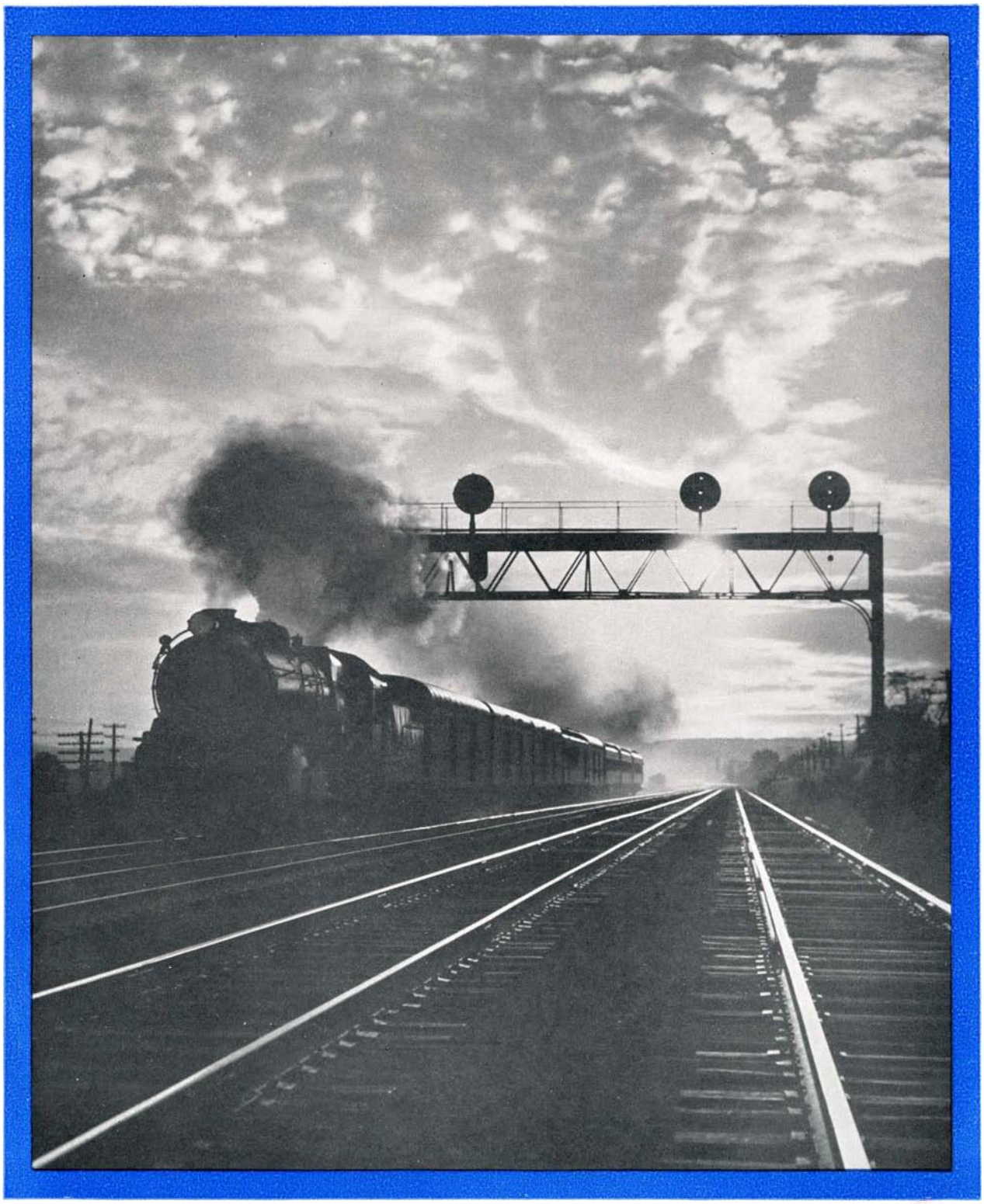
SCIENTIFIC AMERICAN



Steam Still Rules the Rails (See page 180)

VOLUME 152 • NUMBER 4

THE SANITY OF INSANITY

APRIL 1935 • 35c A COPY

Dear Editor—Send Me the List

OF REPRESENTATIVE MINIATURE CAMERAS AVAILABLE IN THE UNITED STATES

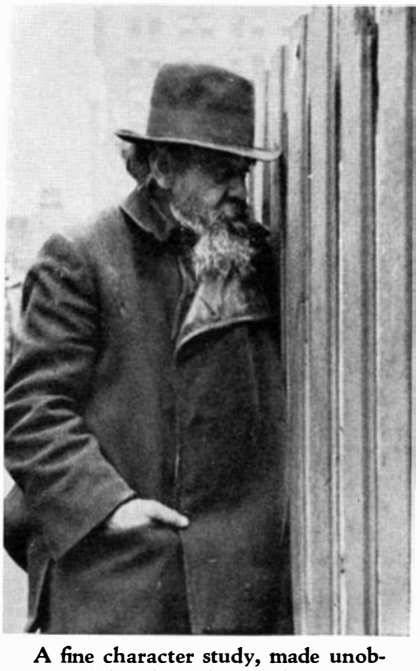
EVERY business day the postman brings letters in large numbers to the desks of the Editors of SCIENTIFIC AMERICAN. The range and diversity of the inquiries on every phase and subject of Science and Invention is a revelation of far-reaching influence and a startling testimonial of the confidence of the readers in the Research and Service facilities of SCIENTIFIC AMERICAN.

IN HARMONY with the new American spirit SCIENTIFIC AMERICAN is marching steadily forward, enriching the lives of an ever-increasing number of worthwhile people in their vocations and avocations.

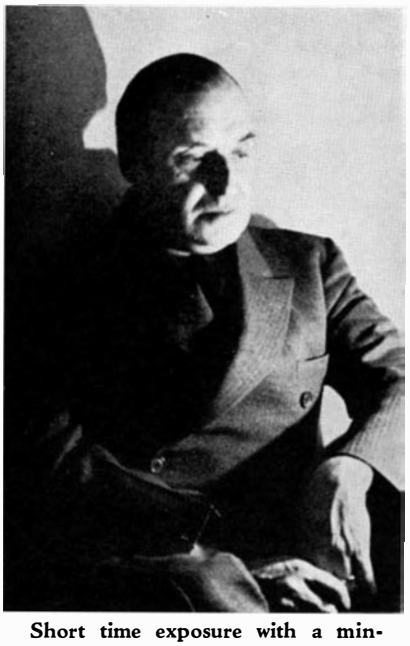
READERS of the February issue of SCIENTIFIC AMERICAN have literally deluged us with requests for the List of Representative Miniature Cameras Available in the United States, prepared by the Research Department of SCIENTIFIC AMERICAN. Since the release of that issue, our circulation has been climbing steadily, and we want our new readers interested in miniature cameras to have the benefit of this carefully conducted research. All you need to do is to send us a three cent stamp and say that you want the list. It will be forwarded to you by return mail.

For the yearly subscription price of $4.00, SCIENTIFIC AMERICAN brings to you each month, valuable information, authoritatively interpreted, on progress in Science and Industry. Mail your subscription today.

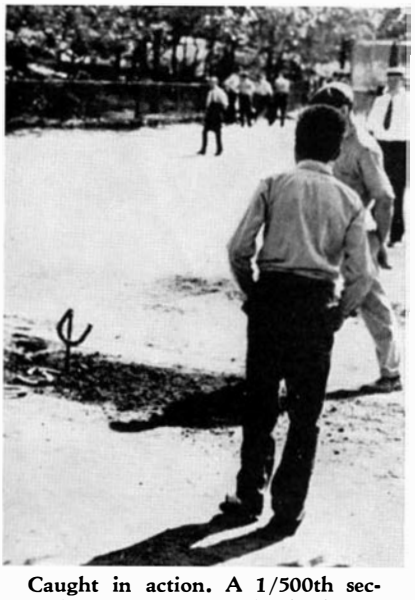
SCIENTIFIC AMERICAN



A fine character study, made unobserved by the subject; the camera equipped with an angle view finder



Short time exposure with a miniature camera. Light furnished by a candle 2½ feet from subject



Caught in action. A 1/500th second exposure "stopped" the horseshoe as it was making a "ringer"

SCIENTIFIC AMERICAN

Owned and published by Munn & Company, Inc.; Orson D. Munn, President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

NINETY-FIRST YEAR • ORSON D. MUNN, Editor

The SCIENTIFIC AMERICAN DIGEST

Of General Interest

Chemistry in Industry

Aviation

Health Science

CONTENTS • APRIL • 1935

SCIENTIFIC AMERICAN, April, 1935. Vol. No. 152. No. 4, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City.

Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

A QUESTION which often leads to interesting arguments is that of the position occupied by American aviation in relationship to the rest of the world. We have been unusually fortunate in obtaining from Igor Sikorsky, well known aircraft designer, an article giving his impressions of the present status of aviation in Europe as compared with the United States. "The main conclusion to be drawn from an air tour of Europe," says Mr. Sikorsky, in his article scheduled for publication next month, "is that American aviation is definitely superior to European aviation, although it is faced with a real danger of rapidly losing its lead." Mr. Sikorsky recently flew over several thousand miles of Europe and visited the most important aeronautical centers. Thus he is able to present in a lucid manner the impressions registered upon his trained mind of the things which he saw.

●

AMATEUR microscopists will revel in the first part of a two-part article to be published in our next issue. In describing a home-built polarizer, Philip R. Tarr says: "Of the innumerable thrilling and educational observations that may be made with an ordinary microscope, few can compare either in beauty or fascination to those made with polarized light. An unlimited field may be opened by adding the necessary polarizing equipment to your own microscope." Both parts of the article will be well illustrated with photographs and drawings by the author.

●

THE first of three articles on railroading, promised in these columns last month, starts on page 180 of this issue. Here you may read of the advantages and disadvantages of steam power, the old standby of railroading since its inception. Next month's article will deal with electrification. Writing on this phase of the subject Mr. G. I. Wright, Chief Electrical Engineer of the Reading Company and the Central Rail Road of New Jersey, says: "Railroad transportation is undergoing a rapid change. Many think we are on the threshold of a new era in which basic alterations in methods and equipment will be adopted. Where does electric traction fit into this picture and what has it accomplished? What are its advantages in relationship to the future?" Mr. Wright proceeds to answer these questions and to give the reader a broad insight into one of the much discussed phases of transportation. The third article, on Diesel-electric power, will appear in May.

NEXT MONTH

¶ Igor Sikorsky gives his impressions of the aeronautical industry in Europe.

¶ "Real Thrills From a Home-Built Polarizer," by Philip R. Tarr.

¶ Railroad electrification: Its place in transportation, by G. I. Wright.

¶ "Did Man Exist in the Miocene Epoch?" by J. Reid Moir.

¶ "Candid" and theater photography, by Jacob Deschin.

¶ Die casting in industry, by Philip H. Smith.

●

IT is always of intense interest to speculate about the age of man on the face of his little home planet. Gradually this estimated age has been extended backward in prehistoric time. In an article to be published soon, J. Reid Moir shows that, if recent evidence proves valid, man's antiquity will be extended to about 3,000,000 years. The evidence in question consists of flint instruments unearthed in certain deposits in England. These implements are being carefully studied by competent authorities and perhaps it may soon be possible to say definitely when man first made his appearance on this planet. The trail of ancient man is leading us into strange regions but its beginning still remains hidden in the mists of antiquity.

●

INTENSIVE research recently applied to die casting in industry has so changed practice that today there are uses for die castings that were undreamed of five years ago. Stampings and sand castings are, in many cases, being replaced by die castings, and better products are often being made at lower cost. Just what has been achieved in this field, and what discoveries have made these achievements possible, will be told in an article next month by Philip H. Smith.

●

SO popular among our readers was the article on miniature cameras published in our February number that we have scheduled for next month an article on "candid" and theater photography, both of which are mainly restricted to the use of the small cameras. Jacob Deschin, the author of this article, says: "The superiority of the miniature camera for this type of work is obvious; its compactness, ready accessibility, ease of concealment just before and during exposure are advantages so patent that no one would think of debating the subject." There are certain tricks which the successful candid photographer must master, some of them pertaining to the photographer himself and some to his equipment. Mr. Deschin points these out and has also supplied a series of excellent photographs which will be used to illustrate the text.

Editor and Publisher

Books SELECTED BY THE EDITORS

MEN, MIRRORS AND STARS

By G. Edward Pendray

EVERY amateur astronomer, every amateur telescope maker, and everyone who takes any interest in astronomy, should possess a copy of this book. In addition, everybody else should possess it. No similar book has ever been written, yet the content of it has been available to writers for a long time. It contains many facts about people and observatories and the telescopes and other instruments in them—tradition, shop talk, even gossip—that have previously existed only in oral form. Its reader will absorb as much general background about the astronomical world as would require five years by the usual piecemeal process.

The book has three sections. Section I is on the history of the evolution of the telescope. Section II is on telescope principles—elementary, of course, for this is a popular, not a technical, book. Section III is on early and modern American telescopes, famous American telescope makers, including amateurs, and future telescopes. The chapter entitled "Amateur Telescope Makers and How They Have Advanced the Art" should boom the market for hat stretchers among all normally constituted amateurs. The appendices contain much special data on American observatories.

This is a book which can be read, not merely by the scientifically inclined member of the family, but *will* be read and easily followed by the rest, and it will tell them what the great modern boom in astronomical interest is all about. It is an all-around, many-sided book, written in a bright, refreshing style, by the science editor of *The Literary Digest*.—$3.14 postpaid.—*A. G. I.*

JANE'S FIGHTING SHIPS FOR 1934

Dr. Oscar Parkes, Editor

JANE'S ALL THE WORLD'S AIRCRAFT 1934

C. G. Grey, Editor

TO take care of the many constructional details and advancements that have been made in a year of more than usual activity both in naval and aircraft construction, these two standard works have been expanded and much detailed information added. Silhouettes and descriptions of new war ships are included in "Jane's Fighting Ships," together with discussion regarding the possibility of further building in view of the breakdown of plans for a further naval limitation agreement. "Jane's All the World's Aircraft" includes discussions of the newer fighting aircraft as well as of the several huge commercial planes which have been built during the year.—"Jane's Fighting Ships" is $23.00 plus duty; "Jane's All the World's Aircraft" is $23.00 plus duty.—*F. D. M.*

BRASSEY'S NAVAL & SHIPPING ANNUAL—1935

Edited by Commander Charles N. Robinson, R.N., and H. M. Ross

IT is a pleasure each year to study this valuable collection of material—now in its 46th year of publication—for in *no* other compilation of naval and shipping notes, data, and discussions can such a wealth of information be found. Particularly interesting to Americans are the authoritative articles on "Naval Forces of the British Empire," "Foreign Navies," "Relative Naval Strength," "Disarmament and Naval Policy," and "Japan and her Navy." "The Merchant Shipping Section," of eight chapters, and the "Air Section," of three chapters, give much valuable data as do also the 160-odd pages of references. Profiles and plans are especially illuminating.—$13.00 postpaid.—*F. D. M.*

TESTING PRECIOUS METALS

By C. M. Hoke

IS it 18K or 14K? Is it gold at all? Is it silver, platinum, or palladium? A revised edition of a valuable book for all who buy, sell, work, or admire the precious metals. It tells how to figure the value of old gold, dentures, solutions, and how to handle them to advantage.—$1.00 postpaid.—*F. D. M.*

IN THE SEALED CAVE

By Louis Herrman

A MODERN addition to the well-known Gulliver's Travels. The present author has taken up the work of Dean Swift and has written, upon a modern basis, a further adventure of Capt. Lemuel Gulliver. The basis upon which this story is built is an admirable approach to so-called scientific fiction, although the present reviewer cannot say as much for the development of the theme. It does, however, make a readable story and will teach the reader a certain amount of sugar-coated anthropology. In the story Gulliver discovers, in 1721, a group of Mousterian people who have lived for thousands of years in a cave on a small island in the Aegean Sea. His adventures among these people and the reason why he was forced to leave them make a story not unworthy of comparison with some of Gulliver's earlier travels.—$2.15 postpaid.—*A. P. P.*

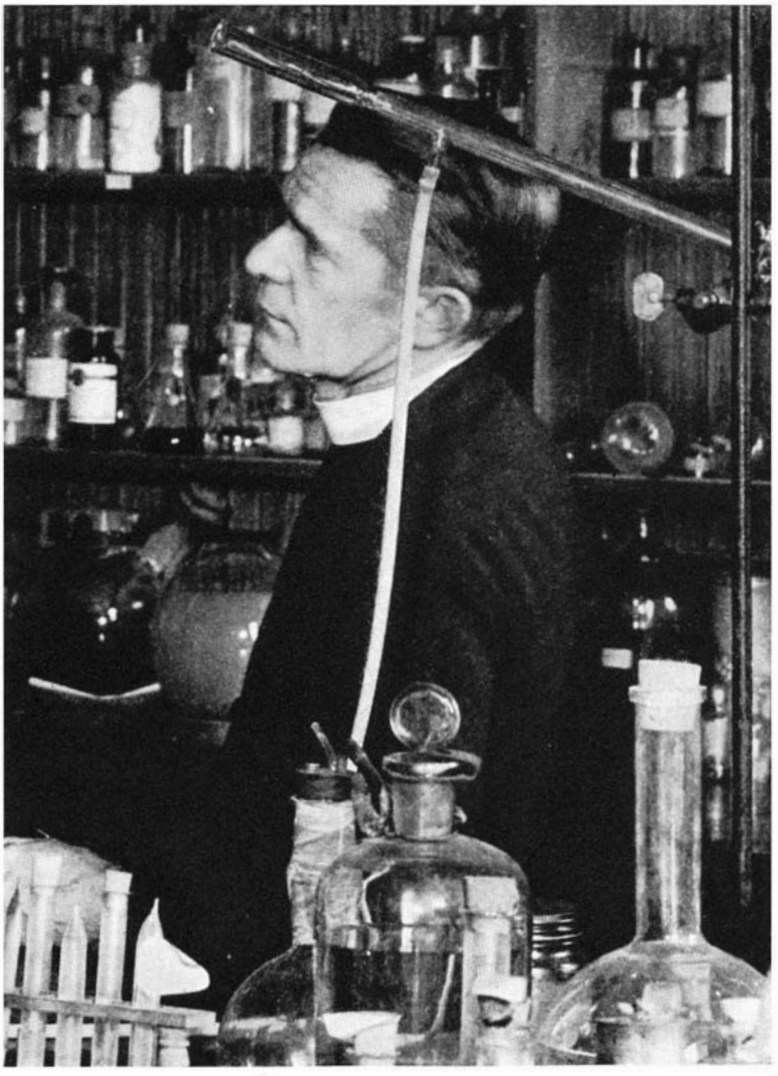
YOUR CARRIAGE, MADAM

By Janet Lane

WHILE this little book of 130 pages is dedicated to the purpose of developing feminine grace and charm through its instruction in good posture, to our minds a more important result

(*Please turn to page* 223)

Personalities in Science



REV. FATHER JULIUS A. NIEUWLAND

THE much-prized gold medal of the American Institute, one of the oldest awards in the United States, has been presented to the Rev. Father Julius A. Nieuwland of Notre Dame University, for the discovery of a process of making synthetic rubber. The American Institute of the City of New York was organized 107 years ago and a list of the recipients of its medal reads like a blue book of progress in the arts, sciences, and industry.

Dr. Nieuwland, in addition to being a professor of organic chemistry, is also a botanist, and a priest of the Roman Catholic Church. He started in 1904 to solve the chemical riddles involved in making artificial rubber, and today it is being introduced as a factory-made product.

Many efforts have been made since 1860 to produce an artificial rubber. In the earliest experiments materials were used that were obtained from the chemical breaking down of the natural rubber. Later, intermediate products such as isoprene were used, and also similar chemical compounds. When alterations in their molecular arrangements were made they changed into resilient, elastic substances, but these products were inferior to natural rubber. The accomplishments had scientific value, but they had little commercial value, as the starting products, isoprene and butadiene, were much more expensive than natural rubber.

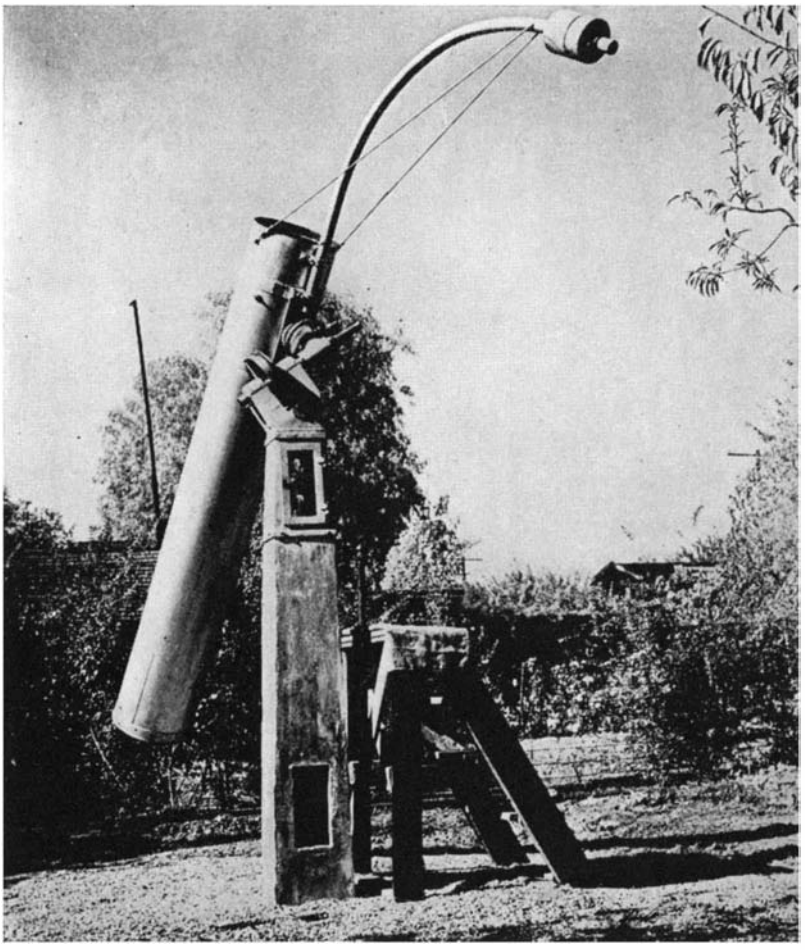
The Rev. Father Nieuwland started his process with a much simpler and cheaper substance—acetylene. This was changed by water to acetaldehyde and oxidized to acetic acid, converted to acetone and reduced to pinacol. The line of research that led to eventual success started when the acetylene was passed through metal chlorides and a gas was produced that could not be isolated. In later experiments with ammonium chloride, both the gas and an oil were obtained. The oil proved to be divinyl acetylene and to have chemical properties that were superior to any previously used compounds for rubber making. Addition of sulfur dichloride produced a rubber, but it was too plastic for practical use.

The E. I. duPont de Nemours Company became interested in the work and arrangements were made under which they took over the commercial development. Their laboratories produced the gas which Father Nieuwland had been unable to isolate in 1906, and found it was monovinyl acetylene which could be changed easily to chlorobutadiene. This differed but slightly from isoprene, the parent substance of natural rubber. When this substance was allowed to stand a few days it changed to a stiff jelly, which, on heating, changed to rubber. This rubber was found to be superior in many ways to the natural product.

"While artificial rubber cannot be made as cheaply, at present, as natural rubber can be produced, the synthetic rubber products of the Duprene type serve as a valuable check to control the price," says *Science Service*. "During wartime and by means of special cartels, rubber has often sold as high as $1.25 a pound. Now it is said that the cartels dare not raise the price of natural rubber above 20 cents a pound. Based on America's annual consumption of rubber, it is estimated that 375 million dollars a year is saved due to the difference in the present price of rubber and what it might be if there was no artificial competitor at hand to serve as a check against price-rising."

The Rev. Father Nieuwland was born in Hansbeke, Belgium, in 1878, but grew up in the United States. He graduated from Notre Dame University and continued his studies at the Catholic University, where he received his Ph.D. in 1904. In the same year he was ordained a priest and became a member of the Notre Dame faculty as Professor of Organic Chemistry.

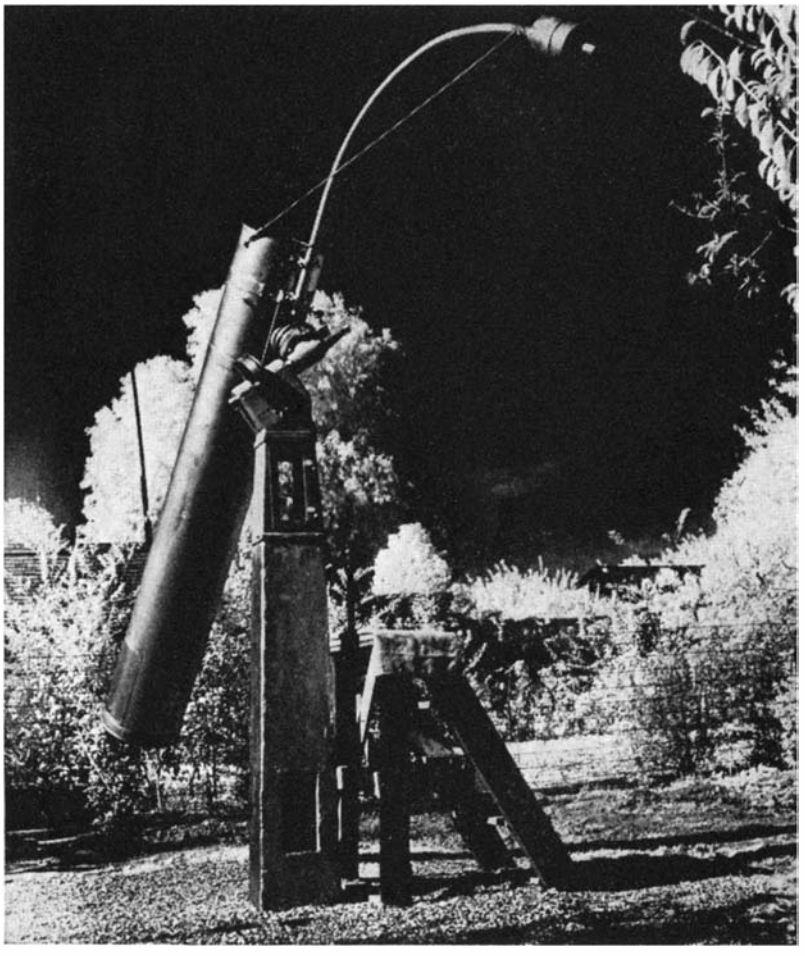
The photograph shown above was taken in Father Nieuwland's laboratory especially for SCIENTIFIC AMERICAN.



Photography on Two Selected Wavelengths

Why Photographs Taken on Long Wavelengths Do Not Look Like Those Which Are Taken With the Waves With Which the Eye is Familiar: Because of Scattering and Differing Reflectances

THE two photographs on this page show the same subject, a 12-inch reflecting telescope made, as were the photographs, by James S. Fasseno, of Pasadena, California. The upper picture was made with rays having an average wavelength of about 1/50,000 inch, while the lower one was "received" by the camera on wavelengths about 50 percent longer—waves which the eye does not perceive because they are in the infra-red. In the infra-red photograph—the lower one—the sky photographs light on the negative hence dark on the print, because very few of the longer waves with which it was taken are scattered by the molecules of the air, and therefore they do not come from the sky, but come to the object from the sun alone. But these same molecules do scatter the shorter waves which are "visible" to the ordinary plate and to the eye, particularly those in the blue, and this is why the sky is blue and why the negative of the ordinary plate is darkened. On the other hand, all foliage contains a substance called chlorophyll, which reflects not only the green rays, which we can see, but very strongly reflects the longer infra-red rays. These are the reasons why infra-red photographs look like snow scenes at night.



Underwood and Underwood

A striking example of advertising photography described in the text. Three negatives were made for the car, head, and hand, and combined in a fourth when the "smoke" was added

PHOTOGRAPHY IN THE 'ADS'

Behind the Scenes . . . Artists of the Camera . . . Temperamental Food Models . . . Photographic Murals . . . Photomontage . . . Color Photography

By JACOB DESCHIN

BORROWING a trick or two from the movies and adding a few of their own, modern commercial photographers are daily turning out pictorial miracles undreamed of only a few years ago. Advertising illustrations which often cause a gasp of astonishment bring these magicians of the sensitized celluloid and glass as much as 500 to 1000 dollars for a single picture. High prices? Yes, on the face of it. But, as Preston Duncan, Hollywood photographer, says: "Almost every person forgets the hundred-and-one real ramifications of the photographer's problem. An artist with pen or brush can usually create at his own easel, but the photographer, of whom realism is demanded, must seek and find or build or trick—all of which requires much preparation, time, skill, equipment, organization."

A successful commercial photographer must know a good deal more than how to arrange his subject properly, push the button, and print a picture. He must not only be master of the technical features of his profession, but a jack-of-all-trades besides, in addition to being imaginative and resourceful, inventive and mechanically versatile. He must not only be able to reproduce a subject to the very best advantage but, according to Ansel Adams, San Francisco photographer, build up the product so that "the softness of velvet appears even richer and deeper than it actually is, steel becomes even harder, and a ten-floor building acquires the grandeur of 20 stories." He must make the subject of his picture assume realistic, strongly appealing, four-dimensional proportions, and be ready to turn an abstract

Underwood and Underwood

Photo made at a trick angle, only a few feet from the floor, gives the impression that the model is about to leap from a great height

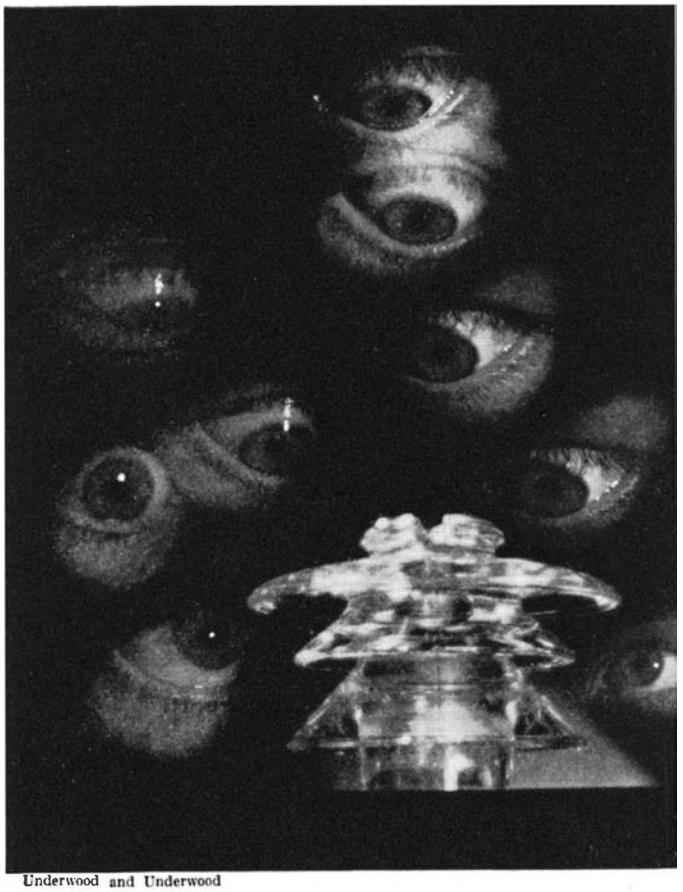
idea into a pictorial reality. If he cannot do these things he might as well step out; there are too many in the field who can.

Scientific research has in recent years brought to light many improvements in methods and materials, so that today for almost every idea that may occur to the commercial photographer there is available the means to realize it photographically. Lenses fast enough to catch the most fleeting expression on a model's face or take a fast snapshot of an indoor theatrical performance, films of a wide range of color sensitivity and speed, which, combined with an astonishing array of color filters and a variety of lighting apparatus, make it possible for the photographer to create as never before. Meanwhile, technicians are constantly striving to provide photographers with materials that must ultimately give them absolute mastery of all the problems of the craft.

VICTOR KEPPLER, of New York City, one of the "stars" of the profession, gives some idea of the commercial photographer's difficulties when he says that he often has to take as many as 600 "shots" in order to get the one perfect picture he wants. A simple cup of steaming hot coffee required the exposure of several hundred films to get it right. To photograph a half dozen strawberries he once had to pick through ten boxes full to find six good "models."

Mr. Keppler says that "food is much more temperamental (before a camera) than any live model," but with 200 degrees, Fahrenheit, caused by the light streaming down on a group of sausages, or on a dish of ice cream, is it any wonder that the one shrivels up and the other melts? However, the resourceful commercial photographer never says no to an assignment, no matter how tough it may seem. So he paints the sausages with oil just before the camera is clicked; he keeps the ice cream in shape by alternating layers of "dry ice" with layers of ice cream in a sherbet glass and wraps it in a towel for an hour, after which the ice cream is ready to face the intense heat for at least the few seconds necessary for the exposure.

Silver and other highly lustrous surfaces are the bane of the photographer's existence because they catch the gleam of the lights and reflect bright blotches. The photographer gets around this by dulling the surfaces and thus reducing reflectivity. Sometimes, however, he must adopt a much more elaborate procedure. Mr. Keppler once hired a special room to do a particularly important silver assignment. The floor was carpeted with black velvet to afford the necessary contrast to the silver pieces arranged upon it. The walls were hung with white Chinese silk to diffuse the light coming through. The camera was pointed from the ceiling, a small hole being provided for the lens.



Underwood and Underwood

An example of photomontage done on a single negative. The eyes are those of one person, who moved about to different positions under the direction of the photographer. It took ten separate exposures to complete this one negative

Similarly, when photographers were tearing their hair trying to devise means for photographing ice cubes in a glass, without producing a flat-toned picture, someone thought up the idea of placing a layer of hard coal back of the glass. This expedient served to outline the striations in the ice cubes and produced a picture that looked like the real thing.

A favorite method with the commercial photographers is the process known as "photomontage," by which a number of images are included in the same picture. As introduced from Europe, where it originated, the procedure was to photograph different units separately, then paste them up in the desired arrangement and retouch in order to blend all into one. This method is known as the process of "stripping" prints together. Advanced commercial photographers have abandoned this for what is considered the more satisfactory methods of either making all the exposures on a single negative or of making several negatives and printing them all together.

