are given, for the author believes these should be used only after thorough familiarity with the old tried and true methods. A most thorough and practical manual. $7.20 postpaid.

EXIT—*By Harold Bell Wright*

FOR three years no novel has issued from this author, the legends of the Papagos Indians being the intermediate title. Somehow one feels that in this present novel some of the mysticism, the intangible, the searching after inchoate realities, aspects which give fascination to Indian lore, has influenced the approach to "Exit." There seems to be less of the joyous forward looking into life which has been so characteristic of this writer; we seem to find more of introspection, spirituality, and the influences of past persons and events. Genuinely interesting from this viewpoint and as fascinating in style and description as ever. $2.00 postpaid.

BLACK SOIL—*By Josephine Donovan*

A STORY of community life on the prairie of northwestern Iowa, consisting of several nationalities which eventually become banded by their vicissitudes and common hardships. The author is well known for her literary work along historical lines and this, her first novel, received the 2000 dollar prize offered by the publisher. Needless to say the story runs with intriguing smoothness and fluency. $2.65 postpaid.

CONTEMPORARY IMMORTALS—*By Archibald Henderson*

WITH the keen insight of an artist and scientist, the author analyzes the lives, both purpose and accomplishment, of 12 of the most productive characters in modern affairs. Swiftly and clearly he delves to the bottom and reveals for us the salient facts which form the fundamental foundation of their impulses, their character, their accomplishment. The analytical mind of the mathematician supplemented by the culture, the language, and manners of many nations has produced one of the most delightful books we have had the pleasure of reading in many a month. Einstein, Gandhi, Edison, Mussolini, Shaw, Marconi, Addams, Wright, Paderewski, Curie, Ford, and Kipling are the sketches given. $2.65 postpaid.

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Adding Machine Inventor Dies

THE ranks of American inventors lost a valuable member when Dorr Eugene Felt passed away recently at his home in Chicago. Born in 1862, his mechanical bent first made itself evident at the age of 14 when he went to work in a machine shop. Early in the 80's Mr. Felt conceived the idea of the adding machine. From an old box, some metal meat skewers and a few rubber bands and staples, he evolved his first model of the machine that was destined to make an important niche for itself in the business world. From this early start Mr. Felt invented and patented numerous mechanical devices. He also found time to interest himself in other phases of science. He was an ardent student of geology and of Biblical history, both of which trends developed during his wide travels in foreign lands.

Central Radio Patent Bureau

WHAT appears to be an important step toward the solution of patent troubles in the radio industry has been taken by the Radio Manufacturers' Association. Establishment of a central patent bureau to collect and disseminate complete information on radio patents was ordered recently by the RMA Board of Directors. The new patent department will be in the New York offices in charge of a competent radio patent attorney.

An extensive library on radio patents, foreign as well as domestic, will be developed in the new patent department. It will collect, digest, and index all radio patents and publications and all information regarding patent litigation. Files of many important manufacturers who are members of the RMA will be centralized in the patent department, which will advise manufacturing members of radio suits and decisions, applications for and issuance of radio patents.

The new patent department will not participate in any patent litigation, but its patent data will be available to all members of the association.

"Gas Saver" Ad Censored

ADVERTISING in connection with the sale of a "vaporizer and decarbonizer" for automobiles that light cars run 57 miles on a gallon of gasoline, is prohibited in an order of the Federal Trade Commission to J. A. Stransky and L. G. Stransky, co-partners trading under the name of J. A. Stransky Manufacturing Company at Pukwana, South Dakota.

Among other phrases contained in the company's magazine advertising was the following:

"Five hundred dollars per month selling a new patented fuel vaporizer guaranteed to save up to 50 percent in gasoline: 40 miles per gallon made with Ford car."

Representations made by the company were found to be exaggerated beyond what was possible of accomplishment as a result of the use of the "vaporizer and decarbonizer" device, and statements to the effect that the device would remove carbon, prevent spark trouble and over-heating, and make engines start easier, were found not to be substantiated in fact.

The order of the commission prohibits, among other, such representations as the following:

"Ford runs 57 miles on gallon of gasoline."

"Ford makes 40 to 57 miles to gallon; other cars show equally remarkable gains; increases power 25 to 50 percent."

"Why not buy gasoline for 10 cents per gallon? New invention. Cuts fuel bills 25 to 50 percent.

"An automobile goes 27 miles on air by using an automatic device which was installed in less than five minutes. The automobile was only making 30 miles on a gallon of gasoline, but after this remarkable invention was installed, it made better than 57."

