SCIENTIFIC AMERICAN

Copper in the Brewery (See page 1)

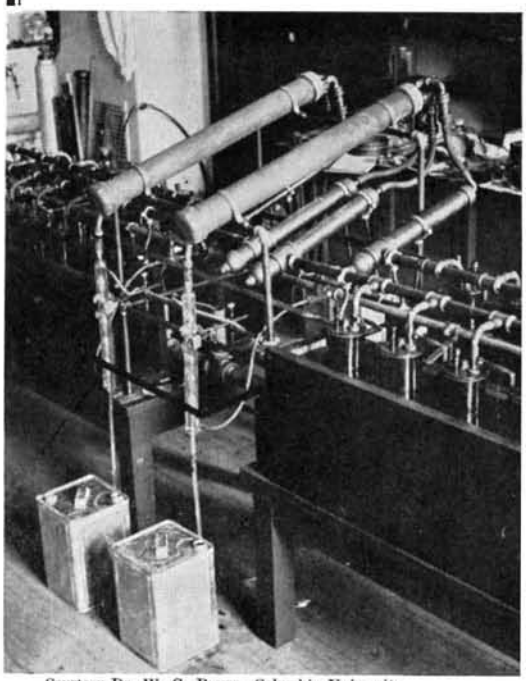
VOLUME 153
•
NUMBER 1

TELEPATHY IN A PSYCHIC MEDIUM

JULY 1935
•
35c A COPY

Dear Editor—

How Important will "Heavy Water" be in a Practical Way?



Courtesy Dr. W. G. Brown, Columbia University
Apparatus for obtaining heavy water

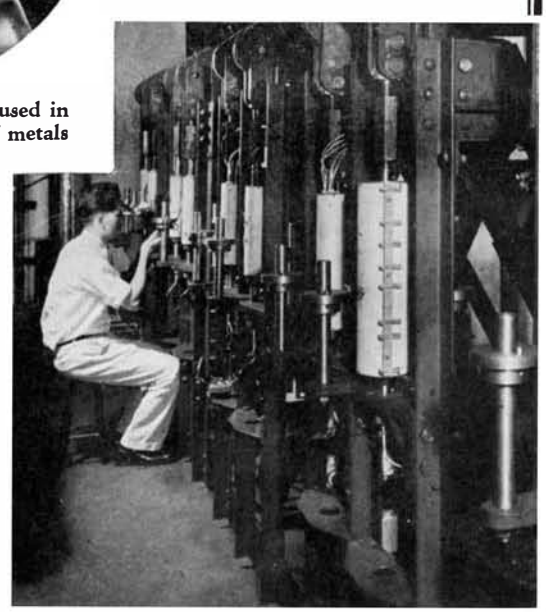
WHEN the discovery of "Heavy Water" was announced, readers wrote to us for more information. Among the questions asked was the one quoted above. So we immediately enlisted the discoverer, Dr. Harold C. Urey, Professor of Chemistry, as a contributor. His article appeared in our June number. Our editors made an independent investigation, and venture the prediction that Heavy Water will reach every reader's life in some practical way within a very few years. Readers will be kept informed not only of each progressive development of Heavy Water from the laboratory stages to its practical application, but also on every other significant development of modern science from its discovery to the finished products in which it reaches the user.

¶To read SCIENTIFIC AMERICAN is both assurance and insurance that nothing of scientific significance will escape your attention.

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 are a revelation of far-reaching influence and a startling testimonial of the confidence of the readers in the Research and Service facilities which are made available by SCIENTIFIC AMERICAN.

Highly accurate equipment used in metallographic inspection of metals

• SCIENTIFIC AMERICAN is a national institution for the dissemination of knowledge regarding the discoveries and developments of modern science. We also keep the public informed on new products directly available to the consumer and those used in industry and transportation.



Determining elongation in a number of creep tests of steel. Telescope micrometer is used

¶ 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

24 West 40th St. New York City

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 · JULY · 1935

COVER

ONE of the many uses to which copper is put, because of its corrosion resistance and other desirable qualities, is in modern breweries. Our cover photograph shows a group of copper brew kettles at Rupperts Brewery. The story of copper and the tremendous strides which have been made in the development of copper and copper alloys is told in the article on page 20 of this issue.

SCIENTIFIC AMERICAN, July, 1935. Vol. No. 153, No. 1, 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

WITH the summer months calling one and all to the outdoors in pursuit of recreation, the subject of snakes and snake bites becomes of paramount interest. Whether you are a confirmed hiker who searches out the most remote wilderness in which to commune with Nature, or whether you just load the family into the car for a day's picnic, there are certain facts in connection with snakes which, for your own sake and that of others, you should know. Probably no other subject has been treated with more stretches of the imagination and with less regard for actual facts than has that of snake bite and what to do about it. Accordingly, an article covering the latest aspects of this situation has been prepared, and is scheduled for publication next month. Having been checked carefully by acknowledged experts, the article may safely act as a guide for those whose work or pleasure takes them to regions where venomous snakes are likely to be encountered. The article tells not only of the *correct* method of treating snake bite, but also how to avoid being bitten.

●

WHEN you turn an astronomer-artist-mechanic loose on a problem such as designing a sun-dial which really tells time, you would naturally expect a workable result. And such a result has been reached by Russell W. Porter, who tells next month of the design of sun clocks, which at first glance appear to be combinations of microscopes, ordinary clocks, and a few other little gadgets. But Mr. Porter, whose writing and drawing ability is well known to our readers, can tell his own story much better than we can, so our best bet is just to say: Don't miss this *practical* article, free from flowery allusions, that will increase your respect for the time-keeping qualities of sun clocks.

●

A FAVORITE source of material for the writers of so-called scientific fiction is the planet Mars, undoubtedly because of the undisputed fact that the planet is more or less similar to our own world. Discriminating readers can wade through such stories, if they do not take them too seriously, and be amused by them, but there is little to be gained by so doing, other than whiling away time. On the other hand, professional astronomers are constantly adding to our store of knowledge regarding Mars, and when Prof. Henry Norris Russell writes of the most recent telescopic work with the red planet, the reader may be sure that he will not only be interested by the story, but will also take away from it many facts that will add to and possibly amend some of his preconceived notions about the subject. Such will be the case next month, when Professor Russell's regular feature will deal with some of the latest facts about Mars.

COMING

℄ Snake Bites; How to Treat and Avoid Them, by W. A. Bevan

℄ Mars, by Prof. Henry Norris Russell

℄ "The Seven League Boots of Photography," by Jacob Deschin

℄ Flood Control of the Lower Mississippi River, by R. G. Skerrett

℄ "Sun Clocks," by Russell W. Porter

℄ "What are Positrons?" by Prof. E. U. Condon

●

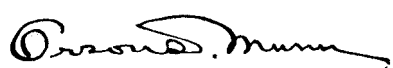
ADVANCED amateur photographers: The interest which you have manifested in the series of articles on photography which have appeared in these pages during the past year and a half (over a thousand of you have written to us on one phase of photography alone) has led us to an important decision. The feature article on telephotography, by Jacob Deschin, to be published next month, will be the last of the series. But . . . hold on a minute! We have planned to give you a corner of the magazine all to yourselves. Each month, from now on, a department all your own will be published, where specific problems will be discussed for the benefit of all. This arrangement will make it possible to concentrate photographic material for ready reference, and to give you the latest and best information in compact form. You asked for this: Go to it! The first appearance of the department will be in our September number.

●

WHEN man harnesses Nature, for whatever purpose, he often finds that he has a real battle on his hands. Of such magnitude is the work which modern civilization has demanded must be done on the Mississippi River. Part of the story was told in our February number—"Canalization of the Upper Mississippi River." Next month the other half will be presented: Flood control of the lower Mississippi River. Some facts and figures will give an idea of the scope of the problem: 650,000,000 cubic yards of earth will be placed in levees; the levees range in height from 20 to 30 feet; there will be 1900 miles of them and they will protect 12,000,000 acres from floods when the work is completed. But you will have to read R. G. Skerrett's article next month to get the whole picture.

●

"WHAT are Positrons?," is the title of our pure science article for next month, in which Prof. E. U. Condon, of Princeton University, gives a clear insight to one of the more recent advances in atomic physics. So rapidly does science progress that it frequently seems that the average intelligent person must be left far in the rear. Knowing full well that our readers want to keep up with this progress, we present, from time to time, articles such as Prof. Condon's, which serve to tell, in understandable language, the present status of certain important phases of research in pure science.



Editor and Publisher

Personalities in Science

Photo by Oscar S. Marshall

DR. JOHN D. STRONG

FOR almost a century astronomers have coated the glass disks of their reflecting telescopes with a layer of silver about one 250,000th of an inch in thickness, to form the mirror which reflects the star light to a focus, and this coating has always been made from a chemical solution in which the glass was immersed. About 1928, several men of science, mostly physicists, began developing a wholly different process called the metallic evaporation process, and that method has already proved so satisfactory that a number of laboratories are now busy coating telescope mirror disks with metal evaporated by intense heat, while others are hurriedly preparing equipment to make mirrors in the same manner.

Three or four years ago only small mirrors could be coated. Later, mirrors as large as 30 inches in diameter were successfully made. Recently the mirror of the 60-inch telescope at the Mount Wilson Observatory was coated with aluminum by the new process, and still more recently the world's largest mirror disk, 100 inches in diameter, was successfully coated with the same metal. This exacting work was done by Dr. John D. Strong of the California Institute of Technology, at Pasadena. Dr. Strong, whose photograph, caught while he was at work in his laboratory, is shown on this page, was one of the pioneers in the development of the metallic evaporation process, and was the first discoverer of a *practical* technique for the use of aluminum, a metal which is superior to others, mainly because it reflects the various parts of the spectrum of light more uniformly.

If a metal is heated to a high enough temperature it will be evaporated like water, and the vapor will recondense on cool neighboring surfaces. This is the essence of the new method. Little pieces of the chosen metal are hung on small helical coils of tungsten wire, which are then flashed white hot by passing an electric current through them. The metal on the coils is not merely melted; it is vaporized. The glass disk is placed a few inches distant, but unless the intervening air were removed, the atoms of the metal could not fly straight across to the glass, because they would collide with the obstructing air molecules, and the result would not be a mirror. Hence a bell jar is placed over the whole set-up, and a very fine seal is made at the bed-plate on which it rests. The air is then pumped down to almost one 10,000,000th of normal atmospheric pressure. For the 100-inch mirror this pumping preparation required eight hours. A current of low voltage next heats, in turn, each of the several tungsten coils arranged around the mirror, and evaporates the metal in a few seconds. A coat one 250,000th inch thick is applied—just as with the former silver.

How simple it all sounds! In practice, however, there are many technical details which can be learned only by an extended apprenticeship, especially if the worker is not accustomed to high vacuum technique. Keeping small-eared mosquitoes out of a screened house in some parts of New Jersey is easy, compared with keeping air molecules from crawling in through the joints that surround a high vacuum.

An aluminum mirror, deposited in this manner, looks so wholly different from the familiar aluminum of pots and pans, that nearly everyone mistakes one for a brilliant silver mirror. Aluminum reflects 89 percent of the visible light and, unlike silver, 80 percent of the ultra-violet (of immense value to astronomy). The metal is automatically protected, as soon as the air strikes it, by a thin, transparent coating of very hard oxide (corundum, sapphire), hence the coat is far tougher than silver coats.

Photograph by Richard T. Dooner

FROM THE FAR REACHES OF WESTERN CHINA

THE first and only habitat group in the world of the takin, a curious form of mountain antelope, has just been placed in the Free Natural History Museum in Philadelphia. The takin (*Budorcas taxicolor*) is a species of ruminant that is found in the almost inaccessible mountains of Western China where it lives in thick rhododendron forests at altitudes of from 7000 to 16,000 feet. It is covered with yellowish-brown hair and has curved horns similar to those of the gnu. The specimens for the museum group were collected by Brooke Dolan, II, and were mounted by Louis Jonas. The erection of the group was directed by Harold T. Green.

Photo by George Masa

Sunset at Indian Gap in the Great Smokies, on the Appalachian Trail

THE APPALACHIAN TRAIL*

A Key to Nature Study . . . For Pedestrians Only . . . A Project of Real Magnitude . . . From the Wilderness of Maine to Northern Georgia

By MYRON H. AVERY

THE Appalachian Trail is a continuous marked foot-path extending through the mountain wilderness of the Eastern Atlantic States. It is a skyland route along the crest of the ranges generally referred to as Appalachian—hence the name of the Trail. It extends from Katahdin, a massive granite monolith in the central Maine wilderness, 2050 miles south to Mt. Oglethorpe in northern Georgia. At the present time this master Trail has been completed, marked and measured except for 75 miles in Maine, extending from Grafton Notch to Mt. Bigelow, and 40 miles in the eastern Great Smokies where the National Park Service is now building a new trail. The Trail traverses 14 states. Its greatest elevation is 6641 feet at Clingman's Dome in the Great Smokies. It is slightly above sea level where it crosses the Hudson River.

A project of real magnitude, the Appalachian Trail might seem to have been the result of many suggestions. It can, however, be traced directly to one man —Benton MacKaye, of Shirley Center, Massachusetts. Forester, philosopher, and dreamer, Mr. MacKaye conceived the plan of a trail which, for all practical purposes, should be endless. He regarded it as the backbone of a primeval environment, a sort of retreat or refuge from a civilization which was becoming too mechanized. He first presented his dream in an article, "The Appalachian Trail—an Experiment in Regional Planning," in the October, 1921, issue of the *Journal of American Institute of Architects.* Others had advanced suggestions of extensive trails in the New England States but the conception of this super-trail was solely MacKaye's. His proposal aroused interest among leaders of the outdoor clubs. The clubs in New York City were the first to undertake actual work on the Trail. Under the leadership of Raymond H. Torrey, the first section of the Trail was opened and marked during 1923 in the Palisades Interstate Park. For it, Major William A. Welch, General Manager of the Park, designed the distinctive Appalachian Trail marker and monogram. The New York-New Jersey Trail Conference was organized and the Trail was carried west toward the Delaware River. Pennsylvania was a seat of early activity.

To better gage the extent of this undertaking it is necessary to turn back 12 years and survey the existing trail systems which could be incorporated into the Appalachian Trail, and the organized groups which could then be

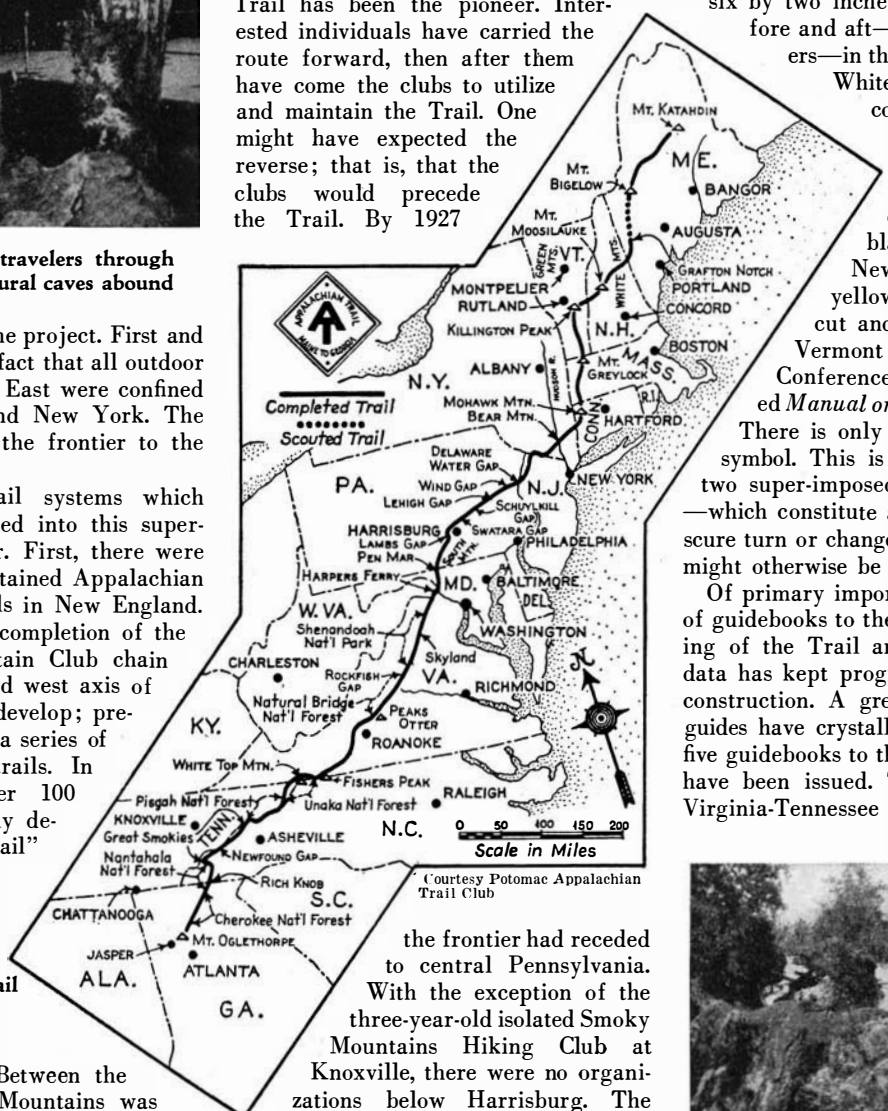
*By special permission of and in co-operation with *American Forests.*

Photo by Myron H. Avery

The Trail leads travelers through regions where natural caves abound

enlisted to further the project. First and most striking is the fact that all outdoor organizations in the East were confined to New England and New York. The Hudson River was the frontier to the south or west.

The existing trail systems which could be incorporated into this super-trail numbered four. First, there were the splendidly maintained Appalachian Mountain Club trails in New England. However, until the completion of the Appalachian Mountain Club chain of huts, the east and west axis of this system did not develop; previously it had been a series of north and south trails. In Vermont the lower 100 miles of the rapidly developing "Long Trail" could be utilized. Between the White and Green Mountains was the Dartmouth College Outing Club trail system. In New York there were the comparatively narrow Bear Mountain and Harriman sections of the Palisades Interstate Park. This was all—perhaps 350 miles out of the necessary 2050. Originally, however, the Trail was thought to be only 1200 miles; its actual development has shown the distance to be almost twice that. In addition to these four sections—in the South—were the National Forests, where connected skyline trails have been subsequently developed to a degree unanticipated by those who early formulated the Appalachian Trail route.



Courtesy Potomac Appalachian Trail Club

The Appalachian Trail

The first enthusiasm aroused by Mr. MacKaye's proposal flared, waned, and, by 1926, had practically died out. The project was moribund; it had degenerated into a fireside philosophy. It was then that Arthur Perkins, a retired lawyer of Hartford, Connecticut, resurrected the project and made it once again a vital, living thing. The enthusiasm and the momentum which he aroused have survived and to these factors is due the practical completion of the present Trail project.

It is interesting to note that the Trail has been the pioneer. Interested individuals have carried the route forward, then after them have come the clubs to utilize and maintain the Trail. One might have expected the reverse; that is, that the clubs would precede the Trail. By 1927 the frontier had receded to central Pennsylvania. With the exception of the three-year-old isolated Smoky Mountains Hiking Club at Knoxville, there were no organizations below Harrisburg. The penetration of the Southern Appalachians began with the formation at Washington, D. C., in late 1927, of the Potomac Appalachian Trail Club. Numerous other Appalachian Trail Clubs followed, so that, with insignificant exceptions, the entire trail route is now apportioned among these energetic organizations. These clubs, aiding in the Trail project, comprise the Appalachian Trail Conference. The Conference functions through a Board of eighteen managers, three being elected from each of the six Districts into which the Trail region is divided. The Chairman of the Board presides as the Appalachian Trail Conference's executive officer.

There have been many experiments in the development of a standard marker for the Trail. The museum collection is extensive. The earliest marker was an embossed, copper square with the trail insignia. Its softness rendered it an easy prey to souvenir hunters, so Mr. Perkins designed a diamond-shaped, galvanized iron marker with the Trail monogram printed on it by a rubber stamp. The marker is then varnished. However, the main reliance in marking the Trail is a rectangular paint blaze, six by two inches. These are placed fore and aft—like highway markers—in the direction of travel. White is the prevailing color, with blue for side trails. Because of local conditions, however, the main Trail blaze in New York and New Jersey is painted yellow; while in Connecticut and a small section of Vermont it is blue. The Trail Conference has issued a printed *Manual on Trail Construction.* There is only one approved blaze symbol. This is the double blaze—two super-imposed blazes or markers—which constitute a warning of an obscure turn or change of direction, which might otherwise be overlooked.

Of primary importance is the issuing of guidebooks to the Trail. The measuring of the Trail and obtaining of the data has kept progress with the actual construction. A great number of local guides have crystallized into a series of five guidebooks to the entire Trail. Four have been issued. The fifth, from the Virginia-Tennessee line to the southern

Photo by Myron H. Avery

Many of the wonders of nature are revealed to followers of the Trail

end of the Trail, awaits the completion of the new trail in the Great Smokies. The Conference has also issued a comprehensive pamphlet, detailing the history, route, guidebook data, and literature of the Trail project.

Shelters, closed and open, are absolutely essential to the Trail. The ideal is a continuous chain of such structures at intervals of a moderate day's journey, say ten miles. In many sections, such as the White and Green Mountains and parts of Pennsylvania and Virginia, this goal has been accomplished. Available public accommodations have been carefully sought out and indicated in the Trail data. This meets the needs of the non-camping hiker. Even in the Maine wilderness one may tramp 173 miles for seventeen days and find, each night, satisfactory public accommodations in the form of a sporting camp, an institution peculiar to Maine. In the territory of the Potomao Appalachian Trail Club a similar eleven day trip of 170 miles is possible.

AND now a brief word as to the route or geography of the Trail. From Katahdin in Maine, the Trail leads for 250 miles through an utter wilderness, past lake and stream over a disconnected series of peaks. It meets the first pronounced mountain group in the White Mountains of central New Hampshire, which it crosses from east to west. Near Rutland, Vermont, the Trail turns south for 100 miles along the Green Mountains. In western Massachusetts and northwestern Connecticut the route leads along the Berkshire and Taconic groups, the worn-down remnant of a much loftier range.

The Hudson River is crossed at Bear Mountain Bridge. Then the Trail leads, close to the New York-New Jersey line, over a seemingly endless series of ridges to the Kittatinny Mountains at High Point Park. Here, for the first time, a narrow ridge crest indicates the route.

Photo by Samuel Merrill

The northern-most extremity of the Appalachian Trail is at Mt. Katahdin in Maine (see the map on opposite page), viewed here from across Katahdin Lake

Photo by H. C. Anderson

One of the official signs designed to guide pedestrians along the Trail

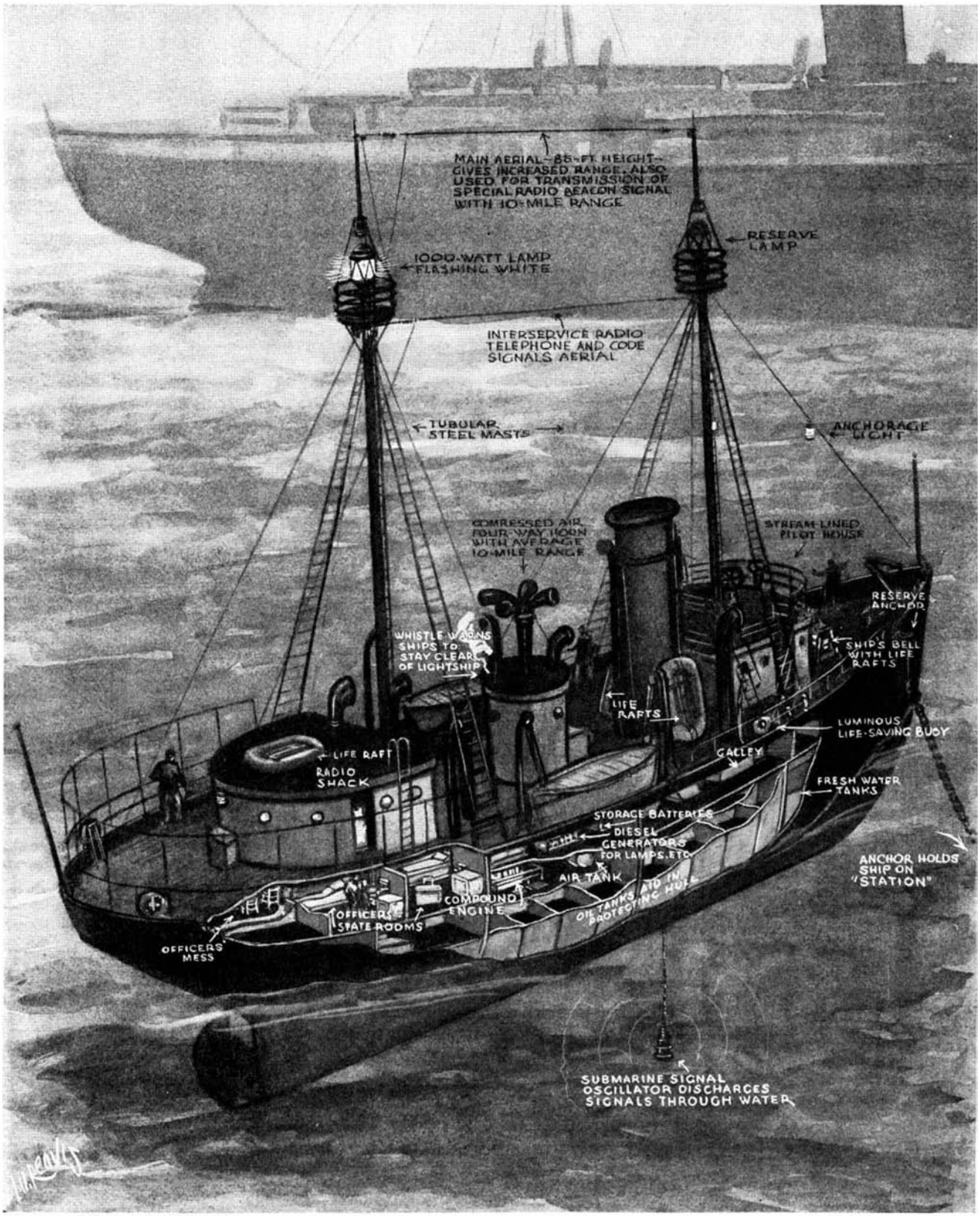
Photo by Vivian Robb

A stone shelter house on the Appalachian Trail

Beyond the Delaware River, this front range of the Alleghenies becomes the Blue Mountain; when the Susquehanna River is crossed the same range has assumed the name of North Mountain. After seven miles along North Mountain occurs the first major change of route; the Alleghenies are left and the Trail crosses the Cumberland Valley by secondary roads to the northern base of the Blue Ridge. Here commences the range which is followed to the southern terminus of the Trail.