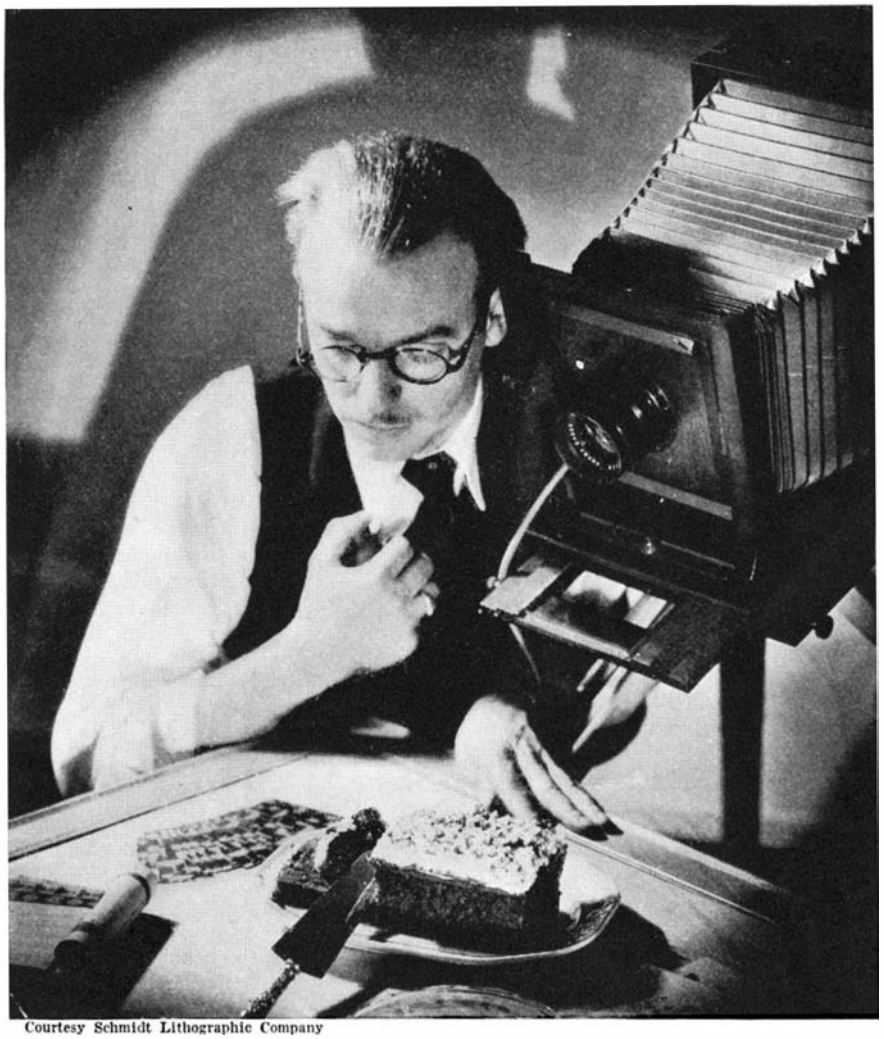
"Compositing," or the taking of separate photographs and then putting them together in such a way as to give the impression of a single picture, is another much-used expedient of the commercial photographer. It was this that saved the day for one photographer when he was asked to do what seemed on the surface an impossible task. His assignment was to get a view of the New York skyline looking through an arched window in the Lincoln Building at Forty-second Street and Madison Avenue, the window to serve as a "frame" for the view. As the arched windows were four stories high, it was out of the question to try to get a picture of the window from the inside, so the photographer went across the street to the roof of a neighboring building, where the height was about that of the arched windows in the Lincoln Building. Using a long-focus lens, he got a large image of one of the arched windows. To get his view of the skyline, he went to the roof of the Lincoln Building on a sunny day when the sun was shining toward the lens and, pointing his camera toward the Battery and the Statue of Liberty, got a picture which served as a "background" for the sunset which he had to go to the bank of the Delaware River in New Jersey to photograph. The first picture, that of the exterior of the arched window, was "doctored" to leave only the window frame, and the "composite" was made by printing the sunset over the hazy New York skyline.

Lon Chaney's make-up tricks served John Paul Pennebaker one day when he had to make a photograph that would demonstrate the idea that smoke holds back the running efficiency of an automobile. He sought and found a model with dramatic ability and fiend-like features, and another model with claw-like hands. He made separate photographs of the head and the hands of the two men. He then photographed a car, posing the models according to specifications and in suitably smaller proportions. Several pieces of glass were placed in planes before the camera, and upon them were arranged the pictures of the

head, hands and the car. The illusion of thick, rolling smoke was effected by placing absorbent cotton in such a manner that it would be out of focus and lighting it in a special way.

"Compositing" has been used in the case of pictures requiring the inclusion of persons who happen to be unavailable at the time. In such a case, a sketch is made up showing the different individuals in various poses about a central object, such as one of the company's products, and a copy sent to each of the individuals, who has his photograph made where he is and in the pose indicated. The pictures thus sent in are enlarged or reduced as required and in other ways retouched. A picture is thus produced as if all participants had actually been present at a single sitting.

Photomurals are being made in increasingly larger sizes. One of the largest on record is the one made last year by Kaufmann and Fabry Company, of Chicago, for the Ford Building at A Century of Progress. It is 600 feet long and 20 feet high, telling in 17 scenes part of the story of the Ford Motor Company. This photomural required nearly seven eighths of a mile of photographic paper 40 inches wide and consisted of 97 panels which took 40 men nearly a month to complete. The original photographs were taken by George Ebling, Mr. Ford's personal photographer. The work of enlarging, mounting, and the various construction details involved were completed by Kaufmann and Fabry.



Courtesy Schmidt Lithographic Company

Commercial photographers often find that food can be more "temperamental" than many live models. When subjected to the intense heat generated by brilliant studio lights, undesirable changes often take place, even in the comparatively few seconds required to obtain the correct exposure of the negative

SO tremendous was the job that it was necessary to build a special apparatus and darkroom to handle the enlarging and printing of the mural, most of the work being done after midnight when steadier electrical current insured greater uniformity of results. The special enlarging machine built for the purpose used 7000 watts of power for lighting.

Framework backing for the panels required 14 tons of steel. Upon this steel work 12,000 square feet of Masonite was attached, requiring 11,000 screws and nearly 25 gallons of a special cement. Then followed the stretching on the framework of 12,000 square feet of special canvas, after which the photographs were mounted on the canvas, 200 gallons of paste being used in the mounting. Each panel, including framework, weighs more than 400 pounds.

An important phase of commercial photography today is color work, its principal contemporary exponent being Anton Bruehl, of New York City. Owing to the extremely difficult technical problems involved, Mr. Bruehl works in collaboration with Fernand Bourges, photographic technician, who has developed a special camera known as a "one-shot" camera, so designated because three negatives, each especially sensitive to one of the three primary colors, red, blue, and yellow, are exposed in the same instant.

"The rays of light reflected from the subject," Mr. Bruehl said in describing the process, "are split up three ways (red, blue, and yellow), going through three different filters to three separate plates, making three color separation negatives from the original subject."

The three separate 8 by 10 inch plates are then bound together and used simultaneously.

THE necessity for getting the extremely sharp detail required for advertising color pictures, combined with the fast exposure needed to get natural expression on the face of the model and the additional difficulty presented by the increased exposure needed because filters are used, obliges the photographer to use an enormous amount of light. This is furnished by 50 to 300 Photoflash bulbs screwed in groups into sockets in large reflectors. These clusters of lights are covered with Cellophane as a precaution against accidents due to bulbs bursting because of the great concentration of heat caused by the proximity of so many powerful lights. No other light is used. Bulbs and shutter operate simultaneously, the approximate speed being about 1/50th of a second. Such "super snapshots" sometimes cost as much as 50 dollars each, which means that every shot must be perfect.

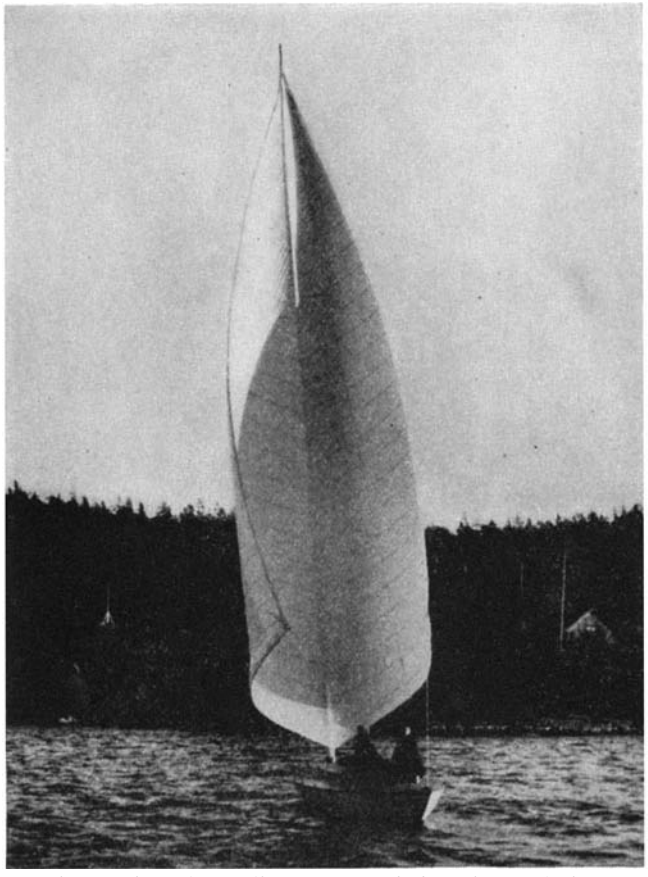
A total of about 600 amperes of electric current, believed to be a record for a photographic studio devoted to "stills" (as distinguished from movies) is available in the Bruehl-Bourges studio for the great array of various types of floodlights, spotlights, and miscellaneous lighting equipment they have at their command.

●

Advanced amateur photographers will find, "between the lines" of the preceding article, much information that will be useful to them in their chosen hobby. Other specific articles coming in future issues will deal with candid photography, the correct use of exposure meters, theater photography with the miniature camera, and other kindred subjects.—The Editor.

A High-Speed Sailboat

No Foresail Or Boom . . . Only One Mast Stay . . . Double Sail . . . Mast Rotates



The new boomless sailboat running before the wind, showing the double sail opened to give a parachute effect

PAGE the Ancient Mariner! Yachtsmen of Stockholm, Sweden, are discussing a new type sailboat without foresail, boom, or stays; a craft so fast that it has beaten larger rivals in recent tests; yet a sailboat so simple to handle that yachting experts expect that the rules of small boat racing may be changed to take advantage of certain of its novel principles.

Invented by Dr. Fredrik Ljungström of the Academy of Engineering Sciences, the new type boat has a revolving mast on which the mainsail is wound up like a window shade on its roller. To reduce sail area, as is usually done by reefing, the navigator simply turns a wheel at his elbow in the cockpit and rotates the mast by a system of ropes. Ball-bearing rollers support the foot of the mast. Regulations concerning revolving masts will have to be changed before this type of boat can be used in sanctioned racing.

The mainsail is triangular but double. Running before the wind the double sail opens out into what looks like a great parachute jib sail. For tacking into the wind one sail lies smoothly on top of the other. Aerodynamic streamlining is achieved in the sail by having its forward edge fixed in a slot on the bow side of the 46-foot pine mast. Thus there is no gap between the mast and sail as is found in ordinary sailing craft, and the over-all efficiency of the sail as a means of utilizing the power of the wind to propel the boat is greatly increased.

The only stay on the boat is a wire running from the tip of the mast to the stern of the boat. Such a lack of stays may arouse yachtsmen's suspicions but Dr. Ljungström has sailed his boat in heavy weather with excellent results.

The lack of stays is one reason for the speed of the boat. Stays—the fixed rigging which keeps the mast in position—have more wind resistance than is sometimes commonly believed. Although the surface area of the wires may be small they vibrate in the wind and hence greatly increase their resistance to a breeze.

For small-craft yachtsmen the new Swedish boat has the following advantages: 1. Less and cheaper rigging. 2. Sail cost reduced. 3. Fewer torn sails because of faster reefing. 4. Less danger of accidents to persons and sails caused by a swinging boom. There is no boom to swing.

Sail area of the new boat is 32 square meters, or about 10,000 square feet, when the two sails lie atop one another as in tacking. The sail area is 20,000 square feet in running before the wind.

Science Service's Swedish correspondent reports: "The boat is frightfully fast and has easily beaten larger boats against which it has sailed. Most amazing is the way the new boat beats up against the wind, quicker and nearer the wind than other boats."

Photographs by *Science Service*

A view from the side of the new boat. Note that there is no open space between the sail and the rotating mast

OUR POINT OF VIEW

Wanted—The Wisest Man

IF you had several millions of dollars to bestow, and had your choice of two clean-cut alternatives—to donate all of the money for medical research, or else to give it for the construction of the world's largest telescope—which would you choose, and why?

At a small gathering of outstanding medical men and a few laymen, a noted pathologist recently lamented the difficulty of obtaining funds for research on a serious disease, and made evident his disgust that, while funds were still needed for medical research, the astronomers had been able to secure millions to build a bigger telescope "just to look at the angels," as he put it. "Man's problems," he urged, "are *down here* on the earth, not up there. *This* is where we live."

This man's one-sidedness was perhaps quite natural, for he was wrapped up in a splendid program of research for humanitarian purposes, and the fact that he evidently regarded the expensive construction of a great telescope as frivolous is perhaps understandable in the circumstances. Perhaps the majority of persons, at least before they had given the matter more than a second's thought, would vote at once to donate the millions for medical research; it seems to be the more important.

But, on further thought, which things are the most important in life? Perhaps a better case can at least be made out for the telescope than would at first seem possible; in fact, the telescope might even win the argument in the end. Man once thought his whole world lay within his actual horizon. Later his nation was the whole world, while overhead were the stars—little lamps in an arched firmament just out of reach. The world existed, of course, for man's special benefit. Then came the invention of the astronomical telescope, by Galileo, and this extended man's mentally cramped little world to an undreamed of size. Subsequently the development of this remarkable instrument has entirely changed man's outlook and point of view on his world and on his own existence. He has partly learned his place in the universe, and is even hoping to learn about his meaning in it, and perhaps its own meaning. A greater telescope is a vital part of that great gradual process of man's emergence from his own ignorance, and those who regard this as the biggest thing of all would vote telescope.

But the real argument is one that probably cannot be decided, because neither side would accept the other's premises. It is essentially an argument in philosophy. It would be a lovely argument, a long one, and an instructive one. Start it somewhere and you will be more than likely to find out!

Yearly Toll

CARELESSNESS seems to be an ingrown American trait, or rather, a suppurative sore which no amount of doctoring seems to be able to retard. That imaginary man from Mars, visiting this planet and noting first the record of a long and excellent campaign that has been waged in the interests of safety, would be shocked beyond power of speech to learn that our 1934 national accident fatality record stood 8.7 percent higher than that for 1933. Accident deaths in 1934 were 99,000, only 300 less than the all-time high of 1930! Carelessness thus mocks civilization, makes a travesty of its ideals of progress.

Motor vehicles caused the deaths of 35,500 people, 4137 more than in the preceding year. A close second come deaths by accident in the home, totaling 33,000, which was 3000 more than in 1933. Occupational fatalities jumped 1000 to 15,000; while unclassified public accidents equalled the previous year's total of 17,500.

Part of the increase in fatal accidents in the occupational classification must have been due to increase in employment and the fact that workers, long unemployed, re-acquire their safety habits slowly. A large proportion of home fatalities fall under "excessive heat." But the increase in motor vehicle deaths is proportionately far ahead of the greater use of cars due to improved economic conditions. For 1934, motor vehicle registrations increased 4 percent over 1933, gasoline consumption increased 7 percent, while motor vehicle fatalities increased 13 percent. Drink accounted for part of this 13 percent increase, although the figures are incomplete; there are always too many unreported cases.

No doubt a good proportion of these accidental deaths—for example, those caused by weather—might be classed as unavoidable, but carelessness, recklessness, negligence caused most of the others. What makes these tragedies the more ghastly is the fact that innocent and careful people often are the victims of some fool who comes through unscathed. Were the person responsible for an accident the only one to suffer, the public might say a benediction at each such passing of a misfit through his own carelessness; for he would thus leave a world safer for others.

Bigger Ships

IN May, the world's largest liner, *Normandie*, will make her maiden voyage from France to the United States. Sometime later—the time has not been announced—the world's largest liner, *Queen Mary*, will make her maiden voyage from England to the United States. To American ears, how familiarly do the phrases ring. In succession, for years, we've heard: "from England," "from Germany," "from Italy," "from France," "from England"; and it's always "finest" or "largest," "fastest," "most luxurious," or "non-rolling." The persistent regularity with which they come to us is a tribute to the excellence of their owners' strategy for capturing American business—partly with loans from their various governments. More pointedly shameful to us, however: These ships are a reminder that we won't build ships to take care of our own ocean traffic and, worse, won't support the ships we have.

For years there has been much talk of building up our merchant marine. Yet we still are far down on the list. In a recent representative month Great Britain and Ireland headed the list with about 600,000 tons under construction; Germany, France, and Japan each was building more than 100,000 tons; and the United States had only 20,000 under construction. Needing ships as badly as we do, this is disgraceful. Over and above that fact, the industries which supply materials for shipbuilding, the many workmen depending upon shipyards for a livelihood, and thousands of seamen, all have suffered greatly by Americans' thoughtless support of foreign ships.

Under the circumstances, it should cause no surprise that, in certain quarters, there have been heard bitter criticisms of "nations that despise and belittle us, yet use our money, which they owe as war debts, to build monster ships to come after more of our money." It is too bad that such statements should be made; nevertheless it is up to us to support our own ships and, in time, build more so that we may keep our money at home.

THERE'S LIFE IN THE OLD

By WILLIAM C. DICKERMAN
President, the American Locomotive Company

THE accompanying article by Mr. Dickerman, besides stirring in us memory of that romance of the rails we of an older generation felt as boys—we were set upon achieving that most enviable position of engineer at the throttle and be superior to ordinary mortals!—also is a splendid statement of facts and arguments for the steam locomotive. It is the first of three concerning railroad motive power. The other two—one which states the case for Diesels, by George W. Codrington, President of Winton Engine Corporation; and the other, on railroad electrification by G. I. Wright, Chief Electrical Engineer of the Reading Company—will be presented in the next two issues. While these three articles will be presented in sequence, the authors prepared their manuscripts independently. Therefore the articles give straightforward facts; they are not parts of a debate.—*The Editor.*

IT so happens that I am the president of a corporation which has been building railroad power units for nearly 100 years. We have long been equipped, not only on the manufacturing but also on the research and designing side, to supply all of the power needs of our customers, whether they be for steam, electric, or Diesel-electric units. Therefore, since I can eliminate the temptation of prejudice from a business standpoint, possibly I can be objective in discussing railroad power problems.

Here, where I am requested to state the case for steam in few words, in order to get to the heart of the matter at once, I would begin with three primary observations:

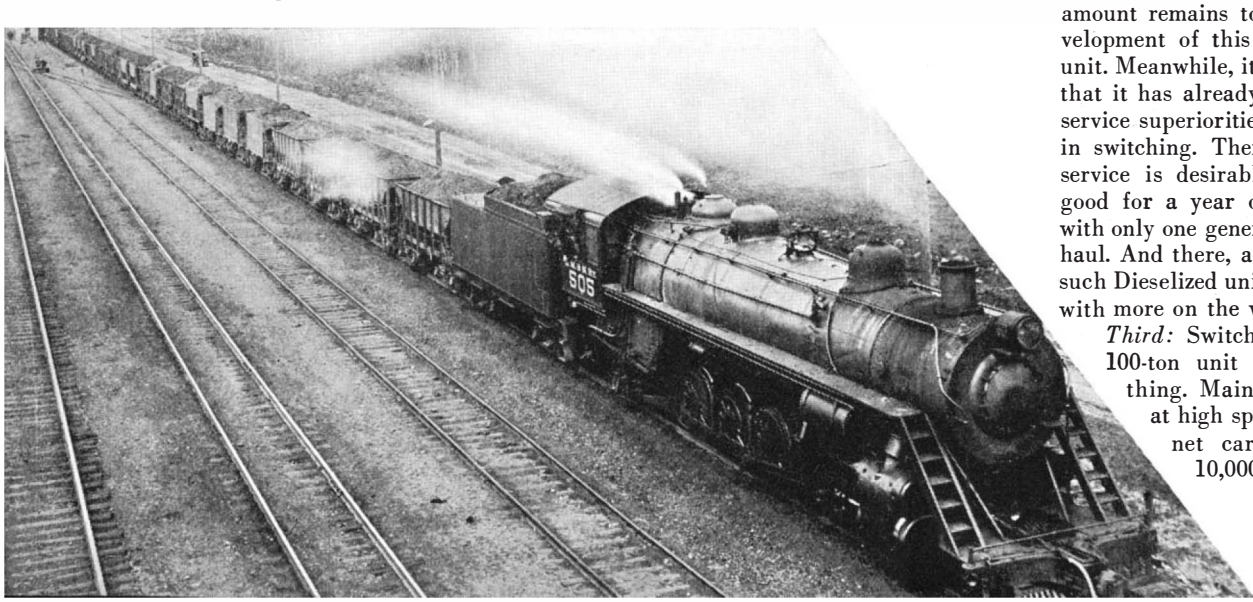
First: Without the least question, each of these three major power units—steam, electric and Diesel- or oil-electric—has, and will continue to have, its place in our swiftly changing railroad transportation picture as a whole. Thus it goes without saying, yet deserves saying again, that the electric locomotive has some distinctive advantages, in congested areas, for example, where the largest possible track capacity is expedient and where, in tunnel operation, it is legally or otherwise required. It also has some disadvantages, notably its high initial cost, and its dependence, in peace and war, on large central power stations and transmission lines and, accordingly, its inability to go it alone, a characteristic which in pioneer days and in countless emergencies has helped to make the steam unit the most useful of all prime movers in history.

Nevertheless, it will be remembered that shortly after the turn of the century, when there had been more than one disastrous tunnel accident and electrification represented the first major contribution of scientific research to railroading, it was assumed in some quarters that all of our roads would soon be electrified; although now only 2400 of our quarter-million route miles are electrified.

IT was indeed stated—September 20, 1907—in a meeting of the New York Railroad Club, by a manufacturer of electric units: "We do not need to say much in defense of the electric locomotive. It does not need any defense. My only fear is that we are going to be compelled to build electric locomotives faster than we can get facilities for doing so." And then came the prediction that the 47,000 steam units in use would soon be replaced by electrics and that many good steam units would go to the scrap-heap! Since then, nearly 60,000 steam units have been made in the United States for use in the United States!

Second: The Diesel- or oil-electric unit represents today another major approach by organized scientific research to railroad power problems, leaving the steam unit, in which more progress has been made in 20 years than in all the years before, to be heard from—a thought that leads me to say at once that the oil-electric might have had a much better chance to replace the steam unit 20 or so years ago.

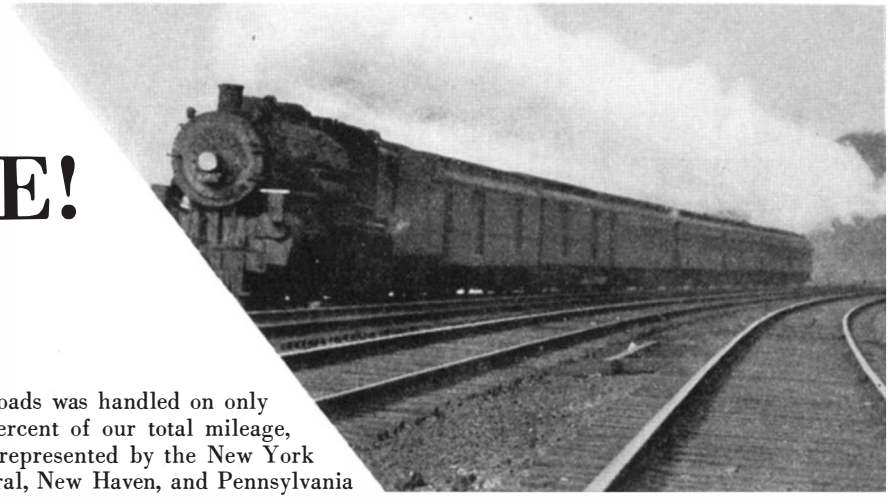
To this new unit we, ourselves, and many other Diesel and electrical manufacturers, have devoted a decade, but only a decade, to adapt it to the uses and the abuses, and the limitations—in size and so on—inherent in railroad requirements. And, as railroad men all know, times without number inventor and laboratory findings of great promise have had to be discarded in the end, because the tests of day-by-day railroad operation in all kinds of weather, under all kinds of circumstances, with all kinds of operators, are so much more rigorous and unpredictable than those in any laboratory.



TRUE, a vast deal of progress has been made in short order, but a vast amount remains to be made in the development of this new railroad Diesel unit. Meanwhile, it is heartening to note that it has already demonstrated many service superiorities over the steam unit in switching. There, where continuous service is desirable, we provide units good for a year of continuous service with only one general shopping, or overhaul. And there, at this date, 150 or so such Dieselized units are already in use, with more on the way.

Third: Switching service, where a 100-ton unit is adequate, is one thing. Main-line freight hauling at high speed and perhaps with net cargoes of more than 10,000 tons, requiring pow-

IRON HORSE!



er units of 3500 to 4000 horsepower, is something else again. Although 60 percent of the steam locomotives of the United States are 20 years old or older, and, therefore, do not reflect the enormous progress made by science during the last 20 years, there has been great improvement in railroad freight handling throughout the country since the roads, badly disorganized and run down, were dumped back on their owners after the World War.

THE record is impressive and it gives great credit to steam, all the more since most steam locomotives are old and, as compared with new ones, are inefficient—so inefficient, in fact, that when one alert road recently replaced a fleet of steam units only 10 years old with new ones, it reported a saving on its investment at the end of the first year of 38 percent!

Further, since we must accept things as they are, our roads now have more than sufficient freight units, inefficient though most of them are, to get along somehow, in a time when economy is the impelling watchword. More to the point: Though some are promised, there is as yet no multi-motored oil-electric unit of required horsepower for main-line freight hauling in existence, let alone in service. Therefore it remains wholly debatable whether such a unit would stand up and whether it would be as efficient, in terms of fuel economy and all-round investment worth, as the modern steam unit, which costs initially not half as much and enjoys the unique distinction of being the simplest, most dependable, and long-lived of all overland power units. Moreover, under these circumstances, it would not seem to be either logical or reasonable to expect our roads, with their maintenance as well as their records and freight service predicated on steam, to provide special oil-electric facilities and experts to supplement facilities and mechanics required for steam units.

For all of these understandable reasons, it is to my notion simply inconceivable, at least until the unexpected happens, that the oil-electric can as yet find place generally in main-line railroad freight hauling. And, to go no further, this conclusion militates against its general acceptance in main-line passenger hauling, especially when freight hauling is the bread-basket of the roads. I find that in 1932, 41 percent of the total passenger revenue of our Class 1 railroads was handled on only 10 percent of our total mileage, that represented by the New York Central, New Haven, and Pennsylvania systems.

With these observations in mind, it would seem clear that the issue, Diesel-electric *vs.* steam, turns on passenger transportation, speed, and the comfort—a necessary accompaniment of speed—which are involved.

At once I wish here to say that I personally feel a profound sense of gratitude to those roads and designers and manufacturing concerns serving them who approached the railroads' difficult passenger problem with a fresh viewpoint, made full use of all available contributions of science, produced the Union Pacific's *M-10001* and the Burlington's *Zephyr*, stimulated the production of other trains likewise new in kind, sensationally focused public attention on the railroads, and made them aware of public emphasis on speed, comfort, and all else that goes to increase the desirability of traveling by rail. These roads and these other pioneers, in my judgment, ought to be awarded Congressional Medals of Honor for the service they have rendered in energizing a new era in railroad travel! Nevertheless, here again I judge three points are in order:

FIRST: The records for speed made by the *M-10001* and the *Zephyr* must be viewed, and by railroad executives everywhere are, as special test performances made under special test conditions not ordinarily practicable in day-by-day railroad operation. It is not deemed economic to make long non-stop runs with small passenger loads or for any single train to side-track other through passenger and freight trains. Further, it is to be noted that of our 241,424 miles of Class 1 main track, only 36,677 is second track, 3162 third, and 2208 fourth.

Second: It goes without saying, on the side of passenger comfort, that such revolutionary, finely appointed cars as those of the *M-10001* and the *Zephyr* can be, and by the New Haven and numerous other roads are rapidly being provided for steam units as well as for Diesel-electric. In other words, particularly because air-conditioning removes the only remaining passenger objections to steam, it may be concluded that passengers in general will not know, and will care less in the future, which unit hauls them, if only they can travel as fast and as comfortably either way.

Third: Since the 90's and thereabouts, when such famous light steam locomotives as old *No. 999* exceeded 100 miles an hour for short distances, no attempt has been made until recently to approach, much less to exhaust, the speed possibilities of steam. In July, 1934, without special preparation, with a regular locomotive hauling a regular train whose car weight alone exceeded by fully three times the total weight of the *M-10001* with full load, a steam train on the Milwaukee Railroad readily broke all world railroad records at that date by covering 69.9 miles at the rate of 91.1 miles an hour. Recently the New Haven has demonstrated that, when given the chance, its steam units can safely and comfortably haul passengers at sustained speeds above 85 miles an hour.

MEANWHILE, and for the first time in American railroad history, the Milwaukee Railroad has ordered two relatively light, scientifically streamlined, new steam locomotives designed to haul relatively light but full-size trains at a cruising speed (a speed efficient in relation to fuel, maintenance, and long life) of 100 miles an hour. (As every one knows, the *Twentieth Century*, one of the world's fastest steam trains, is never permitted to exceed 70 miles an hour.) These trains will be operated between Chicago and St. Paul, a distance of 411 miles, each way, each day, including five stops. With 300 pounds of steam pressure, with 84-inch drive-wheels, of a type affectionately known to railroad men as a 4-4-2, but inwardly as well as outwardly of design totally different from the conventional steam unit, these locomotives, which we are designing and building in co-operation with the Milwaukee, will be the first steam locomotives ever built for speed in the light of present scien-

(*Please turn to page* 222)

THE EARTH'S WABBLING AXIS

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

ONE of the oldest problems of observation is to find the latitude of a certain place, and dozens of ways of solving it have been devised. In theory, it is very simple. We have only to take any one of the hundreds of bodies whose position in the heavens has been accurately calculated—sun, moon, planets, stars—observe it as it is crossing the meridian, and measure how far it appears to be from the zenith or from the horizon below it to the north or south, and then to do a simple sum in addition or subtraction. The navigator can "shoot" the sun with his sextant and do the whole job in three minutes, including all the necessary correction, and come out within a mile or less of the exact value—which is all one needs in the open sea or to pick up a lightship.

On land, with a telescope, some additional refinements have to be considered, but the theory is still simple. The most troublesome complication arises from the refraction of light as it passes downward through the atmosphere. A ray descending from the very zenith would be unaffected, but all those which come in at a slant are deflected—bent downward—so that the stars appear to be higher above the horizon than they really are. The amount of this "astronomical refraction" varies with the apparent altitude and also, unfortunately for us, with the state of the air, increasing as the pressure goes up and the temperature goes down. Every observatory where measures of this kind are attempted has therefore a barometer and a precise thermometer in the observing room. From the readings of these, and by the use of tables derived from thousands of observations in years gone by, it is a matter of a few minutes to calculate the refraction corrections with an accuracy sufficient for almost any purpose—though, as we shall soon see, not quite for all.

Until within the last 50 years, everyone supposed that the latitude of an observatory found from observations thus carefully corrected should be always the same. To be sure, the direction of gravity itself is affected by the attraction of nearby mountains, which slightly deflects that of the whole mass of the earth. But at a given station this effect is constant and can be determined only by connecting many such stations by a precise geodetic survey. The resulting information about the attraction of the mountains, and of their roots buried scores of miles below the surface, is of great interest to the geologist. But the astronomer, if he is busy observing the heavens, cares mainly whether his own zenith "stays put," even if somewhat shifted by local attraction.

To be sure, if he had the good luck to have his observatory at the foot of some great volcano that blew its head off, like Katmai, and lived to return after the catastrophe, he might find a real and permanent change due to the diminished attraction of the truncated peak. But, for obvious reasons, no such case has actually been recorded. In 1888, however, Küstner discovered that observations of the latitude of Berlin showed a definite variation, changing in a few months by more than half a second of arc. The agreement of observations during successive months shows that the change was undoubtedly real. This meant that the angle between the plumb line at Berlin and the earth's axis must change. Which of them moved?

THE question was soon settled by a special series of precise latitude observations made in Hawaii, almost on the opposite side of the pole from Germany. When the latitude of one station increased, that of the other diminished, and by substantially the same amount; hence it was the pole that moved.

Further study brought out the now familiar characteristics of this motion. Imagine a point moving about a fixed "mean pole," in a nearly circular curve about 25 feet in radius, with a period of 14 months. The "instantaneous pole" about which the earth is rotating at a given moment moves about the point in a narrow ellipse every year, but never gets more than just a few feet from it. The 14-month motion is a natural and inevitable wabble which might be expected in any body not exactly spherical in shape if it is not rotating about an axis of symmetry. It is nearly the same from one cycle to the next. The annual motion arises from the loading of the continents by snow in winter, the seasonal changes in winds and ocean currents, and other meteorological sources. It is not surprising therefore that the amplitude and shape of this curve change considerably from year to year.

Since the beginning of the present century a careful series of observations have been made, especially for the study of these polar motions. At first it was hoped that, when the laws of its motion had been found, the place of the pole could be predicted, making a continuance of the campaign needless. But the nature of the annual component defies such hopes, and now by common agreement the observations are to be continued indefinitely.

Many precautions are taken to secure the utmost accuracy. Observations are made with zenith telescopes—instruments to which very precise levels are attached, which can be set at any desired angle to the line of sight. A star south of the zenith is observed; then the axis is reversed in its pivots so that the telescope is directed just as far north as it previously was to the south, and settings made on another star as it transits the field of view. The level serves to secure this adjustment, or to allow for any minute difference between the two settings. A micrometer at the eye end measures how far the stars are above or below the line of sight of the instrument. In this way a very accurate determination can be made of the position of the zenith compared with the average of the two stars. (Suitable star pairs with accurately known declinations are, of course, carefully selected beforehand.) A great advantage of this method is that the troublesome refraction corrections are almost eliminated. The refraction shifts the northern star toward the south, but the southern star to the north, so that the average of the two is little influenced, though careful allowance is made for the residual effects.

In the international latitude campaign a series of stations was chosen, all in the same latitude, 39°8′ north, and equipped with instruments of the same type and size. They were strung around the world—in Maryland, California, Japan, Turkestan, and Sardinia—so that the pole could not move in any direction without approaching some of them and receding from others. Observations were made on every clear night, using the same list of stars at all the stations so that any minute errors which might happen to be in the adopted positions of

the stars would affect all the results alike, and disappear from the differences which revealed the motion of the pole.

Long and successful series of observations have been made ever since (except when war or revolution interfered) and the wanderings of the pole have been continuously followed so accurately that its position at any time, relative to the mean pole, is known to one or two hundredths of a second of arc, corresponding to one or two feet on the earth's surface. But in the course of the calculations a strange thing appeared. In addition to the unmistakable polar motion toward one direction and away from the opposite quarter, smaller changes appeared which affected all the latitudes at once in the same direction, swinging back and forth by a few hundredths of a second with a period of a year. This curious phenomenon, called after its discoverer, the Japanese astronomer Kimura, was a complete puzzle for more than 20 years. The pole could not move toward all the stations at once. If the center of gravity of the earth could move inside the mass northward and southward every year, this would deflect the vertical at all stations alike. But this suggestion is absurd: the tonnage of material which would have to be moved deep in the earth's core is preposterously great. The loading of the continents with snow does not shift the earth's center perceptibly, though it sets the planet wabbling and thus contributes part of the motion to the pole. Was the tiny additional effect also due to a real motion of some sort, or did it result from some subtle error which, despite all precautions, had crept into the observations?

THERE was one suspicious circumstance about the Kimura effect—its period. It continued to run through its cycle in just one year; that is, it followed the seasons. Now there are all sorts of terrestrial influences which do the same, and any one of them might be responsible.