"Makes more miles per gallon than any other device on the market, regardless of the price."

"This wonderful little device cuts the cost of gasoline in half—it made it possible for an auto to go 60 miles on a gallon of gasoline."

"Enables Ford cars to make as high as 61 miles to the gallon of gasoline."

Aircraft Patents Issued

A MISCELLANY of devices, including one design for a super-airplane combining the principles of both lighter and heavier than air craft, is included among the patents issued recently to aeronautical inventors by the United States Patent Office. The "super"-flying craft, the invention of Hugh J. Ross of Cliffwood, New Jersey, comprises a fuselage, gas bags surmounted thereon, motor driven propellers on the sides of the fuselage and means for rockably mounting the propellers on vertical axes for control from within.

Another giant airplane, but not containing the gas bag support, was patented by Bert Messick of Lansing, Mich., and an airplane with wings having air-compressing plates depending from their under surfaces at right angles was patented by George S. St. Louis of Fresno, Cal.

The late Elmer A. Sperry obtained a patent on a beacon system for night flying. Another safety device, a parachute supported by a standard, designed to bring a plane safely to earth, was patented by Frank Arnaiz of Los Angeles. An electrical heating means for airplane wings to prevent the accumulation of ice and snow is the invention of William S. Ingram of Philadelphia.

Patents covering a "means of controlling the angle of incidence of aero revolving blades or wings and propellers" were issued to David Kay of Blackford, Scotland. Martyn Clissford MacPherson of Hayes, England, obtained a patent on a "braking of the under-carriage or landing wheels of airplanes." Hugo Junkers patented a dock for flying machines, and a patent on a floating dock for seaplanes was issued to Paul Degan of Kiel-Dietrichsdorf, Germany. Another German, Otto Krell of Berlin, patented a rotable movable hangar for dirigibles.

Increasing interest in the development of lighter-than-air craft is evidenced by the number of patents pertaining to dirigibles recently issued.

Wolfgang B. Klemperer, for example, procured three patents covering a stabilizing apparatus for airships, a tensiometer, and a bulkhead for airships, collaborating on the last with Paul Helma, also of Akron, Ohio. Their patents and one issued on a gas container for airships to Karl Huerttle, together with another on a wire netting for airships to Paul Helma and Kurt Bauch, all of Akron, have been assigned to the Goodyear-Zeppelin Corporation. These technicians are among those working on the construction of two giant dirigibles for the United States Navy.

Ralph H. Upson, famous balloonist of Brooklyn, New York, procured patents on a dirigible and a type of airship fin which he has assigned to the Aircraft Development Corporation of Detroit. Charles Guidice, also of Brooklyn, designed and patented a new type of dirigible, and a patent on a device for protecting balloons from lightning and other atmospheric disturbances was granted to Alfred Crossley, Washington inventor, who has assigned his rights to the Federal Telegraph Company.

Patents on new types of parachutes have been issued to Charles H. Castagne of Chicago and Captain Edward L. Hoffman of Dayton.

Lloyd Stearman of Wichita, obtained patents on a dolly for airplanes and an air-intake heater, both of which inventions he has assigned to his Stearman Aircraft Company.

Cologne Trademark Void

IN a recent decision by the United States Circuit Court of Appeals, Judges Manton and Swan concurring and Judge Hand dissenting, it was ruled that Muelhens and Kropff, Inc., 25 West Forty-fifth Street, American manufacturers of 4711 eau de cologne, cannot have exclusive right to the use of "4711" as a trademark because the concern does not possess the original formula for the manufacture of the article.

Since 1792 the Muelhens family in Germany has been manufacturing eau de cologne at 4,711 Glockengasse, Cologne, Germany. The formula has remained a secret.

In 1878 William Kropff came to this country as the family's agent. Later a member of the Muelhens family formed a partnership here with him. The trademark "4711" was registered as belonging to the firm, but the secret formula was never revealed to Kropff.

During the World War the Alien Property Custodian seized Muelhen's interest in the firm and later sold it to Kropff. The sale included good-will and the trademark. Kropff then incorporated as Muelhens & Kropff and made and sold a cologne under the trademark "4711."

After the war, Muelhens established Ferd. Muelhens, Inc., and began selling "4711" cologne made according to the old formula. The result was that Muelhens & Kropff brought suit to prevent Ferd. Muelhens, Inc., from using the trademark.