THROUGH southern Pennsylvania and Maryland, where it bears the name of South Mountain, the Blue Ridge continues as a narrow crest line where Trail location offers a few problems. Three hundred miles south in Virginia, where the Roanoke River breaks through the range, the Blue Ridge forks. These forks, sometimes 100 miles apart, form an immense oval, coming together again at Springer Mountain in Georgia, 20 miles from the southern terminus of the Trail. The ultimate route utilizes the eastern rim of the fork as far as New River, then crosses the plateau between the rims to the western fork at the Iron Mountain and continues south. At the southern end of the Great Smokies a cross-range, the Nantahala Mountains, leads back to the eastern rim or Blue Ridge, which is followed uninterruptedly to Mt. Oglethorpe, the southern terminus of the Trail, where the Appalachian Mountains end abruptly.

This brief résumé merely serves to indicate the character of the Appalachian Trail. Its successive changing zones of bird, animal and plant life fascinate the traveler. It is indeed a guide to the study of nature. Remote for detachment, narrow for chosen company, winding for leisure, lonely for contemplation, the Trail leads not merely north and south but upward to the body, mind, and soul.



Drawn especially for *Scientific American*

FOR GREATER SAFETY AT SEA

SINCE the ramming and sinking of the lightship *Nantucket* by the S.S. *Olympic* on May 15, 1934, considerable study has been expended on the design of a strictly modern lightship which will give the greatest possible safety to shipping and also to the lightship and her crew. As shown in the above drawing, Lightship *No. 112* will be provided with sturdy steel masts carrying powerful flashing lights. Amidships will be a four-way compressed air horn and warning whistle. Numerous life-boats and rafts will be placed for ready access by the members of the crew in case of accident.

The new vessel will be 149 feet long, of 31 feet beam, and will have a mean draft of 13 feet. She will have a displacement of 915 tons and will be powered with a 600-horsepower engine. Boiler pressure will be 165 pounds.

OUR POINT OF VIEW

85 Billions!

THE splendid results that are possible from the present housing program, as discussed in these pages last month by James A. Moffett, sound very encouraging. We agree with him that it can start factories humming and put millions of men to work, if the program is properly promoted and the basic ideas are accepted and acted upon by the public. Wise co-operation is the watchword!

Housing, however, is only a small part of the great problem of recovery. Even Mr. Moffett pointed that out in mentioning the necessity for rehabilitation of factories and the replacing of obsolete machinery. Housing has made rapid strides recently but in other fields we see strong evidences every day of better business throughout the country. And since New York has been criticized as the gloomiest part of the nation, perhaps it is pardonable for us to add that we have long since turned the corner ourselves. This is an encouraging sign as is also the recent experience of automobile manufacturers. Production of automobiles in the United States for March and for the first quarter of the year, according to the Department of Commerce, was the largest for these periods since 1929. March production was, in fact, larger than for any month since April, 1930.

People do have money to spend. This is the significant fact gleaned from the recent experience of the automobile industry. The "demand" needs no explanation for it is a well known fact that the replacement time of millions of cars passed two or three or four years ago. So it is with the demand for articles of common use, comfort, and convenience. Someone recently estimated the present "demand" at 85 billion—an accumulated unsatisfied desire for articles to replace those long since worn out, which replacement, had these been normal years, would have occurred once, twice, or even three times since 1929. The 85 billion may have been an arbitrary figure, either too high or too low, but all are agreed that the actual "demand" is far up in the tens of billions of dollars.

The Manufacturers Association estimates that "close to 20 billion dollars in expenditures . . . is pent up in the field of factory expansion, renovation, and rehabilitation alone." As for wholly satisfying this almost universal need for replacements—the job would without doubt keep all our factories busy for years if wise co-operation could but make that demand clamor loud enough. For necessities and even luxuries there is now available more money than there has been for years. Cars are being bought in large numbers; homes or home improvements can be financed easily, as Mr. Moffett explains; and cash can be obtained to finance business, industries, and all the many things we need. We have seen, however, that recovery is a plodding horse, not a thoroughbred racer; and the trouble is that we have been so unbelieving that we have kept him reined in. Isn't it about time to give him his head?

Big Navy?

"A SMOOTHLY functioning majority beat down repeated attempts of big Navy opponents to hold up new ship construction . . ." Big Navy? Please, *please*, explain what is the linkage in the minds of newspaper correspondents when they use the phrase as in this statement taken from a New York newspaper. The reporter was discussing passage by the House of the 457,805,261-dollar bill to build our Navy to Treaty strength. By the terms of that bill we are: to construct one aircraft carrier, two light cruisers, three destroyers over 1500 tons each, twelve destroyers not over 1500 tons each, six submarines; to have 555 new planes, 282 of which will be replacements; and to add sufficient personnel to bring Navy enlisted strength to 95,000, commissioned officers to 8176, and Marine officers to 1074.

It is an easily verifiable fact that these ships are well within the limits of all treaties into which we have entered with other nations. Their total, indeed, falls considerably below the ratio, in respect to one signatory nation, which was assumed at the Washington conference in 1922. After that treaty was consummated, our destruction of enormous tonnage and our failure to plan or build ships was construed as weakness, so in 1927 at London the ratio which most people thought would rule for smaller craft was changed. Washington and London both accepted a relatively lower standing because of Japan's *fait accompli*. What Washington and London now hope to do is to force consideration of real limitation of armaments; and the upbuilding of our Navy to Treaty strength will undoubtedly help. Nothing is farther from the thoughts of American "Big Navy" men than the idea of beginning a disastrous era of naval building competition.

The increase in personnel is desirable for the self-same reason: to improve efficiency to the point where the Navy, in toto, can force a hearing of the plea for limitation and peace. In recent years our Navy has been faced with the necessity of operating with a reduced personnel, for economy's sake, and has suffered accordingly.

We wish, therefore, some bright newspaper correspondent would give us a usable definition of the words "Big Navy" as they apply it glibly—with apparent intent to sensationalize their reports—to the men whom thinking people believe are rendering a service to the cause of peace.

Headlights on the Highway

THE summer months are notorious for increases in the number of motor-car accidents, partly because of the greater number of cars on the highways, and partly because of the carefree attitude of many drivers as they speed blithely along on holiday bent. Perhaps "careless" should be substituted for "carefree," because so many of the horrible catastrophes of the highway are caused by nothing more or less than downright carelessness. Long hours of daylight and pleasant weather tend to make people less thoughtful of the condition of their cars, just so long as they take them where they want to go.

We have written before in these columns of the dangers that arise when car drivers fail to pay attention to small but important details, particularly to the proper lighting of their vehicles. Potential murder lurks behind the wheel of the car that roars along the highway with only one headlight burning. Unlighted tail-lights all too often are the direct cause of fatal collisions. And it is the careless driver who operates his car with such things wrong. These drivers must be curbed. Stricter enforcement of existing laws will help, but essentially the remedy lies in the education of the drivers themselves. They must be compelled to carry spare bulbs for their lights and must constantly be alert. When you are driving a motor car, you are directing a vast amount of power that can become an engine of instantaneous destruction. You would not feed poison to a fellow man: Don't risk his life by operating your motor car with improper lights.

New Light on Ancient

Iron, Glass, the Arch, Bath Rooms, Found to Have Been in Use Far Earlier Than Formerly Supposed . . . 4500 Years Ago . . . A Surprise

By H. H. SLAWSON

SURPRISING discoveries made in the Near East, by archeologists from the Oriental Institute of the University of Chicago, have thrown new light on the technical progress of mankind in the 3rd Millennium B.C., and lead to the conclusion, expressed by Dr. Henri Frankfort of the Oriental Institute, that "man's mastery over matter progressed farther in early dynastic and Akkadian times than is often believed."

The bronze handle for a dagger, mentioned in the article. The iron blade had rusted away long years ago

Among the results of excavations in the Tigris valley near Baghdad, Professor Frankfort reports (1) the discovery of glass dating from 2600 or 2700 B.C.; (2) the discovery of evidence that terrestrial iron was employed for weapons before 2700 B.C.; and (3) the discovery in a private house of four arched doorways, three of which were completely intact.

Although Professor Frankfort's account of these finds has been published for some time [Since 1933—*Ed.*], these three important additions to our fund of knowledge of technology 4500 years ago have somehow been overlooked by the scientific and technical world.

IT was while excavating at Tell Asmar, site of the ancient city of Eshnunna, 50 miles from Baghdad, that the startling finds listed above were made. In the ordinary run of a day's work in sifting the debris of the ruined city, a small cylinder-shaped object was turned up. Scratched by a diamond in a hasty test, it was indicated that this might be glass, and this was later confirmed by more exact examination. The glass is extremely clear and shows few air bubbles, while, as Professor Frankfort reports, characteristic conchoid fractures are in evidence. The professor recalls that opaque glass was fairly common in the middle of the 2nd Millennium, but that clear glass was not introduced before the Roman times.

Horace C. Beck, specialist, to whom the object was referred for thorough study, reported that "if the glass really dates from 2700 or 2600 B.C. it is very surprising. Clear blue glass of a very similar color has been found in the Mediterranean, but it shows much heavier corrosion and it is not older than 800 or 1000 B.C."

Mr. Beck repeated the diamond test, also others, on a microscopic chip from the cylinder. He found its specific gravity to be 2.463 and its refractive index about 1.515. "The specimen from Tell Asmar," his report continues, "appears to have been modeled or moulded to its present shape and has not been cut out of a solid block. The glass is very pure; it has a few small bubbles, but is surprisingly free from striae or inclusion of quartz or dirt. Without spectroscopic analysis it is impossible to say for certain what material was used, but I should think the alkali was probably soda. The coloring may have been accidental, as it is pale. The clearness of the blue suggests that it is due to copper and not iron."

Referring to the discovery that iron was in use 45 centuries ago, Professor Frankfort says: "The most unexpected discovery made was that iron was used for tools before 2700 B.C., more than 1500 years before the day when the first iron dagger known was sent, presumably by a Hittite king, as a present to the youthful Tutenkhamon of Egypt."

On the afternoon of January 25, 1933, the pick of a native workman struck a pottery jar built into the wall of a temple structure amid the Tell Asmar ruins. The jar was brim full of copper utensils, including 60 bowls, four lamps, two bottles, four daggers, a drinking tube, and other objects. The conclusion was drawn that the hoard probably represented a service for a banquet of ritual significance held in the temple, and the question was raised, Was it stolen or hidden from the enemy?

ONE of the objects to which only casual attention was given when the contents of the jar were first inventoried was a bronze handle for a dagger, its perforated openwork construction being of unusual design. Later examination of this handle showed traces of rust in the slot where the tang of the blade had been inserted. Tests of this rust revealed that iron was present in some form.

The dagger handle was referred to Professor Cecil H. Desch, of the University of Sheffield, at Sheffield, England, for further examination. In addition to the original bit of rust Professor Desch found, inside the handle, a lump of similar material, too large to fall through the perforations.

"On analysis," he reported, "this proved to be rusted iron, converted, as usual, by long contact with the earth, into a hard, magnetic, crystalline mass. The position in which it was found leaves no doubt that the blade of the dagger was of iron. Moreover, analysis shows that the iron is free from nickel and is therefore not of meteoric origin."

Professor Desch refers to analyses

All illustrations courtesy The Oriental Institute

The window at Tell Asmar, mentioned in the text, and one of the four arched doorways. This house was built as a residence nearly 5000 years ago

TECHNICAL PROGRESS

made by him of other iron objects found at Ur and Kish in Mesopotamia, whose high nickel content showed them to be of meteoric origin, and concludes: "The occurrence of an iron object of terrestrial origin at such an early date is most striking and of the first importance for the history of ancient metallurgy."

Professor Frankfort, in further discussion of the discovery, admits that it is difficult to explain the fact that iron was smelted and used for tools so early. "Even in the time of Amenemhet III (about 1820 B.C.)," he says, "it was so rare a metal that a ring of gold found in a royal tomb at Byblos contains a small inset of it, as though it were considered the rarer and more costly metal."

PROFESSOR Frankfort recalls that Transcaucasia and Armenia had been great iron-producing centers in classical antiquity. He mentions finding weapons and tools of iron in tombs which had been assigned to the Iron Age, after 1000 B.C., and continues: "Certain objects in the tombs, especially the pottery, argued against the later dating. So it seems to me the iron blade of our knife must have been an importation from the north and that iron was very occasionally used in Armenia during the 3rd Millennium B.C., but not exported, because it was less serviceable than well-hammered copper or bronze."

Supporting this last statement he cites the heroes of the Edda, who had to stop every now and again in the middle of a combat to straighten out their iron swords which had become bent. Concluding, he says: "The spreading of the use of iron in the second half of the 2nd Millennium would then be due, *not* to the discovery that iron could be obtained (a knowledge which we presume to be much older) but to the discovery of new methods for casting and working that metal."

Dr. James H. Breasted, the noted archeologist and Director of the Oriental Institute. Note the arch

Private houses of the period of Sargon I have not been excavated to any extent prior to the time when the Chicago explorers dug into the wreckage at Tell Asmar. The investigations of the Oriental Institute resulted in much new and important knowledge of the architecture and the domestic life of this period.

One of the finds was a window in the wall of an anteroom in one of the private residential houses. "It is the first window in the history of Babylonian excavation to be found completely preserved," asserts Professor Frankfort. It measured about a foot square, and the lintel, made of five stout sticks, still survived, in the shape of a carbonized fibrous substance which clearly preserves the structure of the wood.

The central room of this house had four arched doorways, three of the arches being still completely intact. None of the doors was more than five feet high and the explorers had to stoop to enter.

"That the arch was used at all in this early period is new knowledge," says Professor Frankfort. "Its discovery was as unexpected as that of the window."

AMONG the dwelling houses evidence was found to support the conclusion that the people of the Sargonid era were not unfamiliar with the bath. Describing one of the best-preserved bath rooms excavated, Professor Frankfort explains that the floor was covered with bitumen. A depression in the center of the room held the sherds of a large pot —no doubt a water jar. From one side of the room ran a drain of baked brick which turned outside and disappeared under a bitumen drain. "This room," he says, "contained all the essentials for a bath room. Since we found other bath rooms in other houses . . . we can safely say that the bath was an essential element of the Sumerian dwelling house."

In one of the temples uncovered, the explorers were impressed with "the elaborate arrangements for sanitation." No less than six toilets and five bathrooms were uncovered. Two of the baths were in an inaccessible part of the temple and were provided with individual cesspools. The remainder of the plumbing equipment was connected to drains which discharged into a main sewer, one meter high and 50 meters long. This was vaulted over with baked brick and ran along the outer wall of the building beneath the pavement of a passageway.

A toilet drain, showing better ideas of sanitation nearly 5000 years ago than some civilized peoples (not to mention names) seem to have today

In tracing one drain the investigators came upon a line of earthenware pipes. One end of each section was about eight inches in diameter while the other end was reduced to seven inches, so that the pipes could be coupled into each other just as is done with drain pipes in the 20th Century A.D.

Another adjunct of contemporary civilization, the rain barrel, seems to possess considerable antiquity, judging from Professor Frankfort's finds. "Drip pavements" of baked brick were commonly laid at the point where the water, falling from earthenware eavestroughs, would strike the ground. One such pavement, says Professor Frankfort, "contained three large jars, obviously placed so that they could receive jets of water."

It was in 1919 that the Oriental Institute, under the direction of Dr. James H. Breasted, began its epic effort to trace the rise of man in Egypt and the Near East. The work has continued unabated for 16 years and the many startling discoveries made by the scientists have forced plentiful modification of previously held conceptions about the ancient world.

TELEPATHY AND CLAIRVOY-

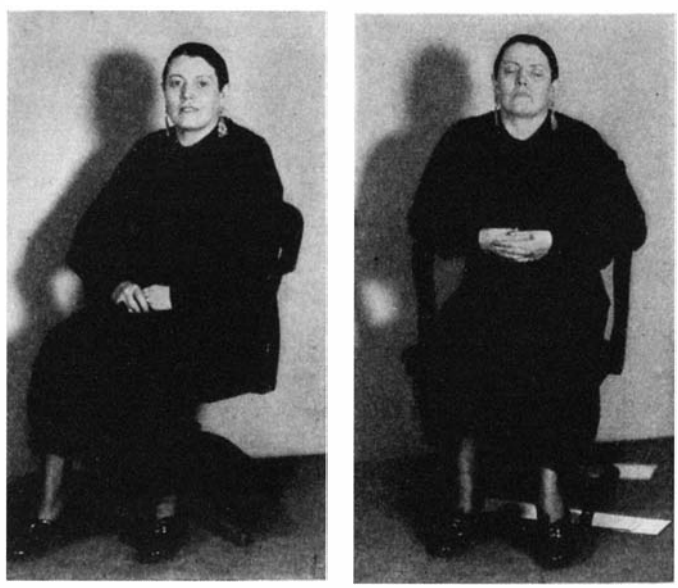
By J. B. RHINE, Ph.D.
Associate Professor of Psychology
Duke University

MEDIUMSHIP is still a puzzle to psychology, although it is now fifty years since William James discovered the famous Mrs. Piper and made a study of her phenomena. Many psychologists here and abroad have interested themselves in these strange cases, but no clear understanding has yet been arrived at. Much has been learned, but the medium as a phenomenon is still a mystery. Some of the ablest minds of the past half century have attacked it. Also there has been no lack of material for study. The Spiritualists have supplied mediums in plenty. Numerous, laborious, and voluminous have been the reports of studies made on these mediums. Why have they failed in their goal?

Most investigators of the medium have naturally set to work to solve the problem of the spiritistic nature of mediumship. The medium claims spirit contact and communication, and this claim is thus made the immediate point of attack by the investigator. The problem is surely a legitimate one, but it is just as surely not logically the first problem to be attacked. Like many other problems in nature, it cannot be solved without being let alone until something else that is naturally preliminary is first solved. For example, it would not be legitimate to ask and investigate who killed John Jones until it is first established whether or not John Jones is dead.

THE spirit theory of mediumship is, in my judgment, to be considered as a possible one only after it is first clearly established that the natural powers or abilities of the medium either in trance or awake are incapable of explaining all of her performances. Then, and only then, may we properly consider hypotheses involving external agencies such as spirits, Universal Mind, and the like.

The difficulty for many people with this more logical approach to the problem of mediumship is that we seem to them to be ignoring or even opposing the spirit hypothesis, in thus setting it aside for an exhaustive exploration for natural gifts that might explain the mediumistic performances. They fear, perhaps, that we may find out it is not necessary to assume spirits to account for the results. But unless we are ready to take the consequences of an investigation, regardless of our wishes or expectations, we are not ready for scientific exploration.



The British trance medium, Mrs. Eileen J. Garrett, in normal waking state *(left)* and in a trance *(right)*. Both she and her "spirit control" scored approximately the same in tests for telepathy and clairvoyance, conducted under rigid conditions

Actually, however, there is no hostility to the spirit hypothesis in this approach. As a matter of fact, it is the only way I see of really demonstrating it securely, if it can be demonstrated. That is, if there is foundation for it in reality. It must also be kept in mind that the phenomena of mediumship are not the only possible sources of evidence bearing on this hypothesis. In the minds of some, there are probably other better sources. But this question does not properly arise in a study of a medium unless and until it is shown that her own capacities are unable to account for the results.

In a series of studies made in the psychological laboratory at Duke University over a period of more than four years, it has been found that many normal people possess capacities to perceive objects not present to the recognized senses, and to perceive the thought impressions of others without sensory cues. These modes of Extra-Sensory Perception (E. S. P.) are called respectively Clairvoyance and Telepathy. In a huge number of tests, now numbering several hundred thousand separate trials, it was shown, among other things, that telepathy and clairvoyance are perfectly natural abilities, are related to certain other mental processes that are better known, and that they are closely related to each other. For example, all the better subjects tested showed both the capacities of telepathy and clairvoyance in roughly equal measure.

AFTER the first 90,000 trials (approximately) were made, a volume was published reporting the work in detail. (*Extra-Sensory Perception*, Boston, 1934.) A lengthy illustrated review of it appeared in SCIENTIFIC AMERICAN, July, 1934, written by my friend and tutor, the late Dr. Walter Franklin Prince.

After the Duke experiments had well passed the 100,000 mark with normal subjects it was decided to apply the procedures to a medium. We were interested not only in the natural abilities of mediums, but also in getting more data on the range of E. S. P. in different types of personalities and in the different personality states of the medium.

We were fortunately able to secure the services of Mrs. Eileen J. Garrett, a well-known British medium, who had worked in other psychological laboratories before, and who had the reputation of being most co-operative in laboratory work. We found her entirely willing to enter into any experiment proposed. Her control personality, Uvani, the Arab "spirit," as he claims he is, who appeared in the trance condition, was not so willing as Mrs. Garrett, but he did comply (reluctantly) with the requests made. He disclaimed any tele-

ANCE IN A TRANCE MEDIUM

A Logical Approach to a Study of the Phenomenon of Mediumship . . . How Tests are Made . . . "Spirit" no Better Telepathist than is the Medium

pathic or clairvoyant powers for himself, saying these belonged to the "instrument" or medium.

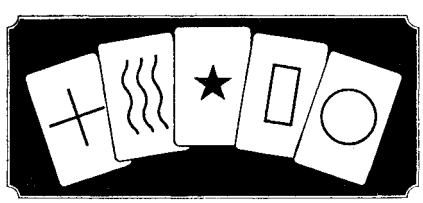
In the three weeks of intensive experimentation with Mrs. Garrett, she made 16,000 trials in E. S. P., nearly 12,000 being tests for clairvoyance, and the rest for telepathy. Only 1575 of the total were obtained from the Uvani personality due to his reluctance.

The tests themselves were simple. For clairvoyance we used packs of 25 cards, containing five each of five different symbols: circle, star, rectangle, plus sign, and wavy lines (see illustration). These packs were shuffled several times, were cut, and then put face down before the medium on a table, in normal light. At first, as she called them, she was allowed to hold the pack of cards in her hand, removing them one by one, and putting them down, faces unseen, on the table again. At the end of the run the calls were checked. After success was reached under this condition, the cards were next left lying on the table and were removed by the observer as the medium called the top one.

THE next advance consisted in taking the cards over to another room, out of sight from the medium. Over a third of the work was done at this distance. In all the clairvoyance tests, no one knew what the card was before it was called, and no one looked at it until the end of the run of 25 calls. The calls were recorded and the cards checked against them while both observer and subject watched both card and call record. When they were in different rooms the observer signalled the medium with a telegraph key when the card was removed and the next one was to be called.