Furthermore, when the study was made still more precise by correcting the observations at each station for the known effects of the motions of the pole, and separating out the residue, it was found that the anomalies at the different places were not really alike in behavior. The latitude appeared to be greatest in one month at one station, in a different month at another, and the curves showing the changes were by no means similar. A noteworthy instance of this appeared at Greenwich. This observatory is about 900 miles north of the parallel of the international stations, but careful observations for latitude have been made there for many years. The instrument employed, by the way,

How the Changing Snow Load, and the Winds and the Ocean Currents, Constantly Shift the Poles

is of a different type—a photographic telescope attached to a ring-shaped float which swims in a trough of mercury and should thus stand at the same level, however it is turned. Its designer, Bryan Cookson, an astronomer of great promise, died lamentably young, and the difficult technic of its operation was later developed and brought to complete success by a new member of the staff by the name of Arthur Eddington. He has now turned to other fields of activity —with what success all the world knows —but the once refractory instrument continues to give excellent results.

When the observations were looked up, and the conspicuous effects of the polar motion allowed for, a definite Kimura effect remained. It was very small, its whole range being only 0″.04 (corresponding to four feet on the earth's surface!) but regular, having the maxima every year in February and August, with minima in May and November. At most other stations there was but one maximum and one minimum yearly.

This anomalous behavior has just been satisfactorily explained by the Japanese astronomer, Kawasaki, who had already interpreted in similar fashion the effects observed at the Japanese latitude station, Mizusawa. In a word, there is no real change at all. What is observed is a spurious effect depending on the direction of the wind!

Years before, the Greenwich Observatory had found that when the wind was in the north and east the observed latitude came out smaller than was otherwise to be expected, and contrariwise when it blew from the opposite quarters. Repeating these studies on eight further years' observations, Kawasaki finds that this conclusion is confirmed beyond all question. With the northeast winds the latitude comes out 0″.06 too small; with a southwest wind, 0″.04 too great, the changes for other wind directions being smaller but in regular progression.

NOW the wind at Greenwich, as at most other places, does not blow in the same average direction, or on the same number of nights in different directions, at different seasons of the year. Knowing the effect of a given wind on the observations, and the average number of nights in each month when the wind blew from each point, it was a matter of straightforward arithmetic to compute the average wind effect.

The resulting curve showed two maxima and two minima during the year, coming so closely at the same time as those of the Kimura effect that there can be no doubt of a real relation. The calculated wind effect however is only about two thirds of the observed anomalies. Some other disturbing factors may be at work, but the wind is evidently the chief culprit.

So far, so good, but why in the name of reason should the wind affect observations for latitude? The telescope is carefully sheltered and no direct disturbance is possible. But influences on refraction are another matter. In calculating the refraction we assume that the layers of equal density in the air lie horizontally—as indeed they should do over level ground and in still air. Suppose that something tilts these layers so that they rise higher toward the south of us and are lower to the north. The direction from which light may traverse the atmosphere without deviation is at right angles to these layers—under the supposed conditions it will be north of the zenith. Rays coming from directly overhead will now be a little deflected, causing a star in this position to appear slightly too far north, and the same will be true, as is easily seen, for the other stars on the meridian. Our instrumental zenith, derived without allowance for this, will therefore be too far south, and our deduced latitude too small.

NOW the Greenwich Observatory stands on the brow of a hill nearly 200 feet high, which faces off to the Thames on the north, while to the southward the ground is nearly level. A wind from the north, blowing uphill, might be expected to produce such an abnormal stratification in the air as has just been described, while one coming from the level to the southward might give a much smaller effect. Not only the existence, but the observed direction, of the wind effect is thus intelligible. It is not certain, however, that the abnormal refraction is produced near enough to the ground to be influenced much by the gentle topography of the London basin. Perhaps more extensive meteorological processes are involved, and a deal more study will be required before the matter is fully cleared up. The half-told tale, however, suffices to show how many are the trials, and how unexpected the successes, of the investigator who seeks to determine anything with all the accuracy of which human skill is capable.

EXPLORING PREHISTORIC

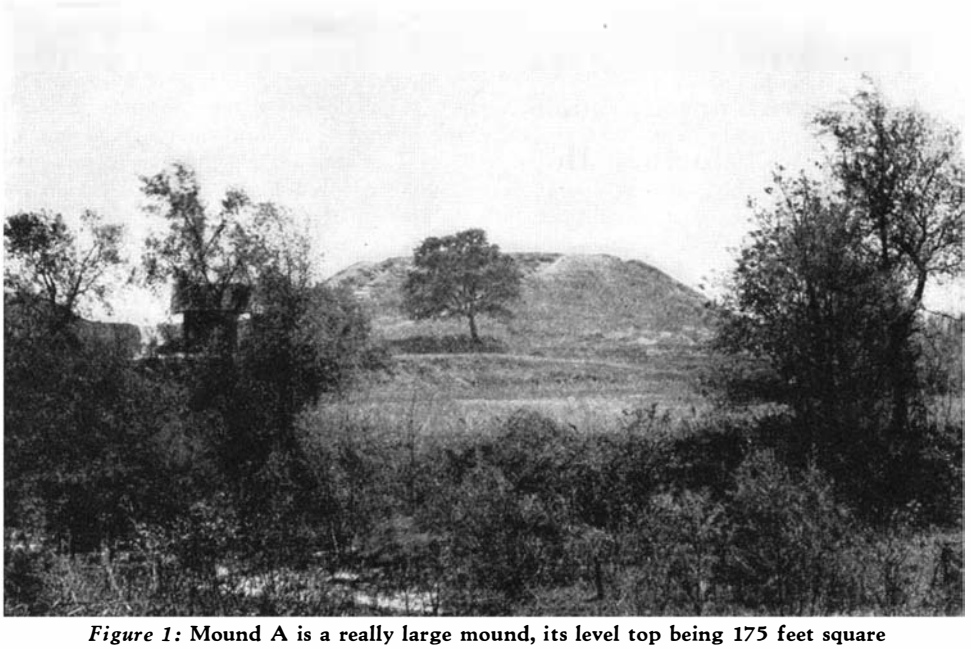


Figure 1: **Mound A is a really large mound, its level top being 175 feet square**

(*Part 2*)

MOUND C, described in the previous installment, lies on a low terrace of natural terrain east of the Ocmulgee River. Two hundred yards to the east of Mound C, across a narrow stream, rises the escarpment of bluffs marking the early geological confines of the Ocmulgee basin. The bluffs run northeast and southwest, curving sharply with the bend of the river near Macon. On the flat crest of these bluffs a level plateau or tableland provides the site of several mounds and a considerable area of prehistoric village site occupation.

Mound A is the most striking feature of archeological interest on the plateau east of Macon (Figure 1). The bluffs stand 40 feet above the river plain and the mound rises 45 feet above the plateau. Both length and breadth dimensions exceed 300 feet. Mound A towers above its satellite mounds and the surrounding country, a picture of grandeur and imposing splendor serving as a monument to the industry and engineering skill of the prehistoric Indian architects who conceived it.

The massive strength and solidity of Mound A stimulate the imagination and enthusiasm of laymen and archeologists alike. It brings to mind pictures of other imposing tumuli famous in the annals of archeology: Monk's Mound in East St. Louis, Illinois, the largest mound pyramid in North America; distinguished mound groups in Ohio, centering about the unique Serpent Mound; the stratified pile of buried cities and cultural debris constituting the site of Troy in Asia Minor.

Mounds of this type are not regarded by American prehistorians as having been constructed primarily for burial purposes. In Mexico and Central America, higher culture centers of the New World, similar large flat-topped, pyramidal mounds were mantled with stone rubble. Distinctive civilizations expressed themselves permanently in stone temples, public buildings, terraces, stairways, ornately carved balustrades. The fundamental assumption is that similar pyramids in North America were the sites of important ceremonial and public buildings also, but that the mound-building civilizations north of Mexico built in wood, supplemented with baked clay daubed on reed and wattled lattice construction. This medium of construction in early American aboriginal architecture to the north makes neither for permanence nor for elaboration and less of it usually remains to be uncovered and reconstructed under the trowel of the archeologist. The adobe and sun-dried brick apartment towns of the southwestern Pueblo Indians are an exception.

The wooden temples and buildings of the mound areas have long since disappeared. But the huge pyramids remain, silent witnesses to a past glory. When one comprehends the magnitude of the engineering tasks involved, and the labors required to transport materials to erect such large earth piles, he experiences a feeling of awe and admiration. These were the "sky scrapers" of pre-Columbian America. It is easy to understand the source of the popular notion, an idea that has found some support in romantic and pseudo-scien-

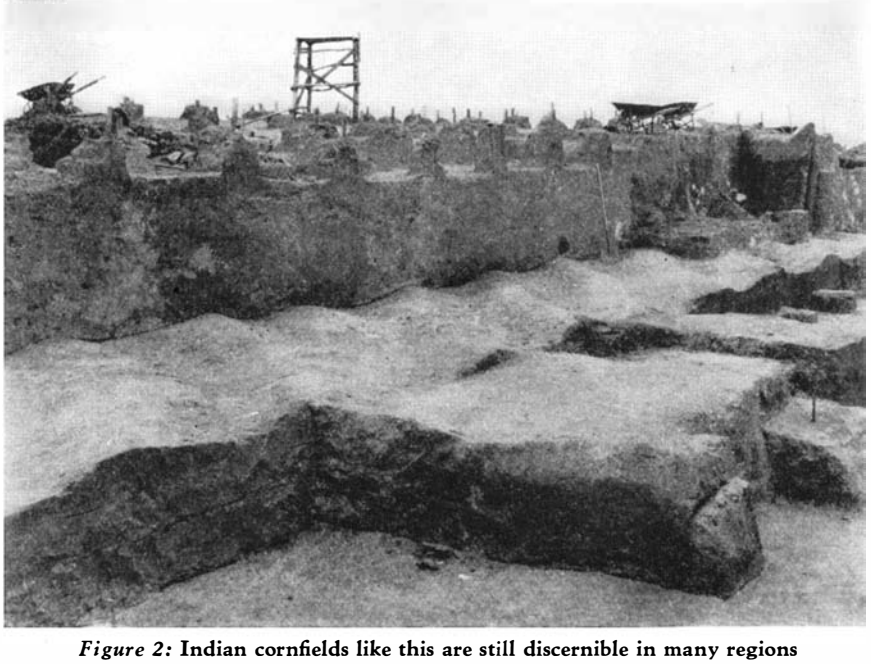


Figure 2: **Indian cornfields like this are still discernible in many regions**

GEORGIA

Massive Mounds Stimulating the Imagination . . . Moundbuilders Were Simply Ordinary Indians . . . Prehistoric Cornfields . . . Ceremonial Houses

By A. R. KELLY, A.M., Ph.D.

tific writings, to the effect that the mound builders were a higher cultured people not belonging to the race of the American Indian. The general conception of the wretched, hard-bitten, culturally impoverished blanket Indian of colonial days has a wide currency. Lo, the poor Indian!

Mound A is too huge to permit of exploration by any ordinarily appointed field expedition. A near-regiment of men, a large archeological staff composed of both engineers and archeologists, with a generous money subsidy, would be required for thorough investigation.

A shaft was sunk from the summit to the base of the mound to obtain cross-sections of internal structure. The shaft was 15 feet long and ten feet wide. It was cribbed all the way down, as in ordinary mining operations. At a distance of 30 feet from the surface it was found necessary to abandon the shaft as unsafe for the workmen. Basket-laid sand in the body of the mound slipped, exerting a lateral pressure against the cribbing and endangering the lives of the men working in the pit.

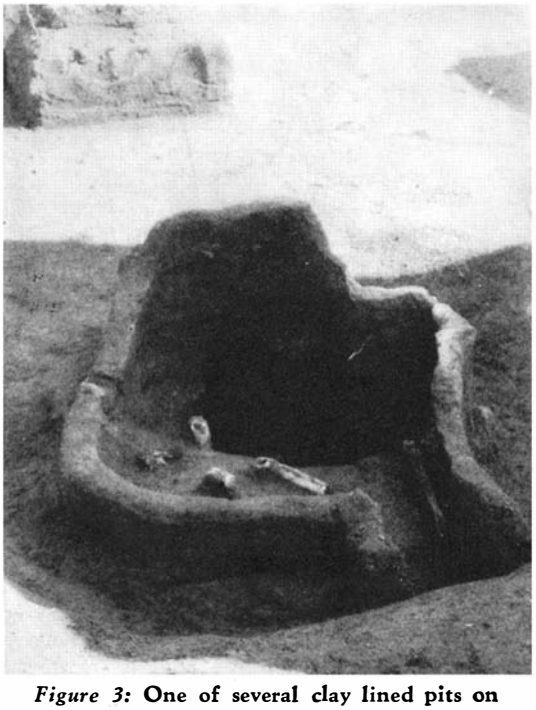


Figure 3: **One of several clay lined pits on Mound D, probably used for storing corn**

THE new plan of attack on Mound A was to sink trenches into the sides of the mound, through the terraces and aprons of the mound to the north, thus exposing the basal structure and relation to the plateau upon which the mound had been built. Timbered, baked-clay, wattle-constructed houses were uncovered by these trenches beneath the slope of the mound on the original plateau level. Other evidences of village or town occupation were uncovered at different levels above the plateau floor, partially covered by stratified sands and clays derived as washed materials from the slopes of the great mound. These series of levels provide a tentative basis for archeological reconstruction of prehistoric settlement on the bluffs or plateau east of Macon. The chronology is now in process of making, as pottery, stone artifacts, house floors and walls, and other evidences are uncovered.

A quarter of a mile north of Mound A, across two railway cuts made through the plateau by the Central of Georgia railroad, is the site of Mound D. Here have been uncovered probably the most striking of the discoveries made during the course of explorations in the Ocmulgee basin.

Mound D in itself is not a particularly imposing mound, from external appearances. About ten to twelve feet in height, oval in shape, flat-topped, with dimensions approximately 125 by 150 feet, this mound is interesting primarily for the important archeological situations revealed inside it.

The most striking fact about Mound D relates to the discovery beneath the base of the mound of a prehistoric cultivated field. The mound builders had constructed Mound D immediately over the site of an abandoned corn field, thus effectively sealing or trapping the cultivated plot of ground from the weathering and erosion of a thousand years or more.

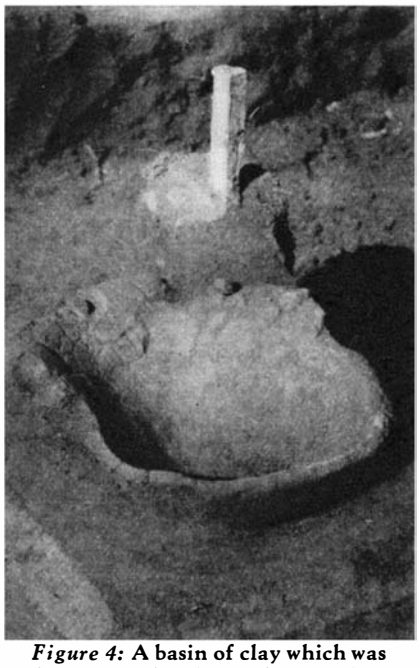


Figure 4: **A basin of clay which was found on the slope of Mound D**

When the mound soil is slipped off by the workmen, at the mound base the drilled rows or furrows show distinctly, running in uniform, parallel lines, the hillocks for corn culture spaced regularly at intervals within the alinement of the corn rows. (Figure 2.) Paths are seen clearly running across the prehistoric field, dividing the cultivated area into small patches.

WITHIN 50 yards of the cleared area where excavations through Mound D have uncovered the prehistoric field, modern corn planted by a negro tenant farmer has recently been growing. A path made by CWA workers cut obliquely through the modern corn field, giving a remarkably similar effect to that produced by the arrangements of paths and rows in the prehistoric field.

Cornfields of historic Indian tribes have previously been preserved and studied by American ethnologists, but the discovery at Macon is especially interesting because it is the first recorded instance of a definitely prehistoric cultivated field preserved for scientific records in the New World. The find is also important in suggesting that the early colonist in the southeastern United States not only took over maize as a domesticated plant but also continued methods of planting and arrangement of fields in much the same manner as that practiced by the Indians.

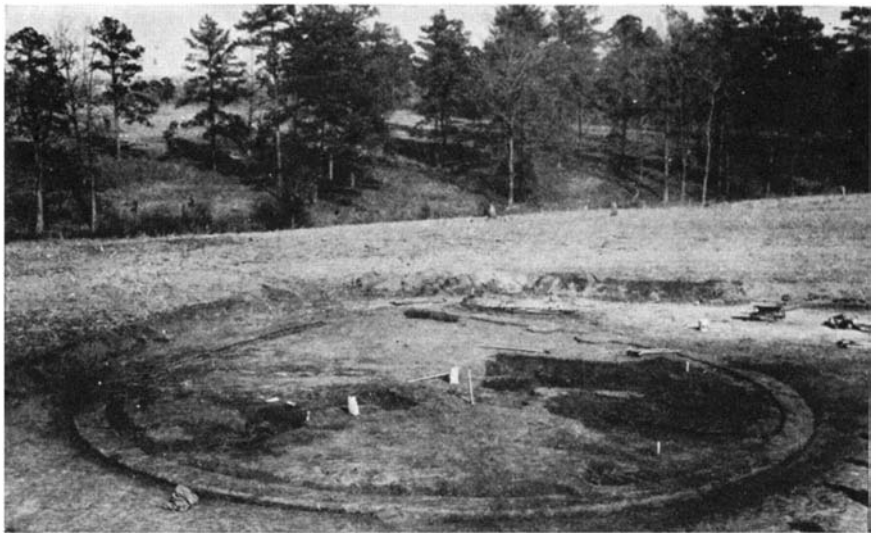


Figure 5: **What the removal of but three feet of clay revealed near Mound D**

In the North Atlantic states such orderly arrangement of cultivated fields in rows, drills, with the hillocks showing only as undulating, hummocky swells in the furrows, are not found. In Maine, for example, colonial examples of corn culture followed the Indian custom of planting in separate hillocks, each swell of earth nurturing a plant, manured, hoed, and tended as a unit by the cultivator. It seems probable that two methods of corn culture have grown up independently, one in the north, one in the south, each borrowed from the Indian aborigines by the early white colonists.

THE discovery of a prehistoric corn field in central Georgia confirms to some extent the anthropological assumption that there is a cultural correlation between the cultivation of maize and the pottery making complex. Nomadic, hunting, semi-sedentary tribes were not agriculturists. They seldom made pottery. Just how complete is the correlation between maize culture and pottery making has not been determined. The find at Macon, antedating de Soto by at least several hundred years, gives scientific data for linking these two items in aboriginal American civilization.

Mound D produced several archeological situations of more than ordinary interest. On top of the mound, in exploring the surface soil for evidences of historic occupation, an area of baked clay mantling house debris and post hole indications of timbered walls was found. Subsequent exploration has revealed that this structure was of wattle and clay-daub construction. The sun-dried clay still carries the imprints from contact with reeds and small saplings used to make the supporting framework of the walls and roof. Such clay molds, often tempered with grass or vegetal fiber and bearing reed or wattle imprints, are known technically as briquettes.

ture on top of Mound D has led us to catalogue this site as the "Granary."

A basin of sun-dried, puddled clay found on the slope of Mound D has given rise to numerous conjectures as to its purpose (Figure 4). The rim of the vessel has been partially broken away, probably as the result of modern plowing over the village site. The original form of the basin must have been very similar to the wash bowls familiar to many boarding house and country hotel patrons.

Approximately 50 feet southeast of Mound D a small knoll of red clay, 50 feet in diameter and raised three to four feet above the surrounding plowed field, appeared to the suspicious eyes of the archeologist in charge of Mound D exploration to be something more than one of "the red hills of Georgia."

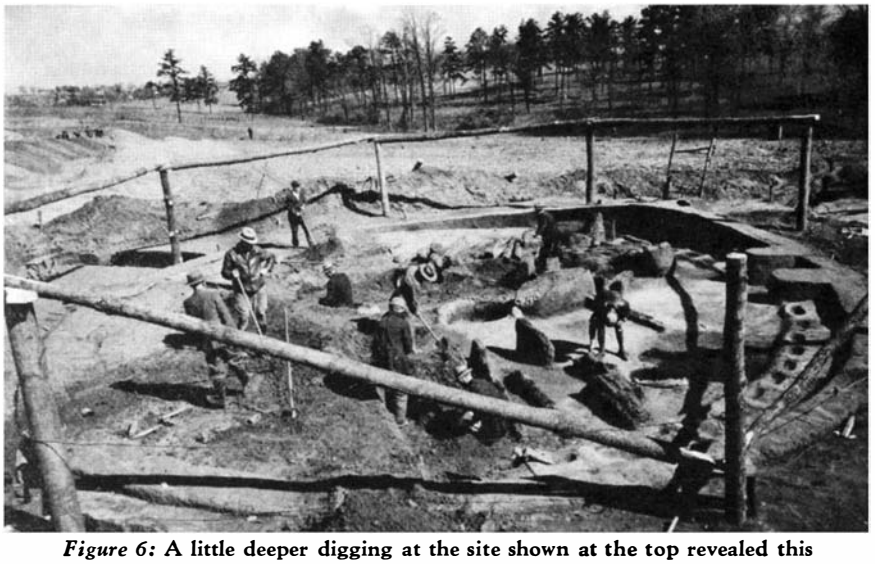


Figure 6: **A little deeper digging at the site shown at the top revealed this**

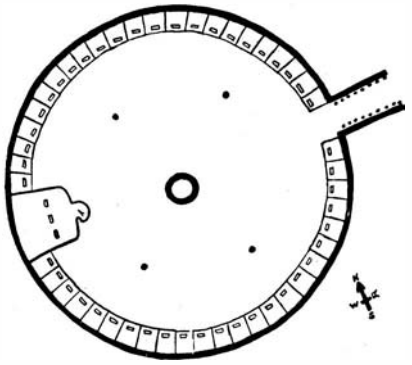


Figure 7: **Plan of the ceremonial chamber shown above and opposite**

In the floors of the square, reed-thatched, clay-daubed house on top of Mound D were set six or seven pits lined with baked clay (Figure 3). These cache pits were 24 to 30 inches in diameter and a foot or more in depth. They seldom were found to contain anything of archeological significance, not even the usual refuse found in pits around Indian villages. The theory is that they were used for the storage of corn. Their presence within the house walls of the struc-

The red earth was sliced off horizontally with shovel and trowel. Soon a perfect circle of baked-clay wall, with a diameter of 42 feet, showed in the carefully shaved flat profile (Figure 5). Two round, U-shaped clay buttresses (see Figure 6) marked the only break in the continuity of the ring of baked clay. These marked the entrance (Figure 7) to a round chamber mounded over with red clay loam.

Further stripping of the overburden of red clay sod uncovered heaps of baked clay, briquettes, and charred roof timbers. As the trowelmen brushed away more house debris the floor plan began to appear (Figure 7). Low, clay-moulded seats, large enough for only a single individual to sit upon with his legs drawn closely beneath his body, Turk fashion, were now exhibited, ranging the inner circumference of the underground chamber. A deep fire pit of baked clay was found in the center. Four large post holes filled with house debris indicated the main supporting timbers of the roof. The charred rafters had fallen in place to the floor. The

fire which had destroyed the ceremonial chamber had been smothered by the falling in of the earth-mounded roof when the supporting roof poles gave way.

On either side of the clay-buttressed entrance, the seats, 23 on the right, 24 on the left, rose in a perceptible hierarchical arrangement of increasing size and higher levels above the floor, to converge upon a central platform or dais upon which three larger and more comfortable seats were moulded for the masters of ceremony. See Figure 7.

Each of the 50 seats had a small oval, dish-shaped depression hollowed out toward the front (See Figure 6, also Figures 8 and 9). Considerable speculation has developed in attempting to interpret the meaning of these small basins in front of the seats. Ethnological data regarding the appointments of historic ceremonial houses of southeastern tribes afford no clue. The dish-like receptacles, like other features in the earth lodge, have no exact analogue or parallel. The most likely theories to date imply their use to hold the ceremonial paraphernalia of the seat occupants, or as small fire boxes in which coals from the central fire were kept warm and glowing.

THE only entrance to the ceremonial chamber was a low, narrow tunnel, 12 to 14 feet long, walled with log uprights. The log moulds, with charred portions of the original wood preserved in sections of the tunnel, still show on either side of the passageway.

One of the most unusual features of the ceremonial earth lodge at Mound D was the zoomorphic form and symbolism of the raised platform or dais set at the back of the chamber, directly across from the entrance and central fire. The platform was built to represent an eagle; the body, neck, head, curving beak, and eye are clearly defined (Figure 8). A peculiar stylistic treatment is given the eye symbol, a broad ellipse terminating in two downward projecting prongs. The prehistoric Indian artists of the southeastern United States often represented the eye of the eagle in this manner in decorating pottery and in engraving shell ornaments and copper plaques.

The essential architectural details of walls, supporting framework and floor plan of this prehistoric ceremonial chamber are so well preserved that it is possible to draw a picture of the structure as it must have been originally. Mr. Francis Etheridge, staff artist of the Macon Mounds expedition, has made rather striking pen and ink sketches of the reconstructed lodge and these are reproduced in Figures 9 and 10.

The interior aspect (Figure 9) shows the floor and wall, as uncovered by archeological exploration. The four supporting timbers were indicated clearly enough by postholes ranged equidistant from the central fire in the floor of the lodge. The details of roof and smoke hole may deviate slightly from the original structure, but there can be little doubt but that the chamber looked very much as the artist has reconstructed it.

From the outside (Figure 10) it is certain that the lodge must have looked very much like a small knoll of ordinary Georgia red earth, except for the smoke hole and tunnel entrance leading in.

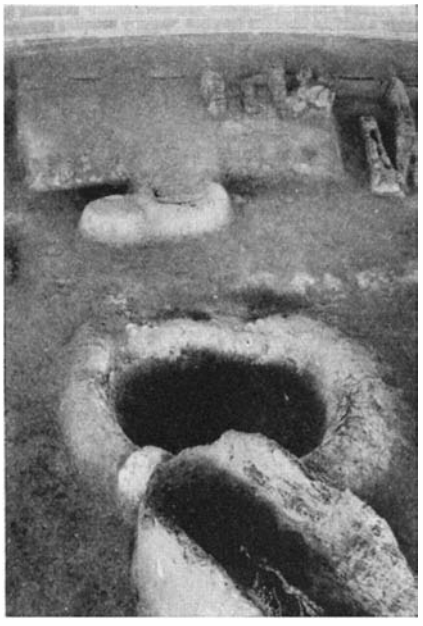


Figure 8: **The eagle mentioned in the article is shown upside down**

VISITORS to the southwestern Pueblo region of the United States will be struck by the superficial resemblance of this underground chamber in central Georgia to the subterranean religious structure of the southwest, the kiva.

Both scientific and lay observers have noted the resemblance. Perhaps the similarity is not as superficial as might be supposed. Future archeological exploration of early ceremonial structures is needed in both the southwest and the southeast before the full implications of the Macon discovery can be made out.

The earth lodge at Macon does depart in a number of essential features from the characteristic structural details of the typical kiva. It was not excavated in natural terrain, as are the kivas and other western subterranean type houses. A mound of red clay loam was made, scooped out to form a circular chamber, the walls daubed with clay and allowed to harden in the sun. Subsequently a roof covered with sod was built over the chamber and passageway. Moreover, the deflector, *sipapu*, ventilator shaft, banquettes, and other southwestern traits are not present. Yet, nevertheless, the structural affinity of the Macon earth lodge is closer to earth lodges of the western United States than to the type of council and ceremonial houses described by early ethnographers for Indian tribes resident in the southeastern section of the country.

(*To be continued*)

Figure 9: Below: **The artist's reconstruction of the inside of the Indian ceremonial house shown on the opposite page**

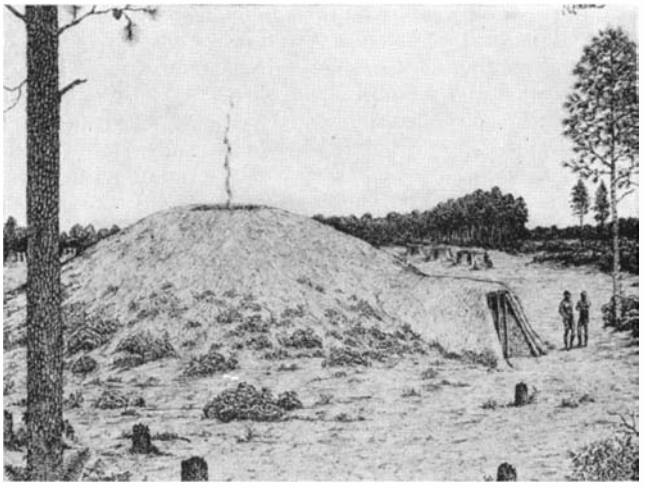


Figure 10: **Covered with earth and smoking at the top, the ceremonial house must have resembled a miniature volcano**

The SANITY of INSANITY or The INSANITY of SANITY

Understand Insanity . . . The Pleasure Principle . . . "Poor Devil, He's Sane" . . . No Desire to be Cured . . . Having a Perfectly Wonderful Time

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

I HAVE an interesting file in my office. It contains, among other things, a pamphlet written in excellent English outlining the world's most novel plan of salvation. Entitled, "The Divine Thrill," it explains that the thrill we receive when our soul is saved is exactly the same as that experienced when we have goose pimples. So the great road to salvation lies in the cultivation of the art of raising goose pimples. Simplicity itself. Another sheaf of typewritten paper, entitled "Von Schlichtenberg, God," tells how the author, through the payment of two dollars and fifty cents to the United States treasury, was empowered by Congress to assume all the rights and titles that go with supreme majesty. Still a third treatise promises wealth and fame to its writer if he will complete a great invention according to the plans given. The invention is a cake of flying soap for use in a shower bath!

Now choose ye, before reading further, as to who were "insane," because choice is not easy. The first paper was by one who died a respected member of his community, loved for his altruism but thought a little "queer" by some. The second individual is confined in an institution for the insane. Examination reveals him as a case of general paresis—syphilis of the brain. The third, he of the flying soap, is in another institution, but the examinations to which he is subjected are in such fields as history or economics. He is a university student who has the gift of automatic writing—he is an amateur spirit medium—and this "invention" is characteristic of the weird ideas which his spirit control sends through.

To understand insanity we must realize that all men are seekers and all have but one goal in sight—happiness. No two choose the same route and the end of the way is often shrouded in pain and misery, but the original goal is the same. Napoleon could not be happy with all Europe under his sway, and St. Helena ended his quest. The criminal in Sing Sing arrived there in pursuit of happiness, and the hobo is as he is because he enjoys it. The average citizen has followed a dream of happiness to his present status and his future course, lead where it will, must be guided by this motive. We call it the "pleasure principle" in psychology.

STRANGE as it may seem, the insane, of all people, are sane, if we would judge simply by the success of this great quest. As a group they are supremely happy. Consider the typical "Napoleon" of your local insane hospital. He *is* Napoleon, in his own mind. He will write a check for 1,000,000 dollars or give you a duchy in France for the asking. To be sure, the National Bank or the French government might not treat him very seriously but in his own mind he is very wealthy and very powerful. "Poor devil," you say, "he's crazy."

But consider your own possible case. You strive hard all your life to get some small savings and become mayor of the local town. Then you are thrown out of office when the country goes alphabetical and your fortune is absorbed by the local bankster. If our Napoleon would condescend to gaze on such a worm as yourself he might well say, "Poor devil, he's sane."

We need no special psychology for the insane. Their minds work the same as our own, only more so—or less so. In the following pages you will see yourself in one of those funny circus mirrors. It may distort and exaggerate but through it all you will recognize the original of the caricature. There, but for the grace of God, go I.

MAN starts early and learns very fast. That is the reason for our insane hospitals. In this respect man is at a great disadvantage contrasted to the dog or cat, which rarely go insane. We can, however, teach them to be crazy. It would be quite easy to treat a dog so that he would bite you when you patted him and wag his tail when you stuck him with a pin; so that he would live on a diet of putrid fish and refuse fresh meat; so that he would go to sleep in a mud puddle and reject a dry kennel. These cases are quite possible, as we know from animal literature, but are not usual.

The animal goes through life with his original drives very little altered. He is like the French kings of whom it was said, "They learn nothing—and forget nothing." But the human is cursed with too much brains and, despite the prevailing notion of college students, the average man learns far too much for his own good—and often goes insane to prove it. "Dumb! Why that boy is so dumb that if he broke his leg the S.P.C.A. would want to shoot him," said Professor X.—but he was wrong. Man builds certain *desires* on the basis of his original drives, by means of mechanisms which we will explain, and these desires are very definitely learned. In fact,

about all of man's activity is based on these learned reactions—and he learns too much.

Psychology would say that the same child could be equally well trained to be a bolshevik, fascist, loyal adherent to King George, the Emperor of Japan, or Huey Long. Our like or dislike for Negroes, Republicans or Democrats is wholly the result of learning. Our tastes in art, music, literature, and our lack of taste in movies, are not born in us. Finally, when the strain of keeping abreast of the latest changes in football rules or N.R.A. codes becomes too great and we go "insane," it is the result of our environment and not because it was "in the family." Psychology no longer accepts the idea of heredity in mental disease.

Illustrations courtesy The Metropolitan Museum of Art

In Bedlam. From an engraving by William Hogarth, in "A Rake's Progress" (Plate VIII), published in London in 1735

WHAT actually happens is as follows, and we need use only the simplest of concepts to get a very fair idea of the subject. The human brain is something like a camera—only it has one great advantage over your Kodak. It has an automatic sensitizer for which the Eastman people would pay a fortune. The sensitizer is emotion of any kind. Under the influence of emotion the photographic plate in the brain becomes many times more delicate to outside impressions. The stronger the emotion the more sensitive the camera becomes. This serves a tremendously useful purpose, for the great lessons we have to learn are those connected with danger and other emotions. You may tell a child of five that eight times nine make seventy-two until you are blue in the face, and have no effect. The dog next door growls at him just once and he never forgets it. This is as it should be, for danger must not be overlooked. A child without fear would be a potential corpse.

Unfortunately, emotion is a two-edged sword. Under its influence we sometimes learn things which look quite unreasonable. For instance, a child cuts its hand, and is taken to the doctor, who sews up the cut without an anaesthetic. Needless to say, the child is badly frightened—the brain is sensitized for impressions. His attention is concentrated on the black bag from which the doctor takes the instruments. Later in life comes out a phobia—fear—of black bags! This impression was burned in at the time of the operation, and associated with fear. For the rest of his life he will always have a horror of black bags. A minor case of insanity, but one which is very easy to understand. So, indeed, are all these instances.

For example, a child is taught bad sex habits by a man who also teaches it to steal. The sex excitement supplies the emotion and on the sensitized brain is printed indelibly the idea of stealing. Result: the kleptomaniac who will steal worthless articles under the very nose of a policeman. Similarly we get the pyromaniac who loves to set fires, and various other curious states. A child found himself confined in a narrow, closed alleyway with a ferocious dog and was badly frightened. The result, strangely enough, was not a fear of dogs but claustrophobia, fear of closed places. An artilleryman during the war was turning the elevating wheel on his gun when a shell struck it and killed everyone but himself. The result here was an inability to stop his arm from rotating, for his mind was occupied with this action at the moment of intense fear—at the moment when the brain sensitizer was working hard.