A majority of the court decided that "assignment" of the receipt is essential to give the assignee the exclusive right to a mark which denotes a product manufactured thereunder. Otherwise the public will be unable to procure the genuine product under the name by which it has always been known.

Those who insist upon the genuine 4711 eau de cologne are not the prospective customers of the plaintiff, for he cannot supply it.

"Special" Book Editions Curbed

A BOOK publishing partnership signed a stipulation with the Federal Trade Commission agreeing, in connection with the sale of a special edition of a book, to cease and desist from using such representations as "The Authentic Text," "The First Authentic Text," or "The Complete Text" as descriptive of the edition, when in truth such statements are not supported in fact.

This firm also agreed to discontinue use of the words "authentic" and "complete" in any way that would imply or deceive the purchasing public into believing that its edition is an authentic one of Edgar Allen Poe's story entitled "The Gold Bug," or that the edition is an authentic or complete text of this story containing all of Poe's alterations and additions, when such is not the fact.

Patent Office Rules Revised

AMENDMENTS to the trademark rules and to the rules of practice of the Patent Office, made to conform to the new law (act of Apr. 11, 1930), relating to fees, and certain recommendations of the committee of the American Bar Association were announced recently by the Commissioner of Patents, Thomas E. Robertson.

"That part of the new rules which includes fees," Mr. Robertson stated, "has been changed to meet with the requirements of the new law approved Apr. 11 providing that the fee for issuing original patents shall be 25 dollars and 1 dollar for each claim in excess of 20, instead of the present fee of 20 dollars and 1 dollar for each claim in excess of 20.

"Amendments to the rules of practice of the Patent Office were made to carry out the recommendations of the patent committee of the American Bar Association. These changes are, first, an amendment to Rule 41, which provides that more than one species of invention, not to exceed three, may be claimed in one application if that application also includes an allowable claim generic to all the claimed species.

"The changes in rules 109, 114, 122, 123, 124, 128, and 130 provides that all motions in interference cases shall be heard by an examiner of interferences instead of by a law examiner as at the present time.

The American Bar Association, it was pointed out, believes that this will expedite work in interferences, lessen the trouble and expense of interferences and bring them to a speedier conclusion.

In the first sentence of rule 109, "An applicant involved in an interference may, at any time within 30 days after the preliminary statements (referred to in rule 110) of the parties have been received and approved, on motion duly made, as provided by rule 153, file an amendment to his application containing any claims which in his opinion should be made the basis of interference between himself and any of the other parties," has been taken out of the rule and supplanted by the following:

"An applicant involved in an interference may, within a time fixed by the examiner of interferences, not less than 30 days after the preliminary statements (referred to in rule 110) of the parties have been received and approved, or if a motion to dissolve the interference has been brought by another party within 30 days from the filing thereof, on motion duly made as provided by rule 153, file an amendment to his application containing any claims which in his opinion should be made the basis of interference between himself and any of the other parties."

The rules from 109 to 130 provide for the substitution of the word, "examiner of interference" for "law examiner."

Rules 162 and 163 contain changes relating to the filing of typewritten instead

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payment must accompany each insertion.

Anyone desiring official copies of patents herein listed may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AEROPLANE—Having a single wing extending longitudinally of the fuselage at a sufficient height and angle to dispose the load forwardly and so balance it, as to cause the plane to come out of a fall and glide safely to earth. Patent 1769320. Henry C. Thompson.

AIRCRAFT—Having an arrangement of supporting and flying control surfaces, by which the usual form of tail assembly can be dispensed with, and yet the craft maneuvered and maintained on a desired course and under perfect control. Patent 1766390. Charles V. Lapin.

AEROPLANE—Of the amphibiantype, equipped with a landing gear, well adapted for water or ground, having novel features of material advantage in taking off from water, and means for preventing sleet and snow collecting upon the wings. Patent 1769393. John T. Rydberg.

Pertaining to Apparel

GARMENT—So constructed that when worn by a patient undergoing treatment for certain diseases, parts of the garment may be adjusted so that only that part of the body effected, need be exposed to view. Patent 1766272. Samuel W. Vallier.

Chemical Processes

PROCESS OF STABILIZING CEREAL BEVERAGES—Containing less than 0.5% of alcohol, by treating the beverage, at any stage of the brewing, with tannin and a siliceous clay, to precipitate the undesirable albuminoids which render the finished beverage turbid when chilled. Patent 1766428. Donato Cozzolino.