In the telepathy tests the same five symbols were used but no card or other objective record was present until, after each call, the symbol of which the agent or sender was thinking would be recorded by him without naming it. In some series he would merely check the successes of the percipient or receiver; in some, a double record was kept, one at each end of the process; and, in a few others, packs of cards were used by the agent as the basis of his order of choices of symbols. That is, he would take the top card, turn it over, and while looking at the card-face would signal the percipient to make a call. This was mixed or undifferentiated E. S. P.

What results did the medium produce? It is not so simple to state these, because this involves mathematical evaluation. True, common sense supports the mathematics, but it does not go very far in dealing with the results. The whole 16,000 trials gave 4018 hits for both phases of E. S. P. and both personality states. Now chance alone would be expected to give 1/5 of 16,000, since there is one chance in five of getting a hit with a five-suit pack of cards with every trial. This gives 3200 hits as the most likely figure from chance alone



One of five similar sets of cards used in the telepathy tests described

and leaves a gain or positive deviation of 818 or over 25 percent above the chance expectation. Chance results vary, it is true, but we can compute its probable range; and this deviation is so far beyond the widest limits given by statisticians to chance results as to leave no argument. The odds against the chance theory indicated by these data would take a number of at least 60 digits to state. Odds in three-place values, however, are enough for the statistician.

This reports the totals of all the trials actually made, without omission. Fuller details are given in the original report which appeared in the December number of *Character and Personality* (Duke University).

Stated more simply, perhaps, we have in the total of 640 runs made by Mrs. Garrett an average of 6.3 hits per run of 25. Now, an average of 6.3 for only 18 runs is mathematically significant. That is, it passes the arbitrary criterion used in experimental science for deciding whether or not a principle is shown by a set of measurements. It means that the odds are 143 to one that the results are not due to chance. But we have 640 runs averaging 6.3 or 35 times the 18 required for satisfying the accepted criterion. So we may all feel comfortably assured that "chance" did not produce the results obtained with Mrs. Garrett.

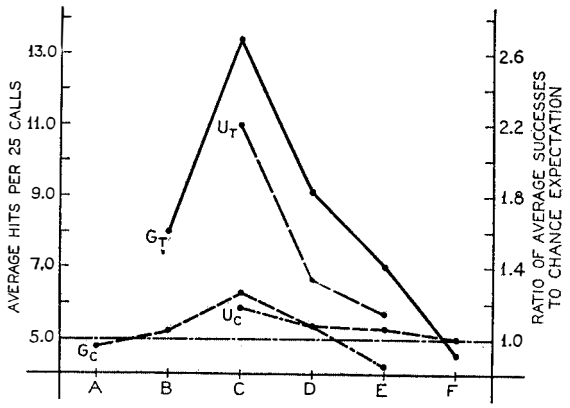
The table on the next page indicates the score averages for the different conditions, clairvoyance and telepathy, for each personality. Also, in order to show the course of development of the scoring, I have grouped the results together in six sub-groups representing the data of three days each (with one exception of two days). Note that Mrs. Garrett began with clairvoyance tests and for the first three days did not get above chance average. In the next three, group B, she got only a little above this in clairvoyance, but on telepathy she did very well with an average of 8.0.

With group C the scores reached the top. From that point on they declined as is shown in the graph. In all four curves point C is the high point. Here too, Uvani, the trance personality, first entered the tests. He started on about equal footing with Mrs. Garrett; he did not begin at the bottom as she did.

The most noteworthy fact in both the graph and the table is the relatively close similarity between the two states of personality, Mrs. Garrett and Uvani. The parallel continues even beyond these totals given here down into details.

THIS close paralleling is the more striking since the scores in the two types, telepathy and clairvoyance, are so wide apart in both cases. That is, the peculiar difference between the clairvoyant scoring level and that for telepathy, as shown by Mrs. Garrett, is found equally striking in the Uvani personality, although it is a feature in which she is different from my other subjects.

The chief point of interest to many will be the suggestion which these results give in the parallel just cited, that Uvani and Mrs. Garrett are essentially the same person, at least in the capacity of E. S. P. It is true that Uvani warned us that he did not possess these powers, that only the medium had them. But how could the "spirit" he claims to be commune with other minds except by telepathy? How could he know all he claims to know of things without clair-



Comparison of scoring rates in telepathy (T) and clairvoyance (C); Uvani (U) and Mrs. Garrett (G)

voyance? Lacking sense organs, as "spirits" must, how function without E. S. P.? Yet it would be hazardous on this evidence to be too sure about Uvani. This is only a beginning.

The next point, and perhaps that of the most consequence, is that, since both personality states of Mrs. Garrett showed strong positive evidence of E. S. P., this becomes a potent explanatory factor in dealing with her mediumship. There has long been a telepathy hypothesis. Now we can be safe in applying this hypothesis to Mrs. Garrett's performances and in adding to it the sister-capacity of clairvoyance. Her mediumistic utterances must pass clearly beyond the explanatory range of these natural capacities she has shown in these controlled tests, if they are to contribute to the spirit hypothesis. This means, probably, that they must show evidential forms not yet developed.

ON the other hand, the evidence of E. S. P. has a positive bearing on the spirit hypothesis. Without E. S. P., such existence would be inconceivable. It gives mind a self-sufficiency it could not get along well without. Only through E. S. P. could mind function without its body.

A further point of interest that appears in these results is the fact that Mrs. Garrett stands, at her best scoring period, about on the level with my other good subjects. She gave an average of close to 10 hits per run of 25. This seems to be a fairly representative average score for subjects at their best. Mrs. Garrett was next to the best subject we have found in telepathic work, but was rather poorer than most subjects in clairvoyance. She felt the monotonous dullness of the routine more in clairvoyance tests.

Finally, let us take up a few of the more likely questions that may occur to the critical reader and answer them briefly.

First: Many wish to know how the subject gets the image. That is, what does introspection yield. It gives almost nothing, and apparently the process is completely unconscious.

Second: What are the necessary conditions for bringing out such capacities? The most important is interest. Spontaneous enthusiasm is best. A certain degree of confidence is necessary. Concentration of attention is required by most, but this varies. Relaxation and abstraction from all save the task is desirable.

Third: How can we know the agent and percipient in telepathic tests do not merely have similar habits of order in selection of symbols? We have the agent vary by an irregular system made up at the time. This has been checked in some of the cases of this study. Best, perhaps, is the cross-check control. We check one run of the agent's record with a different corresponding run of the percipient's record. We have found only the chance expectation in such tests.

Fourth: How do we know that the cards are not merely inadequately shuffled? By checking one run of card records against its successor. This showed no significant persistence of order through the series, and yielded close to chance expectation.

Fifth: Is it possible that agent and percipient are in collusion? There were in the tests with Mrs. Garrett alone six different agents functioning. Most of them were either assistants or staff members. I served as agent in a significant series of runs myself.

Sixth: Is the mathematics of evaluation beyond dispute? Yes, among those trained to understand it. It has been used in this way in several branches of science, and in this particular field has served for nearly 50 years. It has been given attention by several statisticians in connection with this work. We have made over 100,000 empirical trials in checking it, and are fully satisfied as to its dependability. It leaves "no chance for chance" as a theory applicable to these results. But one need not be much of a mathematician to see that Mrs. Garrett's best score of hits in 100 trials in telepathy, two rooms from the agent, is too good for chance.

Seventh and finally: What about the old question of sensory cues? This is answerable for the card work by the 3725 trials made with the cards out of the room, with a wall between card and percipient. These yielded a slightly better score than with the cards in the room. The telepathy done with distance was likewise better than it was with the agent and percipient in the same room. Here too they were invisible to each other when in different rooms.

WHAT is left? The hypothesis of E. S. P. This is not very definite. We know too little to define it in more than non-committal descriptive terms. But it seems to be a natural, mental phenomenon, apparently not a radiation process, not involving a sense organ, and possibly independent of spatial restrictions. It is a phenomenon that challenges many fields and will perhaps stretch across many boundaries in the course of its scientific development.

●

Readers who wish to refer to other articles in SCIENTIFIC AMERICAN *on the subject of telepathy will find the following list of assistance: March 1932 (page 135); March 1933 (page 140); April 1933 (page 214); May 1933 (page 264); June 1933 (page 324); July 1933 (page 10); August 1933 (page 66); September 1933 (page 108); October 1933 (page 152); November 1933 (page 200); February 1934 (page 64); July 1934 (page 5).*—The Editor.

SUMMARY OF RESULTS OF TESTS FOR EXTRA-SENSORY PERCEPTION WITH THE MRS. GARRETT AND UVANI PERSONALITIES, APRIL, 1934

Date	Group	Normal Personality						Uvani Personality					
		Clairvoyance			Telepathy			Clairvoyance			Telepathy		
		Trials	Hits	Av. per 25	Trials	Hits	Av. per 25	Trials	Hits	Av. per 25	Trials	Hits	Av. per 25
10, 11, 12	A	825	162	4.8	.....	.....	.....	.....	.....	.....	.....	.....	.....
13, 14, 16	B	1,475	307	5.2	*575*	*185*	*8.0*	.....	.....	.....	.....	.....	.....
17, 18, 19	C	*3,525*	*888*	*6.3*	*625*	*336*	*13.4*	300	71	5.9	*100*	*44*	*11.0*
20, 21, 23	D	2,850	621	5.4[1]	*1,025*	*374*	*9.1*	400	87	5.4	75	20	6.7
24, 25	E	800	171	5.3	*875*	*248*	*7.1*	300	51	4.3	400	91	5.7
26, 27, 28	F	1,425	284	5.0	425	78	4.6	.....	.....	.....	.....	.....	.....
Totals all 17 days		*10,900*	*2,433*	*5.6*	*3,525*	*1,221*	*8.7*	1,000	209	5.2	*575*	*155*	*6.7*
Totals first 12 days		*8,675*	*1,978*	*5.7*	*2,225*	*895*	*10.1*	700	158	5.6[2]	*175*	*64*	*9.1*

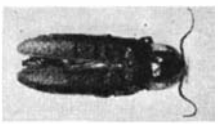
Grand total *16,000 4,018* (av. *6.3*) $+818 \pm 34.1$ $X=24.0$.

[1] $X = 3.5$.

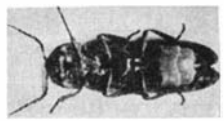
[2] Barely significant, when treated in daily series and combined by taking mean square of independent X-values. But I regard the finality of this formula as still in reasonable question.

From *Character and Personality*

How Bright is a Lightning Bug?



By W. A. PARLIN, Ph.D.
Professor of Physics, Dickinson College, Carlisle, Pennsylvania



THE organ which produces the light in a lightning bug or fire fly is located in the last two segments of the abdomen. These show clearly above, at right. It consists of a fatty tissue containing a large number of tiny air tubes. When the fire fly is stimulated or excited, air rich in oxygen is released by these tubes, which unites with a chemical substance, and a slow combustion or oxidation process takes place. The ratio between the intensity of the light thus produced and the amount of matter oxidized is the largest known to science, the efficiency being better than 95 percent. The best man-made light is less than one percent! Most of the energy in the latter case is radiated in the form of heat.

Under a high-power microscope, the radiating surface of the fire fly presents a gorgeous display of pyrotechnics. After the eye becomes dark-adapted, one sees a soft glow, broken here and there by bright flashes at irregular intervals, and climaxed finally by the brilliant flash coming from the whole surface.

The easiest way to measure very small light intensities is by means of the photo-electric cell, developed during the past few years for the purpose of transforming light energy into electrical energy. This can then be measured directly with a sensitive galvanometer or microammeter, these delicate instruments being capable of indicating currents as small as the one hundred millionth part of an ampere.

One form of the photo-electric cell, the Weston photronic cell, is especially convenient for measuring the intensity of fire-fly flashes. These cells are of the self-generating type, requiring no external circuit voltage. The flat glass surface and projecting rim of the photronic cell serve as the floor and side wall of the enclosure for the fire fly, and a small piece of wire gauze for the top completes the miniature cage. A shield of black paper or other suitable material must be placed over the cell to protect it from any external light.

The photronic cell is connected directly with a very sensitive ballistic galvanometer. A switch is necessary to cut the photronic cell from the circuit, in order to prevent the effect of a second flash occurring before the galvanometer deflection for the first flash is completed.

THE total energy of a given flash will be proportional to the maximum swing or deflection of the ballistic galvanometer. Single flashes from the same fire fly vary over a wide range, hence a series of readings are taken for each of several fire flies, and the average deflection for each series is determined.

A diaphragm is now placed over the sensitive surface of the photronic cell, having an opening approximately equal to the luminous area of the fire fly. A standard lamp of known candle-power is placed above the cell, at such a distance that a flash from the lamp will produce the same deflection as that produced by the fire fly. The light intensity of the standard lamp and of the fire fly are now the same at the surface of the photronic cell. This intensity is given by the ratio of the candle-power of the standard lamp to the square of its distance from the photronic cell. Finally, if we know the distance of the fire fly from the sensitive surface of the cell, its candle-power can be determined. The average brightness of the fire fly is about one fifteen hundredth that of a standard candle.

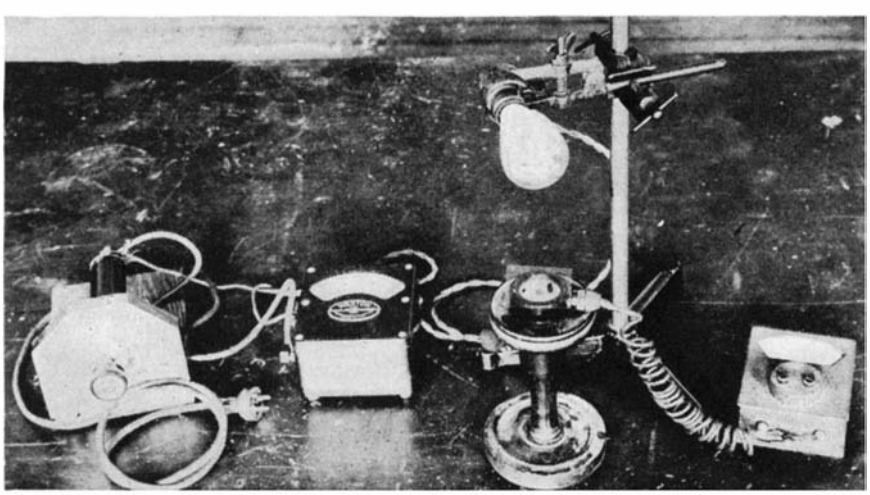
The miniature cage which records the flashes of the fire fly, also the photronic cell (Weston Electrical Instrument Corp.). To permit the insect to be photographed clearly, a glass plate has been substituted for the wire gauze mentioned in the text, for keeping the bug in the cell

If we connect the photronic cell to a radio amplifier, the flashes can be made audible and, by adding a magnetic counter to the circuit, a record of the number of flashes can be had independent of an observer.

Colonel Gorgas, at the time of the Spanish-American war, used the light from a bottle of fire flies to carry out an operation.

Although the fire fly is a very efficient source of light as far as mere visibility is concerned, the fact that its light is concentrated in one color makes it very poor as a general illuminant. The colors of objects illuminated by it would be distorted about the same as by the mercury arc.

How the fire fly can radiate "cold light," free from the enormous amount of heat which is present in all man-made sources of light, is a problem which has baffled science for many years, and its solution will revolutionize our lighting industry.



The assembled apparatus used for measuring the intensity of the fire-fly flashes

Is the Exposure Right?

Advanced Amateur Photographers Will Find Many Uses For Exposure Meters . . . When And How To Use Them . . . Outdoors . . . Indoors

By JACOB DESCHIN

EXPOSURE meters were created and are being widely used on the theory that if a picture is worth making at all, it is worth taking a little trouble to do the job right. Dedicated to the perfect negative, without which no perfect print or enlargement may be had, exposure meters are used by professional and serious amateur alike, for light intensity is a deceiving quantity which even the experienced photographer cannot always evaluate correctly.

The exposure for this fine example of theater photography was determined with a photo-electric exposure meter. 1/60 second at stop f/2

The good negative is that one in which there is an orderly progression of tones from the deepest shadow to the brightest highlight, the whole giving a faithful reproduction in monochrome of the appearance of the subject photographed. There are, of course, many remedies for the many ills of faulty negatives, such as intensification for under-exposure and reduction for over-exposure, the use of "contrast" papers for "flat" negatives and "soft" papers for "contrasty" negatives, and the many tricks and dodges used in developing the poorly exposed negative or in making and developing the final print or enlargement. But like all remedies they are, after all, merely makeshift and cannot be quite so satisfactory as a well-done performance in the first place.

There is no greater thrill in all photographic experience than a good negative of a good subject printed on a paper of suitable surface and of the "normal" grade of contrast, which retains all the gradations of the light reflected from the subject at the time it was photographed.

If the amateur thinks that such a negative is beyond his abilities and that it is only the professional who can achieve such results, let him consider the fact that if he uses good negative material he can give as many as five different exposures for the same subject and get a correctly exposed negative every time. This is due to the fact that good film, and there is good film aplenty, has a tone range of 150 to 1, meaning that it has 150 degrees of brightnesses from the highest highlight to the deepest shadow, and that since most subjects have about five separate tones and very rarely do they exceed thirty, it is possible, for instance, to give exposures varying from 1/10th to 1/50th of a second and each one will be correct. The difference in the longer exposures will be an increase in the over-all density, though the relationship of the various tones to each other will be the same in each negative.

The choice of exposure time, then, depends on the type of work, the effect desired, the kind of paper to be used, and other factors. Given half a chance, the exposure meter will provide the photographer with the ability not only to make adequate exposures but also to choose the particular type of exposure he wants.

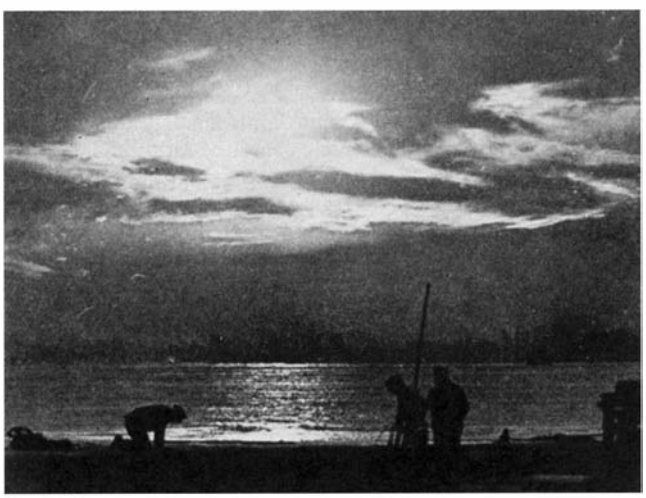
Exposure meters range all the way from the simple slide-rule with tabulated figures indicating various exposure data to the most accurate instrument in its field on the market—the photo-electric type. All meters must take into account the speed of the film material used—that is, the minimum exposure that may be given in order to produce a good negative—and the luminosity of the subject, or the capacity of the latter to reflect light. For photography is, fundamentally, the recording of light reflections. Using as a basis an indicated figure—arrived at by measurement of the light intensity by means of the meter—and guided by the film speed figure, the proper shutter speed and lens opening are found. The exposure selected then depends on the darkness or lightness of the principal part of the subject being photographed, the depth of focus desired, provision for increase in exposure necessary because of the use of filters, and other special factors.

THE simple slide-rule type of meter, which indicates exposures to be given various types of subjects under different degrees of sunlight, depends entirely on the judgment of the photographer as to whether prevailing light conditions at a specific time of day fit the classification of the meter. The great latitude of modern film material, greater in the slower film than in the "super" type, makes it possible for him to veer considerably from the correct exposure and still get a good negative. But these exposures are meant for average conditions and subjects and generally for the brightest periods of the day. Special conditions, such as close work or where it is desired to show texture, are out-

In order to give adequate exposure to the dark subject, the exposure meter showed that the lighter background must be over-exposed

side the accurate range of the slide-rule meter.

A second type of meter, known as the "tint-paper" type, is not so generally used in the United States. With this meter, the amount of light falling on the meter is measured by a sensitive paper which takes a certain length of time to darken, depending on the strength of the light. This time duration is then used as the basis for determining the necessary exposure.



In the type of pictorial photography shown in these two illustrations, the silhouettes "make" *(continued below)*

the picture. Therefore, highlights become more important, and exposure must be governed according to them

The visual or "extinction" meter consists of a tubular eye-piece arrangement by which the strength of light reflected from a subject is measured by holding the eye close to the eye-piece and deciding the dimmest figure in a line or circle of numbers at the end of the tube that can be read clearly and without eye strain. This figure is then used as the basis for figuring out the exposure on the slide-rule on the outside of the tube.

THIS type of meter enjoys wide popularity and many happy results have been obtained through its use, but this also gives only an average reading and will not do for the exacting job. Owing to variations in the eyesight of different users of the meter, one photographer may get a different reading from another. Every precaution must therefore be taken to avoid eye strain and thus give the eye every chance for reading the numbers under normal conditions. The advice is never to take a reading when eyes are dazzled; hold the eye-piece firmly to the eye so no false light can enter; when coming indoors from a sunny outdoors, or the other way about, wait a short time until the eyes have become accustomed to the new light intensity.

The photo-electric meter is the last word in exposure calculators and by far the most efficient—albeit the most expensive—instrument on the market. Its base is a form of light-sensitive cell. Variations in the strength of the light reflected from the subject to the cell are indicated by the movement of a pointer, which indicates the basis for calculating the exposure to be given. The meter is pointed toward the most important part of the subject or that part of it which should be most carefully measured because its correct exposure is necessary to proper over-all exposure. In pointing the meter it must be remembered that the "angle of view" of the meter includes a "cone" of light embracing an area of about 50 degrees, which is that of the average lens. Portraits, small objects, reproductions, and similar subjects require as close an approach as possible, taking care not to obscure the subject. In taking outdoor pictures, care must be exercised that the meter is held at a slight angle so that the sky is excluded from the area of the "cone" covered by the meter. Otherwise a much higher reading will be had than that justified by the subject.

Of course, there are certain cases in which a meter reading would be ignored, if a meter were used at all. There are the "must" type of pictures, such as speed sports snapshots, when wide-open lenses and the fastest shutter speeds are in order no matter what the light conditions. The sports photographer must get his pictures and he will do it even if it means considerable under-exposure. But the independent amateur can take it or leave it. He serves no boss but his own artistic instinct. He will leave speed photography alone when there is insufficient light; he will prefer the soft morning and late afternoon sunlight to the harsh, glaring beams of mid-day; whenever the subject permits he will use the fine-grain, good contrast, slower films with their greater latitude rather than the "super" films with their extreme speed and tendency to flatness and "graininess." Also, since the recording of light reflections is the basis of photography, he will not attempt to take pictures when the light is not interesting, for "flat" lighting, while it will produce a picture, will not usually give a picture to make the heart proud. Contrast, the play of light and shade, is the very soul of photography.

A point about sun-brightness may be helpful: While many amateurs believe that an unobscured bright sun is the brightest photographic light there is, as a matter of fact it is only so when veiled by white clouds. For then the light is diffused into the shadows, whereas in the case of an unobscured sun the shadows are much blacker. Incidentally, the old rule "Expose for the shadows and let the highlights take care of themselves" applies especially in bright sunlight, for under such conditions it is easy for the photographer to be misled into thinking that since everything seems to be so well lighted, the shadows must be too.

OVER-EXPOSURE is better than under-exposure, since the former will produce a print, though it will require longer printing-time than a normal negative would need, while nothing much can be done to improve the negative extremely under-exposed.

In all calculations of proper exposure, the principal thing to be taken into account is that, for the purposes of the exposure, the only light that counts is that which is reflected from the subject being photographed.

●

℄ *If you have not already obtained the* SCIENTIFIC AMERICAN *list of representative miniature cameras available in the United States, giving pertinent data and prices, by all means write for it at once. Ask also for our list of books on photography for the beginner as well as the advanced amateur. Please send stamps for postage.*—The Editor.

IMPOSSIBLE PLANETS

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

RECENT reports from California announce the discovery of four white dwarf stars, doubling the known number of these remarkable bodies.

It has long been known that the Companion of Sirius, and one component of the double companion of the fourth magnitude star Omicron Eridani, were strange objects; for, though of very low real brightness, and hence justly to be called dwarf stars, they are white or whitish in color and presumably much hotter than the sun. But a body hotter than the sun should emit more light per square mile, hence these stars must be small—no bigger, in fact, than several of the planets.

This is not so remarkable by itself, but both of these stars, being double, belong to the rather small list for which masses could be computed, and both are comparable to the sun in mass—the Companion of Sirius being more than 300,000 times the earth's mass, and the other about 150,000. The enormous resulting densities appeared to be incredible until Eddington explained them on the simple supposition that the atoms inside the star were thoroughly ionized—that is, had all the outer parts knocked off them, so that the gas which they formed could be very greatly compressed without their "jamming."