The foregoing cases are very easy of explanation and represent the milder forms of insanity. We call these lighter types of mental disturbance neuroses. They are not always due to the pleasure principle and are not generally found in hospitals for the insane, since they are not a menace to society but can take care of themselves. The individuals whom we regard as "crazy" are usually those suffering from a psychosis. Here the individual cannot care for himself and is very often a menace to his fellow man. Yet, strange as it may seem, his actions are very logical, once we realize the cause behind them. Indeed, these severe cases of insanity are far more reasonable in their conduct, once we understand the "why" of it, than are the others.

Here, however, we have to invoke the pleasure principle which is necessary to the understanding of real insanity. It is almost self-evident in its workings. For example, in the physical field man will not deliberately walk on a tack. He will always seek pleasure and avoid pain. To be sure, he may undergo immediate pain willingly, as in the case of the dentist's chair, but this is for the sake of a future satisfaction.

The psychologist would claim that this pleasure principle also works in the realm of the mind. We think of the pleasant and avoid the painful. You immediately say that is not correct, because some of your thoughts are very unpleasant. This may be true, and yet, if you examine them carefully you will find that the great majority of these unpleasant thoughts really yield great satisfaction along some lines like the following. You think of an insult, which is perhaps unpleasant, but you also plan revenge, which may be very pleasant. Your financial conditions and family worries since 1929 may give you just cause for concern but along with it comes the feeling of self pity or the picture of yourself as a struggling hero—either of which may give you great satisfaction. However, we would not maintain that *all* thoughts are pleasant; merely that man has a strong tendency to think of the pleasant and avoid the unpleasant.

This so-called pleasure principle is the key which unlocks the mystery of insanity in its more severe forms. It is in respect to the satisfaction of this universal human search for pleasure that we say the insane are sane. They, of all people, have learned how to avoid pain and find pleasure. For example, let us take the case of an individual suffering from dementia praecox. These people are the most common of all the insane and are quite incurable. In a typical example the man will sit in a corner of the room all day, talking to himself, smiling at times, quite satisfied with the world. Speak to him and he probably will not answer. Should he do so you will have a marvelous explanation of how his insides are of solid gold, or that he is in radio contact with Mars, or that he is Alexander the Great confined here by his enemies. He may even offer you all Persia if you'll help him escape.

BUT note that he is really happy. He is living in a world of dreams but these dreams are very real. For that reason he is incurable. He enjoys being insane and, with all due respect to yourself, intends to remain that way. The worst offence you could possibly commit would be to effect a cure. This condition is basic to a majority of our abnormal

cases and is a natural outgrowth of the pleasure principle. The insane, the hysteric, the criminal, the pervert, and many other types are as they are because of choice. They do not wish a cure but only protection from the consequences of their acts. Someone defined remorse as "the penalty of being found out."

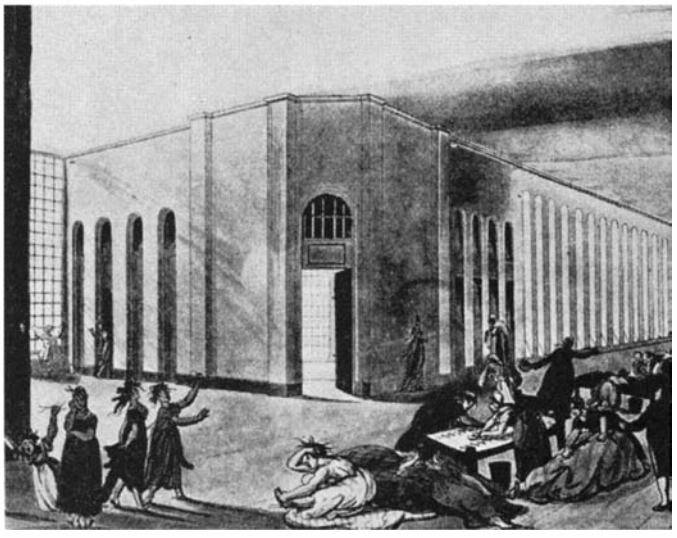
We can readily see why mental disturbances based, as the above, on the pleasure principle tend to be numerous, severe and incurable. The child who cut his hand or was frightened by the dog did not enjoy it. The experience was burned in, but the individual will not willingly repeat the original. The boy will not go around cutting his hand just because he enjoys having it sewed up. Neither will he seek out fierce dogs for the fun of being bitten. Yet that is just why the really insane frequently stay that way.

THE original experience was very pleasant, for there are pleasant as well as unpleasant emotions. If it were connected with sex it may very easily have had a pleasant emotional tone. So he deliberately repeats the experience whenever he gets the chance. He makes sure that it is burned in so indelibly that nothing can remove it. Yet we must not overemphasize the very evident and pleasant emotions connected with sex; there are others.

For instance, Johnny does not want to go to school. He can muster a very small stomach ache. He complains of it and is delighted at the attention. The stomach ache promptly assumes serious proportions and he is allowed to stay home. He has learned a great lesson. Stomach aches are wonderful things and should be cultivated. They can also be very easily faked. So Johnny carefully develops the technique of being sick, which strange to say, very soon becomes quite automatic. When he is faced with a disagreeable situation his digestion goes completely to pieces. As he grows older this may take the form of hysterical vomiting and we have a full blown hysteric on our hands. The original situations yielded great pleasure, which sensitized the brain. They were carefully repeated, because of this pleasure. Now we have them so deeply burned in that a cure is hopeless.

There are two points we should note about this case and those following. The original cause may be entirely forgotten. The reaction becomes habitual. This is easily understood. Tumble any one of you into water and you swim—you don't think about it. On a bicycle you simply pedal ahead. Place a pen in your hand and you write. You have long since forgotten, and probably cannot recall, the exact circumstances in which you first learned these activities.

Secondly, this type of individual is really very clever. You may say in a pitying voice that he is crazy, but he might well look on you as being, at least, very foolish. When you have something disagreeable to do, you do it at the cost of great effort, or at least try. But he always sidesteps and does it in such a way that everyone pities him and comes to his rescue. From one point of view you are the one to be termed "crazy." The insane are quite sane, if we choose to look at it that way.



St. Luke's Hospital. From an aquatint by Pugin and Rowlandson in Volume III, "The Microcosm of London," 1810

The action of this pleasure principle was very well shown in the cases of so-called "shell-shock" which occurred in the last war. These were very interesting in their origin. The man in question was caught between two fires. He wanted to save his skin and he also wanted to avoid disgrace. His solution was beautiful in its simplicity. Let's be sick, because a sick man can't fight and no one can blame a sick man for being sick. The brain was already highly sensitized because of the strong emotions involved. Then, let us suppose a shell exploded close by and buried him. When they dug him out his right leg was wrenched and hurt. There flashed through his mind the idea of paralysis of this member, with the comforting thought that now he was out of the war. His intense fear and desire gave the necessary conditions so that, on an examination, sure enough, the leg was paralysed.

These cases were most interesting. A very small throat wound would result in inability to talk—deafness from a slight bruise on the temple or blindness from the flash of a shell. Note that these people were really sick, but also that it was purely a result of emotion—there was really nothing wrong with the eye, or ear or leg. You might refer to them as insane, because in some cases they were very violent, but note that from one point of view they were very, very sane. They were safe back in hospitals, while their comrades were being blown to bits; and to a greater or less degree this was because of deliberate choice on their part.

Similarly we may apply our same general outlook to the pervert, as seen, for example, in the homosexual. Here we have an individual who at an early age has learned to gratify his sex desires along abnormal lines. His perverted activity has been burnt in on an emotional basis which is self-evident. He now acts in accordance with the pleasure principle. The one factor which makes the majority of these cases incurable is the fact that the individual is happy as he is and has no desire to be cured. Unfortunately his pursuit of pleasure all too often ends in disgrace and imprisonment. The same applies to many cases of the criminal and the criminal insane.

But our best examples come from the field of those major insanities where the individual is no longer in touch with reality at all. For example, take a case like the following. We find a man in an asylum who claims to be a great medical genius. He has a grand elixir which will cure every disease known to humanity. As a matter of fact he will talk quite sanely on most points but on this one he is "off" and, moreover, what he has to say about doctors just wouldn't bear repeating in polite company.

WHAT is the explanation? A relatively simple one and quite sane—from his point of view. As a child he derived his great pleasure from the "superiority" complex. He was taught to regard himself as intellectually superior to all other children—and believed it. In reality he had a very average mentality. Through high school and college his record was poor, but his real interest was medicine, so just wait till he got the chance to "show his stuff" in medical school. He admitted he was a real genius as a budding doctor. So he entered a good medical school, lasted one semester and was flunked out.

That was a terrific blow. Either he wasn't so good or the medical school was wrong. His entire background told him he *must* be good. It was the "theme

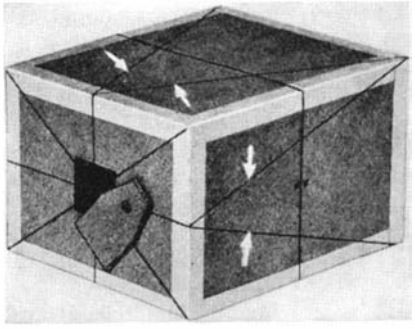
(*Please turn to page* 222)

PINHOLE PHOTOGRAPHY

Pinhole Cameras Not Toys . . . Produce Excellent "Atmospheric" Effects . . . Easy To Make

By FREDERICK W. BREHM

MANY questions have been asked about "pinhole" photography. Some think of it as a child's toy; some look upon it as a distinct novelty. Many advanced amateur photographers consider it seriously and are justified in doing so for pinhole photography has a place in pictorial art. The sketch artist and the painter do not depend upon extreme sharpness of line or drawing to make their pictures attractive but more upon the arrangement of light and shade which, together with the softness of line,



Pinhole camera, showing finder lines, the pinhole, and a shutter

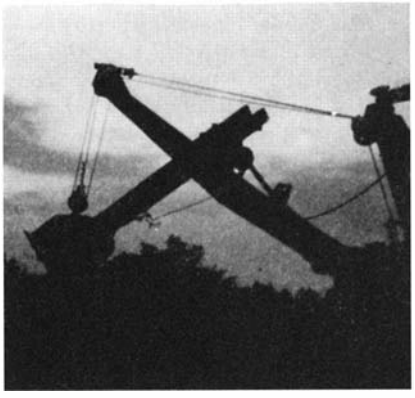
gives atmosphere and feeling. It is this effect that can be reproduced through the use of pinhole photography.

The mechanics of the pinhole camera has largely centered around the making of the pinhole but experience has taught me that thin black paper of hard texture is an excellent material through which to pierce the hole.

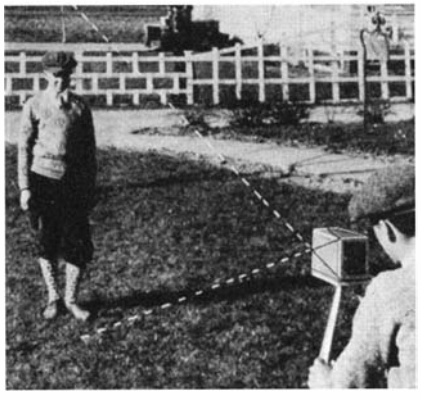
If it is convenient to remove the lens from the camera you now own then a pinhole attachment can easily be substituted. A black paper cap can be made to slip over the shutter barrel, or a light, tight-fitting piece of cardboard may be placed inside the barrel.

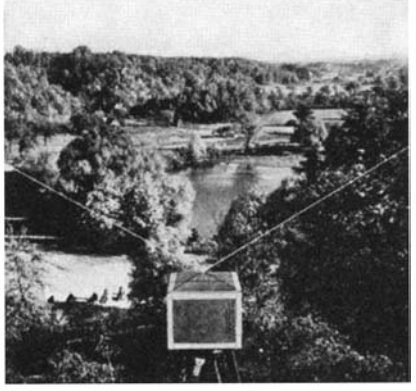
When using either the paper cap or the cardboard fitting, a quarter-inch hole should be made in the center. Over this opening glue the hard black paper through which the pinhole is to be made. A No. 10 needle, 0.020 of an inch in diameter, is used for making the perforation. This hole should be made from the outer surface, the needle being held between the thumb and first finger and carefully forced through with a drilling motion.

If you do not want to disturb the lens of your camera, a cardboard box can be made of proper dimensions to hold either a plate or film holder, a film pack, or a



single cut film. You can use ordinary film. When determining the focal length of the box that is to be made, it is best to follow the old rule of measuring the diagonal of the picture area. The diagonal of a 3¼ by 4¼ picture, for example, is approximately 5 5/16 inches; consequently this should be the distance that 3¼ by 4¼ film is placed from the pinhole. Such a box is easy to make but it must be dead black inside and light tight.





Above and Left: **How the finder lines are used to determine horizontal and vertical composition**

Illustrations courtesy Eastman Kodak Company

Photographs with a pinhole camera. *Above:* 48-second exposure at 8:30 A. M. in July. *Left:* Silhouette taken at 7 P.M. in July: 32 seconds

A convenient form of box is illustrated, on which finder lines have been drawn. When using a box of this type these lines are used to locate the object within the picture area. Where pinhole attachments are used on manufactured cameras, the regular finder is employed in the usual manner.

The following table gives adequate exposures for ordinary cut film:

Subject	Sun	Sun Under Light Clouds	Dark Clouds
Marine and beach scenes, distant landscapes, mountains, snow scenes	8 sec.	16 sec.	32 sec.
Ordinary landscapes showing sky, with principal object in foreground	16 sec.	32 sec.	1 min.
Nearby landscapes showing little or no sky. Nearby subjects in open field, park, or garden	32 sec.	1 min.	2 min.
Shaded nearby scenes, paths in the woods	1 min.	2 min.	4 min.

When using the home-made camera it can be fastened to the tripod with a rubber band. Don't let the camera move when making the exposure.

Finishes which can be sprayed are of comparatively recent origin and are very profitable

PAINTS IN

By PHILIP H. SMITH

Rise of the Synthetics... New Research, New Developments... Rubber Paints... Types for Industry, for Homes . . . An All-Purpose Finish?

ANYONE who has kept a weather eye cocked on the paint and varnish industry, if only to read its recent advertisements, must be aware that this ancient enterprise is in the throes of transition. Hardly a month passes without bringing to the fore some new product and, if we believe all we read, we could assume that the millennium is not far off when there will be a single paint good for all ailing surfaces and which, when placed on the old homestead, can be handed down from father to son.

Such a happy interpretation is inaccurate. The goal of paint chemists has been to produce better finishes, to reduce the time required for application and drying, and to lower costs. To this end they have modified existing practices and have contributed new materials which supplement rather than replace the older ones. Far from creating an all-purpose, everlasting finish, they have spawned innumerable products, each with its own particular uses. And through their research they have quickened the use of synthetic materials.

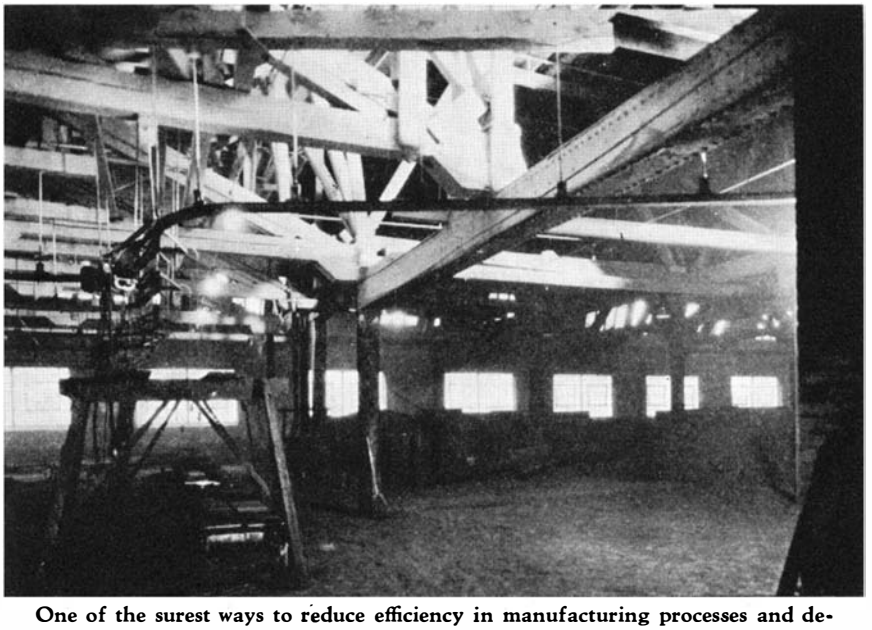
The rise of the synthetics, and notably the resins, is the outstanding feature of paint chemistry and far and away the most interesting, for the synthetics tie in closely with other paint developments and in them lie the possibilities for higher attainments.

The synthetic resins, as with most of the newer discoveries, had their inception many years ago. Ester gum, the first one, was discovered 40 years ago by chemically uniting rosin and glycerine. It was shortly put to use in varnish making because it was superior to raw or limed rosin, and then little more happened in this direction until the advent of nitrocellulose lacquers, also synthetic.

Everybody knows what a whirl the nitro-cellulose lacquers created. Paint chemists laid the foundation for them but the driving force which carried them through to commercial success was supplied by the automobile industry where it was recognized that a quick-drying, durable lacquer would save fortunes in the painting of mass-produced motor cars. It is safe to assert that this development was as revolutionary as any which has struck the paint industry. It almost squeezed the linseed oil, fossil resin varnish makers to the wall. It promptly reduced certain painting operations from multiple, hand-applied to single spray jobs and it demonstrated that time and cost factors in lacquer and varnish work could be modified beyond the manufacturers' wildest dreams.

Of course, this didn't happen overnight. It took years to develop satisfactory undercoats, suitable solvents and workable spray guns to make the new lacquers wholly feasible. But that work, particularly with solvents, paved the way for what was to come. Shortly after nitro-cellulose got under way, the phenolic resins were introduced. It had been found that they could be combined chemically with rosin to maintain a sufficient solubility for varnish work. This brought the so-called "4-hour" varnishes and enamels into being and with them the first general use of synthetic resins other than ester gum.

There are literally hundreds of synthetic resins, each having properties which differ slightly from the others. For commercial exploitation close to a hundred are marketed, representing the types which have the best combination of qualities. There is no longer one type of phenolic, but many types, and there are paracoumarone, indene, and alkyd resins. Just why there should be such a variety can be told best by classifying and describing their use, otherwise the reader's confusion may equal that of the paint manufacturer when he tries



One of the surest ways to reduce efficiency in manufacturing processes and decrease worker morale is to delay repainting as was done in the plant shown

TRANSITION

IN this, the fifth of our important new series of industrial articles by Mr. Smith, there is a "between-the-lines" story for the home-owner. Paint is going to play a vital part in the campaign for better housing which is now being promoted aggressively by the Government, by institutions concerned with health and sanitation, and by several large corporations. This article does not tell the home owner specifically what paint to use. It does, however, tell him what he may expect in paint quality and type.

To answer particular questions on painting problems, there are available the following bulletins which will be forwarded—one or more, as desired—upon receipt of a 3-cent stamp for each bulletin to cover mailing costs:

1. Making the House a Home
2. The New Decorator
3. The Home Decorator
4. Using Paint as Light

In industry the spray gun has worked hand in hand with the faster mass-production methods

to decide which one of them to choose.

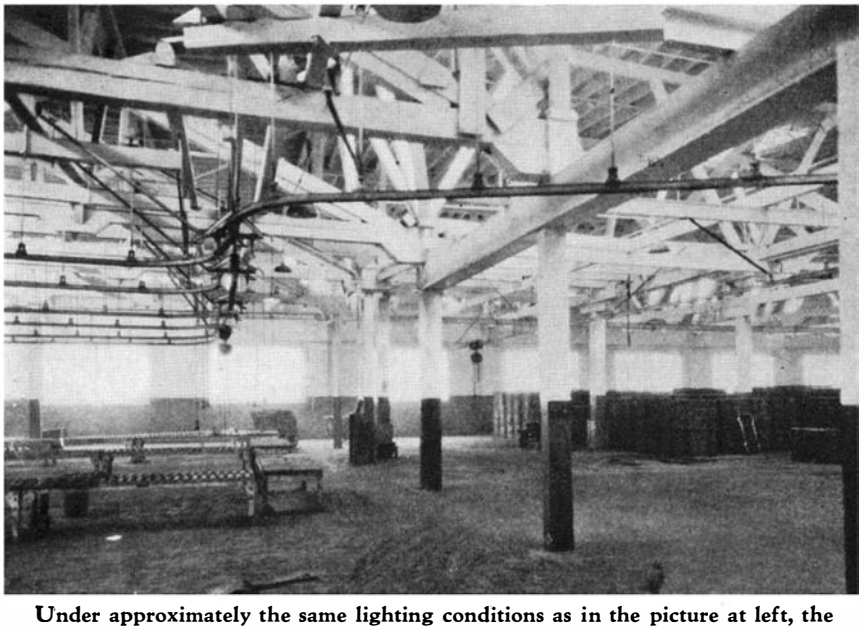
Of the four main groups of phenolics, the first are the rosin modified, or compounds of phenol and aldehydes dispersed in esterified rosin. These resins figure prominently in the "4-hour" varnishes and enamels where quick drying and weather resistance are sought. The second group covers the formaldehyde condensation types, modified with fatty oils. Their use is largely in water-resistant undercoats and baking enamels, and sometimes in lacquers.

Two types of straight phenols make up the third and fourth groups. One is heat-reactive, the phenol compounds being rendered oil soluble and suitable for varnish with dispersion in ester gum or oil. They are used in baking finishes where drying is accomplished by heat polymerization (condensation of like molecules) rather than by oxidation alone. The other type, in the fourth group, is permanently fusible. It is used when quick drying and resistance to water, alkalies, and abrasion are desired.

The paracoumarone and indene resins are neutral, with marked resistance to alkalies, dilute acids, and brine, and their greatest use is in aluminum vehicles and bronzing liquids, coatings for pipes and concrete paints.

We can end this classification with the alkyd resins, made from polybasic acids or anhydrides. Here there are three groups generally recognized. In the first, the resin is modified with natural resin acids and becomes a good ingredient for nitro-cellulose lacquers and for sealers. A second type is modified with non-drying oils and fatty acids for use in lacquers, while the third and last type is modified with drying oils to find some application in practically every type of finish. One distinct advantage of the alkyds is their aid in retention of tint values and high gloss.

The reason these resins figure so prominently in connection with nitrocellulose lacquers, stems from a desire to overcome inherent weaknesses in the latter. It has been patent, for example, that a lacquer which contained a high percentage of solvent and a correspondingly small amount of solid left something to be desired, since a single application meant a thin coat and a substantial loss in solvent evaporation. Synthetic resins came into use when they could contribute a higher solid content, and then, having stimulated creation of many solvents for themselves, it quite naturally followed that they should be used to make their own type lacquers which tended to replace the older one.



Under approximately the same lighting conditions as in the picture at left, the new paint job here pays dividends and promotes safety and worker contentment

RECENTLY a new process was announced which may bring about a recrudescence of the nitro-cellulose lacquers, though commercial application has not yet been fully worked out. It calls for removal of most of the water-miscible solvents, using a mulsifying agent compatible with the film and, finally, emulsification of the lacquer in water by mechanical means. The advantages claimed are a much higher solid content of sprayable lacquer, better brushing qualities, and a reduction in the loss from solvent evaporation, since the vehicle is largely water. Considering that ordinary solvents are inflammable, there would be a reduction in fire hazard.

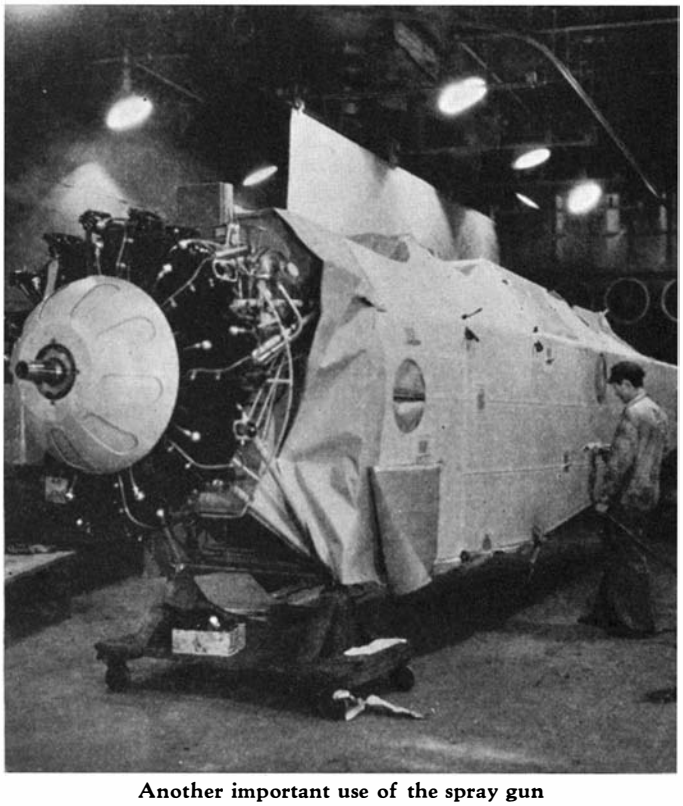
We have portrayed synthetic resins as cutting the widest swath in the industry and this is plainly reflected in the downward curve traced by the importations of natural resins. But there is still another important synthetic to consider. Rubber is being brought forward as a paint base and there are many well-informed technical men who believe that delving in rubber will yield the largest nuggets. Contrary to what might be thought, rubber is being introduced because of its high resistance to acids and alkalies and not for any supposed quality of flexibility. The mental image of a coat of rubber base paint being stretched over a surface is wholly erroneous.

TWO types of rubber bases have reached the commercial stage. One is principally a hydrocarbon derived from crepe rubber; the other a chlorinated form. Both feature resistance to acids, alkalies, and moisture, and both can be formulated to have excellent properties of adhesion. This singles them out immediately for industrial use. The hydrocarbon is pigmented with other ingredients to form a highly plastic material for dispersion in the proper solvents. Variations in formulation make finishes suitable as primers, for use on concrete, or for baking enamels and interior paints. The chlorinated rubber base can be used unpigmented for clear films for indoor purposes, or it can be pigmented with a wide range of ordinary pigments for outdoor exposure and specialty paints, and it is compatible in films with a great number of oils, gums, and resins.

Before we try to evaluate the place of synthetic materials we must consider their use. It is chiefly industrial. Synthetics do find application in lacquers and varnishes, but scarcely at all for interior and exterior walls where approximately 85 percent of all paintable surfaces are said to be. Here synthetics have hardly made a dent—progress in this field is of a different order.

Discussion of household paints demands an abrupt shift from synthetics to natural products—to a discussion of new products, development of new processes, and modification of old ones. Both pigments and vehicles have been affected.

Notable in the rise of natural products has been soy-bean oil. This oil began to have commercial significance after the turn of the century, and in 1933 the paint industry consumed about 8,500,000 pounds of it. It does not have the drying qualities of linseed oil, but it can be used in amounts of 10 to 15 percent of the vehicle in conjunction with linseed and will provide a more elastic film. Furthermore it mitigates the after-yellowing of white paint and enamel. It is now used widely for grinding pastes because it checks skinning-over and fortifies the retention of original tints of the pigment.



Another important use of the spray gun

Fish oil has also grown in favor. Improvements have been made in processing so that today's product has much less odor and its refined types follow closely upon those of linseed. Here again, drying qualities cannot approach those of linseed oil, so only partial replacement can be made. Both soy-bean and fish oils compete with linseed oil more on a price than a quality basis at the present time, but that does not imply that a wider use for them may not be justified as further gains are made in processing and the technique of handling them.

Among the advances in pigments can be mentioned a multiplication of zinc oxide types to obtain special properties such as improved color, brightness, gloss, and leveling. But outstanding in pigment development is the rise of aluminum and the titaniums—dioxide, barium, and calcium base.

Aluminum has received a great deal of attention because it has been brought forward aggressively and has strong eye appeal, but it also has much merit. The aluminum pigments have established themselves firmly in the field of wood primers because of their capacity to prevent "bleeding." They resist acid fumes and the effects of the sun very well, but they are not an all-purpose pigment.

Titanium oxide and titanium barium base were introduced commercially 15 years ago, followed shortly by titanium calcium base. They made a slow but steady gain until recently, then moved rapidly toward the center of the stage when lowered prices made them competitively attractive. Titanium oxide goes into nitrocellulose lacquers where low pigmentation is desired, into oleo resinous enamels and into synthetic resin paints of the glycerine phthalic anhydride or alkyd type. Titanium barium has a much wider use. Its quality of opacity carries it into all types of house paints while its freedom from reactivity has made it a favorite with synthetic resins. Titanium calcium, the newest member of the family, goes into interior paints of the flat wall, gloss, and mill white types, and into primers and sealers. The hiding power of all the titaniums is higher than most opaque white pigments and they are very stable and inert chemically.

THE simultaneous rise of synthetic products with preponderant industrial use and natural products with their broad coverage of household paints presents a picture of currents and cross-currents, and this picture is a valid one. But it is the main flow that we are seeking here and this will become apparent when we touch upon some of the industry's peculiarities.

The making of paints and varnishes has always been a high art and only now is it headed toward becoming a science. Chemists working largely outside the industry, concerned primarily with the utilization of specific materials, have introduced their findings for coördination with existing practice. Thus art and science have been mingled with varied effect. Only in recent years has there been a concerted attempt to seek scientific explanation of everyday procedure in commercial paint and varnish making—to place what has been an art upon a sound basis. This lag makes for slow adoption of the latest fruits of research.

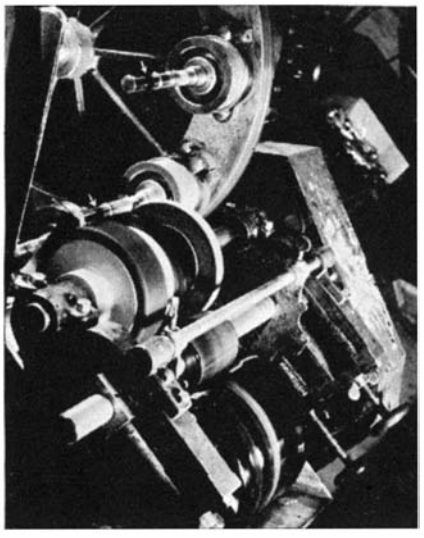
By way of illustration, take the introduction of synthetic resins. They do not stand alone in revolutionary manner, but must be used in conjunction

with rosin, oils, or fatty acids. They go into the varnish kettle—which has always been handled as an art—though their most productive use would presuppose a scientific understanding of the chemistry of the varnish kettle, something which has not yet been worked out for the benefit of the industry as a whole. Working back to fundamentals may conceivably bring forward older materials now appearing to be on the way out, as well as establish the merits of the new. Understanding of synthetic resin reactions, for example, may reveal unknowns relating to the natural resins.

Here current and cross-currents are unmistakable. But ultimately there will be a unified flow involving a scientific grasp of all the many variables now covered by the art. It is essential that this control be established before a maximum use can be made of recent discoveries (or former arts). This will be done. It is being done.

ANY industry in transition suffers a lag in the translation of scientific findings to commercial ends and the paint industry is no exception. Tradition and a solid background even add to the delay, but not forever. There is great impetus for change coming from the purveyors of raw materials who have products for introduction. In time they pass experimentation in the hands of the manufacturer, leading to use if merit warrants. At the moment the speed of introduction is terrific, especially with resins, and the adoption is somewhat retarded by the difficulty of selection.

Let us not overlook the fact that paint is always a compromise. Every paint calls for a different grouping of qualities and there are limits to the speed with which the most satisfactory groupings can be made. Every new pigment, every new vehicle, carries with it its own special combination of qualities which may or may not be altered when grouped with other pigments or vehicles. And there are literally hundreds of new materials. Each enters the arena to



Machine which paints tiny cans for condensed or "minute" coffee. The arrows point to two of the cans

stand or fall on its own merit—to find its own level—and so far the newcomers have been supplementing rather than replacing the older forms. They have not banished the compromise feature but merely lessened it by contributing a broader grouping of qualities. Their real importance lies in the fact that they have expanded the field for experimentation enormously and have thereby multiplied the possibilities for the future.

If anyone looks to the future to provide an all-purpose finish, that future is still far away, perhaps tied to the discovery of an all-purpose resin. At the moment the trend is wholly in the opposite direction—toward specialization. Paint is no longer just paint, where quality of ingredients is indicative of all-around quality of service. The finishes of today must withstand a host of conditions which did not prevail 100 or even 50 years ago. Some must fight corrosion, others must resist gases, and even weather resistance implies different kinds of weathering. A Pullman car, for example, hurtling along with dust abrading its surfaces cannot be protected adequately with roof paint.

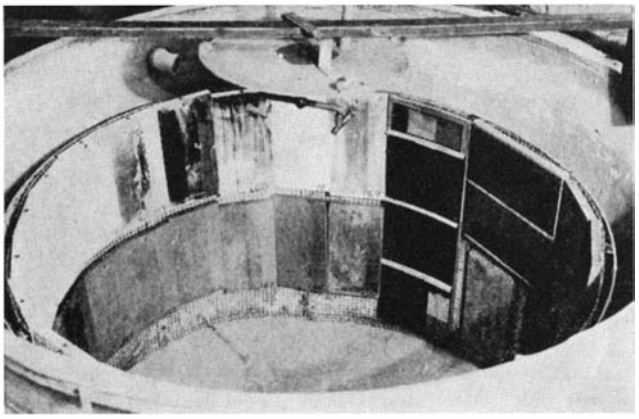
Chemists may very likely create far more enduring interior and exterior house paints. If they succeed, it will probably be through further experimentation with synthetics—rubber, resins, or something yet unknown. Synthetic resins have already established their superiority for the surfacing of electric refrigerators, automobiles, electrical insulation, and for production finishes of many types. Why should they not conquer the field of house paints? That they have not yet done so is due partly to preoccupation with replacement of natural resins and in a measure to disappointment with the outcome of early attempts at utilization.

Given more suitable resins, better combinations, and improved technique, this type of synthetic may yet figure heavily where the home owner will benefit directly, unless the rubber base paints steal a march on it. Chlorinated rubber, for example, gives great promise for exterior finishes. It can be used with most pigments; it has good qualities of adhesion; and flexibility can be imparted to it by ordinary drying oils.

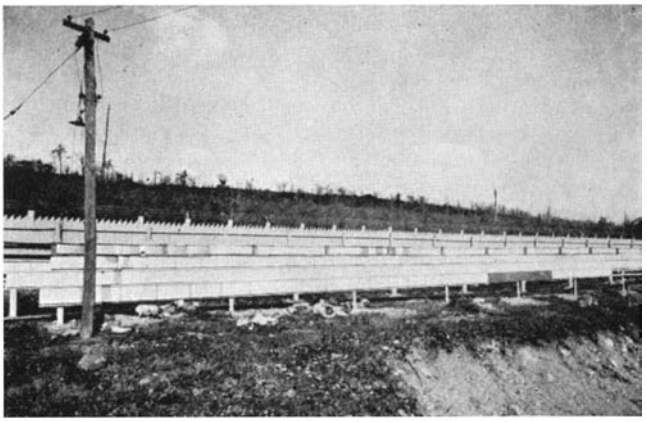
NO paint manufacturer is in a position to prophesy the future of synthetics as opposed to natural materials because he is confronted with factors beyond his immediate control. Whichever proves best, price is a primary consideration, for no matter how good a paint can be made, it must be priced within the consumer's reach and that reach isn't very far. Chemists must succeed in reducing costs still further if there is to be wide acceptance.