Designs

DESIGN FOR A DRESS—Patent 81493. Dorothy Long.

DESIGN FOR A COAT—Patent 81494. Dorothy Long.

DESIGN FOR AN ENSEMBLE SUIT—The inventor has been granted two patents, 81495 and 81496. Dorothy Long.

DESIGN FOR A RADIATOR-CAP ORNAMENT OR SIMILAR ARTICLE—Patent 81530. Guy de Vall.

DESIGN FOR A COAT—Patent 81545. Dorothy Long.

DESIGN FOR A READING CABINET—Patent 81568. Charles J. Abeles.

DESIGN FOR AN ENSEMBLE SUIT— The inventor has been granted two patents, numbers 81589 and 81590. Dorothy Long.

DESIGN FOR LACE—Patent 81616. Ben. A. Ball.

DESIGN FOR A DOLL OR SIMILAR ARTICLE—Patent 81638. Adolph Gramlich.

DESIGN FOR A TOY ANIMAL—Patent 81646. John S. Hooks.

DESIGN FOR A DRESS—Patent 81711. Dorothy Long.

DESIGN FOR A CARPET SWEEPER—Patent 81669. Earle R. Smith.

Electrical Devices

CIRCUIT-CONTROLLING DEVICE—Whereby special mechanism actuated by the steering apparatus of an automobile keeps the circuit of the indicating lights closed so long as the front wheels of the car remain turned in either direction. Patent 1766993. Masao Hasegawa.

THERMOSTATIC ELECTRIC SWITCH—More particularly designed for controlling the illumination of one or more incandescent lamps such as are used in direction signals, in a manner to produce an automatic flashing. Patent 1766430. Clarence K. Davis and Arthur Dick.

RADIO RECEIVER—Having means whereby the volume of output may be easily and accurately controlled from a point remote from receiving set to give desired softness or loudness, adapted for use with any type of receiving apparatus. Patent 1769256. Allen S. Clarke.

of printed briefs and records providing the brief or record does not exceed 125 pages.

"The Bar Association Committee requested that this be done to cut down printing expenses since they are now very high," Mr. Robertson said.

Bottle Trademark Denied

IN a recent decision, First Assistant Commissioner Kinnan held that the Obear-Nester Glass Company of East St. Louis, Illinois, is not entitled to register, under the Act of 1920, the words "Individually Wrapped," as a trademark for prescription bottles made of glass.

The ground of the decision is that the words could not function as a trademark. In his decision, the First Assistant Commissioner said:

"The words sought to be registered as a trademark would have no trademark significance to the purchaser of the goods nor could they have any such significance as they merely convey the plain information as to the manner in which the bottles are packed or arranged for shipment. No one could obtain the exclusive right to use these purely informative and descriptive words in connection with the sale of bottles."

"Bucyrus-Erie" Registrable

AN applicant already owning registrations for the mark "Bucyrus," under the 10-year proviso of the act of 1905, is entitled to registration as a trademark of the word "Bucyrus-Erie" for power shovels and similar articles, the Assistant Commissioner of Patents has held.

While the word "Erie" taken alone is a geographical name and therefore would not be registrable, the opinion states that the combination of the two words, linked together, are to be considered as an entirety, and therefore, the mark does not fall within the provision prohibiting the registration of merely a geographical name or term.

Mis-branded Wood

TWO corporations selling and distributing motor boats have signed stipulations with the Federal Trade Commission agreeing to stop misrepresenting their products as made of mahogany, when such is not the fact. Both companies agreed to cease use of the word "Mahogany" either independently or in connection with the word "Philippine," or in any way which may tend to deceive the public into believing that their motor boats are made in whole or in part of wood derived from trees of the mahogany family, when such is not the fact.

One of the companies also will discontinue use of statements or representations implying that it owns, operates, or controls a factory wherein are built and manufactured the products it sells.

Labels Need Not Be Detailed

THE portion of an order of the Federal Trade Commission requiring a person doing business under the firm names to state the ingredients and percentages of such ingredients which make up a substitute shellac in labels and advertisements of the product has been held by the Circuit Court of Appeals for the Second Circuit to be unwarranted.

The court stated that it would be sufficient to prevent a fraud upon the public if the respondent labels his goods and advertises the same as "shellac substitute" or "imitation shellac," accompanied by the statement that it is not 100 percent shellac, and that it was not necessary to show the ingredients of the product in their percentages.