A third star of the same sort was discovered by van Maanen, and another in the Perseus Cluster by Oosterhout. These discoveries were accidental; the astronomers involved were looking for stars of rapid apparent motion in the heavens which bid fair to have large parallaxes. The large majority of these stars are red, but these two turned out to be white.

A DELIBERATE search for more of the same kind has recently been made at the Lick Observatory by Kuiper (whose interesting work on double stars we recently described). The best chance of success was obviously among those stars which have large parallaxes, and are so faint that their spectra have not previously been observed. Working with a small but powerful spectroscope, and also through measures of color, he has detected three more objects which are clearly of the same kind. All are very faint—from the 11th to the 15th magnitude; and have large parallaxes and small distances—from 50 to 60 light-years. In real brightness they range from one one-hundredth to one five-hundredth of the sun's luminosity.

Adams and Humason, observing the spectra of these stars at Mt. Wilson, find them to be similar to one another, and very peculiar. The lines are extraordinarily wide and diffuse, so that only a few of the strongest can be recognized; but there are enough to show that the atmospheres are hotter than the sun's. One more star, whose parallax and real brightness have not yet been measured, has a similar spectrum and is doubtless of the same sort.

It is easy enough to calculate the diameter of a star, if we know its real brightness and its surface temperature. For the present group the latter is rather hard to estimate, as the spectra are so queer. But the values given below are derived from standard formulas. The calculated sizes are more likely to be too large than too small.

Star		Real Brightness (Sun = 1)	Spectra	Surface Temp.	Diameter (Earth = 1)
Sirius (Companion)		0.005	F_0	7500	3.5
O Eridani (Companion)		0.006	A_0	11500	2.1
van Maanen's star		0.0013	F_8	6000	1.3
Kuiper's stars	1	0.004	A_2	10000	1.8
	2	0.010	A_5	8500	5.6
	3	0.0015	F_8	6000	1.5
Oosterhout's star		0.018?	A_2	10000	8.2?

The values for the last star are uncertain, as its observed parallax is so small (0".011), that any results calculated from it have a large percentage error. For the others the calculated diameter may be wrong by 25 percent, but it is nevertheless evident that these curious bodies are remarkably similar in size. The average for the six is 2.6 times the earth's diameter, or just about 20,000 miles. Only one of them is twice as big, and none is less than half. For comparison, we may recall that in round numbers the diameter of the earth is 8000 miles, while that of Neptune, the smallest of the major planets, is 31,000.

The densities of the first two stars come out 40,000 and 90,000 times that of water. For the others we have no direct evidence, but they are doubtless also very high.

These remarkable bodies evidently represent one of the standard products of nature. They are hard to find, since they are so faint, but if we could make a complete census of all those in a given part of space—say within 50 light-years from the sun—we would undoubtedly find them to be more numerous than the giant stars which, because of their brightness, almost monopolize our ordinary star catalogs.

WHY should they be so unlike other stars and so like one another; and what stage in a star's possible history do they represent?

It is risky even to attempt an answer to the latter question: yet if we dare to say anything at all about the history or evolution of a star, we can hardly avoid the conclusion that the white dwarfs represent the last stage of senility.

A star is forever being pulled together by its own gravitation. Only the expansive pressure of the hot gases inside it keeps it from collapsing. As this heat leaks out to the surface and keeps the star shining, it is replaced by new supplies. We are sure now that these are drawn from some sub-atomic source—just what, we do not yet know—and are sufficient to keep a star like the sun shining for many thousand millions of years; and we are also sure that, whatever its origin, the supply must be exhaustible. Given time enough—much longer than the past history of our solar system—the internal supplies must wane and the star will inevitably contract, slowly but steadily.

If the constituent particles of the gas were atoms of the type with which we are familiar, there would come an end to the contraction when these were jammed so close together that there remained little or no free space between them; and, at the last, the mass would be about as dense as ordinary solid or liquid matter—somewhat denser, on account of the great pressure. But, inside a star, the atoms are broken up into their own constituent parts—electrons and nuclei—and these last are so exceedingly small that an enormous degree of condensation would fail to "jam" them.

Until a few years ago no one could even suggest where an end would come to this process. But the quantum laws

The Investigation of Three Newly-Discovered Stars of the Companion-of-Sirius Type (the Famous Star That Weighs a Ton Per Cubic Inch) Shows That These Extremely Dense Bodies are Old Stars in the Process of Going Out. It Also Shows That Planets Much Larger Than Jupiter are an Impossibility Anywhere in the Universe

which govern the way in which the electrons are built, shell upon shell, into atoms, apply also, though in a different way, to limit the condensation even of the interior of a star. Given a specific volume of space—say a cubic centimeter—these laws permit the crowding of an indefinitely great number of particles into it, but only upon certain conditions regarding their motions. Nature will tolerate only a definite number of slow-moving particles within this volume; if more are to be admitted, they must be faster-moving. Now the pressure depends on the average energy of motion of the particle; hence, to obtain a great density, demands a high pressure. This is true for an ordinary gas; but the details are different here. For an ordinary gas the pressure remains high, even after every bit of heat (energy of motion of the particles) has been extracted which the laws of nature permit to escape. Moreover, the pressure is now proportional to the 5/3 power of the density—not to the density itself, as in the familiar case. When the particles move so fast that they approach the velocity of light, the formula for the pressure becomes more complicated, but it is accurately known.

TO work out just how a star would be built if it were composed of matter which followed this law, is no simple problem, but it has been solved with remarkable mathematical elegance by a young physicist from India, Chandrasekhar, who is now residing in England.[1]

The result of his investigation is that a star of a given kind of matter, and a given mass, after it has lost all the energy which it can possibly radiate away into space and has settled down into the degenerate condition, must have a perfectly definite size and an equally definite internal constitution. For a small mass the central density will be six times the average for the whole star; for larger masses the ratio increases. The larger the mass, the *smaller* will it be when it has shrunk to the limit. (Roughly speaking, its greater power of gravitation enables it to compress itself more.)

For a body composed mainly of the heavier atoms (from carbon and oxygen upward) and of one fourth the sun's mass, the limiting diameter would be a little over twice the earth's. With half the sun's mass it would be 1½ times as big as the earth; if as massive as the sun, its radius would be 85 percent of the earth's. For larger masses the calculated diameter diminishes rapidly, and for 1.43 times the sun's mass there is no longer any limit to the contraction. More massive stars are not subject to this restriction. The reason is simple. In large masses the internal gravitational pressure is very high; to produce this pressure the particles of the gas must be moving fast, and when the calculations are made it turns out that their average motion will be so fast that the mechanism will no longer fall foul of the quantum restriction, however far it contracts.

All this sounds pretty speculative. But it is based on precise calculation, founded on a theory which is generally accepted—though Eddington has recently criticised it (in a paper comprehensible only to a very small group).

IT has two consequences—one capable of observational test, the other of considerable general interest.

A mass of gas which had lost all its available heat and settled down into a state of hopeless degeneracy would, *ipso facto*, be dark and invisible at stellar distances. Stars, when dying but not yet dead, would shine faintly and have nearly degenerate cores surrounded by envelopes of something more nearly resembling ordinary matter. We might expect them to be a little bigger—perhaps twice as big as in the final state. Now this is precisely the actual size of the white dwarfs. We should expect, too, to find that such stars were of small mass, and the only two for which we have data have 45 and 93 percent of the sun's mass. This very striking agreement was first pointed out by Milne, on the basis of an approximate theory, and affords excellent reason for believing that these tiny bodies are actually stars in the process of going out. They are losing energy so slowly, in proportion to the brighter stars, that they may linger on for billions of years before they stop shining altogether.

The whole theory, admirable as is its success, applies only to masses of stellar order of magnitude, for which the central pressures are very great. The history of a really small mass—less than a thousandth part of the sun's—would be wholly different. It would never be very hot inside; as it radiated heat away, the more refractory constituents of the gas would liquefy and solidify, and it would end up as a planet—very much like Jupiter, perhaps, in certain stages—and at the end be a cold, solid body with a core of rock surrounding a frozen ocean, and coated outside with a snow mantle of solid hydrogen. The more massive such a body was, the bigger a planet it would make.

THIS is the opposite of the behaviour for large masses. Hence, somewhere in the interval, the size of a completely cooled body must reach a maximum. Jupiter is certainly on the planetary side, while a body a hundred times as great would undoubtedly settle down as a "black dwarf." The turning point would come at about one one-hundredth part of the sun's mass, and we may guess that the maximum diameter would be not much greater than Jupiter's.

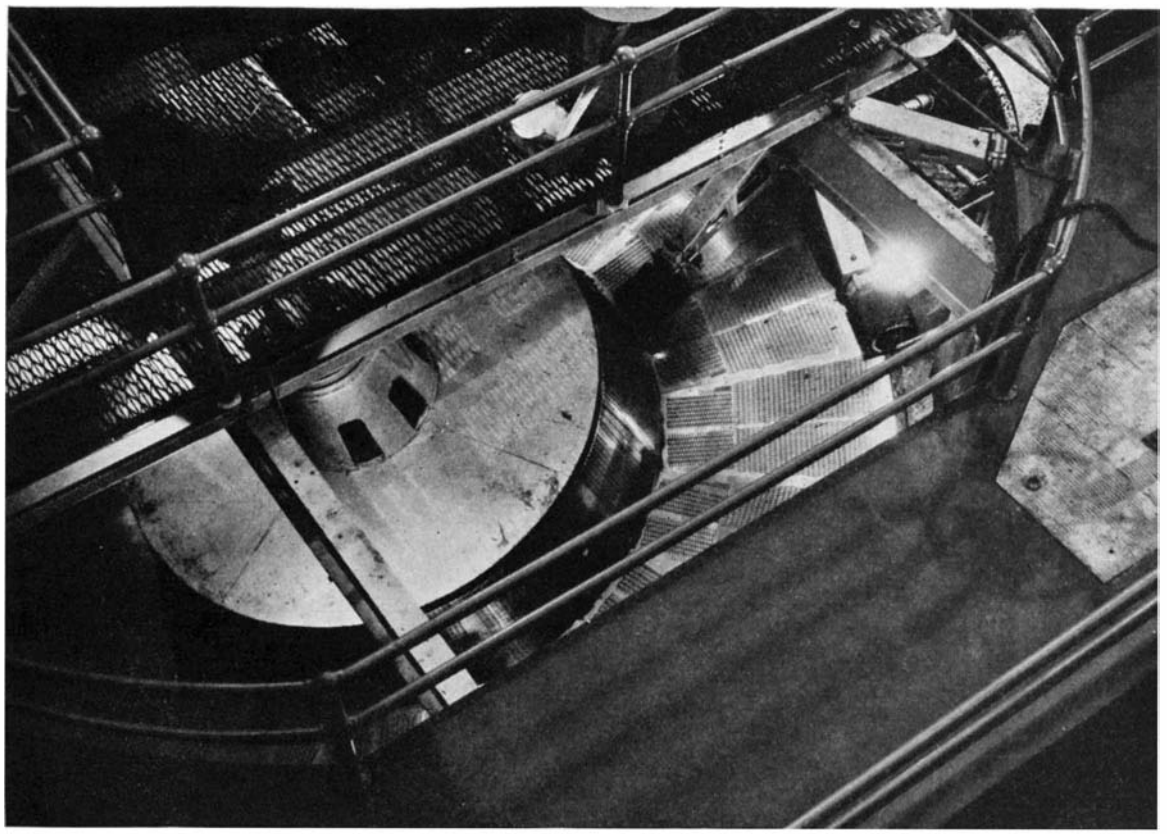
So we have come to the conclusion that *very large planets are impossible*—that is, cold bodies as big as even the smaller stars. Anything as much as half a million miles in diameter—probably even a quarter of a million—must be self-luminous and cannot be in a final state.

The fate of the more massive stars intrigues the imagination. As they cool down they must, so far as we can see, shrink to be far smaller than the earth—smaller than the moon—perhaps no bigger than a large asteroid. By this time something might be expected to happen: but we do not yet know enough about the fundamental laws to work it out clearly. We can hope for no help from observation here; such a body, even while its surface remained hot, would be too faint to be seen at the smallest of stellar distances.—*Princeton University Observatory, May 6, 1935.*

●

Largely because of the successful photography of some clouds of unusual extent on Mars, Professor Russell has chosen this and cognate Martian things as the subject of his next article.

[1] The reader who enjoys skilled handling of differential equations may be referred to the *Monthly Notices* of the Royal Astronomical Society, for January, 1935.



Copper has a wide range of uses. Here is illustrated a mechanically cleaned screen in a sewage disposal plant. It is made of rolled silicon-copper alloy plates—fastened with bolts and nuts of the same alloy

FIGHT CORROSION

Copper . . . Much New Research . . . Many New Uses, Alloys, Adaptations . . . Hardened and Enameled . . . Quick Patina . . . Improves Iron, Steel

By PHILIP H. SMITH

"POUR steel at a temperature of 2600 onto copper which melts at 1950! And not cut, melt or weld the copper?"

"Impossible," some said.

"Let's try it anyway," said others.

So they tried it and it did work. When molten steel was poured into molds supported on copper stools, the high conductivity of the copper dissipated the terrific heat adequately. And with this experiment there was discovered another way to cut steel production costs.

Applied research has been kicking up this sort of stir in copper and copper alloys for several years. Constant pushing against the periphery of the metallurgical unknown has been upsetting tradition and in the metal industry tradition is long, honorable, and well-nigh impregnable. Substitution of copper for cast iron in stools is an example of a successful assault against tradition and logic, but other forms of attack have been made, directed at broadening basic knowledge. The upshot of it is the coming of copper into uses unthought of a few years ago.

Most recent copper developments which have reached the practical stage, make a direct contribution to the consumer. He can now acquire a home built of steel to which a measure of corrosion resistance has been imparted by copper. He can roof this dwelling with copper and have an age-old green patina on it within a very few weeks. Out in the kitchen he can have a range boiler that won't leak and will probably outlast him, while new types of copper tubing and soldered fittings give easier installation of plumbing fixtures. If he owns an old house, copper research has helped him, too. He will soon be able to protect it with a coat of corrosion resistant copper paint, or, if he prefers, he can cover it with copper sheet enameled in transparent colors. Moreover, he can travel much faster to reach this home with less danger of burning out the bearings in his car.

Behind each of these developments is a fascinating story of applied research. Take the copper stools as an example. Here the conductivity of copper is employed to make savings of a dual nature. The ingot as cast is not rough or cracked on its end, with consequent waste, as it is frequently when poured with cast-iron stools, and the copper will last for some 1000 pourings as contrasted to 80 for cast iron. Copper is more expensive at the outset for the metal cost is higher, but when a

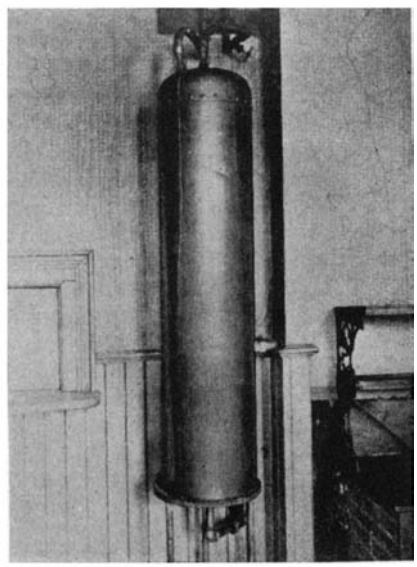
copper stool has served out its life the only impairment is cracking or heat checks, and the metal can be recast in stool form for use again.

When experimenters had recovered from their surprise that copper could be used for stools—and it was a surprise even to those who banked on its success—the next step was to try copper for molds. Aside from the rapid formation of heat checks, the molds performed well and there is now much to support the contention that the practical use of copper molds is not far away.

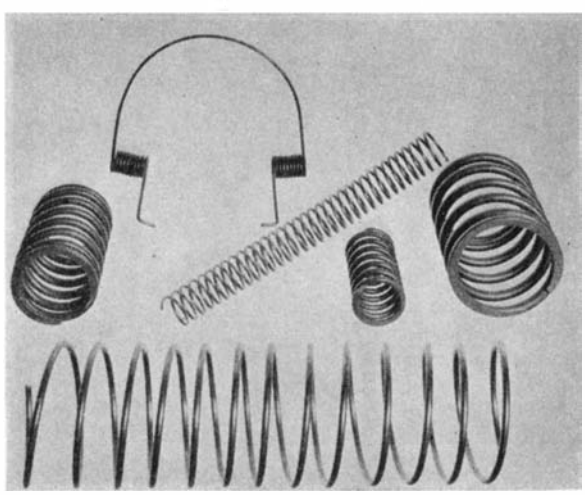
ENAMELING on copper had its origin even prior to the Middle Ages. The cloisonné work of the Chinese and Japanese represents an enameling on copper. These older forms hid the metal, produced a thick, brittle, and expensive coat of enamel and were applicable only to objects of art. Not so with the product of modern research. Here the aim has been to preserve the attractive surface and texture of copper, to make the enamel flexible, transparent, and inexpensive. By achieving this goal, enameled copper becomes suitable for exterior and interior wall surfaces, roofs, and decorative building effects.

They call this new process "crystal-cote." It is essentially a special glass melted onto the metal surface. The enamel can be made transparent, merely to protect the copper without concealing the metallic sheen, or it can be in color either transparent or opaque. The trick, of course, was to develop an enamel that would have an expansion and contraction close to that of copper so that it would not crack, and to apply it so thinly that it would have flexibility. This achieved, builders have at their disposal copper in a new form. It is possible to prepare sheets 18 by 48 inches in size in a variety of colors for use where appearance is to be heightened. The sheets can be flexed and cut to shape, and they won't shatter under a moderate blow. Where necessary, nails can be driven through without damage to the enamel and if the enamel should be knocked off there is still a corrosion-resistant surface underneath.

The Statue of Liberty in New York Harbor now features this product of research. The vaulted ceiling of the tunnel leading to the statue is covered with buff-tone "crystal-cote," while the signs which tell the tripper where to go and what to do are made of the same material in two tones, for this process permits the use of colors in combination to produce pleasing effects.



Still good after 60 years of service: an old copper kitchen range boiler



Strength and resistance to fatigue make beryllium-copper particularly suitable for various springs

Sweating the fittings together in the newer type of copper alloy residential plumbing

It wasn't a very big jump in thinking to consider ways and means of simulating the green color which comes over copper roofs on aging, and two ways have been perfected for producing this patina quickly. In both cases the first step was to find out what a natural patina was—what manner of chemical substance was formed by the interplay of the elements with copper. It was found to be mainly a basic sulfate of copper, a composition like that of the natural mineral brochantite. Knowing that keeping a "conditioned" ammonium sulfate solution in contact with copper would produce the basic sulfate, this was tried. But the patina did not form until—and here was a surprise—until after precipitation of a night's dew. So it was discovered that a controlled humidity was needed to produce a permanent effect.

Apart from spraying copper and letting nature take its course, another method has been developed. It comprises applying an electrolyte embodying a certain concentration of sodium bicarbonate and then subjecting it to electrolysis with the copper forming the anode. Now the charming green coloring, which normally requires from five to 12 years by natural process, can be had at will, and quickly.

Other developments bring pipes and fittings into the home in a more advantageous form. Perhaps the consumer has them in his home already but the chances are he does not know it. Such uses of copper involve an improvement in design whereby tubes slide snugly into fittings to be held tightly with solder, and is in contrast to the older form of threaded coupling. This design gives greater flexibility to the tubing and weighs nearly 50 percent less than the old type threaded pipe. Several forms of this new development are on the market; one type is soldered by placing the solder on the edge where the pipe enters the fitting, whence it is drawn into the slide joint by capillary attraction; another, known as the "streamline" fitting, features a perfectly smooth interior wall surface with no shoulders to impede flow. This type is soldered by pouring the solder through a hole in the fitting to fill the slight cavity between the fitting and the pipe. Whatever the type used, heating with a blow torch melts the solder to let the pipe be withdrawn for repairs.

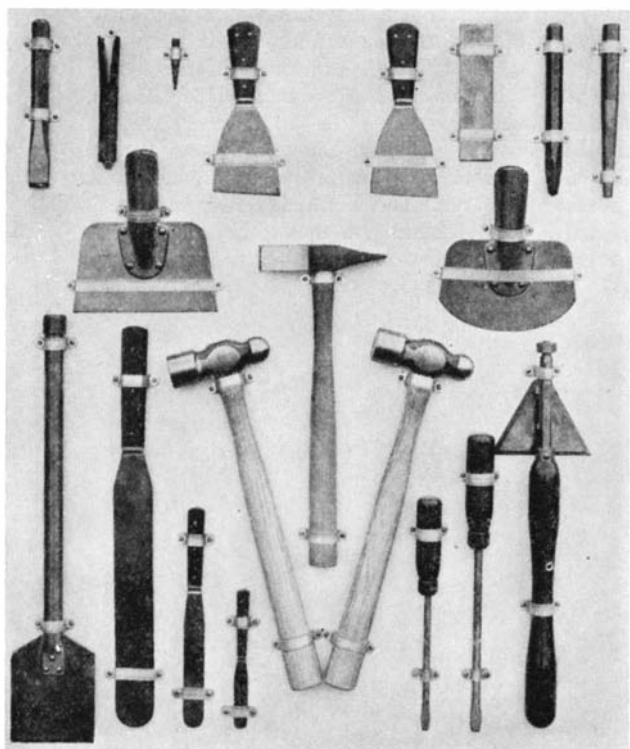
Copper paint, another boon to the householder, is almost too new to mention; it is just on its way from the laboratory. The basic accomplishment, we are told, is the breaking down of the characteristic crystal form of copper to get fine, shapeless particles which will remain in suspension in a suitable vehicle. When applied to a surface, the particles pack together to give solid coverage. Since copper has some affinity for other metals, this paint gives promise of excelling for metal structures, particularly in marine use where corrosion resistance is paramount.

INGENIOUS, but not yet established commercially, is a process for obtaining a relief design or delicately cut tracery on copper sheet. A piece of lace or a pattern in thread is coated in a bath of rubber latex. It is then placed on the copper and sand blasted. The particles of sand bounce off the rubber-covered thread but wear away the exposed copper to create a relief design, or, if blasting is continued long enough, the metal is actually cut out. One can envision great possibilities using the process in conjunction with enameling, for the finished design panel could be protected indefinitely from tarnishing, or given startling color treatment.

If it is resistance to corrosion that has brought copper to the fore for construction work, it is that other quality of high conductivity which has brought it into consideration for automotive use. Starting with the known fact of high thermal conductivity, exhaustive experiments have been carried on to determine whether copper might not be superior for cylinder heads by virtue of lessening formation of hot spots. Under test conditions copper does permit use of higher compression ratios than other standard materials and, of course, this means more power and greater fuel economy. But even without increasing compression, copper cylinder heads have yielded better fuel mileage as compared with aluminum or cast iron and it is thought that there is a definite reduction of hot spots.

Copper cylinder heads have not been adopted commercially, for tests have only recently been completed, but copper-lead alloys have begun to replace the old-type babbitt for main and connecting rod bearings. Like babbitt bearings they will fail in event of inadequate lubrication but instead of promptly burning out and becoming useless, the rate of wear increases sharply and ultimate collapse is delayed. What seems to happen is this: the lead oozes out under excess load and provides enough lubrication to prevent serious injury to the journals.

All these accomplishments of research, novel as they are, are by no means the most significant from the metallurgical standpoint. The laurels must be given for work done with copper alloys, especially the newer ones.



Non-sparking tools made of beryllium-copper. There is no record that the ancients ever made a harder copper

If it were accurate to say that research had rediscovered the lost art of hardening copper to give it the strength of steel, our story of beating the ancients would be blazoned in headlines. Actually the art was never lost, for there is no positive proof that the ancients could harden copper. They produced what seems to be a cold-worked, hard copper, whereas science has produced alloys with steel-like hardness—silicon-copper, beryllium-copper, nickel-aluminum-copper, and others with varying degrees of hardness.

Silicon-copper alloys using manganese as the third alloy are most common; another form uses tin and zinc in combination. The manganese alloy was developed to surmount the high cost of tin. It makes an alloy which has high strength, great resistance to corrosion of the ordinary atmospheric type and also to the action of a large number of chemical corroding agents.

Beryllium-copper, in which 2 to 2.25 percent beryllium and 0.25 to 0.50 percent nickel are added to the copper, makes an alloy which can be given a tensile strength as high as 200,000 pounds per square inch by a "precipitation" heat treatment. Aside from its strength, its outstanding quality is resistance to fatigue. This makes it eminently suitable for springs which have to undergo repeated stresses and vibrations in service. Beryllium-copper enters into the manufacture of small parts where a combination of conductivity, fatigue, and corrosion-resistance is desired, and the making of non-sparking tools for work with explosives or in the presence of explosive gases.