Nevertheless, the paint and varnish industry is definitely on its way to bettering products and if it has not yet created an all-purpose paint, there is no loss. When the consumer needs paint for specific purposes today he can come much closer to having his requirements met, for that is the aim of paint chemistry and that goal is being approached relentlessly.

Illustrations Courtesy American Paint and Varnish Manufacturers Association, New Jersey Zinc Company, and The Sherwin-Williams Company.



Strong light, water sprays, low and high temperatures—all kinds of "weather" are used to test paints in this tank



An outdoor test of surface finishes. Small panels, each with one kind of paint, are exposed to outdoor weather

Clouds below this TWA airliner indicate that a storm is probably raging in the lower air

Fly High for Comfort

By REGINALD M. CLEVELAND

THE true stratosphere plane is not yet. Nevertheless, airline operators are looking to higher and higher levels and actually sending their big transports with supercharged motors and controllable pitch propellers into altitudes of 12,000 to 20,000 feet for regular flying. Only a year or two ago these strata would have been considered no place for a passenger airplane except when necessary to hurdle a mountain range. They are doing this for two reasons: The first is economy and regularity of operation; the second, comfort for the passengers.

On the first count, it is well known that at about 18,000 feet one is normally above the cloud area and has perfect visibility. Through the rapidly developing science of air mass analysis or "polar front" weather predicting, definite strata of favoring winds can be selected with surprising accuracy, especially at high levels. Furthermore, cruising speeds with modern supercharged engines and with adjustable propellers can be maintained around 200 miles an hour in thin air, using only about 75 percent power, although the throttles may actually be wide open.

The newest propeller development, the Hamilton automatic "constant speed" propeller, is destined to aid materially in such operation. It maintains any chosen engine revolution by automatically changing pitch of the blades through the action of a simple governor controlling oil pressure.

It has been determined that on a journey of 600 miles with a specific 200-mile-an-hour airplane equipped with modern engines and propellers, 26 minutes can be saved by climbing at once to 13,400 feet and then cruising at this level for most of the journey before beginning the landing glide, as compared with flying the same distance with the same airplane at or near sea level.

REGULAR transport flight over long distances at altitudes from 15,000 feet upward, however, will inevitably mean the use of fully sealed cabins supplied automatically with oxygen to compensate for the rarity of the atmosphere. Oxygen in flasks is already supplied when such journeys are in contemplation. It has been used regularly on Pan-American Airways over the Andes for a number of years. It was used by a number of passengers on spectacular transcontinental flights on TWA and on Eastern Air Lines which Captain E. V. Rickenbacker commanded. But this is not sealed cabin operation.

It is but a step, however, from forced and soundproofed ventilation, already a feature of modern transport ships, to the sealed cabin with controlled oxygen supply. Such equipment would appear to be a necessity in the nature of things if the high levels are to be continuously used, since human reaction to altitude is a matter of heart, lungs, and nerves. Disturbing or even tragic incidents might well occur which could readily be prevented if the sea-level oxygen content of the cabin were maintained no matter how thin the air which the plane was cleaving.

The whole question of passenger comfort is one which the airlines are finding of growing importance. Creature comforts in the main have been well provided. Notable advances in soundproofing and in the elimination of vibration mark the most recent types of airliners. Temperature control is already satisfactory.

Although with the exception of the giant liners of Imperial Airways and the newest Dutch Fokkers, the same cannot be said of existing airplanes in Europe. The new transport types, especially those of France, which will soon be in the air, are much on a par with our better machines in these respects. Indeed, these planes have taken a whole handful of leaves out of the American book of practice, both aerodynamically and in what might be called the structural comfort features.

Remaining problems relate rather to the method of operation and the actual flying of the planes which reach very high cruising speeds. They apply to flying on one side of the Atlantic as much as on the other.

Approaching the Stratosphere . . . For Economy and Regularity of Operation . . . More Speed With Less Power . . . Avoiding the Bumps

While a high-speed airplane is enabled by its very swiftness to avoid many storms and turbulent areas, it is also true that when it does get into rough air, the impacts of gusts and bumps are much more severely felt than at lower speeds. The plane structure may be of such strength as to be able safely to withstand the stresses involved in these impacts; it may be able, with complete security, to plough through the storm and thermal currents over broken terrain, mountains, quickly alternating land and water, and the like. But the passengers are due for a very unpleasant ride under these conditions.

For this reason, many pilots throttle back when they get into rough air. But many do not, and the plane load of passengers which has taken a thoroughgoing beating does not make the best kind of propagandists. Airlines in this country are beginning to realize forcibly, however, that having sold successfully the idea of speed, they must now give increased attention to the idea of a smooth ride, comparable in all its conditions of comfort to that upon the glistening rails, which is afforded by a first class air-conditioned train.

Winds aloft are, as has been said, in strata. The air may be very bumpy and rough at 2500 feet and very smooth and agreeable at 6000 or 8000 or 10,000. In consequence, the wise airline operator is instructing his pilots not merely to seek the level of the most favorable tail winds, but to seek also the level at which his plane load of passengers may obtain the smoothest ride.

But the comfortable flying of a plane is not concerned only with the matter of seeking the least turbulent air levels. It is a matter also of the whole method of take-off, climb, descent, and landing. Unfortunately there are still on the airlines a few pilots of the "hero" school. They may be excellent fliers, most of them are; they may even be very safe and technically correct fliers, fully conversant with all the details of their craft and skilled in getting the most out of them. At the same time, they may be the worst of advertisers from the point of view of increasing patronage on their particular airline.

It does not sell air transport, for example, on a flight of, say, 250 miles, to climb a fully loaded plane as steeply as possible to a level of, say, 4000 feet where there is an excellent tail wind but bumps like a roller coaster, hold it there irrespective of the gusts and buffeting till the plane is practically over the boundary of the airport of destination, and then lose nearly all the altitude in a couple of wide swooping circles, so that the eardrums and sinuses of every passenger feel as if they were about to burst from the change of pressure.

ONE of the lines which flies fast and high between Pittsburgh and Newark has instructed its pilots to begin to lose altitude flying eastward about at Trenton. The result is that the big planes coast so gently down hill that one hardly realizes that he has just come down 6000, 7000, or 8000 feet in 40 miles. A comfortable maximum descent is 450 feet a minute. It is all just a matter of operating technique, but it is a matter that a progressive line seeking to build up passenger revenue from full plane loads cannot afford to neglect.

Passenger reaction to the kind of a ride he has enjoyed is more or less alike all over the world. A leading French authority whose business requires him to travel frequently between Paris and London was discussing recently the cross Channel air services. There are now three such services on frequent schedules; two are British and one French. One of the British lines is considerably the cheapest of the three. The French line is measurably the fastest of the three, but the vast bulk of the traffic, this experienced traveler found, took the other British service, that of Imperial Airways, because it was the most comfortable. Its huge, roomy planes, fitted like a luxurious club lounge, and offering every physical nicety of first class travel, were also operated with an eye to smooth riding, partly due, of course, to their relatively low cruising speeds. He and the bulk of other travelers who have taken to the air rather than submit themselves to the stormy passage of the Channel, found it well worth while to pay a modest premium and to sacrifice perhaps 20 minutes of time just in order to be comfortable.

Much remains to be learned, of course, in the realm of the relation of weather to flight from the point of view of smoothness. The development of air mass analysis weather forecasting holds out immense promise of much more definite and accurate long-range prediction. It is sure to play an important rôle in the economics of air transport, and there are those who believe that 10 or 15 additional miles an hour average cruising speed, without increase in horsepower or design modification, may be its gift to air travel. It is quite possible that it can do much, also, to iron out the bumps for the traveler.

Modern air transportation. A United Air Lines plane flying high

A view taken from the east bank of the Columbia River at the site of Grand Coulee Dam. Gravel washing equipment is in the foreground; across the river are the contractor's camp and Government road grades

On a Natural Damsite

At Grand Coulee . . . Original Dam Was Pushed Up By Nature . . . Man-Made Dam Will Be In Two Units, For The Development Of Hydro-Electric Power

By GRACE KIRKPATRICK

UNCLE SAM now has underway one of his greatest construction projects, on the Columbia River in central Washington, 92 miles west of Spokane—the Grand Coulee Dam.

Spectacular and colossal as this structure will be—for it is planned as one of the world's largest—still there was a greater dam at the same spot centuries ago. This original dam, however, was not built. It was pushed up by nature, and because of it the Bureau of Reclamation now finds ready at hand a huge reservoir in which will be impounded the waters of the Columbia which will be distributed to millions of thirsty acres.

The story of this dam of ages gone, is the story of the Coulee. It was formed by a prehistoric glacier descending from the north and carrying with it thousands of tons of earth, sand, gravel and rocks. The glacier reached the bed of the Columbia, a mightier river by far than it is today, and dammed it. The torrents of water broke through the high cliffs that border the Columbia, in an effort to find a course, and flowed down what today is called the Grand Coulee or "grand valley." As the glacier retreated to the north, the river returned to its original course and left the Coulee a place of geological wonders, a place of giant black rock and vast silences. It is a valley with walls at some points a thousand feet high, showing in their stratification seven distinct lava flows that descended on the region even before the time of the ancient glacier.

IT is the upper 20 miles of this Grand Coulee, rockbound as it is, which will be closed with dams at both ends to form the reservoir when the Grand Coulee dam is finished. This site was chosen because this old reservoir was conveniently at hand, and because the surveying and testing which were carried on for years by the United States Army engineers, the engineers of the Bureau of Reclamation, and of the state of Washington, revealed a bedrock of solid granite at this point on the Columbia River where the Coulee joins it.

To understand how great this dam will be, it is necessary to know something of the Columbia River which, in the United States, is second in size only to the Mississippi. Because its source is high in a region of melting snows in the mountains of western Canada and Montana, its discharge is more continuous throughout the entire year than that of any other river of the land and in 1934 it carried more water than all the streams of the arid regions of the west and middle west combined. At the site of the Grand Coulee dam, it has a minimum flow of 17,500 second feet and a run-off five times as great as that of the Colorado River at Boulder Dam.

This great surge of water rushes on, sweeping across the state of Washington and forming for many miles the border between Washington and Oregon, unused, to the sea. On the plateaus

above its canyon-like banks are millions of arid acres known as the Columbia Basin project. Dr. Elwood Mead, the United States Commissioner of Reclamation, has called the Columbia Basin "one of the most fertile bodies of irrigable land in this or any other country" and there are 1,200,060 acres of it which can be irrigated from the waters of the Columbia when the Grand Coulee Dam is complete.

The dam is to be built in two units—a high dam and a low dam. The low dam is now underway, the Government having awarded the contract to a group of New York, Iowa, and California contractors who have combined as the Mason-Walsh-Atkinson-Kier Company.

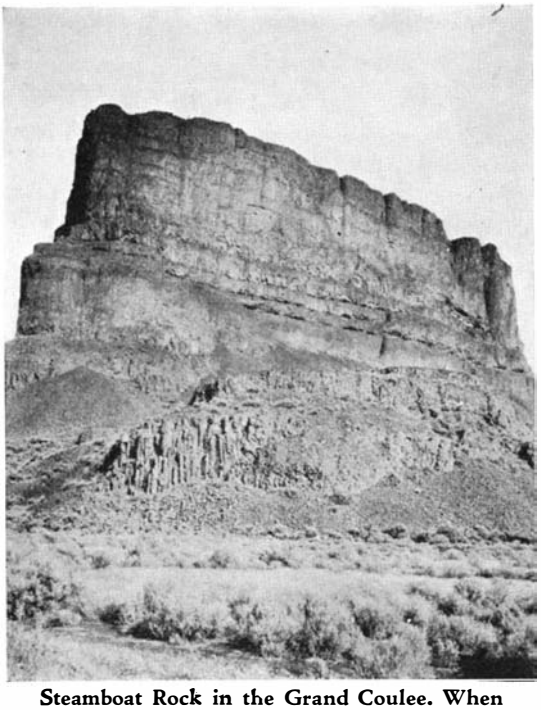
THE low dam is exclusively a power development, while the high dam will be a combination power, irrigation, flood control, storage, and navigation development. It is the key dam on the Columbia River, which river holds the greatest hydro-electric possibilities of any river in the United States. It will raise the waters of the Columbia so that they can be pumped into the reservoir of the Grand Coulee, thence to flow over the parched acres of the Columbia Basin project. It will, in addition, back up the waters of the river to create the longest artificial lake in the world which will extend 151 miles to the Canadian border and beyond.

The Grand Coulee Dam will be the largest power development possible in North America. The high dam, 500 feet above bedrock, and 4100 feet long, or nearly four times the length of Boulder Dam, will develop three times the power of Muscle Shoals, 50 percent more power than Boulder Dam, or as much as the total installed capacity of Niagara.

Until about a year ago, the great river rolled on unheeded. The Coulee was a place of weird shadows and undisturbed sagebrush plains. Then President Roosevelt caused the Public Works Administration to allocate 63,000,000 dollars to build the first unit, or low dam. At once engineers started their surveys and plans. Test pit diggers and diamond drill men moved in by the score to make their observations, with the result that it has been determined that under the swift flow of the Columbia, under the towering hills which are powdery fine with volcanic ash and sand, and under the clay beds of the river banks, there is solid granite. As R. F. Walters, chief engineer of the reclamation service states, there is provided in this granite a perfect and a safe foundation for the colossal dam which, as designed, will be a concrete straight-gravity dam. The first development, now under way, includes the main portion of excavation for the high dam, the construction of a concrete straight-gravity dam about 200 feet below the elevation planned for the high dam, and a permanent downstream coffer-dam and a power plant. The permanent coffer-dam located below the toe of the present development will form the toe of the high dam

The dam now being built will require 4,000,000 barrels of cement, 23,000 tons of steel for coffer-dams, 67,000,000 pounds of steel for reinforcing, and 50,000,000 board feet of lumber.

The low dam will measure 300 feet in height, with a length of 3400 feet at the crest. It will have a total capacity of 700,000 horsepower of electrical energy with 147,000 horsepower to be installed at the start. It will require about four and one-half years to complete.



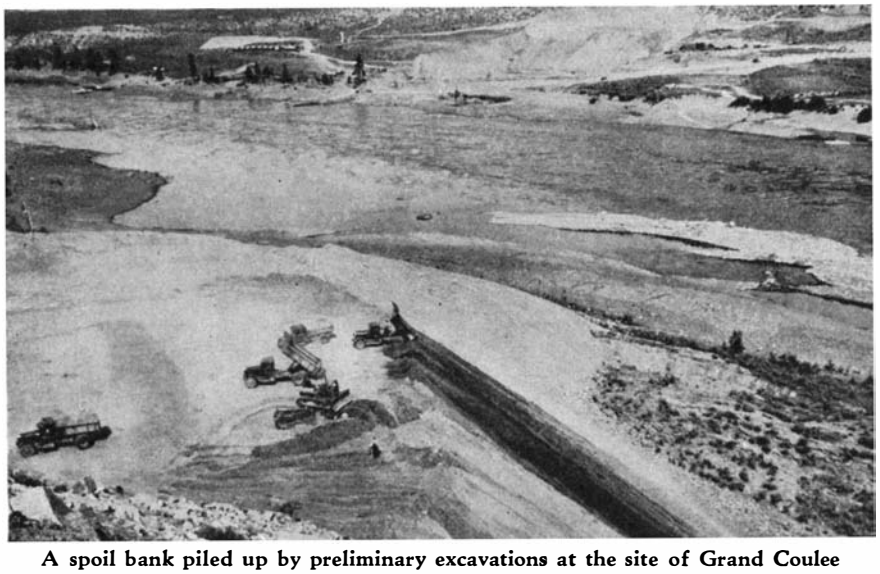
Steamboat Rock in the Grand Coulee. When the dam is finished, many geological formations such as this will be flooded by water

The cost of the ultimate development, or high dam, will be 179,000,000 dollars. This dam will measure 500 feet above bed rock, with a length of 4100 feet at the crest. It will have a capacity of 2,646,000 installed horsepower and require about six years to build. The spillway in the center of the high dam will be 1800 feet long and 325 feet high, and water flowing over it will present one of the world's most remarkable water spectacles.

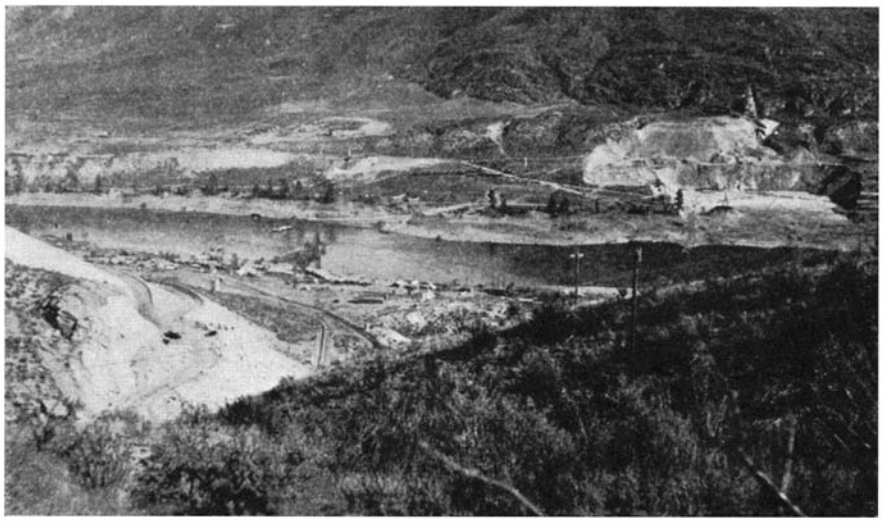
UNITED STATES Army Engineers estimate completion of the Columbia Basin project will add 1,403,000 people to the population of the Pacific Northwest, and based upon the present per capita wealth of this region, the increased taxable wealth will amount to 3,000,000,000 dollars.

In any such mammoth project there are of course problems of engineering, solutions of which seem as miracles to the layman, but in starting the Grand Coulee there were obstacles peculiar to it which had to be worked out at once.

The damsite was some 20-odd miles from a railroad and almost as many from a highway. True, there was a scenic road along the floor of the Coulee and winding down the sheer cliffs to the Columbia, but it was in no sense a heavy duty highway fit to bear tractors and big machines. In fact, it gave way utterly last winter during the preliminary excavation. With a road down the Coulee already complete, the Government is now at work constructing



A spoil bank piled up by preliminary excavations at the site of Grand Coulee Dam. This bank forced up the islands visible at the right, and may have to be removed as work progresses and further excavations are made to reach bed rock



Looking down on the construction work for the Government railroad and highway at the damsite. Excavation at right is for the east end of the big dam

an extension of it from the end of the Coulee down the cliffs to the site of the new Government town and the damsite. In some places this means blasting through solid granite; in others it calls for the careful sloping of easily disturbed hills of fine powdery sand.

A railroad is also rapidly stretching out the 20 miles between the dark Coulee walls and is likewise being constructed down the precipitous cliffs by means of curves and switchbacks.

IN addition, the government found itself compelled to build a bridge in order to build a dam. Since the white man came to the west the Columbia has been crossed at this point by means of a crude ferry. Adequate for Indians from the nearby reservation and for the ranchers and sheepherders bringing their flocks down from the hills, this ferry would not do for railroad cars, for cement, for steel and heavy machinery such as will be needed for a gigantic dam. A steel cantilever bridge is therefore being built to take its place forever.

The actual building of the dam also entails two major problems, according to F. A. Banks, engineer of the United States Reclamation Bureau and in charge of construction at the Grand Coulee.

"The immense amount of excavation necessary, the great force of the Columbia River, and the huge amount of water it carries are three problems which confront us," Mr. Banks said.

Because of the large amount of overburden, and because the dam will stretch out to such great length, the excavating calls for the removal of 15,000,000 cubic yards of material for the low dam and an added million for the high dam, whereas the entire amount of excavation at Boulder Dam totals 6,000,000 cubic yards. The figure given for Boulder Dam includes the excavation for diversion tunnels but there are to be no diversion tunnels at the Grand Coulee.

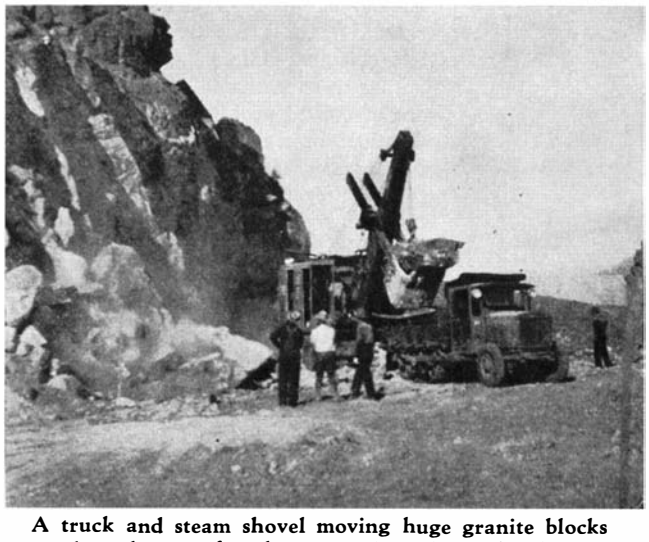
The reason for this last brings us to the second problem, the handling of the great force and flow of the Columbia River while the dam is being built. Engineers have decided that it would be impossible and impractical to dig diversion tunnels to carry the mighty stream in another course while the dam and its foundations were being put in place. To turn the great stream entirely from its deep gorge was much too gigantic a task.

Instead, the plan is to build circular coffer-dams on both sides of the river where the dam will cross, thus diverting the waters to the extent of temporarily forcing them through a narrowed channel in the center of the river. Inside these circular coffer-dams two sections of the big dam will be built, one extending toward the center channel from each shore. In these two sections of the dam, openings or tunnels will be left. When they are complete, the two circular coffer-dams will be removed and others will be built to divert the water from the center channel and force it to flow through the openings or tunnels in the dam. With this accomplished, the center section of the dam will be built to join the two end sections reaching out from the two shores.

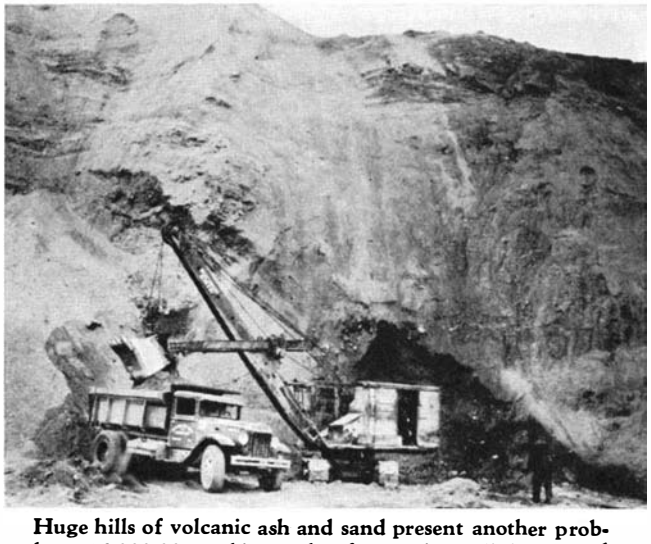
A STUPENDOUS undertaking it sounds, and is. A fascinating task to watch even in the early stages now in progress, for the silence of the Coulee is utterly shattered. Huge bulldozers and trucks are heard constantly. Blasting throws shattering echoes through the hills. Hundreds of houses, warehouses, office buildings are rising where only sagebrush grew for centuries. Pile drivers and gravel washers bang and clatter. Grand Coulee Dam is under way.

●

A vehicular and railroad bridge across the Mississippi at New Orleans has long been needed. Such a bridge is now under construction. The pertinent details of it, as well as the economic significance of its location will be told in an article soon to appear in these pages.—The Editor.



A truck and steam shovel moving huge granite blocks to clear the way for the railroad grade to the damsite



Huge hills of volcanic ash and sand present another problem. 16,000,000 cubic yards of material will be moved

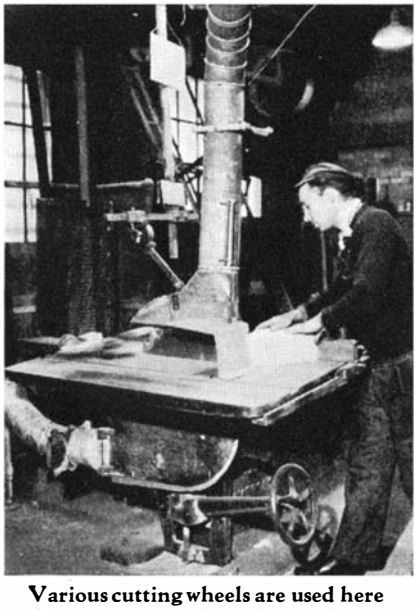
Cork in Fire Bricks

Diatomaceous Earth and Clay Bricks, Molded With Water, Made More Porous By the Use of Cork

By T. E. WOOD

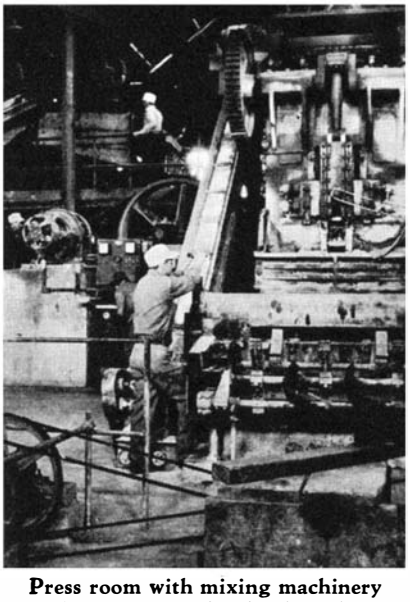
FUEL, heat control, and refractories are the three essentials of the modern furnace. In many cases, gas is considered to be the best and most economical fuel. Heat controls have reached a high point of development. Recently, progress in the refractory phase of this trio has taken a spurt forward, thereby materially increasing furnace efficiency. Refractory insulating brick, now available, will produce savings in fuel and heating time and facilitate heat control by reducing heat losses through conduction and radiation some 60 to 70 percent. These economies result not only from the low thermal conductivity of the semi-refractory materials but also from their light weight which accounts for a low heat capacity. One of the leaders in this field of development is the Armstrong Cork and Insulation Company.

The most important ingredient used in the manufacture of insulating brick is diatomaceous earth, a light cellular mineral that has a very low heat conductivity. Pulverized and mixed with ground cork and clay, this earth is molded to shape and fired in a kiln. The cork is burned out, leaving additional air cells that help to increase the insulating qualities of the brick or molded shape.



Various cutting wheels are used here for cutting special insulating shapes

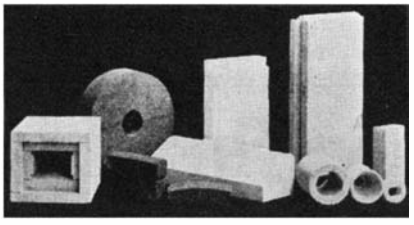
Insulating brick are made at Armstrong's Beaver Falls plant by the soft mud process which consists of mixing the materials with water to obtain the right plasticity, filling multi-cavity molds with this mixture, and subjecting it to high pressure in giant presses. The molds are moved out of the presses and mechanically upset so that the brick and shapes



Press room with mixing machinery and giant press for brick making

fall on traveling belt conveyors which take them to the dryers. Operators remove the brick from the conveyors and pile them on the drying room shelves where they are dried with heat from steam coils. Large special shapes are molded by hand. Firing is accomplished in one of two gas-fired kilns, each 300 feet long. Cars are pushed through the kilns by mechanical pushers. Heat is supplied to each kiln by eight gas burners, four on each side, and as there is no muffle, combustion takes place directly within the kiln.

Nozzle mixing burners are employed, air being supplied by a motor-driven blower through one pipe and gas through another, both of which terminate in the burner. Orifices are set in a ratio of 10 to 1 and the gas and air



A few refractory shapes which can be made by the ground-cork process

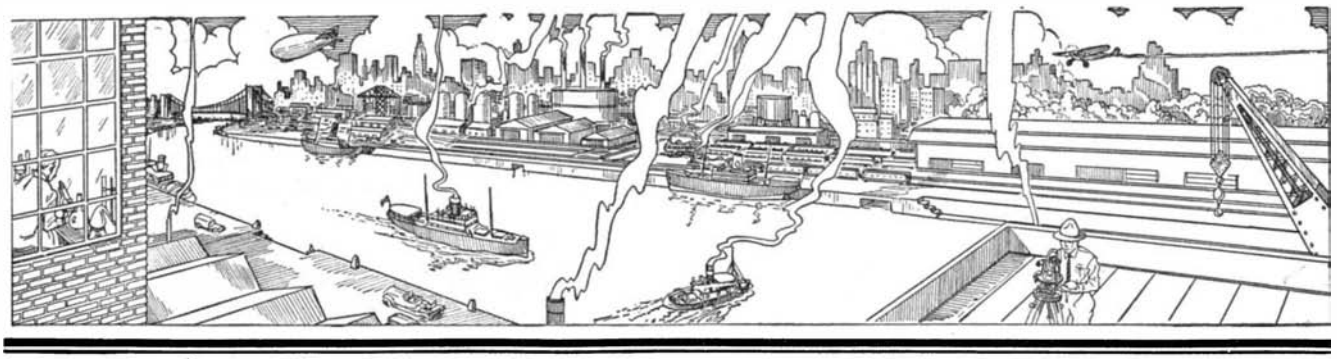
pressures are always maintained at the same pressure by a zero governor in the gas line and a by-pass from the air line.

Fluctuations in the air pressure by turndown or otherwise are instantly reproduced in the gas line and this system permits a single valve control; in this case, a blast gate valve in the air line.

MACHINING to size is an important phase of production in this plant and the tolerance is held to 0.01 inches. When the brick are fired they acquire a slight bow and this is corrected in the first machining by grinding with emery and Carborundum wheels. The other faces are then finished to size. Another important activity of the company, in connection with its customer service, is the manufacture and stocking of a large number of special sizes and shapes. In making up many of these a standard size 24 by 12 by 4½ inches is produced and these are cut to specifica-

Kiln room showing two gas-fired tunnel kilns for insulating bricks

tions with circular and band saws and disk grinders. Standard sizes for skewbacks, circular crowns, and so forth, are made in this way. Adjustable saw tables are provided for a wide range of tapers and heights. Shapes for suspension are drilled for pins and are used for placing a flat arch where furnace conditions permit.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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

A. E. BUCHANAN, Jr.
Lehigh University

Probing Into Brain Processes

CHANGES in electricity in the brain promise to allow physicians to probe painlessly into the brain processes of healthy and sick persons in much the same way that heart action is now studied by graphic records of the electric currents emanating from heart muscle.

Pieces of metal fastened next to the skin

Science Service Photograph

Science probes into the brain processes with this instrument set-up

on the patient's head pick up the brain currents. The patient feels neither pain nor other unpleasant sensation from the strange-looking headgear shown in the accompanying illustration. The instrument, resembling somewhat a radio set, is a vacuum tube amplifying system. This magnifies the brain waves so that the current can operate an oscillograph which writes in light on a film a wavy line corresponding to the fluctuations of the electricity in the brain.

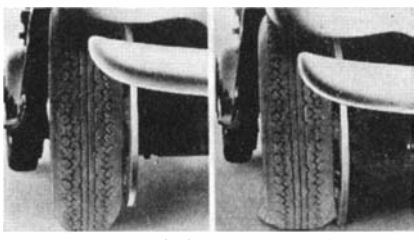
This particular piece of apparatus was used by Drs. H. H. Jasper and L. Carmichael of Brown University and Bradley Hospital in research which confirmed in many particulars earlier work of Dr. Hans Berger of Jena, Germany.

"Electro-encephalograms" is the name for the wavy line records of brain action currents, corresponding to electro-cardiograms, the name for the similar records of heart action now familiar to physicians and to many heart disease patients.

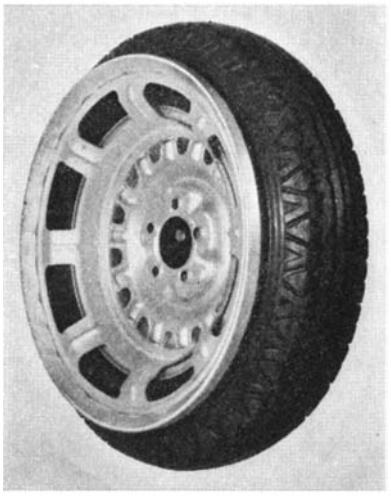
Two kinds of brain waves were detected by both Dr. Berger and Drs. Jasper and Carmichael. Change in size of the larger or "alpha" waves appeared under the influence of various factors such as anesthetics, epileptic seizure, stimulation of the sense of sight or hearing, and work on a "mental" problem. The waves are largest when the person is relaxed. Difference in frequency or lack of synchronism between one side of the head and the other appeared in some normal and especially in sick persons.—*Science Service.*

Attachment Cuts Blow-out Danger

A NEW invention for the motorists' safety is the Tire Guard, a wheel attachment that is said to eliminate all danger from blow-outs at any speed. This Tire Guard is the invention of Herbert V. Ludwick, wheel engineer and designer. The Tire Guard, according to the manufacturers, is really an extra inner wheel or rim that is attached to and becomes part of the regular wheel. When a blow-out occurs or a tire goes flat, the car simply rides on this inner wheel and there is no swerving or undue shock. The Tire Guard device, it is said, keeps the car under easy control when tire trouble happens, and in addition, no damage is done to rims, tires, or tubes.



Two views of the Tire Guards, under normal use and with a flat tire



The Tire Guard, showing how it is rigidly attached to the car wheel

Ralph De Palma, of racing fame, says: "Tire Guards, I believe, could have saved the lives of many fine racing men."

Yarns that Control Dye Absorbtion

RECENT perfection by research engineers of the Ewing-Thomas Corporation, Chester, Pennsylvania, of mercerized cotton yarns with controlled affinity for dye, has occasioned great excitement in the textile industry. Development of the new yarns, which are called Metro-Shade, is of great importance to the two largest branches of the textile family—cotton, one of the oldest known fibers, and the synthetic fiber group, youngest giant of the industry.

Once upon a time fabrics were loomed of silk or linen or wool or cotton. Today's fabrics are much more complex. More than 200,000,000 pounds of synthetic or man-made fibers were produced in the United States last year. The amazing diversity of modern fabrics is the result of combining these various fibers one with another and with natural fibers.

Once stockings were made simply of cotton or wool or silk. Today's stockings frequently combine several fibers, each neces-

sary because it best serves a particular purpose when all are combined in the finished product.

All of this brought about a serious problem to which answer has now been made. Each of these various fibers reacts differently to dye, and what to do about a stocking that comes out of the dye bath deep dark gray in the leg, and pale dirty gray in the foot? How best to achieve perfect dye union between various fibers knitted or woven together in wearing apparel has for years been the subject of intensive study and experimentation. Dye manufacturers have long sought the answer in dye formula modification, with only indifferent success up to the present time.