The Federal Trade Commission had issued an order against the respondent requiring him to cease and desist from using the word "shellac" in labels and advertisements of varnish which was not composed entirely of shellac gum dissolved in alcohol. The order permitted the use of labels and advertisements in the sale of the product if accompanied by words clearly indicating the other ingredients and the percentages used. The appellate court modified the order, by eliminating the latter requirement.

LINE TESTER—For overhead wires, wherein the structural arrangement is of such character that effective contact with the circuits to be tested, will be made regardless of the amount of corrosion, rust, etc., with which the surface may be coated. Patent 1769248. Charles D. Williams.

Of General Interest

WINDOW BOX—Or window refrigerator, which may be easily adjusted to the sill, does not interfere with the opening or closing of the window, provides fresh air while excluding dust, and prevents cold air entering the room. Patent 1769740. John C. Kelley.

CLOSURE CONSTRUCTION — For rubber pouches, hot water bags, and the like, which will be water-tight, less bulky than those in general use, and may serve with a tube so that the article may be used as a syringe. Patent 1769259. Beulah L. Henry.

EMERGENCY SECTION FOR SHIPS—Which will float free if the ship should sink, accommodate all of the people carried by the ship and enough storage of food and equipment to take care of them until rescued. Patent 1768152. Charles F. Rodin.

CIGARETTE CASE AND LIGHTER—In combination, constructed to take up very little more room than that occupied by a standard cigarette case. The lighter is removable for permitting a new refill in the operating mechanism. Patent 1766320. Edward G. Ahrens.

BOAT-SALVAGING DEVICE—Built in as a part of the boat and accessible from the deck, thereby obviating the necessity of passing cables in the mud beneath the ship bottom, for applying hoisting tackle to the sunken vessel. Patent 1769353. Louis F. Long.

LAWN SPRINKLER—Embodying mechanism whereby when the device is placed at the approximate center of a square, the volume of water will be controlled so that the corners will be reached by the spray, and the lawn uniformly sprinkled. Patent 1766514. Henry L. Henry.

SIGN—Constructed for interchangeably holding readable indicia in fixed position on a board, and against accidental displacement, yet allowing when desired an adjustment or spacing of the characters without removal. Patent 1766362. James A. Sears.

ENVELOPE—Which does not require moistening in order to effectually seal it, and in which means is provided for showing at once any attempt to open the envelope. Patent 1768836. Thomas E. Gjorup.

BRUSH—A folding brush in which the bristles are adapted to be received when folded within a protecting housing, the whole forming a compact structure which when unfolded provides a handle and brush. Patent 1770344. Frederick E. Schmidt.

BOX OR CONTAINER—Formed of cardboard and composed of three main parts having flanges projecting from the sides and ends which are joined together by metal staples or other fastening means operating as a protective means against damage by dropping. Patent 1770819. Fred W. Tamke and George W. Boh.

VISIBLE CARD FILE—Having a transparent pocket at the end of each card holder, which will improve the use of the record slip for the permanent items relating to the record matter, and the general operation of the file. Patent 1770793. Luigi Lombardini.

WEED PULLER—Having a pair of pivotally mounted jaws with ground penetrating points adapted to be moved together in gripping relation for removing weeds including their roots, with a minimum displacement of the soil. Patent 1771353. Fred P. Riddell.

1929 French Aircraft Exports Increased

FRENCH aircraft exports during 1929 increased considerably, Automotive Trade Commissioner W. L. Finger, Paris, France, recently informed the Department of Commerce. Land planes with a total value of 209,581,000 francs (approximately 8,207,411 dollars) were exported as compared with 138,898,000 francs (approximately 5,446,190 dollars) in 1928; seaplanes exported amounted to 4,852,000 francs.

The largest markets for French aircraft were Yugoslavia, Belgium-Luxemburg, Turkey, Rumania, Brazil, and Indo-China. In 1929 Yugoslavia imported from France aircraft valued at 40,290,000 francs; Belgium-Luxemburg, 2,713,000 francs, and Turkey, 2,694,000 francs. Although 1929 was the first year that France imported airplanes, the quantity was small. These planes came from Great Britain and The Netherlands.

Fraudulent Implication Stopped

CO-PARTNERS engaged in the sale and distribution of knit goods, such as sweaters, swimming suits, and knit dresses, recently signed a stipulation with the Federal Trade Commission agreeing to stop use of the words "Knitting" and "Mills" in their trade name so as to imply that they own or control a factory in which they manufacture the goods they sell.