The perfecting of age-hardening copper alloys is of real import to the industrial world. It provides designers with a material combining all the desirable properties found in phosphor-bronze with the added advantage that the alloys can be shaped and formed in a semi-soft state and then heat-treated to impart the strength common to alloy steels. It is a development which has provided industry with a highly reliable, workable, strong, non-corrosive metal of many uses, and with great possibilities for the future.

THOUGH very new, beryllium-copper already has diverse uses. It is stronger than non-ferrous alloys and more easily machined and corrosion-resistant than steel, hence it goes into springs, clips, firing pins, and contact points. Silicon-copper alloy also serves the householder quite widely. The latter is used for range boilers, since it resists corrosion better than ordinary copper, and that means cleaner water. It is nearly twice as strong and ductile as copper alone and it welds easily to eliminate the trouble of leaking rivets.

Copper-bearing steel has been used in farmers' fences for many years, but it is only now coming into its own in the metal-consuming industries. Technically speaking, copper-bearing steel is an iron base alloy and belongs in a discussion of iron and steel technology, but it cannot be overlooked when considering copper and its potentialities.

In the early days of iron and steel manufacture, copper acquired a bad reputation because it was thought harmful to processes and decidedly injurious to physical properties of these metals. Certain iron ore deposits were abandoned for no more reason than that copper was present. Recent research, however, has demonstrated beyond question that small amounts of copper improve iron and steel, aside from the corrosion-resistance quality,

and this illustrates once again what research has been doing in booting aside tradition of long standing.

A slight amount of copper in steel adds quite appreciably to steel life under normal atmospheric conditions. Increasing the copper content a few more fractions of a percent adds greatly to strength. It should not be thought that copper makes steel rustless. It does help but the gain is slight compared with that obtained by addition of chromium. Copper is valuable because it is one of the cheapest alloying elements and because use as an alloy gives increased strength without increasing the carbon content. This makes such steels more suitable for welding structures than higher carbon steels which become brittle after welding.

COPPER-BEARING steels are now in commercial use though their potentialities are hardly appreciated. On a tonnage basis copper doesn't rank high as a metal in alloy steel, but measured in potentialities it is extremely important. It provides a means for building more compact structures and for lightening the weight of transportation equipment—two tremendous volume fields for exploitation. The additional strength means that weight and thickness of structural members can be reduced anywhere from 20 to 35 percent and, coupling the corrosion-resistant quality, will give an equal service life.

Quite naturally, attention has turned to the use of copper in cast and malleable irons, for if adding copper to rolled steel improves its physical characteristics 10 to 15 percent without heat treatment and another 15 to 20 percent after treatment, and if cast steel's strength can be improved as much as 20 percent, why can't the irons be improved in like manner? Research asked the question and has already begun to bring in proof that it was not asked in vain. Cast iron is bettered physically by adding copper. Broadly speaking, its strength and hardness are increased proportionately as the copper content increases, while the effect upon malleable iron is to increase its endurance and reduce its susceptibility to inter-granular embrittlement.

To unearth all of the really significant happenings in copper one must wind up one's digging at the mills where research findings are overhauled to make them practical and economical in the commercial sense. It is there, for example, that bright annealing in controlled atmospheres is carried on successfully. It is there that manufacture of oxygen-free, high conductivity copper has been brought to the stage of utility, not to mention many of the achievements already reviewed.

Oxygen-free copper is more highly resistant to corrosion than ordinary "tough-pitch" copper and it can be welded either with oxy-acetylene or the electric arc process to give a union having the strength of annealed copper. It is now being made in all forms, available for a greater number of industrial uses, though rapid substitution is unlikely because of higher cost. For certain applications it is superior to the tough-pitch variety as, for example, for tubes which must resist gassing attack.

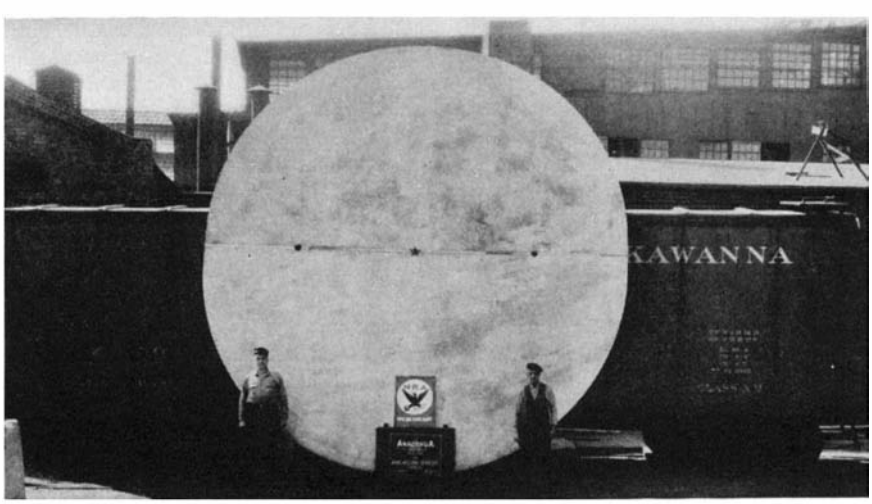
Among achievements in manufacture, two are worthy of special mention as reflecting efforts to cut costs. The first is the electro-deposition of copper in sheet, strip, and foil form, and the second is the swaging of tubing. The former makes possible manufacture of large sheets of uniform thinness without requiring the enormous power which rolling takes. Swaging is likewise a power reducer—a process supplementary to the drawing of tubing. Its purpose is to reduce the raw material in size before drawing starts and it is of real economic advantage when hard alloys are used.

To view all these developments in the copper industry is to be struck with the great volume and scope of basic research that has been carried on all during the depression years. It represents co-operation between producers of the raw materials, the fabricators, and the research organizations to the one end of finding out just what copper has to contribute preeminently to the Power Age. That it has been stimulated by the need to find outlets for copper matters not; the work has been fruitful and of general service. Developments are still coming from the laboratories of the copper companies, from the co-operative Copper & Brass Research Association, and from the Battelle Memorial Institute where much of the recent work has been done, while the labors of the Iron Alloys Committee of The Engineering Foundation continue to bring together all that can be found out about copper as an ingredient of iron and steel.

A cold chisel, tipped with a copper alloy, cuts a cold rolled steel bar

IN the near future we shall probably see commercial development of copper-chromium, copper-manganese, and copper-molybdenum steels and learn much more about the effect of copper on the various forms of iron. Certainly new copper alloys are scheduled to put in an appearance and so are high-strength, copper base, die-casting alloys. Almost any day now we may hear of the successful commercial application of a process of casting thin sheets of copper between slowly revolving rollers.

All this work, completed and projected, provides proof that copper is set to play a much larger rôle in industry. From a new and broader scientific base it challenges other metals. It is no longer the inherent characteristics of corrosion resistance and conductivity alone which recommend it, but these qualities combined with the new ones of strength and hardness, which, all together, provide a formidable combination for the industrial march.



Largest copper-alloy condenser head plates or tube sheets ever constructed

Photographs courtesy The American Brass Company and Stanley Tools.

"Payments on the house amount to no more than rent in the city." Reedsville, West Virginia, homesteaders

BACK *ON* THE LAND

Subsistence Homesteads . . . Business Arrangement for Wage Worker . . . Home-Grown Food Supply . . . Federal Program Gives Direction to Movement Now Slowly Reversing Urbanization Trend

By JOHN HERRICK
Assistant to the General Manager
Federal Subsistence Homesteads Corporation

JOHN SMITH is an average American worker. He furnishes America with its manufactured goods and its raw materials. He makes something less than 1500 dollars a year when times are good. Out of this income he must provide for himself, a wife, and from two to four children. His chief living cost is for food; his second is for shelter; next comes clothing. When these three essentials have been taken care of, there is very little left. If he has a surplus of 100 dollars at the end of the year, he is lucky.

He is a wage worker. Practically his entire income is the result of his own individual efforts. He lives in a city. He is nearly always a renter. He buys all his foodstuffs at the grocery and market. When he has employment, he and his family can get by. If he is laid off temporarily, he feels the pinch at once. When hard times come and employers cut their payrolls, it is not long before he and his family are in real distress. There are nearly four million John Smiths still on the federal relief rolls today.

Tom Jones is another American worker. His income is exactly that of John Smith; his family is the same size. But Tom Jones is employed in an industry that has moved to a smaller industrial town. He is buying a house and a few acres of land on the edge of town. With his garden, his flock of chickens, his cow, and his three or four pigs, he and his wife and the older children are able to supply themselves with three quarters of the foodstuffs they need during the year. This means a big cut in the chief item of living cost. Payments on the house amount to no more than rent in the city.

BUSINESS falls off. The decline deepens into a depression. Tom Jones can get only part-time employment. His income is halved. But he makes use of the days when he is laid off, to plant a larger garden. His wife cans more vegetables. He feels the lack of cash. It is a tough pull, but he and his family have plenty to eat. They have a roof over their heads—a good sound roof, too. No relief or bread line for Tom Jones. Whether he realizes it or not, he is a subsistence homesteader. He is pioneering on a new economic frontier. He has not gone *back* to the land, but *on* to the land.

For a generation and more, America talked about the back to the land movement. For the most part, it remained a nebulous doctrine espoused by social philosophers who thought in terms of Utopian pastoral societies. In actual practice, the people of the United States were committed to agricultural expansion and urban centralization.

The urban population of the country grew from 28.2 percent in 1880, to 51.4 percent in 1920, to 56.2 percent in 1930. In the decade from 1920 to 1930, the percentage of the total population living in cities with 1,000,000 or more in-

habitants increased from 9.6 to 12.3 percent. It was a busy, prosperous, exciting march of the masses while the good times lasted.

It took the depression to rouse the country to the fact that the process of centralization had passed the point of safety, that an economic set-up in which the great majority of the workers were solely dependent upon pay-roll wages was one perilously liable to being thrown out of balance by any unfavorable economic pressure.

As in the case of all depressions, the past few years have seen thousands of people turn to the refuge of the soil. The back to the land movement is actually being put in practice. But merely *back* to the land is no solution. The random, aimless drift which has taken place so far carries with it dangers of mal-distribution of population and of economic instability as ominous as those of the over-urbanization which brought it about.

And it is here that the federal subsistence homestead program steps in to give direction to the movement already in progress under the inexorable drive of distress. Thousands of John Smiths, urban wage workers, are to be given a chance to go *on* to the land and become Tom Joneses, subsistence homesteaders.

When Congress passed the National Industrial Recovery Act, it included in Section 208, Title II, authority for the President to undertake a program through the establishment of subsistence homesteads which would "provide for aiding the redistribution of the overbalance of population in industrial centers." Section 208 appropriated 25,000,000 dollars to be made available to the President for "making loans for and otherwise aiding in the purchase of subsistence homesteads." The section further provided that "money collected in repayment of the loans should constitute a revolving fund."

President Roosevelt designated the Secretary of the Interior to carry out the program and authorized the creation of the Division of Subsistence Homesteads. The Division was organized August 23, 1933. A subsequent order by Secretary Ickes created the Federal Subsistence Homesteads Corporation to act as the Division's operating agency. To date, more than 60 subsistence homesteads projects are in various stages of development; 40 have been publicly announced and a score or more are in various stages of planning. Among those publicly announced, actual house construction has been started upon some 17 projects, and land development is under way on most of the remainder.

The Division of Subsistence Homesteads operated for its first ten months under the directorship of Dr. M. L. Wilson, who resigned June 30, 1934, to become Assistant Secretary of Agriculture. The work of the Division is now in charge of Charles E. Pynchon, general manager of the Federal Subsistence Homesteads Corporation.

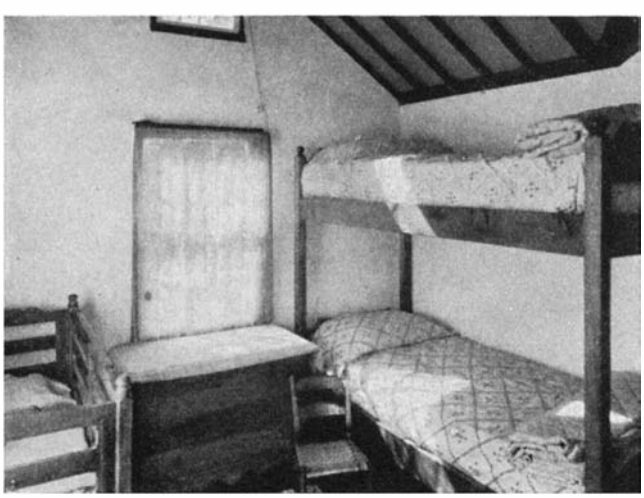
One of the houses now completed and occupied in the Experimental Community at the Reedsville, West Virginia project

THE name "subsistence homestead" is self-explanatory. It denotes a house and outbuildings located upon a plot of land on which can be grown a major portion of the foodstuffs required by the homestead family. It denotes production for home consumption and not for commercial sale. In that it provides for subsistence alone, it carries with it the corollary that cash income must be drawn from some outside source. The central motive of the subsistence homestead program, therefore, is to demonstrate the economic and social value of a form of livelihood which combines part-time wage work and part-time gardening or farming to produce a food supply.

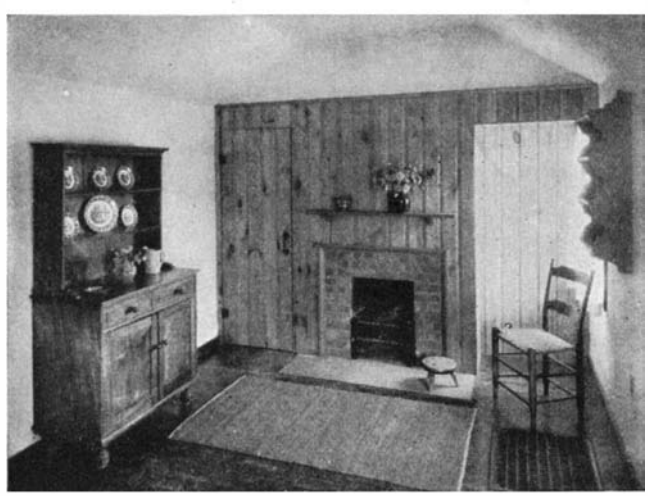
The program of the Division of Subsistence Homesteads is being pursued in the sincere belief that it can furnish to large classes of American citizens a means of obtaining greater economic security and a higher standard of living, that its work offers a way to a new economic stability not only of the individual, but of the nation.

The same industrial trend that has broken down economic security has also destroyed certain social values.

Socially, also, the program offers tangible benefits. It gives to those hitherto prevented by lack of capital and income a chance to move from crowded slum and tenement areas, with



Even the furniture of this children's room was made by unemployed under direction of Committee on Self-Help



This living room of one of the homes in the Reedsville, West Virginia, project is plain but neat and comfortable

An attempt is made to uphold the traditions of the locality of each project. Here, under construction, is shown a modified log and stone house in Tennessee

all the social conditions that go with them, to the healthier atmosphere of the suburbs, or the country. It re-emphasizes the home and family as the social unit; it promotes neighborliness and a community life, and in this day of specialization and mechanization, it provides an outlet for individual creative energy.

In addition to its principal aim of encouraging the decentralization of industry, the Division of Subsistence Homesteads is attempting to deal with a number of special problems.

Homesteads projects have been undertaken looking to the rehabilitation of members of the so-called "stranded groups" of industrial workers who have been left unemployed, probably for good, by the moving away or closing down of whole industries, by technological changes, or by the exhaustion of natural resources, as in the case of soft coal miners and workers in the lumber industry.

IN a limited way, and in special areas, the Division is also undertaking demonstrations of rural rehabilitation, in order to prove to urban dwellers that it is both possible and desirable to live on and draw part of their sustenance from the land.

Though the program of the Division exemplifies the new spirit of making the Federal Government the servant and helper of the average citizen, it is neither Federal charity nor paternalism. The Division is not an agency of emergency relief.

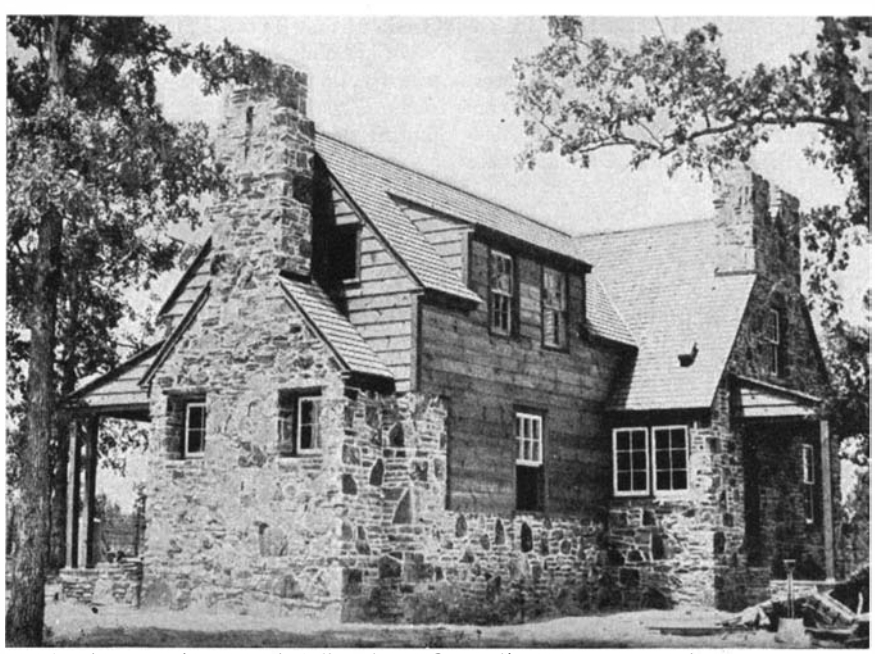
The 25,000,000-dollar appropriation as specified by Congress is being used —except for necessary administrative and experimental expenditures—in making loans which the homesteaders will repay. While the risk taken is greater than would be assumed by a private agency, still the whole program is based upon a businesslike arrangement between the homesteader and the federal lending agency. Homesteaders are not given their houses and land, but must buy them under a contract providing, as a rule, for repayment over a period of 20 years. Because of this fact —that it is a business agreement, albeit a liberal one—the subsistence homesteads program carries with it none of the evils seen in loss of self-respect and dependence on a paternalistic government, which often are the results of purely charitable relief.

The responsibility of the Division is to assist families who are on an economic level above that of the sheer relief group. It is essential that homestead families have a reasonably assured income large enough to enable them to meet their payments. It is required also that they be of good character, have some knowledge of agriculture or gardening, and that they be sincerely desirous of co-operating in making the program a success. It has also been ruled that homesteaders must be American citizens.

The attempt is purposely made to choose divergent types of projects so that as many various problems as possible may be dealt with. While projects may be listed as being under development in 23 states, it should be noted that they are not located by states or on any other geographic basis, but are undertaken with a view to covering the various problem areas of the country.

In size, individual homesteads vary from the acre or two of the worker's garden type to from 20 to 30 acres in rural projects. An average homestead would include approximately five acres. Houses range from three to six rooms, and in cost from 1200 dollars to a maximum, in a few instances, of 3000 dollars. The attempt is made to create a homestead which will sell on the average for 3000 dollars or less. This purchase price includes the house and outbuildings, and, in most cases, essential farming and gardening equipment, seed and fertilizer, a small flock of chickens, a pig or two, and possibly a cow, or a horse or mule.

THE members of the Division feel that they are part of a great pioneering movement. The rôle of the Division is that of trail blazer and guide. With the funds at its disposal, generous as the appropriation was, it is impossible for the Division to do more than test out and experiment, and by its success and failure demonstrate what are the safe routes to follow. It must be the task of local government and private enterprise to develop the territory thus opened up. It is the confident hope of the Division of Subsistence Homesteads that the trail it is marking will be broadened by the march of many thousands of John Smiths, on their way to settle the new frontier.



A subsistence homesteader's "castle" at Crossville, Tennessee—and it cost approximately 2000 dollars! This low cost was possible because virtually all raw material used on this project is available nearby. The homesteaders contribute labor, being paid half in cash and half as credit toward purchasing homes of their own

WORLD-WIDE RADIO

ALL-WAVE RECEPTION

A Universal Hobby . . . Daily Weather Reports . . . Noise on Short Waves . . . Care in Tuning

By M. L. MUHLEMAN*

ALL-WAVE reception has become a universal hobby. Every day and hour there are literally thousands of people in all parts of the world occupied in the diversion of tracking down distant stations, or merely enjoying the varied programs, educational features and unexpected thrills the wavebands have to offer. It is the greatest show on earth.

From five meters right up to the edge of the standard broadcast band, the ether is filled with every conceivable type of transmission. In this wide frequency spectrum will be found the commercial radio telegraph stations, the experimental television and radio picture services, the ship-to-shore and transoceanic radio telephone links, the police and aircraft stations, the communication facilities for expeditions to far parts of the earth, the amateur telegraph and radiophone stations and, above all, the large group of international broadcasters.

The international broadcasters operate in the wavelength bands of 11, 13, 16, 19, 25, 31, and 49 meters, the waveband employed depending upon the time of day or night. The police radio stations are to be found at 7 meters (not covered by the average all-wave receiver) and at 120 and 175 meters. The two latter bands are used constantly day and night. The airport stations operate in a number of wavebands, the principal one being in the vicinity of 55 meters. The amateur radiophone bands are located at 5, 10, 20, 75, and 160 meters.

THERE is one more waveband that should not pass unnoticed. It is not a short-wave band, but is incorporated in a few of the latest all-wave receivers. This is the group of wavelengths, above the standard broadcast band, where there are operated some 75 Department of Commerce Weather Report Stations. Complete general forecasts are broadcast six times daily, commencing at 1:31 A.M. and ending at 9:31 P.M. These specific forecasts are for the public and are transmitted on a frequency of 236 kilocycles, which corresponds to a wavelength of about 1271 meters.

Though the high-power stations of Europe, Canada, Central America, and South America lay down strong signals over a considerable area of the United States, it should not be assumed that these stations may be received with the same ease and with the same clarity as a local broadcast station. There are many occasions when these stations are received just as well as a local station, but one cannot hope to expect results of this sort as a regular happening.

OUR Service Department has prepared a list of the Department of Commerce Weather Report Stations mentioned in the accompanying article, which list will be mailed upon request. Stamp, please, for postage. The list gives location, wavelength, and call letters, enabling you to get weather reports from all parts of the country.

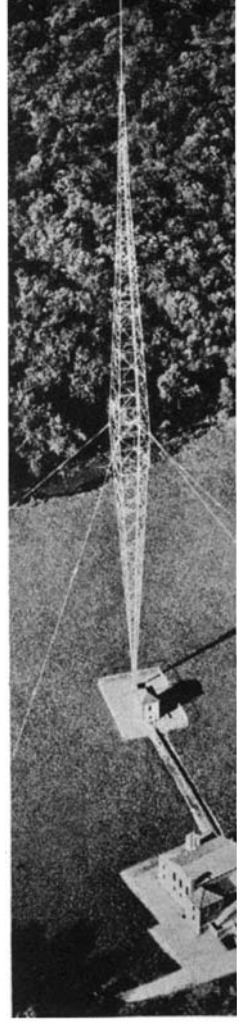
Also still available are the Short-Wave Station List, covering the world, and the listing of representative all-wave receivers. They, too, are free on request. Just send a stamp for postage.

—The Editor.

There are many points to be considered with regard to all-wave reception. Most important of these is the change in operating wavelength as the day progresses. Daventry, England, cannot be heard in the 19-meter band after noon, or in the 49-meter band before 3:00 P.M., Eastern Time. Keep in mind that these bands, as two examples, are day and night bands respectively.

The difference in time between countries should also be kept in mind. Thus, Daventry goes on the 49-meter band at 3 o'clock in the afternoon, Eastern Standard Time. But, when it is 3 o'clock in New York it is 8 o'clock in the evening in London.

It would be well to gain some appreciation of the utter uselessness of listening for stations in an unused band, by tuning in on the 20-meter amateur phone band just before dusk, and witness the peculiar phenomenon of sky-wave propagation. For a time the stations in the middle west come booming in at any eastern reception point. As the sun commences to set, these stations slowly fade out and from the background rise the stations in California. These signals hold up for possibly a half hour and then slowly give way to the signals from stations in Oregon, Washington, and Alaska, as the reflected waves of these latter stations pass over the east coast. Finally, these, too, fade out and the 20-meter band becomes as silent as a tomb—a daylight band has gone dead for the night.