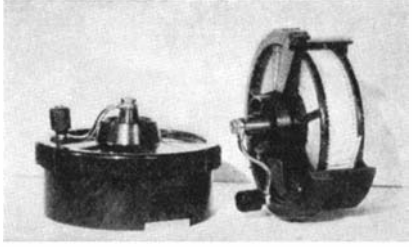
Ewing-Thomas technicians attacked the problem from the cotton point of view. After several years of experiment and research they succeeded in producing mercerized cotton yarns with either a heightened or a retarded affinity for dye. This was accomplished through control of the basic structure of the yarn as this structure relates to depth of shade in dyeing, says Henry A. Stafford of the Ewing-Thomas Corporation. Metro-Shade No. I processed for high affinity to dye is the answer to Bemberg yarn combined with cotton, while Metro-Shade No. II with retarded dye affinity is designed for use with viscose yarns.

Two facts involved in the Metro-Shade development are the appearance of the finished merchandise in which, of course, clarity, depth, evenness and fastness of dye are highly important, and the cost of the finished merchandise, in which dyeing is an important consideration. With Metro-Shade yarns, it is pointed out, single instead of multiple dye baths are possible, less dye is required to get results, and "seconds" or inferior merchandise, due to dyeing imperfections, are materially reduced, thus increasing production.

It is interesting to note also that color differentiation can now be achieved through use of the new yarns. Children's socks, for example, can now be candy striped in one dye bath simply by alternating Metro-Shade yarns with regular yarns. Very often, also, woven or knitted fabrics such as ribbons or gloves, not to mention beachwear, have cotton backs with synthetic fiber faces. Here again, Metro-Shade is highly important in the achievement of rich, even colors. And in case you have forgotten your Greek from which Metro-Shade derived its name —it means "combining of shades."

Film Developing in the Air

THE Davidge Film Laboratory, of Hollywood, has created a new method of developing photographs, enabling fliers to put exposed films in process before returning to their naval base or airplane carrier.



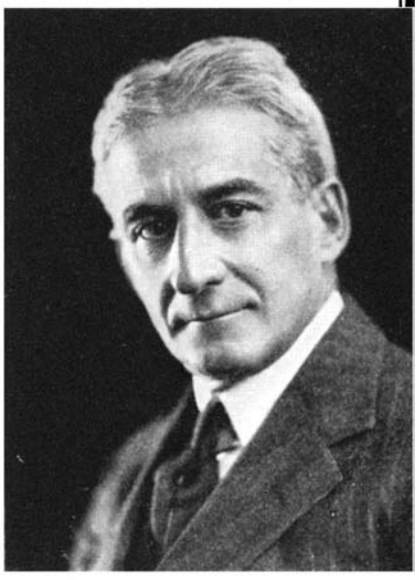
Movie film-developing tanks used to process film strips while flying

The tanks are completely molded in Bakelite. Light is kept out of the tanks by a bypass which also drains the tank of its developing solution. The tank has met with considerable approval all over the world, some having been adopted by the Japanese Navy, with considerable demand created on the part of other countries. Other patented construction features produce absolute maximum of agitation insuring rapid uniform development of both high-lights and shadows with color separations and gradations that heretofore have been considered impossible. Film capacity is 25 feet of 35-millimeter film, or 50 feet of 16-millimeter stock. The amount of developing solution required is about 18 fluid ounces. It is stated that this small developing unit is also used by the professional cinematographer and sound recorder for tests of short lengths of exposed negative film while "on location."

PROGRESS In This Age Of Science

As Told to Scientific American

By GERARD SWOPE
President, General Electric Company



A GREAT development we are looking forward to in the electrical art is the extension of the electron tube into the power field. Direct-current transmission of electric power has long been the quest of engineers and such power tube development may accomplish this in the near future. Direct-current transmission of power possesses striking advantages of control and stability, which would greatly simplify existing problems and greatly reduce present limitations in long distance transmission of electric power.

In the home and factory, electric power and heat already have largely reduced human physical exertion. Few, if any, are the household tasks that cannot be done electrically, and, we think, done better. Research and development in the electrical industry have continued and are preparing the way, through air conditioning, to far more healthful living in the office, in public buildings, and in the home.

Research in our own laboratories has been continued throughout the depression and will be continued in the future. It has a great stimulation to the art and progress in the electrical industry, and we believe new inventions and better methods are bound to be as great in the years ahead as they have been significant in the past.

GENIUS

THE declining birthrate in the professional classes need not cause us to expect social disaster, according to studies at Harvard of 3000 school children. These studies show that geniuses in largest numbers spring from the middle classes.

Lubricated Raisins

SEEDED Muscat raisins are sticky, messy things to handle, as every housewife who has pried them out of a package knows. Yet they are mighty good raisins. So the raisin folk have devised a way to pack them that eliminates the old sticky, compressed block of raisin meats. They are now lubricating each raisin so that it is not sticky at all, but bright, shiny, and separate. It takes only a gallon of oil to lubricate a ton of raisins. And here's the best part of the idea—the oil is made from the seeds of the raisin.

The oil extracted from the seeds is refined to such a point that it can be used as a salad oil. It does not affect the flavor of the raisin, does not become rancid, and helps protect the fruit from insect infestation.

From 2000 to 4000 tons of cleaned, dried seeds are removed from California raisins each year. This makes more than enough oil to "grease" all the sticky raisins and to "shine up" the otherwise dull seedless varieties. The surplus oil is sold for salad oil, according to *Food Industries*.—*A. E. B.*

New Solvent for Rubber

A SOLVENT for synthetic and natural rubbers has just been announced by E. I. duPont de Nemours and Company. This new solvent is beta-trichlorethane, a non-inflammable, water-white chlorinated hydrocarbon.

Besides its unique solvent power, beta-trichlorethane is a rapid and powerful solvent for such organic materials as oils, fats, waxes, tars and natural resins. It is miscible with alcohol, ether, and many other organic solvents, but is practically immiscible with water.

Other properties of beta-trichlorethane include a boiling point of 114 degrees, Centigrade, (237 degrees, Fahrenheit), a specific gravity of 1.4406 (12 pounds per gallon), and high stability in the presence

A motor car being carried by a Burnelli all-wing lifting fuselage plane in a recent spectacular test. This type of plane is described in these columns

of light and water. Because of this last property, it is non-corrosive to most materials of construction, an important feature in industrial applications.—*A. E. B.*

HAPPY LANDING!

AIRPORTS and landing fields in this country totaled 2297 on January 1. Of these, 664 were partially or fully lighted for night use.

All-Wing Lifting Fuselage

FOR many years Vincent J. Burnelli has been engaged in the application of an original and valuable principle—the Burnelli Lifting Fuselage.

Our readers will grasp from the illustration the essentials of a Burnelli transport. The fuselage is itself an airfoil blending into the highly tapered wing. The engines are placed at the nose of the fuselage itself without the necessity of outboard wing nacelles. The pilot and co-pilot are seated well behind the two propellers and the propellers are set very closely together, with tips just clearing one another in their plane of rotation. A great many advantages derive from these characteristic Burnelli features.

The passenger cabin can be made of relatively enormous width, commodious and comfortable, without the slightest sacrifice of aerodynamic efficiency. The airfoil-shaped fuselage does its own lifting, so that for a given gross weight and a given landing speed the area of the wings may be reduced by the full extent of the projected area of the fuselage. The area and length of the cantilever wings being reduced thereby, their structural weight goes down accordingly. Since the wing merges into the top of the fuselage, downward vision for the passengers is unimpeded. This is achieved in the ordinary high wing monoplane but then it is awkward to retract the landing gear. In the Burnelli design it is possible to retract the landing gear directly into the bottom of the fuselage, owing to the great width of the latter. Again, since the engines are so far ahead of the fuselage, a natural shock-absorbing system is provided as a safeguard to both pilots and passengers in case of a crash. The fact that the two engines in this arrangement can be placed closely together reduces the unbalanced turning moment should one motor go out of commission. On the first flight, the speed and control were excellent but the trials ended in a disastrous accident.

Moving pictures showed that the two ailerons fluttered, then came off; first on one side and then on the other. The right wing tilted downwards. The pilot "gunned" the right engine in an effort to pick up the low wing, but nothing could stop the roll. Soon the right wing tip crashed into the ground followed by the two engines, which were both torn from their mounts by the terrible impact. The experienced pilot, Lou Reichers, had cut his ignition switch and kept the landing gear retracted into the cabin floor. The crash, while regrettable, served as a remarkable demonstration of the strength and safety features of the airplane. The pilot himself, though shaken, escaped all injury. With the whole front of the ship acting as a vast shock absorber and with the rugged construction of the plane, the pilots' cock-pit and the passenger compartment remained virtually intact.

The Burnelli engineers, after careful investigation, have decided that the ailerons were not sufficiently balanced in weight about the hinge and that the dual control system was somewhat too flexible. A second ship of very similar construction, with the aileron system thoroughly revised, is being pushed ahead. With our sympathies to the constructors goes the confident hope that the new ship will soon be successfully completed.

In addition to the advantages enumerated above, the cheapness and simplicity of construction of the Burnelli transport has a decided appeal for certain of the airline operators who are watching these developments with considerable interest.

In a recent spectacular test of a Burnelli ship very similar to the one which crashed, a motor-car of the roadster type was carried below the fuselage as shown in the photograph. The purpose of this demonstration was to prove the possibility of using aircraft for high-speed transportation of small land vehicles or boats. In times of war, for example, small tanks might thus be carried to the scene of action and released at strategic points.—*A. K.*

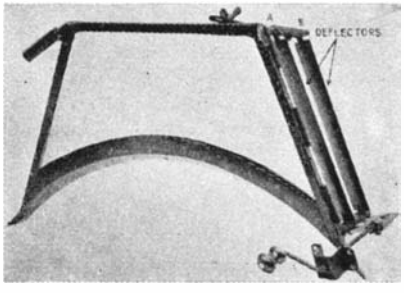
New Windshields for Bad Weather

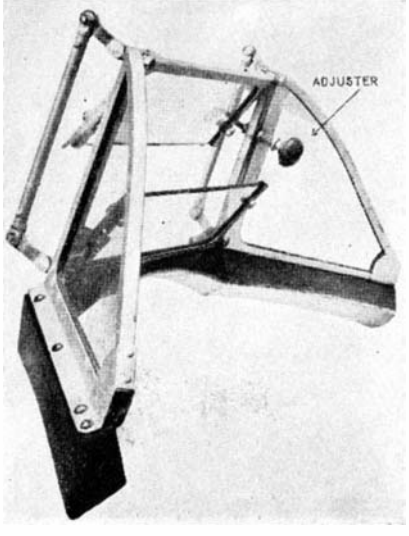
THE windshield of an airplane is used to protect the pilot from wind and bad weather conditions while preserving an adequate field of view. The shielding is a comparatively simple matter, but obvious difficulties arise when rain, snow, or ice impairs the vision.

Sometimes these difficulties are met by mechanical windshield wipers. Attempts at electric heating of the windshield have been moderately successful. In enclosed cabin machines side windows are arranged to slide open so that the pilot may look out without an excessive draught being created.

In the open cockpit, heating is very difficult, and there are no side windows. The British Air Ministry has therefore made experiments with new types of windshields for bad weather, to be used in open cockpits, which are promising. Strictly speaking we should not say new windshields, but rather new accessories to the windshield.

In one type, deflectors, consisting of small airfoils, are placed at the side of the windshield and slightly ahead of the screen proper. When these deflectors were turned into the wind, it was found by scientific wind tunnel test that the velocity of the wind outside the cockpit but in the lee of the deflector was reduced to negligible proportions. Therefore the pilot could look out at the side of the cockpit without discomfort.





***Above and below:* Two airplane windshields for use in bad weather**

In another type the windshield is divided into two parts, and so arranged that the upper part can be staggered ahead of the lower part. Wind tunnel tests showed here that the air was deflected upwards without any perceptible draught being felt in the cockpit, yet vision through the opening was perfect.

While open cockpits are now rarer than was the case a few years ago, anyone flying in an open ship might do worse than to use one or the other of these two gadgets. —*A. K.*

New Aerial Towing Target

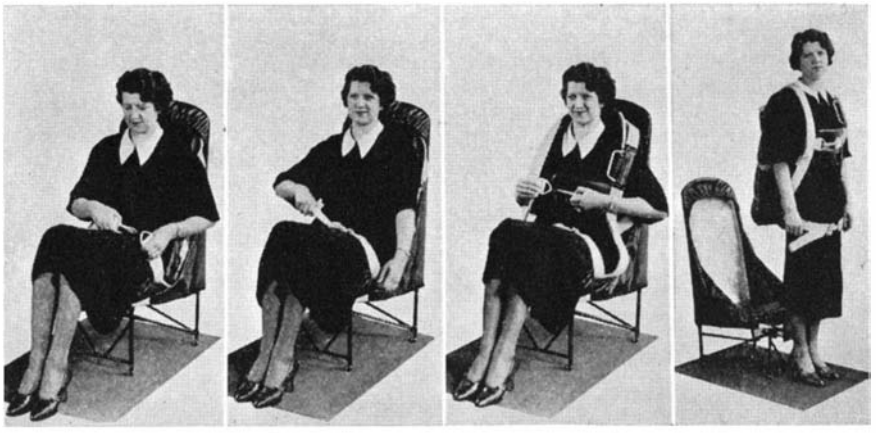
THE Matériel Division of the Army Air Corps has introduced a new type of towing target of considerable interest. The new targets are towed by manila rope in place of steel cable, as greater flexibility of operation and reduction of expense is obtained thereby. The main difficulty with these towing targets hitherto has been the fact that they reduced the airplane speed so much.

The old design was semi-dirigible in type, cone-shaped, closed at the rear, with the mouth held open by a large ring. Unfortunately, the weight of air imprisoned in the cone reduced the speed considerably. The new target is almost a straight sleeve, open at each end, and thus imposing very little drag other than the frictional drag of the fabric. Two sizes of target are available, one three feet in diameter and 30 feet in length for anti-aircraft practice, and one two feet in diameter and 15 feet in length for aerial gunnery practice.—*A. K.*

Precautions for Alaskan Flying

PACIFIC Alaska Airways have no easy task in operating in the region whose name they bear, and the Lockheed Electras employed by this company have a number of special devices to make them suitable for service in severe cold and rough country.

The types of engine shutters commonly used on aircraft protect only the crankcase. As can be seen in one of the photographs, the shutters of the Alaskan planes can shut off the cold air from the front of the engine completely and form part of the cowling ring. On the sides of the fuselage nose are mounted ice shields or abrasion shoes. These consist of rubber sheets covered with doped fabric and cemented to a frame of dural strip, which is itself riveted to the metal skin of the fuselage. Another accessory, employed as far as we know for the first time in connection with a retractible landing gear, is a bicycle-type mud-guard mounted over the wheels. Many a retractible landing gear has jammed because of mud and dirt, and this simple guard may avoid a serious accident. The sturdy chassis ends in a fork over the wheels and is retracted by means of a powerful gear.—*A. K.*



The various steps in attaching the Chair Chute described below

Parachutes for Transport Planes

A WELL known parachute designer, Floyd Smith, has sent us a well written and convincing statement in favor of the use of parachutes for passengers on transport airplanes in scheduled services.

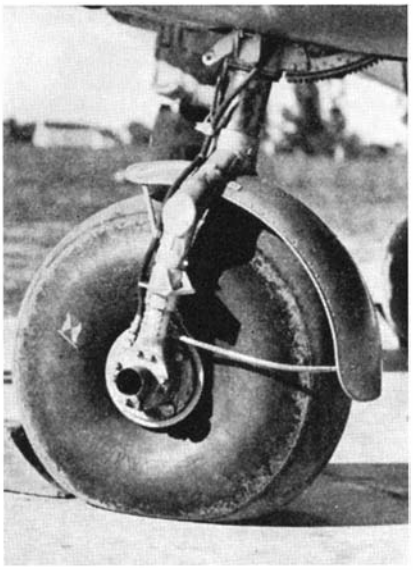
In most emergencies, says Mr. Smith, there would be ample time for individual parachute equipment to be attached and used, particularly with the special transport 'chute equipment now available. Examining the records of accidents, Mr. Smith shows definitely that there would have been both sufficient altitude and sufficient time for utilization of a 'chute in many such mishaps, with the consequent saving of many lives.

The Irvin Chair Chute is so designed that when not in use it fits into the back of the chair and is completely unobtrusive. The photographs show how quickly and simply the 'chute may be fastened. The passenger fastens the lap strap into place first. Then the lap strap is drawn tight, with ease and without disarranging the clothing. Then the chest strap is quickly fastened. The harness automatically adjusts itself to correct size as the passenger arises.

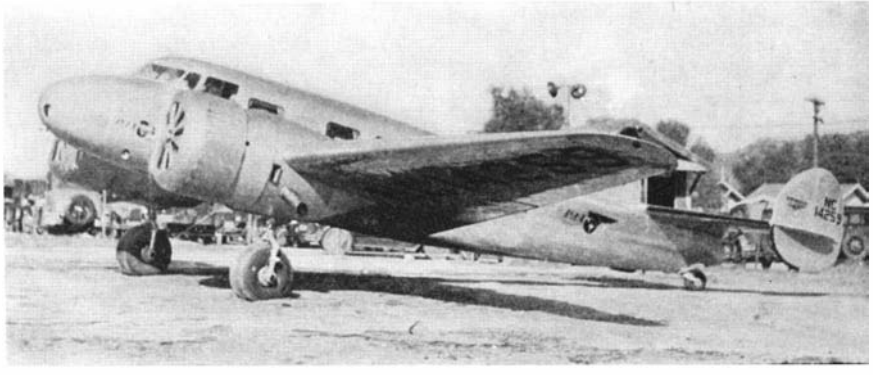
The freedom from accidents in jumps made by inexperienced persons indicates that to jump, wait a few seconds, and then pull the rip cord is not at all a difficult feat.

In some countries an automatic release is incorporated consisting of an extra cable coiled in a pocket on the pack with a snap on the free end, which may be attached to any suitable part of the plane before the person jumps.

It is also possible that the Irvin Chute Company will shortly place on the market an automatic rip-cord handle, which will release the parachute within a predetermined time, after a button is pressed just before the jump is made.—*A. K.*



Above: **A retractible landing gear with mud-guard.** ***Below:*** **Monoplane designed for use in Alaskan flying**



FEWER PILOTS

STRANGELY, there was a drop to 13,949 of pilots holding active Department of Commerce licenses on January 1, 1935 as compared with 13,960 on January 1, 1934. Aircraft licenses also dropped—from 6896 to 6339.

Bradshaw's Air Guide

ANYONE familiar with traveling in Great Britain knows the enormously bulky Bradshaw's Railway Guide. Now No. 1 of Bradshaw's International Air Guide, a book of some 176 pages, has made its bow to

the public. It is remarkable how well the whole of Europe is now covered with airlines operating on regular schedule; fascinating to look at the map of Europe and read of the cities which can be reached by air: Oslo, Sweden, and Leningrad, in the extreme north; Sicily and Crete in the extreme south; Damascus in the east; Cairo in Egypt. The possibility of flying over the classic Mediterranean or the age-old Pyramids is certainly tempting to the American tourist.—*A. K.*

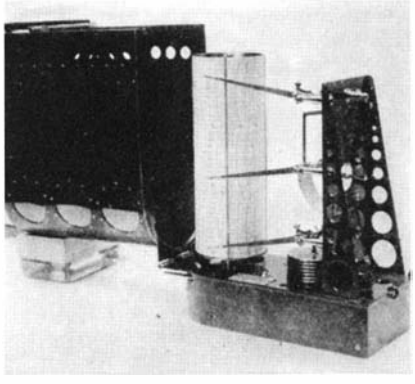
Altitude Flying Will Improve Weather Predictions

CLIMBING to altitudes of over three miles, Army, Navy, and commercial pilots will now carry instruments aloft with them each day from 20 different airports to record conditions in the higher air and give United States Weather Bureau experts increased data on which to base their forecasts.

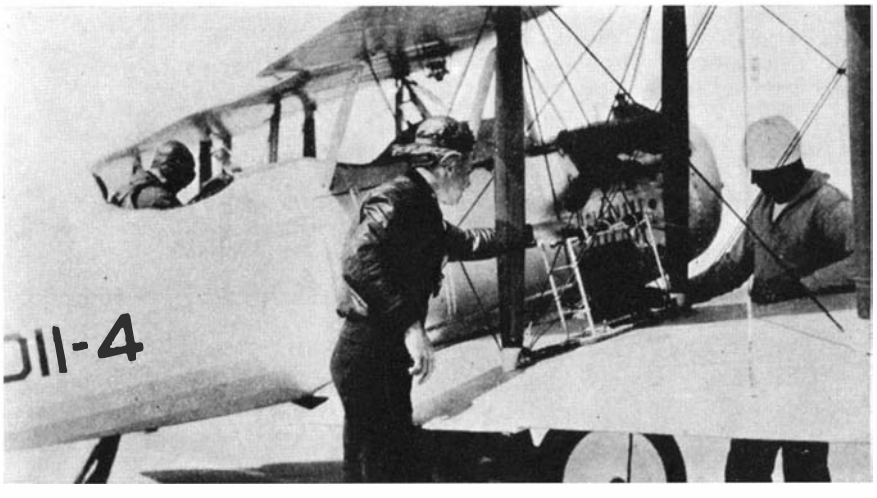
For the past two or three years commercial pilots have been making daily jaunts above the clouds to take observations for the weather man, but up until a short time ago, mass analyses of the upper air have not been conducted on a large scale.

Each observation pilot has attached to the wing of his plane a meteorograph, an instrument which automatically records humidity, temperature, and pressure. These are the three "R's" in the science of predicting the waves, eddies, and cross currents of that turbulent sea, the atmosphere. In addition, the pilot notes the altitudes of the top and bottom of cloud banks, the positions and altitudes of rainstorms which pelt down into dry strata of air and never reach the ground, and local disturbances such as thunderstorms or dust clouds. Pilot balloons sent up from the ground and watched through precise telescopic instruments furnish a method of finding accurately the direction and speed of different layers of air as the small, gas-filled spheres rise through them.

Of the many services, regional and national, which the United States Weather Bureau performs, Dr. C. C. Clark, Acting Chief, considers that the use of extensive airplane observations at high altitudes will be most important to commercial and military air travel. Pilots will know more definitely what lies ahead when they hop off; they will know whether they can climb to a desired altitude without encountering a snow squall or head wind, or whether danger lies before them.—*Science Service.*



***Above:* Meteorograph. *Below:* The instrument mounted on an airplane**



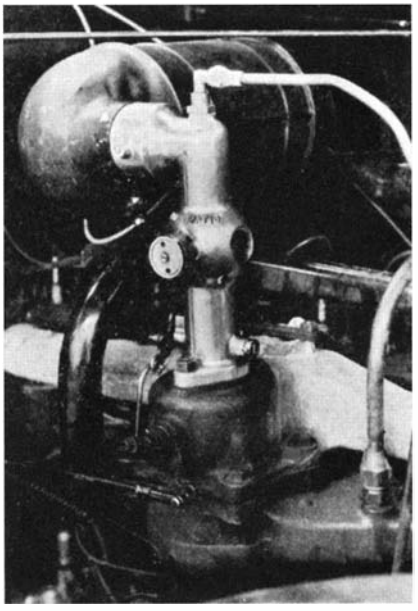
Floatless Carbureter

ONE of the photographs and a drawing herewith illustrate a new carbureter entitled the Vac-U-matic, invented by Lee Bowman, a designer of low-powered aircraft engines. It is a well-known fact that for an engine of any type to be economical, the ratio of gas to air in the mixture has to be just right at any speed. It is claimed for the new carbureter, of which many tests have been made, that it will always maintain the correct mixture.

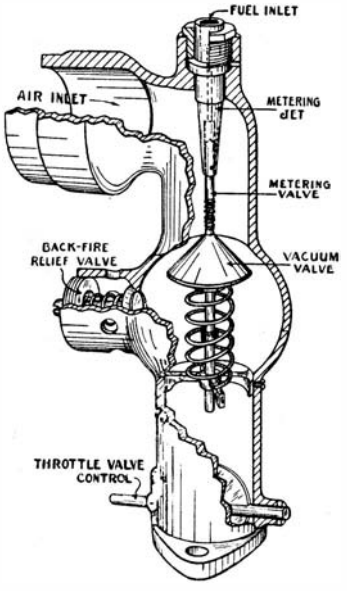
The Vac-U-matic is a dry carbureter having no float, no gasoline reservoir, no adjustments, or idling screw arrangements. There is only one casting and one moving part. It is particularly suitable for aircraft use because it cannot flood in any position that the airplane may take up.

In operation, the suction developed by the engine pulls the vacuum valve away from its seat against the spring, which permits the passage of air into the manifold and into the cylinder. The vacuum valve is resiliently connected with a simple metering jet by means of a metering valve. This plunger moves simultaneously with the vacuum valve. Thus the engine by its suction regulates the amount of mixture drawn in by the throttle, and so maintains the proper ratio of fuel and air at all speeds. Tests have proved that the carbureter never chokes up, never gets too rich or too lean, because the vacuum cone reseats itself when back-pressure develops. With the flame forced out through the back-fire relief valve the dangers of back-fire are largely eliminated.

While qualitative tests have been entirely successful, the quantitative tests of power and economy under varying fuel loads will be awaited with much interest.—*A. K.*



***Above:* The floatless carbureter described here, and, *below,* a diagrammatic section, showing the parts**



Aluminum Paint as Primer

WRITING in a recent issue of *Industrial and Engineering Chemistry*, F. L. Browne, United States Forest Products Laboratory, says: "Repeated comparisons of the durability of white paints on wood when applied in the customary manner, using the white paint itself for the primer, consistently demonstrated a distinct superiority in service for paint applied over aluminum primer. The improvement in durability was manifested by a retardation in the rate at which paint coatings, embrittled with age, flaked from the bands of dense, horny summer-wood present in

(*Please turn to page* 211)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

HERE is a whole new chapter of interesting material written by Russell W. Porter of the California Institute of Technology, with an accompanying batch of his own drawings. He entitles the story "More Small Lens Wrinkles," and intends it as a follow-up to his chapter on eyepiece making, contained in the book "Amateur Telescope Making." He writes:

"JUDGING from the letters I receive from men who have made their mirrors, and are now contemplating or actually making their eyepieces, it would seem that an increased interest has sprung up among amateurs who desire to complete their entire telescopes with their own hands. I have for years urged mirror makers to try their hand at small lens making, telling them that the difficulties are no greater, and that the fun is just as great. I have picked up a few more ideas on the subject since writing the chapter on eyepieces (page 66, 'Amateur Telescope Making,') and am here offering them to the 'fraternity,' along with a description of the spindle I have been using here at Pasadena the past four years.

"Figure 1 shows the general set-up, the spindle and motor bolted to a cast iron slab. The motor is 1 h.p. (1725 r.p.m.) giving ample power for the larger work running up to 2½" diameter. The spindle is 6" long, $\frac{7}{16}$" in diameter and runs in ball bearings. The dish *A* is removable, and a horizontal stud at *B* allows turning the spindle easily into a horizontal position for centering work. The dish can be clamped, *C*, in any azimuth so as to bring the lever arm *D* to the most comfortable position. The lever arm is provided with a universal joint *E*, and the rod itself can be slid sidewise and rocked, so as to bring the pin *P*, carrying the lens, to just the right place over the lap. Two pulleys on the motor and two on the spindle, of ⅝", 1", 1½", and 2" diameter, allow a wide range of speeds for the different sized lenses.

"I experienced trouble with the belt, trying different materials in order to obtain the smoothest action and longest life. The one on the machine now is the most satisfactory. It is leather, round, and has no joint, and was cut from a strip of 4" belting (*a*, Figure 6). Slots in the base permit taking up the stretch. My last addition to the machine is locating the starting and stopping switch *F* within easy reach—for the left hand is usually occupied holding the lever that controls the spinning lens—also the provision of a brake *G* for quickly bringing the motor armature to rest.

"The amateur, in attempting his own machine, may well disregard certain features shown in my design, for this instrument was made with the resources of a large machine shop. The patterns are all expensively cored, the castings aluminum. But the essential features should be retained—namely, a smooth running spindle (plain bearings will do, but must be kept carefully oiled and protected from grit), a smooth running belt, a detachable dish, and provision for bringing the spindle to a horizontal position.

"With the machine so described it is unnecessary to depend on a lathe for turning up the various curved surfaces on the brass laps, for you are virtually already provided with a speed lathe set up on end. A very little practice with a hand tool made out of an old file, using the lever arm as a steady rest as shown in Figure 2, will form a lap in a few moments so that it fits its templates.

"Of course, for good work, the laps should be made in pairs—male and female—and ground together. Much time will be saved in holding the laps to their correct curvature, if the bulk of the glass has first been removed from the glass blank, before placing it on the machine. (See A.T.M., p. 67, Figure 53*b*.)

"I am now using four grades of abrasives: Nos. 90, 1F, and 600 Carborundum, and 305 emery. An addition of an equal amount of talc to the emery will almost surely prevent scratches in the final grinding. It leaves the glass with a surface that comes to a polish in a few moments. Scratches usually show up with 600 Carbo. A fruitful cause is letting the lap become too dry. It doesn't take long for the rapidly rotating tool and spinning lens to move the lubricant away from their central areas. Should the worst happen the lens will seize to the pitch, the pin on the lever arm will jump out of its pivot, and the lens may fly off into the dish and very likely suffer a chipped edge. Perhaps a hardwood dish, or a dish of some material that will cushion such a blow, would be advisable.

"I find it pays to do some thorough house cleaning when changing from one grade to one finer, also that it pays to put down fresh newspapers, to scrub the hands well with a scrubbing brush and clean the finger nails. My four grades of abrasives are kept in four glass cups—caster cups—(at the five-and-ten, at a nickle each). I ground their edges on a sheet of window glass, then cut up the window glass into cover plates.

"IN polishing I cover the tool, or lap, with only about 1/16" of rather hard pitch and, while still warm and rotating on the spindle, smooth it up to shape with its mate (wetted). The prepared fine-ground lens will do about as well. The rouge polishes faster if the pitch is rechanneled often. It only takes a moment with the blade of a pen knife, and Figure 3 shows the way I do it. The pitch at the center of the tool can well be removed, for it permits the pitch under pressure to flow toward the center as well as the edge.

"The tyro must work out his own salvation until he knows just how far to let his spinning lens move away from the center of the rapidly revolving tool, in order to have the polish come up evenly on the glass. He will notice that with the center of the lens directly over the center of the tool, they are both going at the same r.p.m.—they are as one—and no action is taking place. Theoretically, and assuming perfect contact and also assuming that the tool retains its shape (which it never does), a position for the lens center from the tool center will be found when the lens

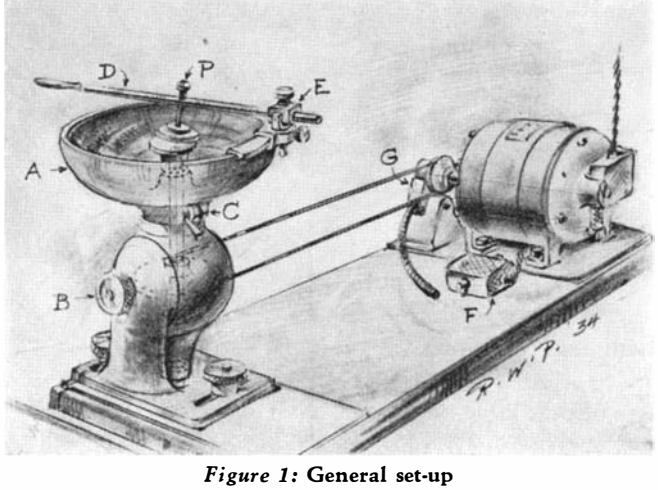


Figure 1: **General set-up**

ceases to spin and comes to rest, and beyond that critical point it will start spinning in the other direction. But pitch, as mirror makers know to their sorrow, is queer stuff, and possessed of seven devils, and one must find for himself about how far the lens should pass across the tool.

"What is actually taking place between the glass and pitch surfaces is rather complicated. In Figure 6*b*, with the tool rotating

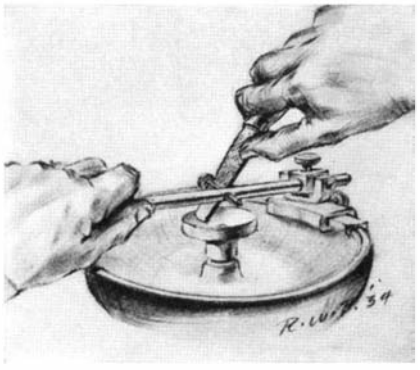


Figure 2: **Turning a brass lap**

anti-clockwise as shown, the areas on the tool at *A* and *C* will tend to give the lens the same rotation as the tool. But around *B* the tendency of the tool is to turn the lens in the opposite manner, namely, clockwise. Moreover, heat is being generated, the pitch is flowing, and the slope of the surfaces is continually changing with the stroke.

"In general it can be said that enlarging the central cavity in the tool will bring more of the polishing action to the outer parts of the lens, and trimming down the size of the tool to less than that of the lens will have the opposite effect. The length of stroke is, of course, important.

"As with mirrors, it is desirable to remove the lens as few times as possible. I use a match-stick to apply a drop or two to the lap when necessary. By carefully moving the spinning lens so as to expose as much of the center of the tool as is safe, the rouge is applied at the center and allowed to work outward by centrifugal force.

"The danger of producing zones by paring away the tool at center or edge might argue for a full-sized tool, uniform throughout, the exact counterpart (obverse) of the lens surface itself. Zonal irregularities become apparent when two lenses with contact surfaces—say flint and crown of an achromatic doublet—are viewed under monochromatic light. The interference rings are not evenly spaced, there are too many of them, and they depart from circles as the lenses are moved eccentric to each other.

"CENTERING comes next. When the lenses are polished, the dish is removed, the clamping nut *H* (Figure 4) unscrewed and the spindle brought horizontal. For centering I use an attachment (Figure 4) that slips over the seat formerly occupied by the dish. This gadget comprises the rod *K* carrying the edging plate *L* and a screw *M* acting against an arm of *K*, and the guard *N*. The right adapter (*A* in *c*, Figure 6) is pressed on the tapered spindle end and a little hot pitch daubed on the flange at *B*. With the flame of a bunsen burner (Figure 5)—an alcohol lamp will do as well—the adapter and spindle end are given a warming and the lens cemented

(*Next page, please*)

THE AMATEUR ASTRONOMER

(*Continued from preceding page*)

against the flange *B* (Figure 6 c). By giving the spindle a few turns and looking at the lens, the reflections from the lens (of different parts in the room, lights, and so on) will be seen to wabble. The lens is then moved a trifle on its seat and the spindle again given a turn. If you have reduced the wabble—if the reflections show less movement—you moved the lens in the right direction. If not, and it has increased, you have made a bad matter worse. A few tries and the secret is out and you know which way to move the lens to reduce the wabble and finally to wipe it out altogether. What you see in the lens as it rotates remains fixed. The axes of the spindle and the lens coincide. Probably the pitch has cooled off before the job is done, but a few passes of the flame allow the adjustment to be carried on indefinitely.

"We are now ready to edge the lens. On goes the edging plate *L* (Figure 4), and the screw *M* is advanced until the edging plate just touches the lens. The dish is placed as shown, with some 1F Carbo and water in it, and a spoon. The motor is started, the guard *N* dropped and the Carbo spooned on to the edging plate. As the plate is brought to bear on the lens under the action of screw *M*, and the Carbo is dragged under the lens edge, the ear detects a vibration of the plate due to the pounding cam action of the lens. In a short time, as the glass wears down, this pounding disappears and one has only to watch with an outside calipers (*O*, Figure 5) for the lens to come down to the required diameter. The lens is removed under a little heat, placed in kerosene (or gasolene) over night, when it can be washed clean with soap and water.