They agreed to discontinue any other use of the two words which may have the tendency to mislead the purchasing public into the belief that these partners operate a factory.

Mine Safety

THE possibility of eliminating the use of electrical equipment in coal mines in Utah and substituting compressed air apparatus, will probably be considered by the state industrial commission, according to O. F. McShane, a member, who is investigating coal mine explosions.

It is stated that recent explosions have been caused by ignition of gas by the use of electrical equipment and Mr. McShane is serving notice on coal producers that they must show within a reasonable time that they can control this danger by introduction of new safety devices.

COMPACT-HOLDING RING FOR VANITY CASES—Wherein spaced fingers are used to resiliently hold the compact plate in position, the fingers being so arranged that an implement may be placed there between for ejecting the plate. Patent 1771337. William G. Kendall.

ADJUSTABLE HANDLE—Whereby brushes, mops and such articles may be releasably held in different angular positions to enable a person to more conveniently carry out cleaning operations. Patent 1771325. John R. Cotter.

DEVICE FOR PRODUCING AND DISPENSING LATHER—Having means for agitating the soap and water to produce a lather without the necessity of shaking the device, and to insure the dispensing of the lather only, precluding the discharge of water. Patent 1771292. Frank P. Gallipoli.

IRONING BOARD ATTACHMENT—By which those parts of garments which have been pressed, and depend from the board as a result of shifting to press other portions, are effectively supported to prevent contact with the floor and soiling. Patent 1770890. Frank Pons and Levert W. Wilson.

Hardware and Tools

PIPE COUPLING AND ROTARY TOOL JOINT—In which a plurality of threaded sections are screwed into each other with the threaded sections having a differential pitch, and means for locking certain of the sections against independent rotation. Patent 1769381. Gustavus A. Montgomery.

SAFETY SPRING—Or door closing device, having means for limiting the outward movement of a door or other hinged member, in order to protect the hinges, or any object with which the door might collide. Patent 1771299. Fred E. Justus.

Machines and Mechanical Devices

WASHING MACHINE—Which may be connected by a hose to a house faucet and either hot or cold water used for the operation of the machine and for constantly passing clean water in contact with the clothes. Patent 1769221. Harley A. W. Howcott.

TENSION INDICATOR AND COMPENSATOR FOR WARPING CARRIAGES—For textile fabric such as rayon, silk, and fine counts of cotton, etc., particularly adapted for producing rayon becase it overcomes the action of jerks on the warp sections when starting and stopping, thus avoiding stretching. Patent 1769244. William G. Trautvetter.

VARIABLE - SPEED TRANSMISSION — Which makes use of two friction discs and two friction wheels, the construction permitting the gears to be bathed in lubricant while still keeping the discs away from the lubricant, thus operating efficiently at all times. Patent 1766240. Julius L. Allen.

JIG—For separating ore or minerals from rock or lighter material, and more particularly a jig wherein a pulsating column of water is used in conjunction with a grate to effect a classification of a bed of material. Patent 1769287. Asa R. Chase.

MOULDING MACHINE—Wherein dough can be molded into mass of the same thickness throughout, such as pan bread, of a predetermined length, or shaped to provide rolls or loaves known commercially as French or Vienna bread. Patent 17711 (reissue). Frank A. Scruggs.

WAVE AND TIDE MOTOR—Characterized by a plurality of floats capable of being mounted in a body of water for movement in response to wave action, and means responsibe to variations of levels, such as resulting from tidal action. Patent 1766457. Charles H. Ruth.

AUTOMATIC ALARM CLOCK FOR HOTELS—By which the occupant of any particular bedroom may be rung up at any desired hour, an electric lamp being lighted at the same time in his sight, the alarm is automatically repeated a second time. Patent 1769830. Vlderico Giomi.

APPARATUS FOR TREATING ASPHALTIC OILS FOR THE PRODUCTION OF ASPHALT—Whereby asphaltic oils can be treated to produce oxidized asphalt possessing a relatively high melting point and a relatively low degree of penetration, and the time required for distillation greatly reduced. Patent 1766446. Max R. L. Miller.

BUN-CUTTING MACHINE—In which a rotary cutter or knife is employed for cutting buns or other bakery or food products, without marring or making them objectional in appearance, the machine may be adjusted to completely sever or cut partly through. Patent 1766450. John A. Ost.