† WABC

The next point of importance is that of noise. There is considerably more noise in the short-wave bands than in the standard broadcast band. This is accounted for by the fact that such electrical devices as vacuum cleaners, electric heating pads, telephone dialing systems, and so on, create electrical impulses the wavelengths of which fall in the short-wave bands. The radiations from the ignition systems of autos do not spread out quite so much, but raise havoc in the 19-meter broadcast band and the 20-meter amateur phone band. Noises are further accentuated due to the fact that all-wave receivers operate at high degrees of sensitivity when tuned to the weak signals of short-wave broadcast stations, whereas much less sensitivity is required for the proper reception of local broadcast stations.

THESE noises cannot be eliminated entirely, but they can be reduced by the use of special types of aerials designed for this purpose, some of which have been described in past issues of SCIENTIFIC AMERICAN.

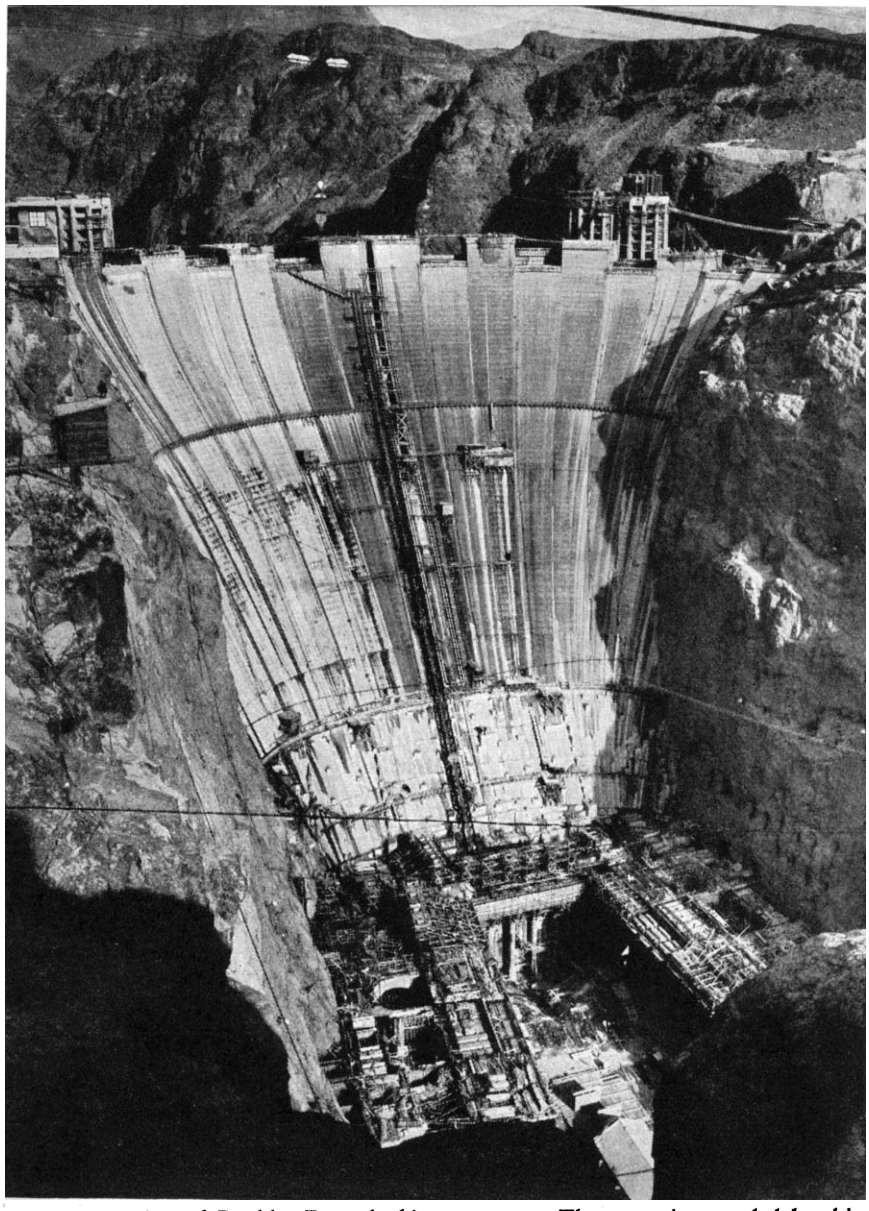
The final point to keep in mind is, that no matter how fine a dial-drive and band-spread mechanism an all-wave receiver may have, one still must tune with care. It is an easy matter to ride right by a station without being aware of its presence. If you choose to track down distant stations for the purpose of obtaining cards providing verification of reception, by all means, tune slowly.

*Editor, Communication and Broadcast Engineering; Radio Engineering; (Radio) Service.

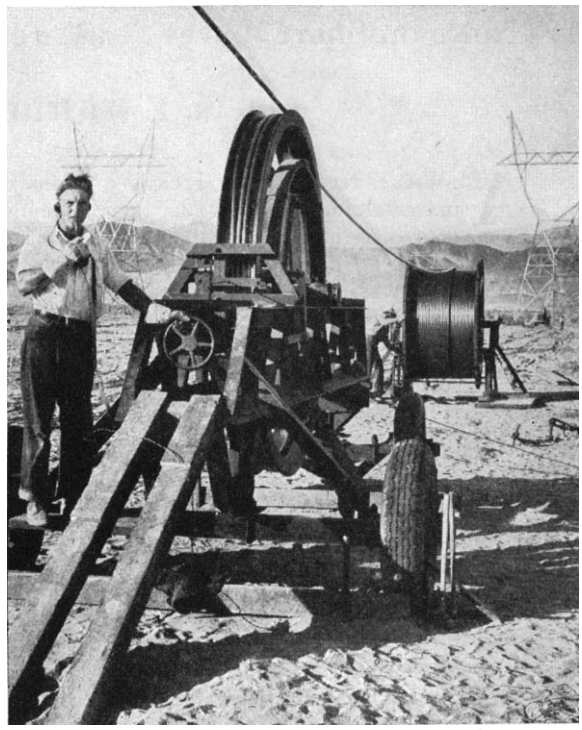
†Photograph courtesy Western Electric Co.

POWER FROM

By ANDREW



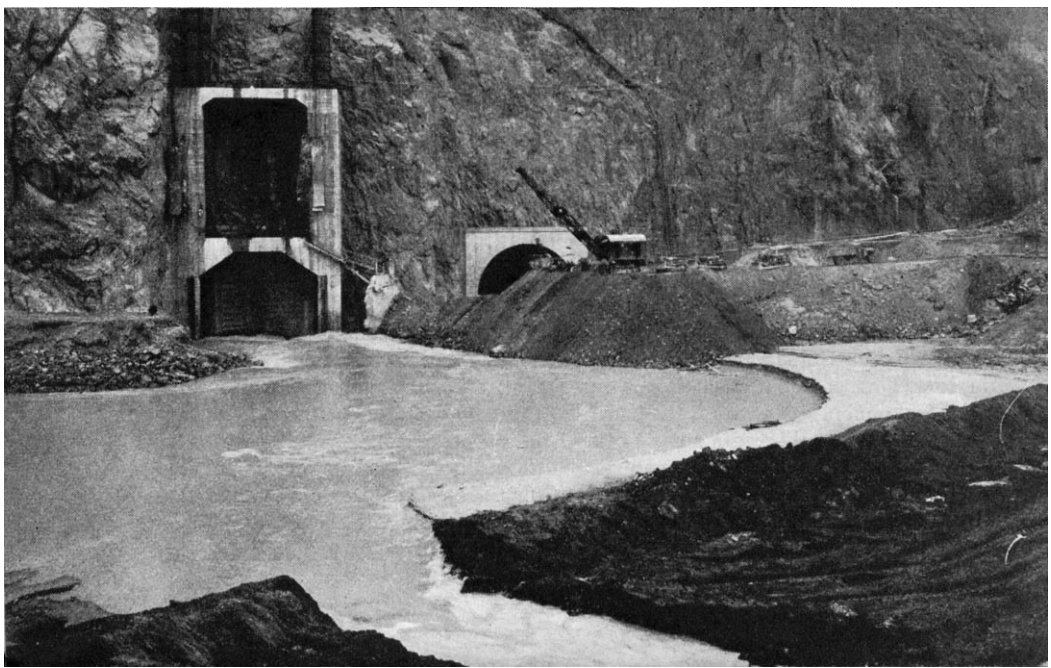
A recent view of Boulder Dam, looking upstream. The water impounded by this monumental piece of engineering construction will serve a two-fold purpose of irrigation and hydro-electric power generation, while the dam will act to avert serious flood damage often done by the hitherto unleashed waters of the mighty Colorado River

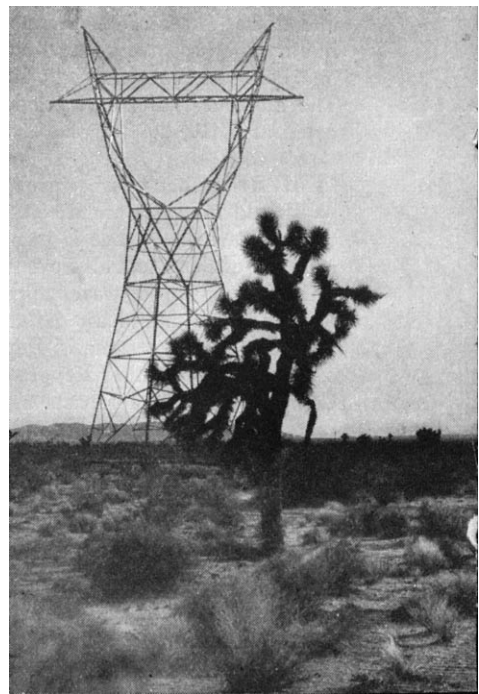


Equipment used in feeding the transmission line cable, as it is drawn over pulleys on the towers. The cable is pulled from the huge spool in the background, and three turns are taken around the eight-foot drum in the foreground. The operator, in constant telephonic communication with the crew of the tractor hauling the cable, controls the feeding of the heavy copper conductor by means of a hand-operated brake acting on the drum

Below: Closing the last of the gates through which flowed the water of the Colorado River while Boulder Dam was under construction. With the diversion tunnels closed, other work on the dam and appurtenant projects continues apace, while the enormous reservoir slowly fills

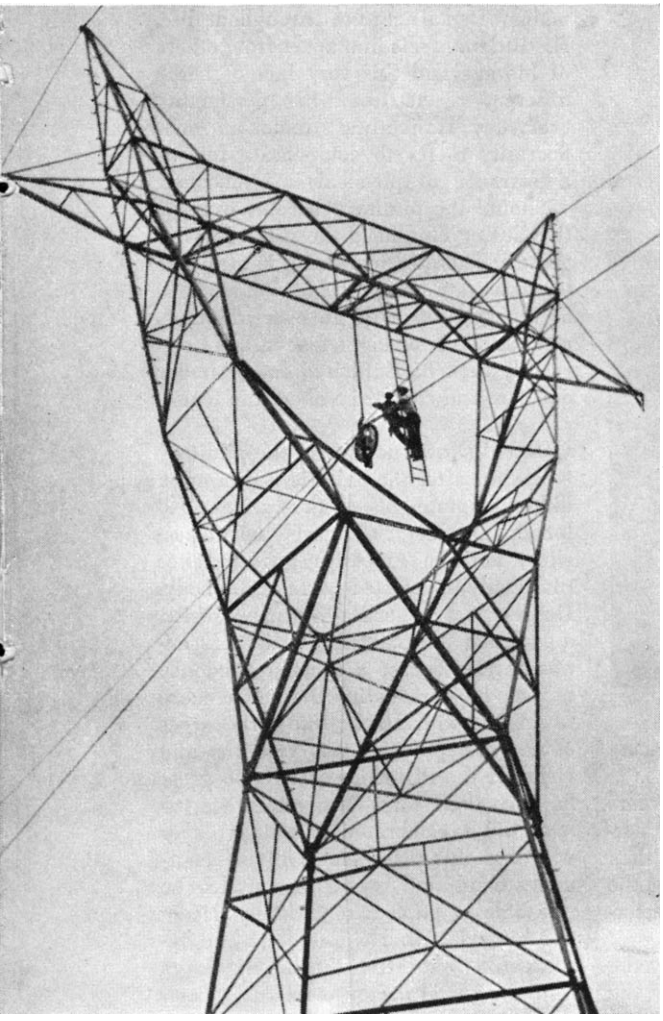
Below, center: A section of the Boulder Dam transmission line, showing the completed double row of steel towers stretching toward Cajon Pass. A total of 2680 of these towers will be erected to support 6727 tons of 1¼-inch hollow copper conductor, measuring 1620 miles in total length, required to transmit electrical energy to the consumers in Los Angeles at 275,000 volts





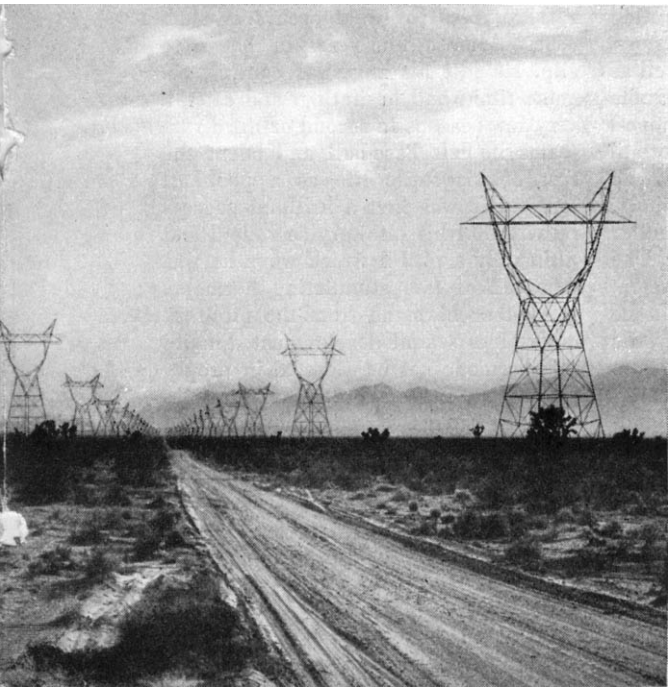
BOULDER DAM

V R. BOONE

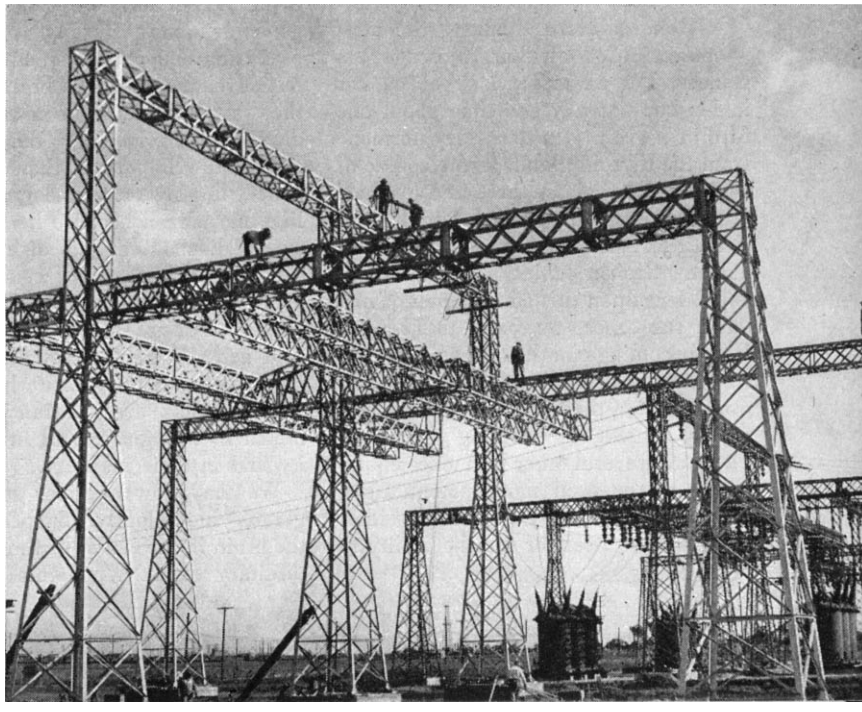


Left: Perched 90 feet above the ground, linemen are shown at work on one of the pulleys over which the cable is drawn. The Boulder Dam transmission line will carry enough electricity to supply 4,000,000 homes. [See also page 293, December 1934 *Scientific American.* Editor.]

In order to protect the transmission line and towers against damage by lightning, a counterpoise, buried beneath the ground, connects the line of towers. A special counterpoise plow, shown above operating over rough terrain typical of much of the country traversed by the line, also carries a reel of the cable and lays it in the trench that it has opened



Below: A huge switch rack to which the transmission line connects, and from which power received will be distributed through a network of lines to the ultimate consumer



PERSONALITY GLANDS*

Giants . . . Dwarfs . . . Fanatics . . . Neurasthenics . . . Loafers . . . All Made by Disordered Glands

By R. G. HOSKINS, Ph.D., M.D.
Director of Research, Memorial Foundation for Neuro-Endocrine Research, Harvard Medical School

EVERYONE knows in general what personality is, but no one has satisfactorily defined it. It includes everything that gives individuality to the individual. The problem then is, what do the glands contribute to the make-up of the particular self of each of us?

Everyone has many glands—actually living chemical laboratories. Well-known examples are the salivary glands that keep the mouth moist, the tear glands which upon occasion cause salt water to trickle down our cheeks, or the glands in the skin that help keep us cool in summer. These all take from the blood that courses through them different substances which are combined to form secretions. These secretions then pour through ducts to their various spheres of action. The glands which we are to consider, however, are different from those mentioned. Their secretions, instead of being discharged through ducts, are returned directly to the blood stream. Thus they are distributed throughout the body to produce a large number of important effects. These regulatory substances are known as the internal secretions or the hormones.

THE hormones are among the most powerful of all known drug substances. For example, each of us has in his body at any one time about one fifth of a grain of a necessary hormone from the thyroid gland. In the course of a year we use about three and one-half grains of this substance all told. This is a little more than the equivalent of half an aspirin tablet, yet we are all dependent upon this small pinch of material substance, thyroxin, to keep us from becoming complete imbeciles—the statement is literally true. Without thyroid secretion the human being becomes merely a sort of walking vegetable. There are several other hormones equally potent, or even more potent, upon which we are fatally dependent either for existence itself or for the ability to make existence worthwhile. All of these affect personality.

The author

From certain writings of recent years one might get the impression that personality depends upon little else than hormones. Such is emphatically not the case. Many factors go into the determination of individuality.

In the makeup of the personality the two most important features are the mentality and the emotions. The quality of the mind determines whether the individual is intelligent or stupid. Intelligence depends primarily upon the kind of brains one gets from his ancestors, but development of the brain as well as the way it works is to a considerable degree determined by the hormones. Even more important than the intelligence, however, are the emotions. We like one person because he has a jolly, sunny disposition and dislike another because he is glum or conceited. The emotions are closely related to the instincts. Indeed, the emotions might be said actually to represent the way the instincts feel to the person who has them. The instincts are substantially determined by hormones, both in their quality and in their intensity.

We may now consider some of the glands individually. Suspended from the brain in the center of the head is the pituitary gland. When this gland fails to develop properly the individual remains of small stature throughout life. His littleness sets him apart from others of his age and this very fact of being different reacts upon his personality every day. He is always under an inner necessity to try to compensate for his appearance of physical insignificance.

Should the pituitary become over-active during childhood the result is overgrowth. There is now living in a middle western state a boy of 17 who, because of the possession of an over-ambitious pituitary, is over eight feet tall. He can readily tuck his full-sized father under one arm and carry him about the house.

SHOULD over-activity of the pituitary begin after the child is grown up, a different state of affairs arises. No longer is symmetrical development possible, but the excessive growth takes place only in selected parts of the body. He becomes a gorilla-like monstrosity, a so-called "acromegalic." His deformities have of course a constant tendency to warp his personality. But he has more to contend with. During the early stages of the over-growth he is vigorous and virile. If the distortion is not too great he may even turn it to advantage, as once did a celebrated base-ball player who had this disorder. With his enormous hand and powerful muscles he was able to pitch a remarkably deceptive curved ball. He was alert and resourceful. But after awhile the large pituitary gland began to fail, as it commonly does both in giants and in acromegalics.

The case of the base-ball player is rather typical of what occurs in such cases. After a few years he began to slip. He lost his muscular control, became timid and hesitating, and after a very few seasons in second or third rate teams he left base-ball and spent the rest of his futile life as a pool-hall loafer. He was first a brilliant success by virtue of his pituitary secretion, and ultimately a pitiful wreck when he was deprived of this stimulating hormone.

Another hormone from the pituitary determines sexual development. Should this hormone not be secreted in proper amount the individual remains throughout life sexually and emotionally a child. The fanatical reformer is likely to be a person of this type. Having no possibilities in himself of satisfying self-development, he attempts to compensate by making over the world, and thus

gaining a gratifying sense of power.

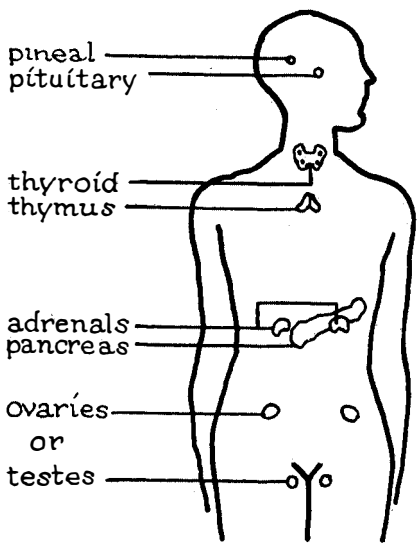
From the pituitary another secretion that regulates milk formation has recently been discovered. During the later stages of pregnancy and after the birth of the infant this hormone aids in keeping up the maternal food supply for the child. It is definitely true in experimental animals, and probably will prove to be true in human beings, that this latter hormone—prolactin it has been called—is an important factor in setting up and maintaining not only milk secretion but the maternal instincts as well. Under its influence unmated female rats have been made to adopt and mother large families of babies, and roosters have been made to cluck. I would not care to say that human mother love is merely a matter of hormone chemistry, but I suspect that the future will show prolactin to have a significant part in this emotion.

IN the lower part of the neck lies the thyroid gland. When its secretion is completely lacking the individual lives at only about half the normal vital speed. He is listless, mentally stupid, and sluggish of memory. Aside from a tendency to subdued truculence, his emotional life is almost colorless. Fortunately, thyroid deficiency of this marked grade is rare. Unfortunately, however, lesser degrees of thyroid deficiency are quite common and are frequently overlooked even by excellent physicians. The victims are likely to be over-weight, though this is by no means always the case. They fatigue easily and on slight provocation become cross and irritable. They are able to pull themselves together for brief periods, but soon relapse again into their feeling of inadequacy. Statistics on this subject are not available, but it is altogether probable that a considerable proportion of the unfortunates who go through life labeled "neurasthenic" or "psychoneurotic" are victims of this mishap.

It must be emphasized that there are many causes other than thyroid deficiency for this state of affairs, but in those cases in which it is the cause the condition is readily corrected. Sometimes even as little as one tenth of a grain of thyroid substance a day is sufficient to restore the individual to satisfying normality. Commonly less than one grain a day is needed.

Unfortunate as are the results of thyroid deficiency, even worse is the opposite condition. Over-activity of this gland gives rise to a condition of alert tenseness by which the person may be driven to death. He may live at twice the normal speed. Even with a voracious appetite he is unable to keep the vital furnace adequately stoked, and often literally burns himself out.

The thymus gland in the upper part of the chest has long been under study, but little convincing evidence of its importance has been available until recently. It was believed to have something to do with development, and that when it was defective the individual remained weak and futile in his personality. Within the year, however, it has been reported that thymus extract can produce in the offspring of treated animals a remarkable precocity of development. When only a few days of age the baby rats were as advanced as they should have been in a month. It is as though human children were ready for high school at the age of three years. The extract has not yet been tried on human beings but the experimental evidence suggests that it may some day prove to be an important resource in the treatment of retarded children.



Glands which secrete regulatory hormones into the blood stream

The adrenal glands which lie just above the kidney also contribute to personality. From these glands is derived the well-known hormone "adrenalin." It is probable that this secretion plays no significant part during times of ordinary quiet existence but that, under emotional stress, it is discharged from the gland and has important stimulating effects that permit us better to muster our bodily resources to meet emergencies. Without the aid of adrenalin we should no doubt be less competent in emergencies and our personalities so much the less effective. In the primitive scheme of existence emergencies called for activity—and adrenalin secretion was probably always helpful. Nowadays, however, emergencies often call, not for immediate activity, but for self-control and calm thinking. Nevertheless, in such conditions the adrenal glands still pour out their stimulating secretions and thus add to the difficulty of remaining calm and collected. It is this behavior of the adrenals which probably gives much of its point to the old saying that "worry is worse than work."