"What I have here described (as well as in Chapter XI, Part I, A.T.M.) are the wrinkles and methods worked out by myself without being prejudiced by a knowledge of professional practice. Undoubtedly some of them will appear crude and amusing to the professional. For example, it may be that a better way of making a lens run true on a spindle is to use a fork (*d*, Figure 6) and, as explained on pages 69-70, A.T.M., I have used them both, but I remember a bad scratch that developed when I used the fork. There may be other simpler and more orthodox ways, but it's been lots of fun working out one's own technique.

"To me a lens is a wonderful and beautiful object, and I shall be well repaid if what I have described will start others of our now large following of telescope makers to try equipping their instruments with their own oculars."—Pasadena, California, December, 1934.

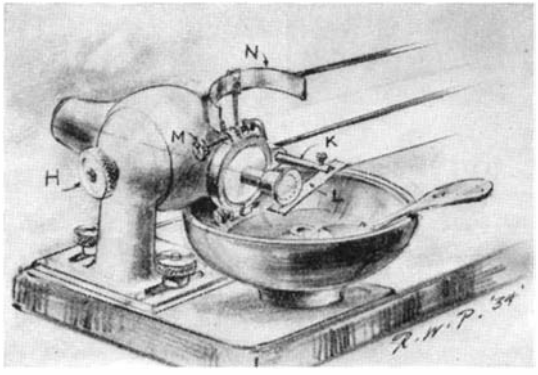


Figure 4: **The centering gadget**

WE nominate Mr. Porter's article, above, for inclusion in the new "A.T.M. Supplement."

And what is the new "A.T.M. Supplement"? It is something that, as yet, isn't. It is something that is to be. We plan to publish, next fall, a companion volume to A.T.M., similar to it in binding, format and typography but thinner—perhaps 128 pages. Into this we shall pour a general collection of items long and short, which we either have on hand or can think of, such as reprints of articles on telescope optics, odd data, more "contributions from advanced amateurs," and general material of use to telescope makers, all brought together in one book, an *omnium gatherum*. Reprinted items from past numbers of the present department may also be included. This book will be sold either with A.T.M. or separately, as desired. We have already started to assemble the ingredients of this book, but we want also to get the ideas of our readers, concerning what they think ought to be put into it to make it a round peg in a round hole.

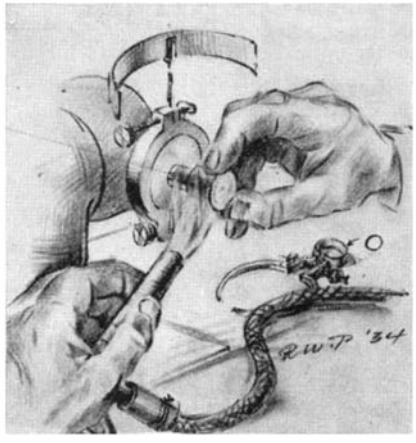


Figure 5: **Centering the lens**

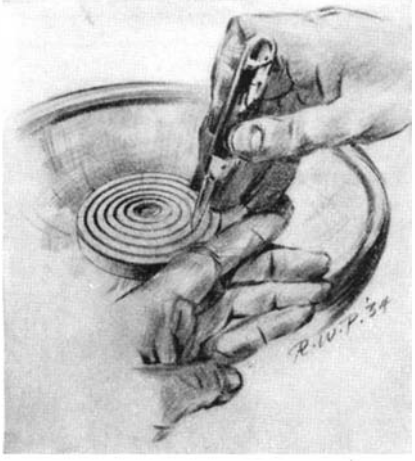
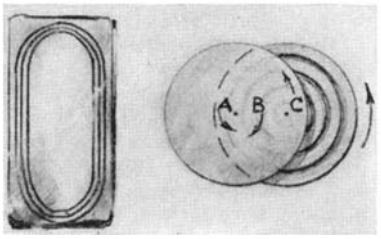
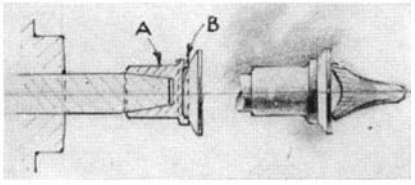


Figure 3: **Rechanneling the lap**



a **b**



c **d**

Figure 6

Above all, we want this to be a practical book—no articles on purely theoretical optics or about the pretty stars. Tentatively, we think there should be a good, solid section on telescope mounting design. Whom do you nominate that is qualified to contribute that section? A short section on making setting circles; we have one or two small things on this already, but who has further material? Who can furnish a compact chapter on clock drives—not merely about them but telling exactly how to make them? What other subjects need coverage and who will cover them? Gentlemen, name your poison. We solicit your advice but do not guarantee to take it! And we must move with celerity. Write to us.

LAST month, after your scribe had read and passed, supposedly to the printer, the final proofs of the pages for this department for the March number, a nefarious gang of his fellow editors (or fellow clowns) secretly conspired to insert his photograph in these pages, under a caption which read "The Mentor of the Amateur Telescope Makers." In an accompanying note they accused him of modesty, an unscientific statement which is also libelous, and they even called him a gentleman. The very picture itself was a libel, being one which they are believed to have scavenged from a waste basket after your scribe threw it there because it too closely resembled that of Al Capone. In brief, the only accurate statement connected with this whole deep-dyed plot was the assertion that your scribe would not see the picture in the magazine until too late; and this is the very assertion that, with sad, wet tears in his voice, he is dead certain nobody on earth will ever, ever believe—no, never. And did not the conspirators know that very fact? Aye, they even admit it, and they actually laugh about it. Your scribe's most fervent disclaimer, they say, will merely be regarded as a part of his original put-up job, and so will all further disclaimers, right on out to infinity and beyond.

In these heart-rending circumstances, with his spirit crushed, and in a hopeless fix, your despairing scribe has picked out a nice hole, is now about to crawl into it and pull the hole in after him. Goodbye, goodbye—alas, goodbye forever!—*The Dementor of the Amateur Telescope Makers.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 206)

softwood lumber. The benefit gained by priming with aluminum paint was greatest for woods that have much summer wood, such as southern yellow pine and Douglas fir. When repainting was neglected for some time, coatings applied over aluminum primer suffered less damage and the surfaces were then more easily and durably repainted."—*A. E. B.*

HEAVY-WEIGHT

A three-year-old English boy who weighs 140 pounds has been reported to the *British Medical Journal*. Doctors have not decided upon the cause of the excess weight in this particular case but most believe that he is suffering from a gland disorder known as Frohlich's disease.

DYED SPONGES

FOR years many attempts have been made to discover a dye which could be used on natural sponges. It was recognized that such dyed sponges would have so much better eye appeal that they would be able to compete more successfully with the artificial kind.

Such a dyed sponge has now been placed upon the market. It is guaranteed to be of a genuine Sheepswool variety, "Sheepswool" being the designation of a very soft and clean ocean sponge. These new sponges in various pastel shades are wrapped attractively in Cellophane and may be found in most any department store.

JAPANESE FISH TELL WHETHER BABY MAY BE EXPECTED

AFTER discovering a male that puts on a "wedding dress," it was only one step further scientifically to find in his mate a lady who responds immediately and obviously to prospective motherhood. This interesting couple is Japanese and belongs to a family of fish called the bitterlings. Mr. Bitterling's change of outfit during the breeding season has been found to have a limited use in medical science. Mrs. Bitterling's odd practice of suddenly elongating a tiny projection from her body is now believed to possess important possibilities in medicine, among them a speedy test for pregnancy.

At the obstetric and gynecologic clinic of Prof. N. S. Heaney, Rush Medical College, Chicago, three physicians, Drs. A. E. Kanter, C. P. Bauer, and A. H. Klawans, have been using the female Japanese bitterling to make pregnancy tests on their women patients. Results are so promising that a preliminary report of their work is carried in the *Journal of the American Medical Association.*

Less costly in laboratory funds and ani-

mal life than the Friedman and Ascheim-Zondek pregnancy tests now in use, this fish test is expected by its authors also to surpass in clinical advantages. The other two tests must be done on rabbits and mice, and to complete them the animals have to be operated on and destroyed. Not so with Mrs. Bitterling. She sends out her little flag of motherhood over and over again, with a two or three week interval for recuperation. The fish are inexpensive and easy to maintain because they take a small amount of space, food, and care.

The physician or laboratory worker places a properly selected fish in a bowl containing a quart of water and a small amount of kidney secretion from the woman patient. Usually within the first 24 hours, the fish flies her signal by quick growth in the little oviduct which protrudes from her underside. The other two tests mentioned require two or three days for completion.

USELESS

FRUSTRATION of purpose seems symbolized in a new variety of evening primrose which develops full-sized buds but never opens them. This plant was recently found among a group of experimental plants by Dr. George H. Shull of Princeton University.

Most Powerful Electric Locomotives

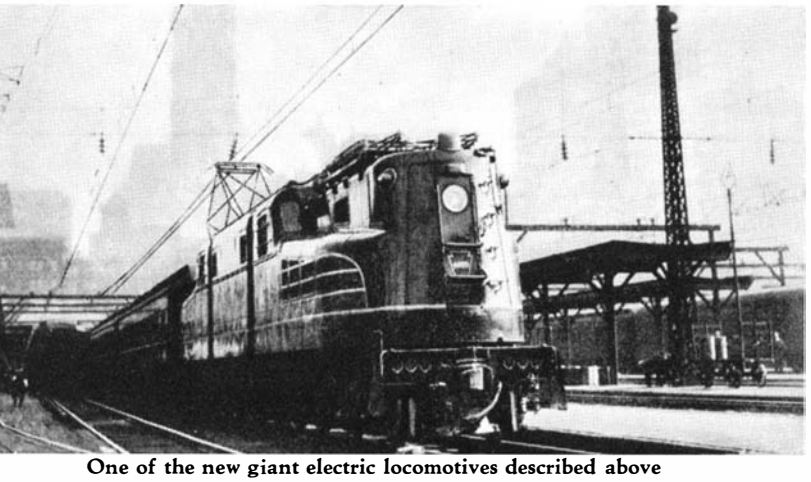
A TOTAL of 57 streamlined electric engines, to be the most powerful electric passenger locomotives ever built in the world, are now being constructed for the Pennsylvania Railroad. Costing almost 15,000,000 dollars, these new giant electrics have been specially designed for the railroad's high-speed passenger service which was inaugurated between New York, Philadelphia, Baltimore, and Washington early in 1935. They will be capable of making a regular operating speed of 90 miles per hour, and will haul trains of standard size and length. Twelve 57-inch driving wheels, six on each side, will drive the fully streamlined, articulated engines along the tracks with full power of 4620 horsepower at high speed.

Each end of the locomotive will slope gently inward from the floor to the cab roof, with rounded shoulders running toward the central operating compartment. The engineman's control position will be at the center of the cab, giving unobstructed view of the track and making possible a design of the cab extremely pleasing to the eye.

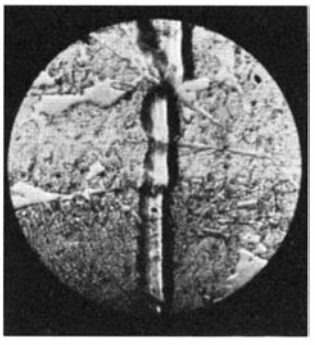
Eighteen complete chassis will be built at the Pennsylvania's Altoona shops, and that works also will apply the electric propulsion and control apparatus to the chassis of 25 additional engines. Twenty-five chassis, to be equipped at Altoona, will be built at the Baldwin Locomotive Works at Eddystone, Pennsylvania. The General Electric Company at Erie, Pennsylvania, will build 14 complete locomotives, and the electric propulsion and control apparatus for nine additional engines. The Westinghouse Electric and Manufacturing Company at Pittsburgh, Pennsylvania, will build the electric propulsion and control apparatus for 34 locomotives.

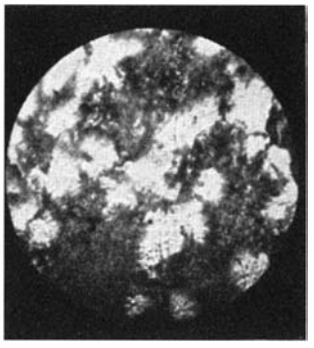
Each locomotive will cost in the neighborhood of 250,000 dollars.

The Pennsylvania's new passenger engines will be 79½ feet long, of all-steel construction, and will weigh 460,000 pounds. Each will operate on an 11,000-volt, 25-cycle, single-phase system, the current to be fed by overhead wires through a pantograph. The maximum starting tractive effort will be 72,800 pounds.



One of the new giant electric locomotives described above





Upper right: New black alloy piston and a standard type. *Left:* Photomicrograph of a scratch on an untreated piston. *Right:* Same diamond point leaves no noticeable scratch on a treated aluminum piston

Black Aluminum Alloy Pistons

THE latest step in the evolution of the aluminum alloy piston is Alumiliting—a process which forms a hard, smooth aluminum oxide surface as an integral part of the piston. This surface has fine bearing qualities and materially increases the resistance of the piston to scuffing. The life of a piston thus treated is substantially lengthened; cylinder wall wear is reduced.

The engineers of Aluminum Company of America are responsible for the development of this piston. The hard surface is obtained by electrolytically treating the piston by the Alumilite process. The aluminum alloy pistons are electrolytically treated in large tanks; the equipment resembles that used for electroplating. If desired, the operation can be made fully automatic and continuous. Machining and grinding are done before treatment and the thickness of the Alumilite finish can be controlled uniformly and within close limits. The outside surface is made out of the metal and is not a layer of material deposited on the surface. This accounts for the tenacity with which it adheres to the piston surface and explains why there is little change in diameter during the treating process.

The Alumilite finish has the hardness and smoothness of a fine bearing surface. In addition, it contains innumerable invisible surface cavities which absorb oil, and the importance of this, when the engine is first started, is recognized. The hardness of the Alumilited surface is of material benefit in reducing ring-groove wear and in maintaining piston pin bore diameters within their original limits. Unusual protection against scuffing is obtained.

Psychopathic Leaders

LEADERS, followed and even revered in their time, are often "the most bizarre of the psychopathic types" of the period in which they live. Dr. Ruth Benedict in her illuminating ethnological study "Patterns of Culture" does not exempt some of those personality patterns which have played important parts in American development.

"The Puritan divines of New England in the 18th Century," she writes, "were the last persons whom contemporary opinion in the colonies regarded as psychopathic. Few prestige groups in any culture have been allowed such complete intellectual and emotional dictatorship as they were. They were the voice of God. Yet to a modern observer it is they, not the confused and tormented

women they put to death as witches, who were the psycho-neurotics of Puritan New England. A sense of guilt as extreme as they portrayed and demanded, both in their own conversion experiences and in those of their converts, is found in a slightly saner civilization only in institutions for mental diseases. . . ."—*Science Service.*

Salesman Buys Sample

AN aluminum salesman received a request to call on a certain customer. Upon his arrival he found that what the customer wanted, and wanted in a big hurry, was a small piece of aluminum about .00035 of an inch thick and perhaps five or six inches square. Thinking fast, the salesman asked the customer if he had a nickel in his pocket. The customer had. Whereupon the salesman took it, stepped out to a nearby store, purchased a chocolate bar. Returning, he removed the aluminum foil wrapping from the chocolate bar and handed it to the customer.

Then he split the confection with him and a good time was enjoyed by all!—*Aluminum News Letter.*

Cricket Houses for Cricket Fanciers

DID you ever see a cricket wash her face, comb her hair, eat her dinner, or lay an egg? If you have never owned a pet cricket, you have missed a lot of fun.

A new-style patented cricket house is not only arranged for convenience in feeding the crickets, portability, and ventilation, but is made so that a high degree of visibility is possible at all times. Through its two vertical glass sides that hold in place the soil filling, the activities of the lively growing crickets are always in view, and many of the eggs laid by the females are plainly visible beneath the surface of the soil. One female cricket will lay as many as one hundred and fifty eggs in one of these houses. Not only can the eggs be seen in the soil, but the actual laying of an egg may be closely watched without disturbing the tranquillity of Mama Cricket.

You can see the growing crickets "change their clothes" of brownish-black and appear in a nice new suit of light-straw color. It usually takes a cricket about 15 minutes to make this change, and within two or three hours after the change has been made the new light-colored suit will turn nearly black.

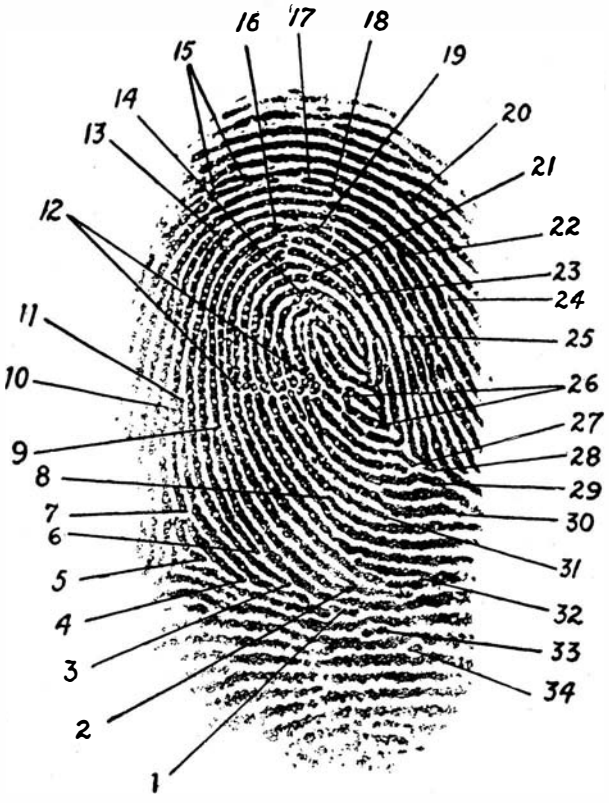
Angora *Is* Angora

WHEN is an Angora not an Angora? This seemingly foolish question was involved in a recent proceeding brought by the Federal Trade Commission against the Joseph Benn Corporation, a prominent yarn manufacturer of Greystone, Rhode Island. The Benn Corporation used the name "Angora" to describe yarns made entirely of Angora goat hair. The complaint issued by the Commission alleged that this was an unfair method of competition and that "Angora" only applied to rabbit hair. On January 25, 1935, after the taking of extensive testimony, and after reading the briefs and hearing the arguments of counsel, the Commission dismissed the com-

Reproduced from page 95 of

THE FINGER PRINT INSTRUCTOR, by Frederick Kuhne, Bureau of Criminal Identification, Police Department, City of New York—$3.15 postpaid.

FIG. 47



AN ENLARGED FINGER PRINT

Numbers 1, 5, 33, and 34 are described as short ridge lines; 2, 9, 14, 16, 19, 20, 25, and 32 as a bifurcation of ridges; 3, 4, 6, 7, 8, 10, 11, 13, 17, 18, 21, 23, 24, 27, 28, 29, 30, and 31 as abrupt ending ridges; 15 and 26 are called islands; and 12 shows several small ridge dots and ridge terminations caused by a cut.

JUST as in the Hauptmann trial, finger prints are always of vital importance. Although everyone may not qualify as a finger print expert, everyone should be interested in the study of prints. It is both fascinating and scientific. The Finger Print Instructor was prepared as a text book for the guidance of experts and is generally used by police departments for training. It is simply written, comprehensively illustrated, and includes questions and answers for comparison and self-examination. It is, therefore, a complete, authoritative instructor for all persons interested in finger prints. If you are considering a stimulating scientific hobby, a study of this book will provide you with all the essential information. It is easy to read, easy to understand, and the directions on how to apply your knowledge are easy to follow.

The book is divided into three parts:

PART 1. Finger impressions, their uses, description of the various patterns, the taking of prints, and their classification.

PART 2. Making comparisons and the filing of prints, with schedule of various classifications in their order of filing, preparing cases for court and powdering impressions.

PART 3. Questions relative to the finger print system, with their answers, and plates or illustrations showing various patterns, etc.

Send for your copy today. You will find The Finger Print Instructor a fascinating and valuable book, and will take pride in owning a copy. It is the sort of a book you will refer to again and again when you and your friends read about and discuss crime and how to prevent it. Fill in and mail the coupon below with your remittance.

Use the coupon for your convenience in ordering

SCIENTIFIC AMERICAN, 24 West 40th Street, New York, N. Y.

Send me a copy of The Finger Print Instructor, by Frederick Kuhne. Enclosed is my remittance of $3.15 postpaid.

Name.....

Address.....

plaint against the Joseph Benn Corporation, thereby affirming their right to use the word "Angora" to describe yarns made of Angora goat hair.

From this it would appear that in spite of all the flux and change in modern times an Angora is officially still an Angora.

DEODORIZER

ODORS about the house, and especially those left after cooking strong foods in winter time when it is too cold for proper ventilation, are disgusting not only to the family but more so to visitors who may be present. Various fumigants and deodorizers have been used to destroy such odors

Deodorizer "match sticks"

but more often they simply blanket the odor with a more powerful scent of some kind. In cases where such things as incense are used, the resulting combination of odors is frequently more obnoxious than the original.

We have just had the opportunity of testing a new deodorizer which seems to fulfill its purpose admirably and leave but a slight scent of its own. This deodorizer comes in the form of matches, the long heads of which are a composition of black material. When struck as one would strike an ordinary match and inserted in a hole in the box container, these Fumettes, as they are called, smolder without flame for two or three minutes. Each one effectively clears the air of such odors as those remaining after cooking fish or cabbage. They are sold in boxes of 30.

TREASURE TROVE

THE treasure in a pirate cave in an island off the coast of Spanish Honduras consisted of broken rum bottles knee-deep. This was one of the archeological surprises found by Dr. W. D. Strong of the Bureau of American Ethnology. Rum fellows, those pirates!

LONG DISTANCE THERMOMETER

THE chemical engineer can now sit at home in the suburbs and see just exactly what is going on in the vats and tanks of his plant, miles away. The Bristol Company has introduced a new device known as the Metameter, for the indication and recording of temperatures, pressures, levels, and other process conditions or operations at any distant place, up to several thousand miles from the detecting instrument. The Metameter combines a transmitter, an electrical circuit for conveying

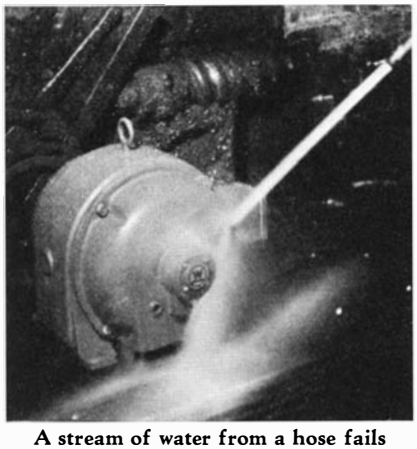
the impulses to the receiver, and a receiving instrument which mechanically translates the impulses received into the measurements made. These are recorded continuously on a 12-inch chart. The durations and not the intensities of the transmitted impulses are proportional to the values measured. Therefore, neither voltage fluctuation nor the resistance of the line affect the accuracy of recording and only a two-wire circuit, such as existing telephone lines, is required.—*A. E. B.*

JAIL NEST

MOTHERHOOD means a six-months' jail sentence to the female of one species of African hornbill. The male bird seals the female into her hollow-tree nest and feeds her and her brood through a narrow slot in the clay wall of her voluntary prison.

Splash and Drip Proof Motor

CONDITIONS in many industries frequently make it impossible to place electric motor drives where water will not be splashed, or will not drip onto the motor frame. For such applications Westinghouse has developed squirrel cage motors completely protected against splashing and



A stream of water from a hose fails to penetrate this water-proof motor

dripping liquids. The motor frame and the end brackets are solid cast iron, to resist the effects of moisture. An efficient system of baffles in the bearing brackets allows ample ventilation yet prevents liquids from entering the motor interior.

Drug Addiction Fought by Science

THE dramatic nation-wide drive against drug addiction being carried on by federal law enforcement agents is being paralleled by an attack on the same problem by medical scientists. If the scientists succeed, there will be no further need for the legal fight, because the scientists are pushing ahead in efforts to achieve a non-addicting substitute for morphine.

The biggest advance in this scientific fight is the production in the University of Virginia laboratories by Dr. Lyndon F. Small

of a new derivative of morphine, called dihydro-des-oxy-morphine-D, which is 10 times as effective as morphine in relieving pain. In the recent announcement of the patenting of this drug, Dr. Small and colleagues with true scientific caution refused to state any opinion as to its possible addiction properties. Their studies of the drug have been made on monkeys and the question of addiction in humans can only be determined by observing its effects on humans.

This crucial point is about to be tested in the following way: Patients suffering from advanced tuberculosis and severe cancer are sure to become addicted to morphine because that is the only drug which will relieve their pain and cough. A group of such patients will be given the new drug to relieve their suffering. If they fail to develop addiction to it, this new drug with the long chemical name will be hailed as the long-sought, safe substitute for morphine and possibly as an aid in the prevention of narcotic drug addiction. If it can be used in the case of persons already addicted to narcotic drugs, it might aid in their "cure."—*Science Service.*

Amateur Microscopy

ALTHOUGH the German speaking countries, where they take their science very seriously, have the popular but scholarly magazine *Micro Kosmos* for the amateur microscopist, no similar magazine for the lay reader has been published in the English language, and many have felt the need of one. Into this gap, now that good microscopes for amateur needs are inexpensive and plentiful and many amateurs possess them, there comes a new journal, *Practical Microscopy*. Because of the good standards set by the first numbers of that magazine, we are glad to welcome it on behalf of many potential readers.

No doubt, in a few years, a body of serious-minded amateur microscopists sufficient to form a nation-wide organization, will have grown up in this country, and nothing will build it up more rapidly than the availability of a sound organ, devoted to the popular and semi-popular interpretation of authoritative microscopical science. This the new journal appears to be.

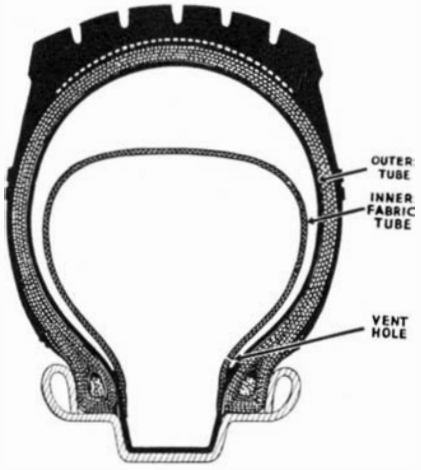
Quick-Freeze Keeps Cheese

THREE years of experiment at the University of Wisconsin have revealed that quick freezing can be applied to cheese, reports *Food Industries*. The procedure is to cure the cheese and freeze it in small units for distribution to consumers. Quick freezing has been found to preserve the quality of the natural cheese and holding the produce in cold storage delays spoilage in the package due to mold growth, leakage of fat, or change in quality.—*A. E. B.*

Double Tire-Tube

RUBBER companies have been concerned with the problem of tires and tubes which upon blowing out do not cause disaster. Various types of sealing compounds, one of which was described in a recent issue of SCIENTIFIC AMERICAN, have been tried—some successfully and some not so successfully. There has also been invented a device which consists of an additional rim to take the weight of the car should the tire go suddenly flat. One such device is described in an accompanying item in this issue.

From the Goodyear Tire and Rubber Company comes information of a radically new type of protection against disaster when the tire itself is ripped. This new idea is incorporated in a tube, the protection consisting of an additional inner fabric



Section of a double tire-tube

tube which normally is inflated with air at a pressure equal to that in the main or outer tube. As shown in the accompanying illustration, there is an easy interchange of air between both tubes through the tiny vent hole near the wheel rim. Should a blowout occur only a portion of the air is lost and the tire drops down only slightly to ride on the inner fabric carcass which loses its air very slowly. This permits the car to continue under perfect control until the driver has time to pull off the road and stop.

Aluminum Production in Sweden

A NEW aluminum factory, the first one in Sweden, has been put in operation at Mansbo, near Avesta. The factory is owned by the Swedish Aluminum Company, a sister company of the Norwegian Aluminum Company, which in turn is closely connected with the Aluminum Company of America. The Mansbo factory is one of the most modern plants in the world for the production of raw aluminum and its alloys. Its production capacity is 1800 metric tons annually, which approximately corresponds to the total present consumption of Sweden. Forty-six large electrolytic furnaces and two smelting furnaces for the casting of ingots of aluminum and alloys have been installed.—*A. E. B.*

Testing Influence of Environment

WITH adopted children to aid them, psychologists are attempting to pin down that elusive problem: Which is more important to a child's intelligence, his heredity or his environment?

The answer appears to be that environment is relatively insignificant.

The elaborate precautions that are being taken to control the experiment, so that the

true influence of environment may be measured, were described before the American Statistical Association, by Dr. Alice M. Leahy of the Institute of Child Welfare, University of Minnesota.

Conflicting reports from previous psychological studies prompted the investigation by the Institute, Dr. Leahy said.

"From the data so far presented, we may conclude that environment has a relatively less significant rôle in the determination of intelligence than heredity."

If further analysis supports the tentative results, then, said Dr. Leahy, "we must conclude that the influence of environment on measured intelligence is relatively insignificant."—*Science Service.*

Prize for Young Biological Chemists

A PRIZE of 1000 dollars and a bronze medal, to be awarded each year to the young man or woman who has done outstanding work in biological chemistry, has been announced by the American Chemical Society. The prize was established by Eli Lilly and Company, manufacturing chemists of Indianapolis, for the purpose of stimulating fundamental research in biological research. Recipients of the prize must be under 31 years of age and will be selected by a committee of eminent biological chemists, appointed by the president of the American Chemical Society.

The first award of the new prize will be made at the meeting of the American Chemical Society in New York during the week of April 22.

The company's interest in biological research is further demonstrated by its newly erected laboratory building. The laboratories are beautifully appointed. The rubber-tiled floors vary in design, so there is no monotony. The walls are of enameled brick, while the wainscoting in the hallways is of travertine. The equipment throughout is modern and adequate, and one research worker remarked that he had never seen so much new equipment at one time in his life. Adjacent is a series of small private rooms available to those engaged in protracted work, while the book stacks, modern in every detail, house a library extraordinarily complete for the special work it is to serve.

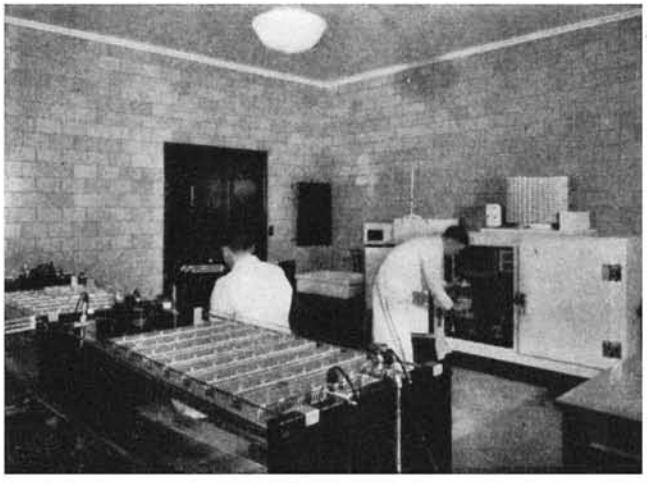
The animal quarters are unique in scientific laboratory construction. They are air-conditioned and provided throughout with equipment such that sanitary conditions can be maintained with a minimum of effort.

The staff of the research division includes over 75 chemists, pharmacists, pharmacologists, bacteriologists, and others trained in the medical field. Forty of this number devote their entire time to research problems.—*A. E. B.*

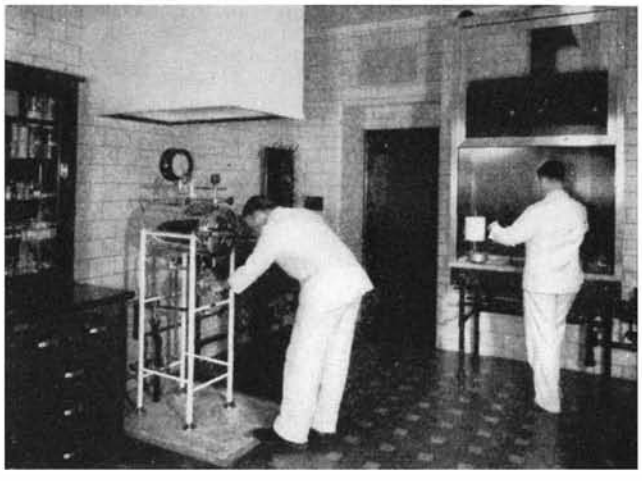
Smoking Mothers

WHEN a mother smokes heavily before the birth of her child, some of the substance in tobacco smoke which makes the heart beat faster is transmitted to the blood of her unborn child and also makes its heart beat faster, Drs. Lester W. Sontag and Robert F. Wallace found in experiments conducted at Antioch College.

In their scientific report to the *American Journal of Obstetrics and Gynecology*, these



Right: **A stock of frogs used for testing various drugs in the Lilly laboratories is kept in the large refrigerator at the right**



Left: **A view of the Lilly pharmacological department. This company is offering a prize to be awarded to a young chemist for outstanding research work in biology**

physicians make no statement concerning harmful effects of maternal smoking upon the unborn child. But taking into consideration the work of other scientists on the effects of nicotine in the milk of smoking mothers, they consider it "not improbable" that maternal smoking before the birth of the child may have permanently harmful effects on the offspring.

A careful study of the newborn children of mothers who smoke heavily before their children are born is, they believe, the next step to be taken in order to reach a scientific conclusion as to whether mothers should or should not smoke while bearing and nursing children.—*Science Service.*

Electro-Deposited Shellac

RECENT experiments in Bangalore, India, reported in *The Chemical Age* (London), show that shellac can be deposited electrically from its solution in alkalies. Apparently the process may be applied either for the purification of shellac, or for its intimate admixture with other materials, including rubber. Electro-deposited shellac is not as soluble as usual in alcohol, but this solubility can be restored by proper treatment with acetic acid. The first attempted practical applications are for the recovery of shellac from scrap and waste on the one hand, and for the direct application of insulation to copper wires on the other. Wires treated with mixtures of shellac and rubber, after a conditioning treatment, are well and strongly insulated, according to *Arthur D. Little's Industrial Bulletin.—A. E. B.*

An Aid for Amateur Movie Photographers

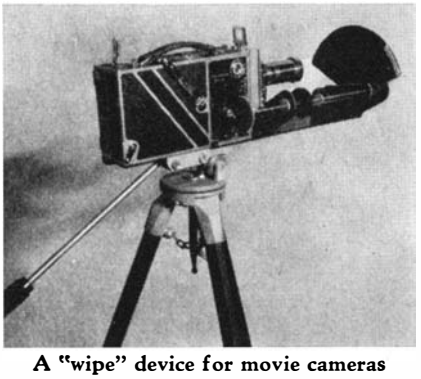
A NEW radial "wipe" device has been designed by Du-Morr Laboratories for use with the Ciné Kodak Special movie camera. This device enables the amateur photographer to secure the same effect that is used in professional photography where one scene is wiped off the screen by the next, thereby avoiding abrupt change from one scene to another.