SUGAR DISPENSER—For mechanically delivering measured quantities or any multiples thereof, the several quantities being accummulated within the dispenser and all being discharged as a single quantity by one tilting movement, the parts are readily removable for cleaning. Patent 1768091. Gus N. Adair.

LOOM MECHANISM—A reed-like batten with mechanism for moving the same toward and from the fell, beating up the filling as it is inserted and coincidently effecting a combing of the work shed. Patent 1770269. Benjamin D. Hahn.

LUBRICATING DEVICE—Including a well from which a capillary feeding element immersed in lubricant leads to the parts to be lubricated, and whereby a constant level is maintained in the well, whereby uniform feed is obtained. Patent 1770036. Albert Johnson.

GRINDING FIXTURE—Capable of accurately grinding the face radius and sides of both large and small milling cutters and backing off to proper clearance in one operation, can be used on any standard machine. Patent 1770318. Andrew McAndrew.

LOCK—Of the portable or "padlock" type, having a shackling element formed for general application and capable of assuming different angular positions without presenting an obstruction, but held locked against unauthorized removal. Patent 1770812. Ellsworth F. Seaman.

VACUUM AND PRESSURE PUMP—Which after reaching a constant speed will produce a definite pressure or vacuum, and once such pressure or vacuum is attained the pump will not operate to increase it beyond this maximum. Patent 1769257. Ralph G. Demaree.

BOAT DAVIT—In which the use of blocks and tackle are eliminated, is vertically movable with the sides of the ship, maintains the boat at a fixed distance from the ship, and prevents upending of a boat during launching. Patent 1771372. Julian W. Bournier.

DISHWASHING APPARATUS—Having a plurality of brushes of different characters and configurations, connected for rotation with a motor shaft, whereby plates, platters, glasses and other tableware may be rapidly cleansed. Patent 1771934. Mattia Marangoni.

WASHER—Having a steam jacket and heads securely bolted to the grooved rings on the ends of a cylinder, the inner face being entirely lined up with sheet nickel, particularly adapted for use in connection with the dry cleaning of clothes. Patent 1771638. Wallace C. Johnson.

Medical and Surgical Devices

SURGICAL APPLIANCE—By means of which a constant temperature may be maintained with solutions such as "the Murphy drip" intravenous injections, saline and other solutions, as well as solutions for feeding the human body, and for blood transfusions. Patent 1770832. Donnie L. Bass.

Prime Movers and Their Accessories

PROTECTING TRAY FOR VALVE CHAMBERS—Capable of being readily applied, and in such position as to form a protecting covering to receive and collect the carbon particles, cuttings and other waste matter, in such manner as to prevent contamination of the oil. Patent 1766469. Chauncey H. Stout.

Pertaining to Recreation

TOY—In the nature of a "hobby-horse" but differing by the employment of a structure that will produce a more bouncing motion, as well as a rocking motion, thereby exercising the abdominal, back and leg muscles. Patent 1771920. Benjamin Gordon.

Pertaining to Vehicles

AUTOMOBILE DOOR HINGE—Whereby entrance to the front and rear seats is had by way of a single door, capable of being opened on both the front and rear edges, thus facilitating ease of entrance or exit from rear or front seat. Patent 1769273. Jacob A. Penner.

TIRE-DEFLATING SWITCH—A simple and efficient device which will automatically notify the user of the vehicle that he has a flat tire, or one that is partially deflated, the alarm system indicating the location of the particular tire. Patent 1769427. John B. Garside.

FUEL METER FOR AUTOMOBILES—An apparatus comprising a receptacle with valves in the top and bottom, and a rod operating the valves and a float, whereby the amount of fuel consumed may be measured and registered. Patent 1766262. Claude Simmons.

AUXILIARY WATER-CIRCULATING MEANS FOR AUTOMOBILE ENGINES USING THERMO-SIPHON SYSTEMS—Which will eliminate all belts, pulleys, gears, packing glands or parts that would wear or leak, and their attendant disadvantages, yet possessing a considerable means of boosting the water circulation and be easy to install. Patent 1766408. Robert F. Stephenson.

BRAKE EQUALIZER—For four wheel brakesf adapted for ready application to any type o automobile for applying the brakes while at the same time providing for an equalization of the pressure, and the proper force for stopping the vehicle. Patent 1770030. Ray Freeman.

LUBRICATING SYSTEM — Comprising tubes leading to the different parts of an automobile, providing a lubricating system which may be actuated by electrical apparatus which includes the ignition switch. Patent 1769258. Coy C. Goodrich.