From the adrenal gland is obtained also the hormone "cortin." This substance has only recently become available and its properties are not well known. It seems to influence all of the living cells of the body. When cortin secretion fails, the individual develops Addison's disease, a condition in which the personality suffers. The patient becomes physically weak, restless, irritable, and lacking in co-operation. When cortin is supplied artificially, there results a restored sense of well-being, of energy and of enthusiasm. So much for extreme conditions. What part cortin may play in ordinary everyday life, and especially its influence upon the personality, have not yet been adequately studied. There are on record a few cases in which the adrenal glands have become enlarged and in which the individual, whether male or female, acquired a marked accentuation of masculine attributes. These cases suggest that the adrenals may contribute a quality of virility to the personality, but the quality has not yet been obtained in adrenal extracts.

FINALLY a few observations may be made about the sex glands. From time immemorial these organs have been removed from farm animals to bring about docility of temperament and to facilitate fattening for market. When the glands are removed before maturity, either in animals or in human beings, the result is essentially the same in all cases. The individuals fail in sexual development. They are more or less lacking in vigor and initiative, though the operation is not actually the ruinous calamity that it is popularly supposed to be. In the experimental animal the mating instincts fail to develop, and in the human subject normal romantic interest in the opposite sex is not acquired as the individual reaches adulthood. When the operation is performed later in life the effects are somewhat variable. A certain degree of instability of temperament is likely to develop and, in women, especially, unusual irritability may be apparent. Individuals of both sexes tend to become over-weight.

The foregoing constitute but a few of the outstanding facts which bear on the subject. The relation of the hormones to personality is one of the most interesting, and perhaps is the most important, topic in the whole field of the internal secretions. Unfortunately, however, the psychological has been the most neglected aspect of the subject. The result is that this important chapter remains yet largely to be written.

Nevertheless we can safely say that the personality is importantly determined by the influence of hormone factors. There are several hormones, the complete lack of any one of which would essentially ruin the personality.

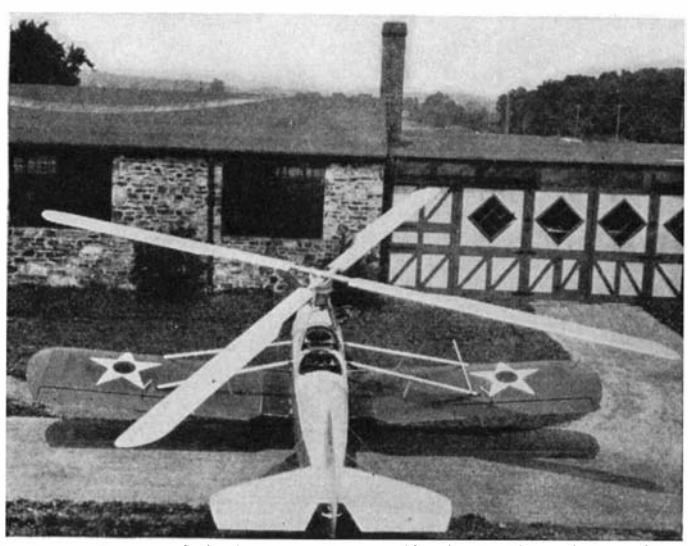
WINGS THAT TURN

Possibilities of Rotating Wing Aircraft . . . Vertical Rising . . . High-Speed . . . Roof-Top Landing

By REGINALD M. CLEVELAND

THERE is every evidence of an awakened interest in rotating wing aircraft. In the effort which is widespread, both here and abroad, to impart certain important safety factors to the flying machine in order to broaden the field of its application and make it more adaptable to the needs of the average man, designers are devoting increased attention to the inherent possibilities of machines with lifting surfaces which revolve around either horizontal or vertical axes.

Thus far, those craft which depend for lift upon vanes rotating about a horizontal axis, such as the Rohrbach plane in Germany and Mr. H. H. Platt's Cyclogiro in America—which may be grouped under the general definition of paddle-wheel aircraft—have not passed beyond the stage of wind tunnel tests. Somewhat extensive tests by the National Advisory Committee for Aeronautics on the last named design, however, indicate that there are no insuperable difficulties, at least in small sizes, and that a paddle wheel machine able to rise vertically, hover, or even to fly backwards, can be constructed.



A rear view of the latest type of Wilford gyroplane designed for naval use. It is equipped with a fixed low wing and provided with four rotor blades which feather in flight

A prime object of these designs, which might be termed radical, as well as of those aircraft whose rotating vanes revolve around a vertical axis, such as the autogiro, the gyroplane, and the helicopter, is, of course, to assure ascent and descent almost, if not quite, in a vertical path and thus to make usable restricted areas for both landing and takeoff, and to enhance enormously the general utility of the flying machine.

THE helicopter, long considered an aeronautical dream, if not an actual nightmare, gives promise of rapid emergence into a more practical realm. The French are said to have a helicopter which has been able to take aloft a 75-millimeter gun. The British expect to fly this summer a helicopter of the Asboth type built at the Blackburn works, for which test indications predict a flight range of two hours and a reasonable useful load from a power plant of 300 horsepower. This machine is somewhat in the nature of a cross between the true helicopter and the autogiro in that its rotors are of relatively large sweep—39 feet—and, although power driven—which is the essence of the helicopter principle—may be declutched and operated autorotationally as in the autogiro.

The same thing holds true of American efforts towards helicopter construction which have not yet reached so advanced a stage. Mr. W. Lawrence Le Page, of the consulting engineering firm of Day and Zimmerman, told the members of the Institute of the Aeronautical Sciences not long ago that he believed a helicopter of relatively small horsepower, having such factors of hybridization with the autogiro, would be entirely practical and give satisfactory performance as to forward speed, useful load, and pay load.

A summary of rotating wing aircraft might also include the convertible airplane called the Herrick vertaplane. This is an airplane designed to take off and fly with the efficiency and speed of the ordinary biplane; then, by release and autorotation of the special upper wing, it can reconnoiter and land with the convenience and safety of a windmill plane. The vertaplane has been in the air both as a biplane and as a windmill plane, although conversion in flight has not, to my knowledge, been accomplished.

The most notable advances to reach concrete form, however, have been in the field of the autogiro itself. The direct takeoff, or "jump up" described by Juan de la Cierva before the Royal Aeronautical Society, opens up wide new avenues of utility to the windmill plane. [See also page 317, June 1935, SCIENTIFIC AMERICAN. *Ed.*] This takeoff, which is accomplished by spinning the rotor through engine power to a speed above normal while the vanes are at a flat angle, and then declutching and changing the pitch of the blades to a high lift angle, should make possible the use of very small fields or of flat roof tops, and even of landing areas of rough surface such as plowed or stony land—land altogether out of the picture for the fixed-wing airplane.

OF very definite significance for the private flier is the order recently placed by the Bureau of Air Commerce with the Autogiro Company of America for a machine having this direct takeoff characteristic, but, in addition, two other modifications aimed at practical use by the average man. These are, first, folding vanes which already have been applied to the giro, and a method of coupling the engine to the landing wheels so that the machine, with vanes folded, can be driven on the highway and subsequently stored in the ordinary one-car garage.

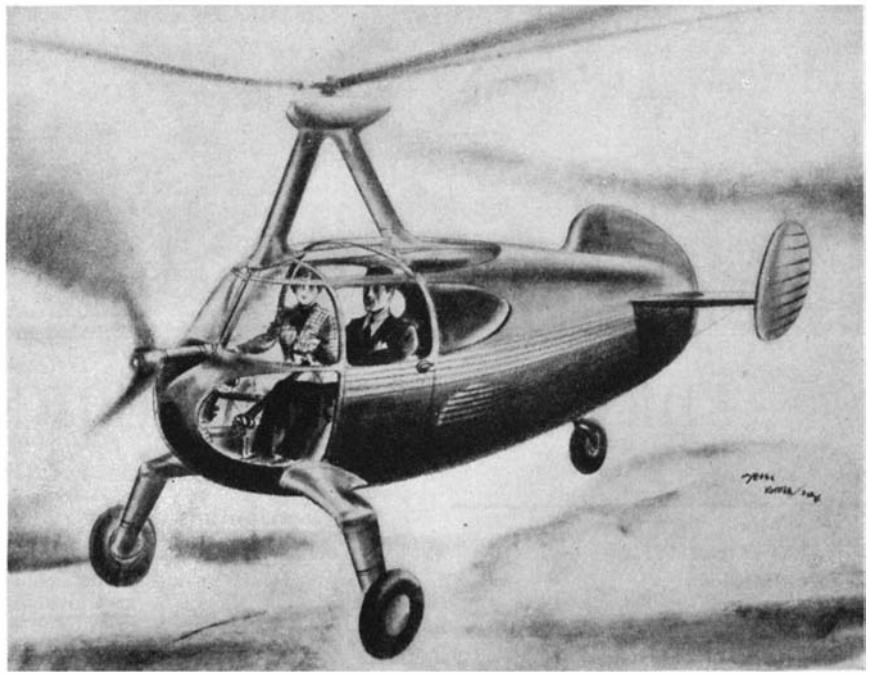
A number of details, of course, will have to be worked out for the road use of this odd flying machine. Problems of brakes, lights, license plates, and the like naturally will arise. These, how-

ever, are minor considerations which present no real factors of difficulty, and it now seems altogether probable that before Autumn a machine will be in the hands of the Bureau which can not merely descend in a virtually vertical path and land with only a very few feet of roll, but can be taken off again from a lawn or a "pocket-handkerchief" field or, if desired, tuck back its wings and trundle along the roadway to the family garage. Some specifications on this machine are: weight gross 1350 pounds; overall length 24 feet; width, vanes folded, 7 feet; tread 64 inches; wheelbase 114 inches; speed in air (top) 115 miles per hour; on road 20 to 25 miles per hour.

Señor de la Cierva told his British auditors that the direct takeoff, when fully developed, would permit autogiros to jump high enough to clear any number of ordinary obstacles, such as small houses, trees and the like, from a distance of only a few yards. Jumps up to heights of 60 or 100 feet were theoretically possible, he added, without reaching prohibitive accelerations of the rotor before takeoff, but in his view an initial height of about 20 feet would be the maximum required for practical purposes. He pointed out that direct takeoff should offer very interesting and obvious possibilities in regard to seaplane and amphibian application.

THE Spanish inventor had much to say, however, to his audience of British aeronautical experts, about the development of the autogiro aside from this spectacular one of leaping off the ground. He told his hearers that no effort had been made to realize in practice earlier predictions of autogiros of speed and useful load comparable to conventional airplane performances, because attention had been centered on fundamental development of the autogiro principle itself and upon production of the direct control 'giro in which wings and much of the tail surfaces had been dispensed with.

"In many instances," he said, "sacrifices in one direction have had to be made in order to improve some other point until increased knowledge has permitted us to redress the balance again. Simultaneous progress all along the line is only possible when a final formula is established, and the autogiro is only now arriving at that stage. Until then it will necessarily lack that refinement of design which can only be attained by repeated steps in the same direction. Speed, which incidentally we do not consider to be the only criterion of utility of aircraft free from some of the limitations of the airplane, will come as the result of stabilization of general conception and of the concentrated efforts of a greater number of engineers. So will useful load, and while we make no claims to superiority in every respect, we are convinced that we will not be far behind the airplane in what might be called airplane performances."



An artist's drawing of the "roadable" autogiro being constructed for the Bureau of Air Commerce. This ship is discussed in the accompanying article

The inventor cited in support of this opinion statements of John B. Wheatley, an engineer of the N.A.C.A., who has told the Society of Automotive Engineers that "there is apparently ample reason for anticipating the development of an autogiro in the near future that will equal or exceed the high speed performance of the equivalent airplane, that is, an airplane of the same power and useful load."

Señor de la Cierva points out that the most efficient rotor produced thus far has a maximum lift-drag ratio—excluding the drag of the hub—of between 13 and 14. This represents an increase of some 40 percent on the best rotor of five years ago, and of perhaps 80 percent on early rotors. At the same time, the maximum lift coefficients have been very materially increased.

These results have been obtained by making the blades cantilever and by suppressing the suspension cables, replacing the cumbersome inter-blade bracing by non-reactive dampers at their root attachment, using more efficient airfoil sections, replacing the fabric covering which constituted a relatively irregular and deformable surface, by a rigid superstructure, and by diminishing the solidity considerably.

The reduction in drag-producing solidities has been made possible by a better knowledge of the strength requirements of the blades and refinements in their construction, and by reduction of the number from four to three. Many secondary problems of a dynamical nature were involved in the suppression of one blade, and while difficulties that a further reduction to two blades present are considered of greater magnitude, it is quite possible that this may be done in future. Experimentally, satisfactory two-blade rotors have been produced.

By the introduction of direct control and the elimination of the small fixed wing and even of the rudder for any sort of ordinary flying, the autogiro has attained very greatly improved performances. The most efficient machine thus far built reaches a top speed of nearly 110 miles an hour, and carries a useful load of nearly 500 pounds, with an engine of only 75 horsepower. Absolute maximum speed attained is about 125 miles an hour, and minimum speeds in level flight of the order of 15 miles per hour have been obtained with very lightly loaded machines. Maximum altitude has been around 21,000 feet.

"IMMINENT improvements in various directions," Señor de la Cierva told his British listeners, "will make roof landing a perfectly safe maneuver, and I can say that we are ready to study from now on any form of application involving flying from small platforms or reduced enclosed spaces. The ability of the autogiro has been doubted to reach speeds of the order of 200 miles an hour, without losing considerably on the side of slow speed. This is quite definitely not so. The development of direct takeoff will undoubtedly considerably amplify the field of application and while the autogiro will have many of its own, direct take off and the attainment of high speeds will make it competitive with both airplane and helicopter."

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

Pneumatic Rivet Passers

RIVETS for both the Golden Gate and the San Francisco-Oakland bridge towers are delivered from the heating forges to the riveters by compressed air. Designed originally for use in shipyards where rivets often must be driven in enclosed spaces walled off from the rivet heaters, the pneumatic rivet passer is new to structural bridge work. Each unit consists of a cone-shaped reservoir placed at the forge, a suitable length of flexible steel tubing and a receiving receptacle in the hands of the bucker-up. The heated rivet is dropped into an opening in the reservoir, and its weight opens a flap valve which closes after it through the action of a counterweight. The operator then releases a blast of air that carries the rivet through the tubing at a speed of about 15 feet per second. The receiver is a metal cylinder containing a spring element that cushions the impact of the rivet.

Above: **Intake end of the pneumatic rivet passer, and,** ***right,*** **the receiving receptacle with spring buffer**

The pneumatic rivet passer is designed for efficient vertical transportation up to 125 feet. The flexible tubing has an inside diameter of two inches, which provides sufficient clearance around the rivet head to prevent the delivery velocity from being too high. Greater safety and lower costs are claimed for this equipment. It delivers rivets to points relatively inaccessible. Heat losses are claimed to be reduced while the scale is removed from the rivets as they slide against the walls of the tubing in transit.—*Engineering News-Record.*

Gun Detector

MANY legends have already grown up around the American "Devil's Island," Alcatraz Prison, in the Bay at San Francisco. One of these has to do with the absolute impossibility of smuggling past the guards guns or tools of any kind. The device which does this mechanical "frisking" may be adjusted to set off an alarm, turn on flood lights, or automatically shut the door leading from the room when some man passes carrying a concealed weapon or metallic tool.

The parallel loops of the gun detector are concealed in the door frame

Recently Dr. David Luck of the RCA-Victor Laboratories gave a working demonstration of this apparatus and a test of it is shown in the accompanying illustration. The system consists mainly of three parallel loops of wire concealed in the framework of the doorway and connected to a control box. A flow of voltage set up in the center, or driver loop, is picked up by the two outside loops, spaced at equal distances apart to create a perfectly balanced circuit. The introduction of a metallic object such as a gun, file, or knife will upset the delicate balance of the circuit, and cause an alarm. The device is absolutely harmless and, unless it is desired, persons passing through will not know they are being examined.

Besides its actual effect, it has a psychological one in discouraging attempts to smuggle weapons into prisons.

Preventing Silver Tarnish

A NEW method of treating silver to render it resistant to tarnish has been patented by a Swiss chemist, Dr. Finckh of Stuttgart. The treatment, which is quite simple and cheap, is said to work equally well with alloys of silver.

The metal to be treated is immersed in a solution containing 0.5 gram of chromium trioxide per liter of water. An alternate procedure is to use a solution of 100 grams

of sodium dichromate per liter of water and to immerse the metal twice, keeping it in the bath for three to six minutes. A third possibility is to use a 10 percent solution of either sodium nitrate or sodium nitrite, followed by immersion in 10 percent aqueous ammonia. Other surfacing solutions may be used, such as 20 to 50 grams of ammonium persulfate, 20 to 30 grams of sodium persulfate, 30 to 50 grams of hydrofluoric acid, or 10 to 30 grams of copper sulfate (slightly ammoniacal) dissolved in each case in a liter of water. The more concentrated the solution used, the shorter must be the period of contact with the metal.

In the case of pure silver, a solution of 10 grams of sodium sulfide per liter of water is recommended. Naturally, this forms a coating of silver sulfide over the entire surface. The object is then immersed in a dilute sodium cyanide solution. Here, as in all other cases mentioned above, a protective coating is formed, but its thickness is kept so slight that the original natural color of the metal is maintained.—*A. E. B.*

Automatic Broadcasts of Flood Warnings

THE State of California is now operating a series of automatic radio stream gage transmitters in connection with flood control and watermaster service activities of the Division of Water Resources.

The use of these radio stream gage indicators serves the public interests in California in a very vital respect. During major flood conditions advance information on the rapid fluctuations of streams on which

Courtesy *California Highways and Public Works*

The mechanism that sends out automatic flood warnings; and inventor

they are installed make them of paramount importance in the saving of life and property. In the watermaster activities the saving of water and crops and the protection of individual water rights are of major importance.

The radio transmitters, entirely automatic in operation, at frequent intervals send out a signal indicating the gage height of the stream at the moment. The signal is received in the State Engineer's office in Sacramento.

The fluctuations of stream flow in the major rivers contributing to the potential flood hazards in the valleys can be observed directly and accurately many hours in advance of the time when the crests of the high water would reach critical points on the valley floor. By means of this advance information a better, safer, and more satisfactory operation of the various flood control and relief structures along the river can be accomplished.

These automatic radio stream gage indicators are made possible by the use of a unique automatic keying device which was originally developed privately in 1931 by Associate Hydraulic Engineer Irvin M. Ingerson, shown in the photo at the left.

The flood warning device is in the little shelter atop the gage well

The automatic keying device consists of a series of commutators that are so arranged as to "key" the radio transmitter to give a signal that is the accurate gage height of the stage of the water at the time of transmission. For instance, a gage height of 7.42 feet would be listened to as being seven short dashes, at one-second intervals (easy to count), then a pause, then four dashes, then a pause, and then two dashes. The call letters of the station are also automatically "keyed." The keying device is operated by a weight-driven clock and by a float on the water surface in the gage well.

PROGRESS In This Age Of Science

As Told to Scientific American

By KERMIT ROOSEVELT
President, Roosevelt Steamship Company, Inc.

THOSE of us who spent our days of childhood in the 1890's have seen many and miraculous changes in this world. Even the elastic imagination of a child would have to be stretched beyond all bounds, if asked to vision in the guise of anything but fairy tales many inventions which we now regard as commonplace, such as the radio and television and the transatlantic telephone. Indeed it was not until my father was President that we had either electric light or telephone service in the house at Oyster Bay.

Transportation has also gone through its own amazing transformation. The automobile made its entry, causing a complete revolution in the building of great trans-continental highways, with the result that the railroad has been challenged by private motor cars and buses and trucks.

Those of us who make our livelihood from ship operation are very naturally keenly interested in watching the development of commercial aviation. The steamship can scarcely be wholly superseded, but unquestionably both passenger and freight traffic by air are assuming increasingly important rôles. Every year new lines are opened up, and for those who are adventurous or in a hurry, the difference between crossing from San Francisco to Honolulu in 17 hours instead of four days makes a very definite appeal.

In no business can one afford to stand still, and in nothing is this more evident than in the world of transportation where, if we are to survive, we must keep alert to every development and improvement.

Famous Cod Loses Supremacy

COD-LIVER oil, old-time standard rickets remedy, has not nearly so much rickets-preventing vitamin D or growth promoting vitamin A as many other fish oils. Oils from mackerel, tuna, sea-bass, and swordfish have from 100 to 400 times more of these vitamins than cod-liver oil, Dr. Charles E. Bills of Mead Johnson and Company reported at the last meeting of the American Society of Biological Chemists.

Three-quarters of all the liver oils were more potent than cod-liver oil in vitamin D and nearly all surpassed it in vitamin A. The vitamin content of the oils varies with the zoological classification of the fish. Most potent in vitamins A and D are the fish of the order *percomorphi*, to which belong mackerel, tuna, sea-bass, and swordfish.

Next come rockfishes and sculpins. Fish with soft bones contain little vitamin D and no measurable amount of this vitamin could be found in sturgeon or gray sole.—*Science Service.*

AIR PASSENGERS

CIVIL airplanes in the United States carried 1,859,031 passengers in 1934. In 1933 the total was 1,739,275. Of the 1934 total, 461,743 made flights on domestic scheduled air lines.

"Our Wings Grow Faster"

ONE of the most experienced and well known American airplane designers, Grover Loening served in the early days of aviation as Chief Engineer for the Wright brothers and pioneered with the famous Loening amphibians. While not immediately active in the construction of aircraft to-day, he is maintaining his interest in aviation to the fullest extent, and his recent book "Our Wings Grow Faster" has created somewhat of a sensation. The book is partly autobiographical, partly historical. In Mr. Loening's case biography and aviation history are really one and the same thing. Charmingly and vividly written, it is astoundingly frank. The history of American aviation is one of great achievements, both engineering and industrial, coupled with some incidents which are not entirely to its credit. The not so creditable side of this industry appears here for the first time between the covers of a book.

Thus in a section headed "The Detroit Conspiracy," he writes: "Preparedness parades were taking place all over America in the latter half of 1915 and 1916. And 'patriots' were already arriving in Washington in the soon-to-be-familiar guise of 'dollar-a-year men.' Some of these were perfectly sincere, with high motives. But the way step after step led the automobile crowd in Detroit to the ownership, control, direction, and parceling out of practically all aircraft and aircraft-motor business, by the time we entered the war in 1917, is a pattern that fits much too beautifully together to be accidental."

Under a heading "The More Cost, the More Plus" he makes the following bitter but well informed indictment of our airplane manufacturing policy during the war: "Just stop for a moment to consider that our aviation plants of the period just before our entry into the war could, with reasonable enlargement, have easily delivered to the front by November, 1918, over 2000 two-seater airplanes equivalent in performance to D.H.'s and much safer. And yet the Detroit cabal's great effort had produced only 213 planes in Europe by that time. . . . Delivered 213 airplanes at a cost of 640,000,000 dollars! Not quite true, but it is not so far off either."

But it must not be thought that the author is concerned with solely "de-bunking." His book deals with the most striking and important events and greatest advances of American aeronautics, in a vivid, concise, and absolutely fascinating manner.

Grover Loening secured, on his thesis at Columbia, the very first degree in aeronautics, Master of Arts. His thesis was first published in a series of articles in SCIENTIFIC AMERICAN in 1911, and then reprinted in one of the very earliest technical works in this field, "Monoplanes and Biplanes."

In "Our Wings Grow Faster," the author tells how he chiseled his first flight; of early days at the Wright factory; the first successful flying boat; the early history of the Army's aircraft division; America's great come-back in aviation after the war; the inception of the Loening amphibian; the boom times as they affected aviation; sidelights on Lindbergh; the great deflation of aviation securities—each brief section is as fascinating as the other.

Grover Loening, plane designer and author of "Our Wings Grow Faster"

Loening is an individualist and his own efforts were successful because they were individual. Why did he succeed as a designer? "I could have merely taken orders from perhaps a regimented, government-dominated board," he writes, "decreeing the design of the next larger or faster D.H. 48 which would undoubtedly have been a washout for two very good reasons. First, a board is long, narrow, and wooden. Second, you cannot create or inspire talent by order of the commanding officer." It is fortunate for aviation that the well beloved and brilliant Grover did follow his own bent.

What of the future? "So we shall see faster, and still faster commercial flying. At five hundred miles an hour, 50,000 feet above the ocean, flying through the warmer stratosphere, far above storms or ice or fog, sealed in a cabin furnished with conditioned air at ordinary sea-level pressure —this is the way we will cross New York to London in six hours in the not very distant future."