Bakelite laminated is the main material of construction. The device consists of a ⅛ inch thick laminated base which has a ½ inch lip on one side to provide rigidity and light weight. The base is fastened to the tilting tripod head by screwing the tripod handle through a stainless steel bracket on the underside of the base.

The camera is mounted rigidly on the wiping device by the tripod bolt. A fan, covered with black velvet on the face toward the camera, is mounted in front of the lens and geared so that it can revolve, shutting off the field of the camera at the end of the first scene.

In the actual making of a "wipe," it is necessary to produce several frames on the film, in which each successive frame has a greater portion of the area blocked off, or unexposed. This process of cutting the field of the camera is accomplished by the rotation of the fan in front of the lens. This is made possible by engaging the gear of the wiper with the gear on the camera while it is recording the closing action of a scene. When the fan reaches approximately the upper position the camera and fan are stopped.

At this point the position of the fan is noted on the index scale in the upper right corner of the fan. Next the film is rewound 24 frames with the shutter closed. Then the



A "wipe" device for movie cameras

fan is placed in the same position it occupied at the end of the first scene, and the camera is ready to take the next scene. With the fan in place, and the gears meshed, the camera is started when the action begins. This causes the fan to revolve out of camera range, gradually revealing the second scene, at which time the gears are disengaged, allowing the operator to continue shooting the ensuing action until another "wipe" is desired.

Heavy Water Molecules Act as Tracers

WHEN you take a drink of water, half of it is still in the body after nine days. And the average time a water molecule stays in the body is 13 days. This is the summary of investigations making use of heavy water for physiological studies of the water content of the human body which have been developed by Prof. Georg von Hevesy and E. Hofer of the University of Freiburg in Germany.

Because heavy water molecules can be distinguished by physical tests, although inseparable chemically from ordinary water, they can act as tracers in studying how the body eliminates water by respiration, perspiration, and urination. Previously physiologists have never been able to make exact tests of how long the water in any particular drink stayed in the body.

Half the original quantity of water taken into the body is lost in from eight to ten days. The average time a water molecule spends in the body is from eleven and one half to fourteen and one half days. "To explain this comparatively long time," state Prof. von Hevesy and Mr. Hofer, "we have to assume that most of the water taken becomes completely mixed with the water content of the body."—*Science Service.*

Roughening Steel Floor Plates

SURE footing, necessary in all factories and plants where employees are passing to and fro in the course of their work, is always a highly important factor. The use of plain flat steel plates for truckways, door sills, loading dock toeboards, is general in all practice. Scrap material that would otherwise be junked is often used. Becom-

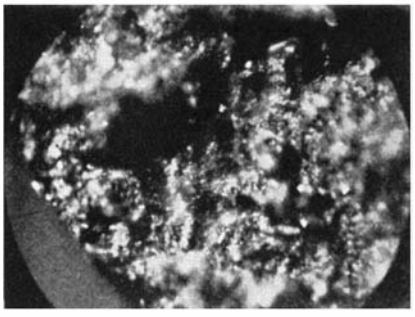
ing slightly worn, these plates often get a highly polished surface and become very slippery, especially when oily, greasy, wet or under winter or outdoor conditions. These can be roughened up very nicely with the use of the oxy-acetylene blowpipe flame.

Hold the flame on the steel plate in one spot until the spot just melts, then rapidly remove the flame. Do this in as many spots on the plates as necessary to give sufficient roughness. The small indentations with the rough, hard edges of these artificial pit marks, constitute a long wearing roughness of just the right amount to prevent slipping—even when pushing a heavy loaded hand truck. The pit marks might well be spaced about one inch apart in both directions, either in straight rows or alternate rows.

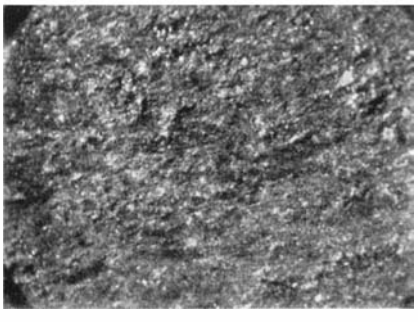
Certain advantages of this method are as follows: a roughened non-slip surface can be created in a few minutes at short notice with small expense; a plate can be treated while in place—one reason for the low cost—or without removing it from service, even temporarily; the surface can be made with any degree of roughness to suit demands or conditions.

Better Resistors for Radio Sets

CONDENSERS, volume controls, and resistors are the most common causes of breakdown in modern radio sets, according to Ralph Sayres, pioneer radio man and president of Lynch Manufacturing Company, resistor specialists. "The fundamental defect in most resistors," he states, "lies in their porosity and may be observed through



Above: **Photomicrograph of an ordinary radio resistor.** *Below:* **A new resistance material, at same magnification; fine-grained in structure**



a powerful microscope. Due to their porous texture, most resistors readily absorb moisture, and are therefore sensitive to atmospheric humidity which alters, appreciably, their resistance value. In this porous mass there are countless voids and inclusions, and electrical contact is limited to point-contact only."

A new type of resistor now on the market is said to overcome these troubles, being rock-hard and moisture-repellent. Of a special ceramic composition, extruded under tremendous pressures at what engineers call "dazzling yellow" heat, this new resistance element affords a compact, homogeneous substance that is uniformly conductive, without pores, voids, or their resultant point-contacts.

Green Highballs

HIGHBALLS that turned green as guests sipped them, had the proprietors of a swank hotel on the west coast worried—to say nothing of the consternation of the customers—until a chemist was called in to explain the phenomenon. James H. Collins, of the Arthur R. Maas Chemical Laboratories, recounts this amusing incident in *Chemistry and You*. To make it all the more perplexing, it was found that highballs made from different liquors did the same thing, but that not all of them turned green every time.

The answer was quite simple, although it took a little detective work by the chemist. Good liquor contains tannic acid, which it picks up from the cask in which it is aged. Tannic acid turns green in the presence of iron. The iron was present in some of the ice. The chemist discovered that two or three of the cans used in the ice plant had rusted slightly. If ice from these cans got into the highball, it turned green—otherwise not.—*A. E. B.*

Floor-Fixer

AMOLASTIC is the name of a new product recently put on the market by the Floor Treatment Division of American Oil and Disinfectant Company. It is a fine-grained asphalt emulsion which is mixed with materials such as cement, sand, or gravel, and is used for repairing and resurfacing all types of floors.—*A. E. B.*

Unique New Business Card

PROBABLY 99 business men out of 100 who have any great number of callers, have tucked away in some corner of their desks stacks of business cards. They usually drop these in the drawer with good intentions: they will transfer name, address, and telephone number to their address books later on. Somehow they never quite get around to it.

With a card recently developed the difficulty of keeping addresses of callers is obviated. The face of this business card, which has been given the name "Keep-a-tab," is the same as that of any ordinary card. At the end on a fold-over flap, however, there is printed or engraved the name and address of the salesman or firm and the telephone number. This end or back-flap tab is gummed so the prospect can easily tear it off and insert in the proper alphabetical position in his address book. It has the advantage of small size for insertion even in very small address books, it eliminates the messy drawer of cards that can never be found when wanted, and makes more sure the preservation of salesmen's names and addresses.

This new card was worked out by Mr. V. J. Sawdon and Mr. Kent R. Costikyan,

Advertising Executive of Platt-Forbes Inc. Patents have been applied for and cards are now available either in blank or finished form.

Gasoline Machine Guns

FROM time to time we have had occasion to point out in these columns that the power in gasoline is far greater than that in black powder and other explosives—to be more exact, gasoline has more B.t.u.'s per pound. This explanation has hitherto been necessary to correct the impression of many people that internal combustion engines could be made to operate on gun powder with a resulting increase in power. Now it seems that still another view may be taken of the possibilities of these two explosives.

According to a writer in *Army Ordnance*, gasoline is suggested very often in the daily press as a more efficient propelling force for machine guns. "Last fall," says the writer, "a dispatch from Berlin announced that Europe was astounded with the invention of a Japanese machine gun using centrifugal force to fire 9075 projectiles per minute absolutely silently. Those who were present at the 1920 meeting of the Army Ordnance Association at Aberdeen will recall the demonstration of a similar gun which was operated by a truck motor and discharged 1200 tempered steel bearing balls per minute. However, the range was insufficient.

"Eventually some such device may be perfected. At all events it is of interest to compare the available energy in gasoline with that in gunpowder:

	B.T.U. Per Lb.	Work in Kg-M
Pure Nitrocellulose	2000	467,500
Black Powder	1230	291,100
Gasoline	20,000	4,760,000

"The only advantage of the powders is that they liberate their energy almost instantaneously, which the far less expensive and more powerful gasoline fails to do."

Nitramon, A Revolutionary New Explosive

A REVOLUTIONARY new blasting material for use in quarries and in other blasting operations such as stripping, cannot be detonated by the strongest commercial blasting cap, by impact, by flame, nor by shooting a rifle bullet into it. In actual use it is exploded by means of a large diameter cartridge of dynamite. It is non-headache-producing and is rendered absolutely water resistant by being sealed up tightly in a tin can. It is stated to represent the ultimate in safety in so far as a blasting agent is concerned. It represents a very radical departure in the explosives field. This new development has been covered by two patents, one for the product itself and the other covering its method of use. It is non-freezing.

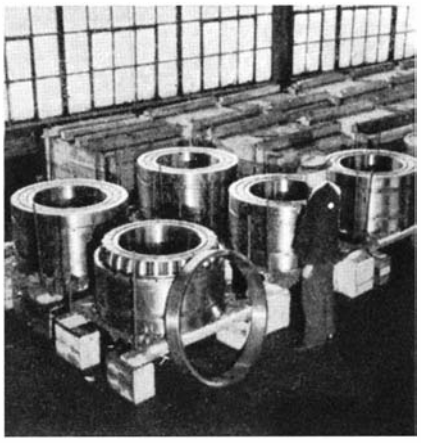
The new product, known as Nitramon, will be marketed only in large diameters, for example, four inch, four and one half inch, five inch, and seven inch. It is adapted solely for use in large diameters and has been designed specifically to fulfill as nearly as possible the ideal qualifications for use in quarries and in coal stripping operations.

The fact that it cannot be detonated by any of the ordinary means used to detonate explosives makes it safe for transportation in a degree hitherto unknown for any blasting agent.

Work on this new explosive has been going on for months. It has been tested both in the duPont laboratories and in the field and by agencies outside the company.—*A. E. B.*

Giant Roller Bearings

JUST a few of the 1400 Timken tapered roller bearings which will be used in the new Ford steel mill are shown in the accompanying photograph, ready for shipment.



Huge roller bearings for steel mill

Fifty-two bearings of the size shown (25½ by 40½ inches), each weighing 4086 pounds apiece, will be installed on the back-up roll-necks of hot strip mills and cold strip mills. The loads on the back-up roll-necks of a single stand reversing cold mill will be carried by four similar bearings.

Eighty-seven different sizes of bearings will go into the equipment now under construction. These bearings vary in weight from one pound for the smallest up to 7640 pounds each for the big ones used on the single stand reversing cold mill.

In all, 185 tons of Timken bearings will be used in the new Ford mills, now being built by The United Engineering and Foundry Company. It is believed that this is the largest single order for steel mill anti-friction bearings ever placed.

Dust from Above

OVER 50,000 tons of meteorite dust are estimated to fall upon the earth daily, according to Prof. H. H. Nininger, secretary of the International Society for Research on Meteorites, curator of meteorites at the Colorado Museum of Natural History, director of the Nininger Laboratory, and owner of the largest private collection of meteorites in the world.

"Through this constant bombardment, the earth is being built up by shattered fragments of previous worlds," Prof. Nininger says. He explains that while a meteor like that observed on March 24, 1933, might leave only a few pounds of solid stones, it also left behind a dust-cloud covering an area of many miles, and from 20 to 60 miles

high. "This cloud was about 1000 cubic miles in volume, and may have contained thousands of tons of star-dust which gradually settled out on the earth."

"Although accurate counts by trained observers have placed the number of meteorites falling into the atmosphere at 20,000,000 daily, meteorites are not easy to find. There are very few men alive who have ever found even one piece of one meteorite."

"One of the greatest difficulties in making an accurate study of meteorites and their fall is that ordinary observers are so mistaken in their idea of distance. People frequently tell me that they narrowly escaped being hit by a meteor which actually never passed within 100 miles of them."

1934 Tornado Toll Below Average

WEDGING a dime into a tree trunk and driving a 10-foot plank through the chassis and steel body of an overturned automobile, the outstanding tornado of 1934 lived up to its family reputation for prankishness. Real twisters, however, were comparatively few and far between in the United States last year. Windstorms violent enough to do a great deal of damage swept over the Midwest and parts of the East and South, but they were not of tornado intensity.

Weather Bureau records show that there were only 76 true tornadoes in 1934, as compared with 260 in 1933, and 152 in 1932. The 76 twisters of 1934 cost the lives of 32 people and demolished property valued at nearly 2,800,000 dollars. But the tornado toll of other years has run from 36 lives, in 1931, to 794, in 1925, and from a property loss of nearly 3,000,000 dollars, in 1923, to one of about 43,500,000 dollars in 1927. Since 1916, the records show, only one year, 1919, has had as few twisters as 1934 had. The 65 tornadoes in 1919, however, killed 205 people and destroyed property worth 6,861,000 dollars.

The tornado belt, the Weather Bureau says, is commonly presumed to be Arkansas, Missouri, Iowa, Illinois, and much of Kansas and Nebraska. A tornado, however, may appear in other parts of the country, as was evident last year when New Orleans, Cleveland, and Indianapolis were hit. Nor, the climatologists add, do twisters follow any special plan. Past performance is no key to where or when the next one will strike, or the damage it will do.

CURRENT BULLETIN BRIEFS

Bibliography of the Redwoods. A plea to save the redwoods, one of the priceless heritages of our western states, together with a lengthy list of books, magazine articles, and so on, devoted to this particular type of tree. *Save-the-Redwoods League, 114 Sansome Street, San Francisco, Calif.—Gratis.*

Vocational Teacher Training in the Industrial Field. Four reports of the Committee on Trade and Industrial Teacher Training of the American Vocational Association, Inc., stressing the importance of an adequate staff of trained teachers for the successful operation of a program of publicly supported vocational education. Vocational Education Bulletin No. 172. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

Safeguarding Electric Service in the Home. The wiring of electric lights and other electrically operated devices in the home is often taken too much for granted. This booklet and inserted material stresses some of the points that should be watched. *Write for Bulletin 435-A, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

The United States Coast and Geodetic Survey. A summary of the work of this body in surveying and charting the waters of the United States, and also of its other activities. Of particular importance to both motorists and those who use boats of any type. *United States Government Printing Office, Washington, D. C.—Gratis.*

Vital Impurities. The importance of certain impurities in Chilean nitrate fertilizers. *Write for Bulletin 435-B, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

Farm Property Improvement outlines the adaptation of the Better Housing Program to farm conditions, pointing out how this plan makes possible needed farm improvement work. *Federal Housing Administration, Washington, D. C.—Gratis.*

Pioneer Wind Tunnels, by N. H. Randers-Pehrson, is a description with illustrations of some of the original wind tunnels used for determining aerodynamical properties. *Publication 3294. Smithsonian Institution, Washington, D. C.—20 cents.*

Dark Field Optical Systems. A practical discussion of the subject, together with illustrations and prices of equipment necessary for the work. *Write for Bulletin 435-C, Scientific American, 24 West 40th Street, New York City—3 cent stamp.*

Electrical Grounds on Water Pipes, by H. S. Warren. Grounding electrical circuits on pipes often is detrimental to the piping. This is a discussion of the types of grounds employed, their purpose, and the probable effects on water piping systems. Monograph B-821. *Bell Telephone Laboratories, 463 West Street, New York City.—Gratis.*

The Sperry Pilot for Automatic Flying. Complete descriptions with excellent drawings of this gyroscopically operated automatic pilot, telling how it operates, how it is used, and its advantages. *Write for Bulletin 435-D, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

Teaching Farm Credit. It is essential that every farm be operated under a systematic financial program. This 44-page pamphlet tells how such a program may be arranged. Vocational Education Bulletin No. 178. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THERE'S LIFE IN THE OLD IRON HORSE!

(*Continued from page* 181)

tific knowledge. But, at that, they will not exhaust the speed possibilities of steam.

The steam unit—the new rather than the old iron horse—is not, for all these reasons and others that might be suggested, done for. There's life in her yet! Indeed, I feel I may venture the thought that, far from being done for, the steam unit may take the challenge of the oil-electric as it took the challenge of electricity, in its stride, as it were, and continue to rule the rails—at least the main-line rails.

In switching service, where a 100-ton unit is adequate, the oil-electric is without question here to stay. In branch-line work, where there are now more than a thousand Dieselized and other internal-combustion rail cars in service, it has a definite function up to a certain point. In many instances it has already eliminated the spectacle of old main-line passenger locomotives, some with boosters and in some cases even freight locomotives of 2500 or 3000 horsepower, being used to haul trains of two or three cars. Therefore it is wholly possible that in due course light steam units, new in kind, may appear to compete successfully with oil-electrics, even in branch-line work.

In any case, those of us who are directly associated with American railroading have at least three things to be thankful for:

First: We have three power units, instead of two, to work with.

Second: Without question we are entering upon an era certain to be characterized by extensive replacements as distinguished from repair, notably of passenger power units and passenger equipment, to the end that our roads can regain lost passenger traffic by providing the fastest, safest, most comfortable overland transportation.

Third: In this picture there is opportunity for science to make its third major contribution to railroading by applying, although tardily, its many accumulated findings to the generality of steam locomotives.

The stage is ready.

During the last 15 or 20 years locomotive steam pressures have been advanced from around 200 pounds to as high as 850. Every part of the unit has come in for redesign or other improvement, with the result that the service thermal efficiency of new units is approximately double that of those built 20 years ago. Meanwhile, runs between division points have been increased from 100 or 150 miles to 500, 600, 700, even above 800 miles, and the mileage covered between overhaulings has been increased around 10 times, so that today many passenger locomotives go 300,000 miles without a general shopping.

Accordingly, though I repeat that we are equipped, and it is our job, to give our customers whichever power unit is for them most economic, all things considered, I judge that the steam locomotive is a long way from done for; may well increase the respect and affection railroad men have for it; will gain, rather than lose, from the competition of the new main-line unit, the oil-electric.

THE SANITY OF INSANITY, OR THE INSANITY OF SANITY

(*Continued from page* 190)

song" of his life—and we can call to mind just such cases from our own acquaintance. So the school was wrong and he said so—said so very loudly, in fact. He started a little laboratory in the barn and suddenly discovered his grand elixir of life, the medicine that would cure anything. He put in on the market—and nothing happened.

That needed explanation. Ha! He had it! The medical profession was persecuting him. His great discovery would put all doctors out of work. It was a conspiracy. So he wrote the head of the American Medical Association, giving him fair warning to "lay off." Nothing happened. Another letter brought no result. He wrote President Hoover. Still no result. So one day, goaded to exasperation he took a gun, called on the nearest doctor and shot him. Moreover, he'll tell you he was quite justified in doing so. Furthermore, if you accept his original "theme song," he was. But note that all through it he was merely pursuing the pleasure principle. His greatest pleasure came from his own feeling of superiority. As the object of a plot by the combined medical forces of the entire country he really feels important. He believes it and is happy.

So the story goes. Here is "Britannia, the Pride of the Ocean." She is there because of persecution by an American admiral. Another has a wonderful scheme of supplying New York City with ice in the summer: a system of chutes will bring a glacier down from Greenland to Times Square. Of course this would ruin the New York ice companies, so they have had him confined in an asylum. One chap sits in the corner and grins all day long. Another raves at the top of his voice that he is John the Baptist preaching in the wilderness. Both are having a perfectly wonderful time. We might continue these cases by the dozen, but would always find the same story.

Each of us has a theme of life. We can define it psychologically in terms of the pleasure principle. Some seek wealth, some fame, some power.

But the insane have solved life's problem. They have accepted at its face value Christ's dictum "The Kingdom of God is within you." You wish wealth—they have it. You seek for power but this chap *is* Napoleon. You laugh and say he's insane. But what are *you* seeking? Happiness! Have you found it? Only partially, at best, and you may be very unhappy. He is so pleased with himself that in a great many cases he won't even waste time talking to you. You, my friend, in his opinion, are a mere worm and a very foolish worm at that.

He is incurable because he doesn't want to be cured. After all, is he not very wise? You toil, you strive, you worry and as like as not you end your life in comparative poverty. He never works, he's well fed and worry never crosses his path. He dies a multi-millionaire. Well may he look at you and say, "Poor devil, he's sane."

Books SELECTED BY THE EDITORS

(*Continued from page* 172)

of following its guidance is greatly improved health. SCIENTIFIC AMERICAN articles have shown the close relationship between poor posture—sitting, standing, moving—and poor health. As the posture is corrected, there is improvement physically and mentally. This volume will, therefore, be surreptitiously borrowed from the wives of many tired business men and read by said T.B.M. for efficiency's sake. Children should be encouraged to read it. —$1.90 postpaid.—*F. D. M.*

RADIO ROUND THE WORLD

By A. W. Haslett

A SURVEY of present-day radio including a chapter which gives the necessary historical background. There is a simplified discussion of the Heaviside layer, the effect of the sun on radio transmission, and other phases of radio phenomena which often are puzzling to the layman. 196 pages, illustrated with drawings and photographs.—$1.90 postpaid.—*A. P. P.*

CLINICAL AND PATHOLOGICAL APPLICATIONS OF SPECTRUM ANALYSIS

By Dr. Walther Gerlach and Dr. Werner Gerlach

THERE is no general semi-popular treatise on spectrum analysis in the English language (as there should be) but this 130-page book is a very practical and not highly technical treatise on one of the many special aspects of this subject. To the reader who comprehends physical optics and is familiar with laboratory apparatus, it tells how to set up and use light sources, take spectrograms, and make spectral analysis of biological samples—organs, secreta, excreta; how to apply spectrum analysis in electropathology, in shot wounds and on bullets (detective work); also its use in examining for traces of various elements. It is a translation from the German and is a practical rather than a theoretical book, covering a wide variety of applications within the single field mentioned.—$4.50 postpaid.—*A. G. I.*

MARVELS OF MODERN CHEMISTRY

By Beverly L. Clarke, Ph.D.

MORE and more it becomes apparent even to the most casual observer that the science of chemistry has a very definite effect on our everyday lives. In this book the author has attempted to make a general survey of all phases of chemistry—a stupendous undertaking—and to explain them clearly and simply for those who may have forgotten all of the chemistry they ever learned. The result is a book that is entirely understandable. In a few places chemistry symbols are used where it is unavoidable but certainly not to an extent which might deter the average reader. 374 pages, illustrated, with a comprehensive bibliography and index.—$2.65 postpaid.—*A. P. P.*

BEFORE THE DAWN OF HISTORY

By Charles R. Knight

THIS book consists of a collection of large reproductions (the format is 9 by 12) of the author's large and famous mural paintings of prehistoric animals permanently hung on the walls of the American Museum of Natural History, New York, and the Field Museum of Natural History, Chicago—paintings of giant dinosaurs and primitive extinct mammals: uintatheres, titanotheres, creodonts, glyptodonts, and so on. In his qualification to write this book and paint these pictures in their proper environmental settings, the author is practically unique, for he may be looked at both as an artist who understands the scientific aspects of his subjects and as a scientist who can paint. His paintings are as nearly authentic as it is possible for science to make them. Opposite each painting there is a scientific interpretation. The author also explains how he builds up these pictures, after much painstaking research. —$2.65 postpaid.—*A. G. I.*

DIESEL HAND BOOK

By Julius Rosbloom

A GREATLY enlarged second edition of a work that has been standard for several years. It is a practical book of instruction for engineers and students, on modern Diesel engineering—land, marine, locomotive, air, automotive, and portable installations. Profusely illustrated, 543 pages.—$5.25 postpaid.—*F. D. M.*

THROUGH SPACE AND TIME

By Sir James Jeans

SIR JAMES JEANS' latest piece of popular writing is very popular indeed, containing eight lectures which he recently delivered to audiences made up of persons from eight to eighty years of age. Its chapters deal respectively with the earth, the air, the sky, the moon, the planets, the sun, the stars, and the nebulae, and make very easy, informative reading.—$3.20 postpaid.—*A. G. I.*

THE MODELMAKER—Volume XI

Edited by W. Edmonds Spon

FOR those interested in the hobby of making working models, this 316-page book will prove interesting and useful. Details, instructions, plans for making an amazing variety of models that work: Airplanes, locomotives, boats, railway systems, and pumps and other machinery. Gossip of the hobbyists, also.—$2.40 postpaid.—*F. D. M.*

HISTORY OF MAGIC AND EXPERIMENTAL SCIENCE

By Lynn Thorndyke, Prof. Hist., Columbia Univ.

THIS is a lengthy work of two volumes, with a total of 1259 pages exclusive of appendices and index, and it is a continuation of two volumes covering earlier centuries of history, published by the same author in 1923. It is scholarly and exhaustive and its purpose is to provide background for the student who wishes to obtain more than a superficial insight into the historic origins of early and evolving science. By "magic" the author does not mean sleight of hand tricks, which is only a special, modern usage of that word, but a mass of ideas or doctrine representing an early way of looking at the world. From our modern point of view it is easy to separate the sciences of astronomy and chemistry from the superstitions of astrology and alchemy—these distinctions nowadays seem self-evident except to thousands of the uncritical whose mental outlook is medieval. Centuries ago the two were one entity; was not the court astrologer Kepler also a great astronomer? But it was the early magicians—astrologers, alchemists, and others—who were the first to experiment, and modern science with its experimental method evolved out of these early efforts. It is impossible to comprehend the significance of modern science in the world without studying the history of science, and this learned work will greatly enlarge the point of view of the student of that subject.—$10.50 postpaid.—*A. G. I.*

SCIENTIFIC AMERICAN ADVERTISERS

APRIL · 1935

Advertising Director
WALTER DREY
24 West 40th Street, New York, N. Y.

Advertising Representatives

EWING HUTCHISON COMPANY
35 East Wacker Drive, Chicago, Ill.

BLANCHARD-NICHOLS-COLEMAN
Los Angeles, San Francisco, Seattle and Atlanta

Published by MUNN & COMPANY, INC.
24-26 West 40th Street, New York

ORSON D. MUNN, President JOHN P. DAVIS, Treasurer I. SHELDON TILNEY, Secretary

EDITORIAL STAFF · ORSON D. MUNN, EDITOR

ALBERT A. HOPKINS
A. P. PECK
F. D. McHUGH
ALBERT G. INGALLS
A. M. TILNEY
PROFESSOR HENRY NORRIS RUSSELL
PROFESSOR ALEXANDER KLEMIN

CONTRIBUTING EDITORS

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

CHURCHILL EISENHART, Princeton University.

REV. WM. F. A. ELLISON, Director of Armagh Observatory, Northern Ireland.

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

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

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

WALDEMAR KAEMPFFERT, *New York Times.*

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

SYLVESTER J. LIDDY, New York Bar.

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

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Associate in Optics and Instrument Design, California. Institute of Technology.

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

J. B. RHINE, Associate Professor of Psychology, Duke University. Honorary Research Officer, Boston Society for Psychic Research.

PHILIP H. SMITH, Industrial Research.

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

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

Vol. 152, No. 4. 35 cents a copy. $4.00 a year, postpaid in United States and possessions. Canada, $4.50; other foreign countries, $5.00, postpaid. Illustrated articles must not be reproduced without written permission; quotations therefrom for advertising and stock-selling enterprises are never authorized. "Scientific American" registered United States Patent Office. Files are kept in all large libraries and articles are indexed in all leading indices.

SCIENTIFIC BOOKS AT SUBSTANTIAL SAVINGS

ALL the volumes are new and in perfect condition. After a careful selection of titles, we contracted for large quantities and are sharing the resulting savings with you. If your order amounts to $5.00 and less than $10.00, deduct 10 percent from the total. If your order amounts to $10.00 or more, deduct 15 percent. On all orders of $5.00 or more, we will include a copy of "Liberty," by Everett Dean Martin, a Book-of-the-Month Club selection selling regularly for $3.00, ABSOLUTELY FREE.

OUTLINE OF PHYSIOLOGY

By DR. V. H. MOTHAM, *Professor of Physiology in the University of London*

1 With a genius for making complicated scientific facts at once clear and interesting, this author has written a book for those who want to know the vital facts about the human body; how it is put together and how it functions. Interesting, lucid, instructive. Everything from nerves to glands. 279 pages, illustrated.—$3.00

WHERE IS SCIENCE GOING?

By MAX PLANCK, *Professor of Theoretical Physics at the University of Berlin, with a prologue by* ALBERT EINSTEIN.

2 Dr. James Jeans said of Max Planck: "His contribution marked the end of the mechanical age in science and the opening of a new era." A Scientific Book Club selection. Max Planck knows how to interpret modern science for the general reader. His volume, with remarkable clarity of thought and expression, is as stimulating as it is profound. 221 pages.—$2.75

THE MATERIALS OF LIFE

By T. R. PARSONS, *M.A. (Cantb.), B.Sc. (London)*

3 A first general presentation of biochemistry—that science whose recent discoveries (such as vitamins and insulin) have lengthened life. 280 pages, with numerous illustrations and diagrams. If you want to understand the materials of which living things are made and the complex fascinating changes that these materials undergo during life, read this book.—$3.00

THE SCIENCE OF HUMAN REPRODUCTION

By DR. H. M. PARSHLEY, *Professor of Zoology, Smith College*

4 Biological aspects of sex, 312 pages, illustrated. With complete bibliography and index. This book defines the different physical and psychological characteristics of men and women. It explains the zoology of reproduction; the part played by the glands in sex and reproduction; life before birth; the biology of human behavior. A full scientific treatment.—$3.50

THE SCIENTIFIC OUTLOOK

By BERTRAND RUSSELL

5 One of the greatest books by one of the greatest of living authors. 277 pages. Brilliant with epigrams, informative and exciting, this book is both a warning and a challenge. The effect of science on theology and of theology on science is just one of many similar controversial subjects presented. At least 100 other topics of similar importance are to be found in this fascinating volume.—$3.00

WHAT ENGINEERS DO

By WALTER D. BINGER

6 For all those who are curious for information about what engineering is, this is the story of construction and civil engineering. It is an outline of what has been accomplished in this field and describes some of the new methods and means by which success was attained. Written for readers of all ages. Truth that is more fascinating than fiction.—$2.75

THE TWILIGHT OF PARENTHOOD

By ENID CHARLES, *M.A., Ph.D.*

7 The dangers of overproduction and the menace of underpopulation; the eugenic aspects of the problem; the technical revolution in food production; in fact, all the vital factors of population growth are treated fully and fairly in this volume. For everyone interested in social and political questions. 226 pages.—$2.50

PREPARATION FOR MARRIAGE

Edited by DR. KENNETH M. WALKER, *F.R.C.S., with introduction by* DR. LOGAN CLENDENING, *author of "The Human Body"*

8 175 pages, indexed with a glossary of scientific terms. Of books that deal with the purely physical aspects of the marriage problem, there is an oversupply, but this book recognizes and shows the equally great importance of the psychological and spiritual elements. It embraces such subjects as Courtship, Intercourse, Fertility and Sterility, Birth Control, Continence, Sex Aberrations. There is a chapter of Advice to Advisers.—$2.00

LIBERTY

By EVERETT DEAN MARTIN, *author of "Psychology—The Behavior of Crowds"*

9 When originally published, this was a Book-of-the-Month Club selection. The American Library Association says Mr. Martin's work as an educator is more important than that of popularizing knowledge. He is a deep and sincere student of psychology. Mr. Martin asks the question: "Is Freedom a matter of laws or of psychology?"—and answers it. For your permanent library. 307 pages.—$3.00

USE OUR BOOK SERVICE

All books on scientific and allied subjects. Scientific American Book Department. *Write for free circular.*

FREE

With Every Order of $5.00 or More, A Copy of

LIBERTY

By Everett Dean Martin

A few of the fascinating subjects treated in this important book are:

Liberty in Ancient Athens
Christian Liberty
Freedom and the Renaissance
Romantic Ideas of Liberty
Liberty and Tolerance
Freedom and Power
Freedom and Morals

Remember, we will include a copy of this remarkable book absolutely free with all orders of $5.00 or more. The coupon is for your convenience in ordering. Check the numbers of the books you want and mail it to us with your remittance today.

This Coupon is For Your Convenience. Use it.

SCIENTIFIC AMERICAN, 24 West 40th Street, New York, N. Y.

Send me the books I have checked. ☐ No. 1 at $3.00 ☐ No. 2 at $2.75

☐ No. 3 at $3.00 ☐ No. 4 at $3.50 ☐ No. 5 at $3.00 ☐ No. 6 at $2.75

☐ No. 7 at $2.50 ☐ No. 8 at $2.00 ☐ No. 9 at $3.00

I enclose.....

Name.....

Address .....

Deduct 10 percent from list price if order is more than $5 and less than $10.
Deduct 15 percent from list price if order is more than $10.

A copy of "Liberty" given ABSOLUTELY FREE on all orders of $5.00 or more.

"I'm not worrying . . .
. . should I meet with an *Accident* or *Sickness* tonight!"

FOR LESS THAN 3c A DAY YOU CAN PROTECT YOURSELF AND THOSE DEAR TO YOU!

SUPPOSE you meet with an accident or sickness *tonight*—will your income continue?

Remember, few escape without accident—and none of us can tell what tomorrow holds for us. While you are reading this warning, somewhere some ghastly tragedy, flood or fire, some automobile or train disaster, is taking its toll of human life or limb.

Now is the Time to Protect Yourself

If you suddenly become ill—would your income stop? What if you suffered from lobar pneumonia, an appendicitis operation, or any of the many common ills which are covered in this unusual policy; wouldn't you rest easier and convalesce more quickly if you knew that our company stood ready to help lift from your shoulders the distressing financial burdens in case of a personal tragedy?

A sudden accident! A sudden sickness! Can you say neither will happen to you?

Then don't delay another day. Protect yourself by insuring in the largest and oldest exclusive accident insurance Company in America. Send the coupon NOW for complete information about our new $10,000 Accident and Sickness Policy.

Mail coupon for FREE copy of booklet "CASH or Sympathy"

MAIL THE COUPON NOW

North American Accident Insurance Company
641 Title Bldg., Newark, N. J.

Gentlemen:

At no cost to me mail copy of your FREE booklet "CASH or Sympathy." There is no obligation.

Name.....

Address.....

City..... State.....

Over $20,000,000.00 Paid in Claims!

Under Direct Supervision of 46 State Insurance Departments

Established Over 48 Years

AGENTS Wanted for New Territory

Largest and Oldest Exclusive Health and Accident Insurance Company in America

NORTH AMERICAN ACCIDENT INSURANCE CO. OF CHICAGO

641 Title Bldg., Newark, New Jersey

Some of the Features of This Limited Policy

ONLY $10 A YEAR
CAN BE PAID MONTHLY IF DESIRED

No Medical Examination
No Dues No Assessments

Men and Women
16 to 69 Years Accepted

$10,000
Principal Sum

$10,000
Loss of hands, feet or eyesight

$25 Weekly Benefits
for stated accidents and sickness

Doctor's Bills, Hospital Benefits, Emergency Benefit and other liberal features to help in time of need—all clearly shown in policy. This is a simple and understandable policy — without complicated or misleading clauses. You know exactly what every word means—and every word means exactly what it says.