SIGNAL ARRANGEMENT FOR AUTOMOBILES—Which includes a current switch, signal horn, signal lights, constructed in such a way that all signals, optical and acostic, can be separately connected or disconnected by means of one and the same current switch. Patent 1770835. John F. Bolin.

TOURIST CAR—With the over-all dimensions of an ordinary truck, but providing a relatively large floor space when stopped for camping, embodying indoor and outdoor sleeping quarters, comfortable transportation for travelers, convertible articles of furniture adaptable for various purposes, and observation quarters. Patent 1771911. Harry W. Berneck-ing.

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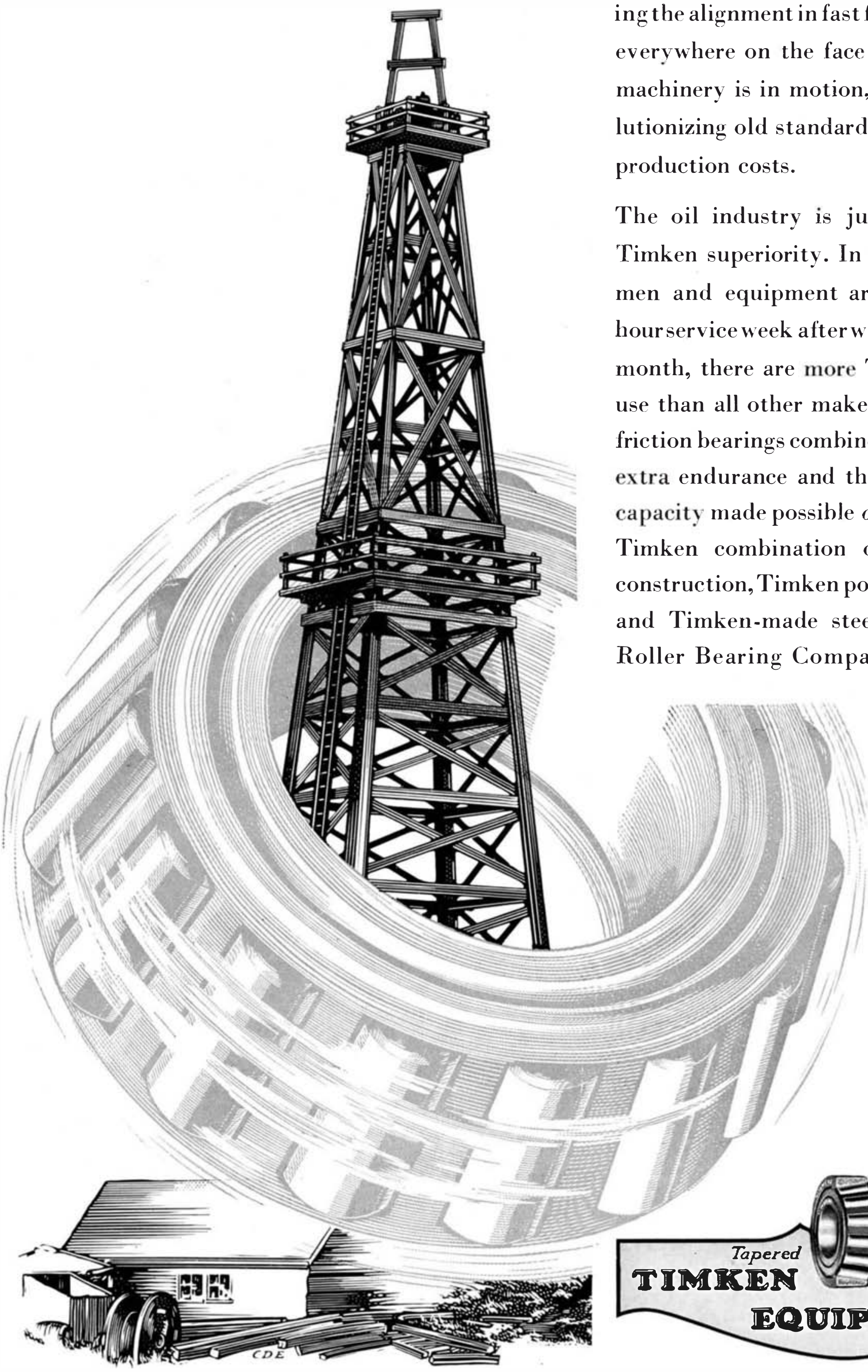

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