Altogether a stimulating and inspiring book.—*A. K.*

British Air Subsidy

IN a recent article by Mr. Igor Sikorsky which we published, a statement was made regarding the subsidy to Imperial Airways by the British government. In justice to the airline, we publish below an abstract of a letter from the Air Ministry in London which gives in detail the facts concerning the subsidy:

"In reference to your letter to the British Air Ministry . . . in . . . 1924 Imperial Airways was formed with a nominal capital, subscribed by the public, of £1,000,000 and in an agreement with the British Government this Company received a subsidy of £1,000,000 spread over 10 years. This sum worked out at £137,000 for the first four years, after which there was a sliding decrease until the end of the tenth year at which time the Company was to receive a final payment of £32,000."

EMERGENCY

THE 272 Department of Commerce emergency landing fields in the United States are now open for casual use by licensed aircraft as well as for emergency use by any aircraft, provided the pilots comply with regulations pertaining to the use of such fields.

The Future of the Airship

NOW that the depressing effects of the *Macon* disaster have worn off, we can discuss the future of airships dispassionately.

The first reaction of the public and press was that the wreck of the *Macon* marked the end of the American airship history, because of the extreme hazards involved in their operation.

But, strange as it may seem, a better theoretical case can be made for airship safety than for airplane safety. They have inherent stability under the action of gravity, can hover without using up fuel, their motors can be repaired in flight, and they have so large a range that fog and loss of course are no longer to be feared in transoceanic operation. The specifications for airship strength carry theoretically a larger margin of safety than do airplanes. An airship cannot indulge in aerial acrobatics, but neither is it subject to stalls and spins.

This all seems at variance with the record of destruction. But if this record is examined more closely it will be found that failures were due to political and service considerations, and to lack of continuity in training of the naval personnel. In the wreck of the *Shenandoah*, the Commanding Officer disregarded the advice of his Aerological Officer to go south. On board the *Akron*, the Commander acted with pitiful confusion in trying to avoid the violent storm areas. In the *Macon* disaster, the testimony indicates that the weakness of the fin was disregarded because the airship had to take part in naval maneuvers.

The Goodyear Zeppelin Company has operated its small blimps for six years, and carried thousands of passengers without accident. The splendid record of the *Graf Zeppelin* in world flight and many transatlantic crossings is familiar to all of us.

If naval officers were not switched from airships to battleships, and if the airship were used with more discretion, it would be no more hazardous than the airplane.

Commercial operation of the airship across the Atlantic has been shown again and again to be practicable and profitable, at least in the most serious engineering studies. At the moment there is no seaplane which is really capable of use across the Atlantic in regular passenger service. This summer the Zeppelin company plans to put its new airship into regular service across the Atlantic, and this will be a most interesting experiment.

The threat to the commercial use of the airship is that its place may fall between the fast liners such as the *Queen Mary*, with a service of a little over four days across the Atlantic and luxurious accommodations and general holiday atmosphere, and the airplane capable of non-stop operation between New York and Paris at a cruising speed of 200 miles per hour. Such an airplane, Mr. Igor Sikorsky tells us, is entirely feasible with present day knowledge of aerodynamics and structures.

What would be a reasonable national policy with regard to airships? Let us use the privilege of a mere writer to lay down the lines of such a policy, for Washington perhaps to read and certainly to disregard!

Let us continue to build naval airships, but build stronger rather than bigger craft, sacrificing some of the extreme requirements of the Navy and putting more of the structural weight into structural strength. Also let us not concentrate too much on one type, the neo-Zeppelin type, but give the Metalclad principle a chance, and perhaps look into the semi-rigids which have done such wonderful work.

Let us organize the airship service of the Navy into a distinct unit so that our splendid officers and men may receive better training, particularly as regards weather and storm avoidance.

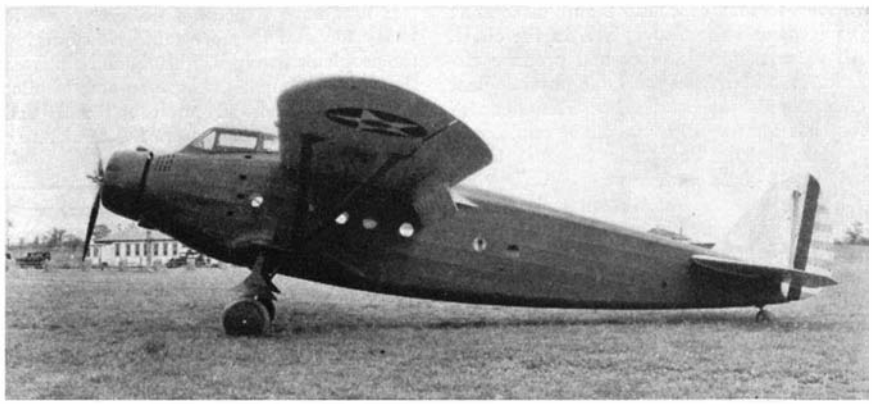
It would be advisable also to keep a careful watch on the new German service across the Atlantic, and if this proves satisfactory, to appropriate money to finance such service under the American flag.

But since the seaplane is so strong a potential rival of the airship even in over-ocean service, any step in financing airships for commercial service should be balanced—at a quarter the cost—by giving the heavier-than-air constructors a chance to see what they could do in giving us an airplane or flying boat capable of real speed and non-stop operation across the Atlantic.

We have tried to make this brief statement as impartial as possible. Airship people reading it will be only partially satisfied. The airplane people are immune to criticism; exponents of lighter-than-air are particularly sensitive to even the mildest expression of doubt or criticism.—*A. K.*

A Cargo Carrier

WHILE a great deal of air express is being carried through the air, our airline operators have so far been content with using airplanes designed for the triple duty of carrying passengers, mail, and cargo. It has remained for the Army Air Service to purchase perhaps the first all-cargo transport in America. This is the Fairchild cargo transport, termed by the Army *XC-31*. It is not in the 200-mile-per-hour class, but has, nevertheless, a top speed of a little better than 160 miles per hour, an empty weight



The Fairchild *XC-31*, an all-cargo transport purchased by the Army

of 7322 pounds, and a useful load of 5678 pounds. The ratio of useful to gross weight thus is about 41 percent. This is a very high figure for a modern land transport. The payload is 3600 pounds, which is also far more than is usually carried in a modern transport of this size.

The machine is, indeed, a flying freight car. All the luxuries of modern air transport have been dispensed with. The cabin, with small windows, has a cargo space 19 feet long, 6 feet 4 inches wide, and 6 feet 4 inches high, with a capacity of 775 cubic feet. When the ship is at rest on the ground the cargo door is just at the right height to register with the tailboard of a standard Army truck backed up alongside.

The Army drew on all its operating experience in drawing up the specifications of this machine. Spare engines, whether air or liquid cooled, can be put inside the cabin in regular packing boxes. Three Wright Cyclones constitute a capacity load by weight. All kinds of materials can be lashed to demountable stanchions or to the floors. For the transportation of wounded, six litters may be installed, three on a side, leaving plenty of aisle space for attendants to work in, or for additional wounded to be carried on chairs. As a troop carrier, 15 Army chairs may be installed and military equipment can be lashed down between the chair aisles. For delivery of emergency food or supplies, a large cargo chute has been installed, from which containers may be ejected and guided by parachutes to the ground. The single pilot's seat is in an enclosed cabin, high up, from which the range of vision is adequate in all directions.

The plane is built mainly of dural with fabric covering. Wheels are retractible and a Wright Cyclone is employed for the power plant.

We have often had occasion to speak of the Zap flap. This forms a part of the lower surface of the wing and not only hinges downwards but moves backwards. As a result, its lift increasing qualities are far greater than those of the ordinary trailing edge or split flap. This flap is clearly shown in its retracted position in the photograph. —*A. K.*

Passenger Comfort

IN a paper presented before the Institute of Aeronautical Sciences, Preston R. Bassett defined, for the first time in the literature of aviation, what constitutes passenger comfort and discomfort in air travel. His findings are based on careful and practical studies conducted over a period of years, with flying experience on many types of aircraft both in the United States and in Europe. The accompanying chart gives a graphic illustration of his views on the subject of comfort.

In this chart there is an interior Comfort Zone, within which the air traveler is entirely comfortable. To this Comfort Zone there is a psychological boundary, outside of which is the Discomfort Zone. The boundary is termed a psychological one, since the discomfort just outside of this boundary is largely in the mind of the passenger. At the outer limit of the Discomfort Zone, there is another boundary which is termed the physiological boundary, because at this point the discomfort is truly physical, and because outside this boundary the human body cannot function continuously.

Skilled pilots of experience can "take it" much better than passengers. They are scarcely affected in the Discomfort Zone, and can even stand up to some degree of the Unbearable Zone which lies outside the physiological boundary. But it is not the comfort of the pilot with which airline operators are primarily concerned. In fact, a pilot very "resistant" to discomfort may be an actual drawback to the popularity of the airline, while a sensitive pilot with less hardened reactions is apt to be more mindful of the happiness of his passengers. For example, at the discussion of Mr. Bassett's

Chart of air passenger comfort

paper, one veteran pilot, Haizlipp, pointed out that he kept his passengers from air-sickness because his sense of smell was so acute. He smelled exhaust gas fumes long before anyone else, and made sure therefore that the air inside the fuselage was always sweet and clean.

The great value of Mr. Bassett's work lies in the fact that he has measured and assigned definite quantitative values to the

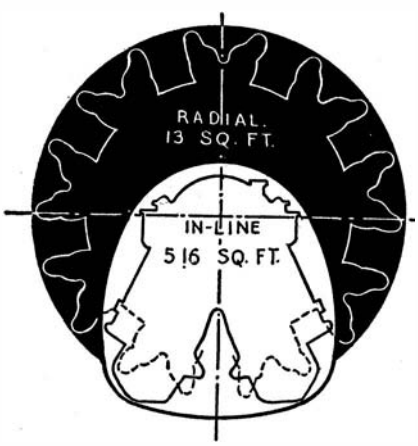
various factors of comfort and discomfort involved, and these are given in the chart. All these factors interact and produce air-sickness, which is of the same physiological character as sea sickness, or train sickness for that matter, with the same unpleasant symptoms. The Passenger Comfort Chart will repay close study.

The first section of this chart is termed "Angle." When a ship at sea or an aircraft rolls five degrees or less, the passengers remain comfortable. Beyond 5 degrees, the actual physical discomfort increases rapidly, and at 20 degrees roll everyone is uncomfortable (including the captain or the pilot) and all those who are going to be seasick or airsick are already in that condition!

The second section deals with acceleration. To most people sudden up or down motion is much more unpleasant than pitching or rolling, and air travelers speak with particular distaste of "bumps" or "air pockets." It is only necessary to have an acceleration 1/10 that of gravity to pass into the discomfort zone, and 1 g. is unbearable. (In an elevator the maximum acceleration is probably only 1/3 g.)

The next sector on the chart is vibration. Mr. Bassett has measured vibrations with the "vibrometer" and finds that vibrations of more than .008 of an inch cause a passenger to keep his muscles tense and prevent him from relaxing. Hence the great emphasis laid in airplane design in preventing engine vibrations from reaching the passenger cabin. It is not difficult to cushion the seats so that very little vibration reaches the passenger through the seat, but it is equally important to prevent vibration of chair arms, floor, foot or head rests, and so on.

When it comes to ventilation, it has been found that more rapid change of air is required in the airplane than anywhere else, and a minimum of 40 cubic feet per minute



Above: **Comparative frontal areas of in-line and radial airplane engines.** ***Right:*** **Front and side views of the new Ranger engine for private planes**

is necessary. This is far more than is provided in the best of the modern moving picture houses.

We have often discussed noise in the airplane. A decibel level of about 70 is found in a Pullman car, and anything up to 85 is within the comfort zone. A level of 120 is unbearable.

Mr. Bassett has done a splendid piece of work in setting up specifications for comfort. Our airplane designers and constructors now have something perfectly definite to try for, and they are rapidly conquering the problems involved, with much help from the Sperry company, whose automatic pilot has largely removed pitch and roll, and whose sound-proofing studies have done so much to silence the airplane.

MILES PER ACCIDENT

MISCELLANEOUS aircraft operators in the United States flew 392,141 miles per fatal accident in the period July-December, 1934, representing an advance over the corresponding period of 1933 when the miles flown per fatal accident were 377,200.

A Fine Engine for the Private Plane

THE Fairchild Aviation Corporation announces that its subsidiary, the Ranger Engine Corporation, has actively entered the aviation market with a series of 6-, 8-, and 12-cylinder engines, as the result of four years intensive engineering work. Without slighting the other fine motors being produced, we describe below the 6-cylinder engine, which is particularly well adapted for use in private planes, and which like the others of the series is in-line and inverted.

There is a definite reason for the utility of in-line inverted engines. As the diagram indicates, the in-line engine of power equal to the radial has a very much smaller frontal area. With the large radial, no air resistance can be saved in a military ship by cutting down the cross-section of the fuselage, since the large frontal area of the radial is still there to disturb an equal area of air. With the in-line, the fuselage can on occasion be cut down, with appropriate aerodynamic saving. In the private plane, the dimensions of the cabin cannot very well be reduced to match the engine, but the smaller projected area of the engine, particularly when it is inverted, gives the pilot improved vision over the nose of the plane. And improved vision is one of the vital elements in airplane design. Also an in-line engine lends itself nicely to streamlining.

The 6-cylinder Ranger develops 145 horsepower at 2250 revolutions per minute and has a dry weight of only 350 pounds. It has stood up successfully to power tests at speeds much higher than this rating, namely 3500 revolutions per minute, and has developed a mean effective pressure of 230 pounds per square inch. This gave 69 horsepower per cylinder and 1.04 horsepower per cubic inch displacement. Those of our readers who are familiar with automobile engines, will by comparison recognize what an immense concentration of power this means. The engine is cooled by placing a scoop at the side and leading air to each cylinder by means of baffles.

With its six cylinders and perfect balance, the Ranger is smooth running and almost entirely free from vibration. Here are a few other points which should appeal to the experienced operator:

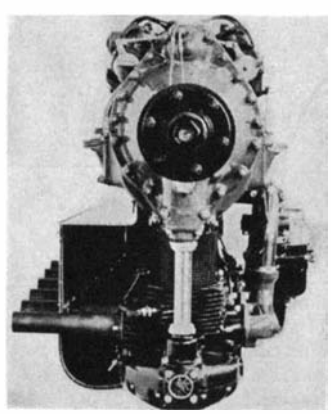
There are no parts to be oiled manually, with the exception of the magnetos, as all moving parts are lubricated by full pressure feed from the engine-driven pumps. The valve actuating mechanism, due to the inverted design, is completely enclosed in an aluminum housing, the cover of which serves as an engine oil sump. Failure of the oil system is forestalled by a special feed system The pressure feed to the main bearings and the connecting rod bearings is so designed that each bearing is fed with oil from both sides.

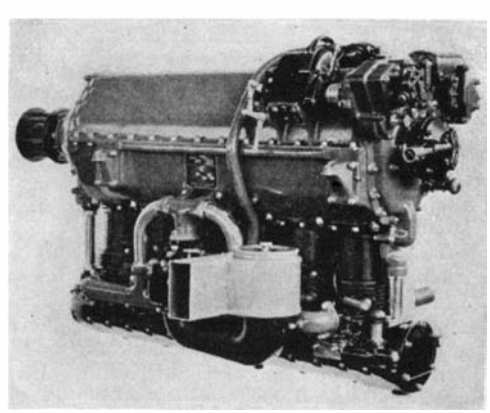
The in-line principle in engine design, skilfully embodied, is bound to be of great service to private flying.—*A. K.*

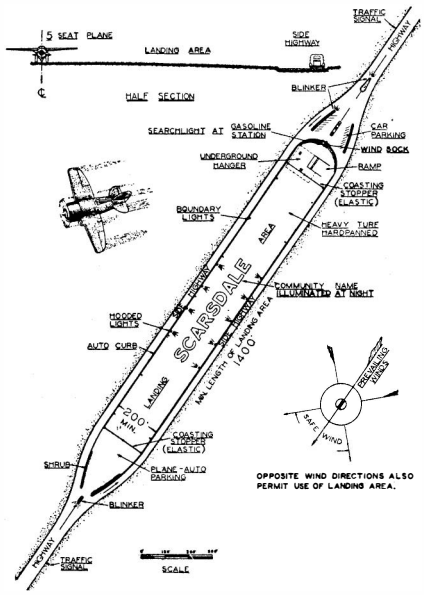
A Novel Form of Landing Field

IN the expenditures shortly to be undertaken by the Government on such a lavish scale, the construction of a large number of airports might well be considered. Grover Loening, whose book is reviewed elsewhere in these columns, advocates as part and parcel of the great highway system now being planned, the allocation of funds to an airport system. Every ten miles or so, along the nation's highways, there should be a reasonably good landing field, say about 2000 feet square, right alongside of and connected with the great highways. Such a network of airports, say 10,000 in number, would cost about 200,000,000 dollars and would open to flying many mountainous and swampy sections of the country. Near almost every large city there is an airport of some kind. What the private flyer now needs is not an extension of such large airports, but a greater number of smaller, intermediate fields, conveniently located.

Directly in line with this suggestion is a novel form of landing field designed by an airport engineer, A. W. McKaig, illustrated in our drawing on the following page, and termed "Aeroplot."







The "Aeroplot" aircraft landing field

The "Aeroplot" would involve merely a widening of a section of the highway right-of-way to a minimum width of 200 feet on a length of 1400 feet. Airplanes would be permitted to land or take-off during the night or day on this area, within two lanes of highway or parkway without interference from traffic. Semi-automatic highway traffic stop signals would be located beside the highway at a suitable distance from both ends of the landing areas. At the time of a take-off or landing, the field attendant would stop all highway traffic. The signals might also be operated by the pilot of a plane through a tuned buzzer or siren signal from the plane which would actuate a tuned and timed receiving switch located on the premises and connected with the highway traffic stop signals. It is also possible that full automatic actuation of the signals might be possible by using plane detectors adjusted for duration and distance.

The landing areas would be best located at such a point on the highway or the parkway where the right-of-way parallels the direction of the prevailing wind. An adjacent landing area would also be located where the highway is at 90 degrees to the prevailing wind, and at the proper gliding distance from the first intermediate field. In this manner every contingency of weather and wind would be provided for in the most economical manner.

The concessionaires for gasoline, oil, and so on would serve both airplanes and automobiles.

The details of the scheme are sufficiently indicated by the drawing, on which are marked boundary lights, hooded lights, blinkers, elastic coasting stoppers, ramps, underground hangars, and so forth.

Mr. McKaig's plan is the result of many years' experience in airplane operation and airport construction and deserves study. —*A. K.*

Pectinized Malted Milk

AN old favorite, malted milk, may be given a new twist by the addition of pectin, it has been discovered by California Fruit Growers Exchange, Los Angeles. Pectin provides the creaminess usually obtained by the use of ice cream. In the soda-fountain malted, it may replace all or part of the ice cream. In packaged malted milks intended for the home, in which ice cream commonly is now used, it has even greater possibilities. The pectin is put into the malted milk either by mixing the two materials as powders or by adding a pectin solution before reducing the milk to a powder.—*A. E. B.*

Warning Deters False-Alarm "Bugs"

A DEVICE that sounds a loud warning signal simultaneously with the "pulling of the hook," and can be conveniently mounted upon the peaks of existing municipal fire alarm boxes, is a recent contribution to the war on false alarms.

This little device with a big and raucous voice, not easily confused with automobile horns or other street noises, is known as the Arrestolarm. When the alarm is operated, the down pull of the lever trips the mechanism of the Arrestolarm to sound a raucous signal of a minute's duration. A convenient winding handle is provided for

An alarm that prevents false alarms; warning bell mounted above fire box

the use of the fire department member who is charged with the rewinding of fire alarm boxes after each alarm.

It is not expected that this "howler" will completely eliminate false alarms, but it is felt that it will tend to reduce the number from the most troublesome false alarm spots by attracting the attention of police, passersby, or local residents to the box in time to observe the culprit.

Fever as a Friend

THE idea of a doctor trying to give his patient a fever would have seemed revolutionary and crazy in our grandfathers' time, when every effort was bent toward driving the fever out of the sick body. Now it has become a friend, something with which to fight and cure diseases. Since the Viennese physician, Wagner von Jauregg, found that the high fever of malaria was curing syphilitic infection, medical scientists have used malaria and many other means to induce fever in the treatment of disease. By electricity and by short radio waves and by prolonged hot baths they have deliberately raised their patients' temperatures to what once would have been considered dangerous levels. The latest tool for producing fever is, strangely enough, air-conditioning, hailed originally for the relief it brought from uncomfortably hot summer weather.

The idea of how fever brings about a cure has changed, too, even in the short time that it has been used as a form of treatment. Medical scientists first thought the high temperatures killed the disease germs. Dr. F. W. Hartman, of the Henry Ford Hospital, Detroit, explained in demonstrating his air-conditioning apparatus for inducing fever that in his opinion the fever acts by stimulating the defensive mechanism of the body.

The air-conditioned chamber raised the body temperature to 103 degrees, Fahrenheit. Dr. Hartman and his associates, Drs. R. J. Major and H. P. Doub, believe it is better than any of the other methods for elevating temperature because it is more easily controlled. While it is not yet on the market, they estimate that it can be made for about 250 dollars.—*Science Service.*

WIRELESS!

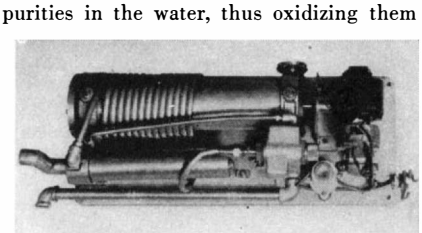
MORE than 45,000 miles of special telephone circuits are in use every day in connection with radio broadcasting in this country.

Residential Water Ozonizer

WE had occasion in our January, 1932, issue to describe an outfit for purifying water in rather large quantities for swimming pools, large buildings, and the like, by the ozone process. This process has now been adapted to a smaller unit which can be used to purify residential water supplies. The new unit is 19 by 8½ by 6½ inches—small enough to be placed over any sink or water drain.

Electrical current at 110 volts is taken from the household wiring system and stepped up to 8500 volts. This is connected to an ozone generator which consists of a glass dielectric separating two electrodes, one of aluminum and one of copper. Between the aluminum and the glass dielectric is a small space to permit the passage of air. The corona discharge between the two metal plates passes through the air in the space between, thus converting some of the oxygen into ozone.

This manufactured ozone is then thoroughly mixed with the incoming water supply as it passes through an injector. The third atom of oxygen in the ozone, being a free atom, immediately combines with impurities in the water, thus oxidizing them

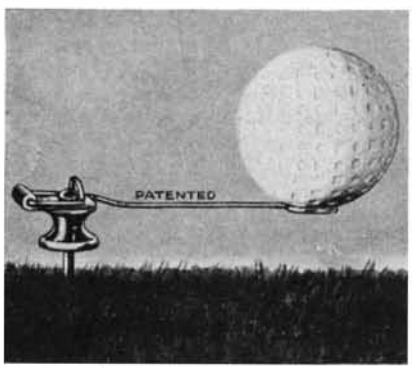


Water ozonizer for the home

and transforming them into harmless substances. It will destroy bacillus coli, most other bacteria found in water, microorganisms of all sorts, objectionable odors, colors, and tastes arising from vegetable or other organic origin. Ozonized water is, therefore, palatable, odorless, and tasteless, the excess ozone being allowed to escape in a column of the device.

Golf Tee that Spins

ONE of the latest inventions for the golf player is the Grigg Spinner Golf Tee, illustrated here. It was originated by an individual who gave serious thought to improving the primitive golf tee. The tee is machined from brass, nickel plated and pol-



ished, making it durable and rustless. It holds the ball at the right height and spins free of the ball when struck. It folds up and can be neatly tucked away in bag or pocket.

Sugar Tablet Tabs

A SUGAR refiner has adopted for wrapped sugar tablets a tear-open tab that enables diners to get at the sugar without undue fumbling. Credit for this long-needed development goes to American Sugar Refining Company, manufacturers of the Domino brand, says *Food Industries.*

Rubber in Mattresses

OF all recent rubber developments, the new product called "NuKraft" is unique. NuKraft is rubber-insulated hair cloth fabricated into loops forming a series of figure eight springs. It is used as spring decking for inner spring mattresses. The rubber ages well, not showing any appreciable deterioration when artificially aged for a period representing about 10 years of actual service. This product is vermin proof, sanitary, and free from objectionable odors. NuKraft bridges the openings between springs and evenly distributes the weight. It not only provides additional springing but eliminates the necessity of tufting to keep the material in position.

The Black Widow

THE black widow spider is more deadly to its own kind than to mankind. The female of the species, the worst biter of the family, usually eats her mate and often her young. She attacks human beings only if they irritate her when she is hungry. A well-fed black widow spider is anything but aggressive, according to Dr. F. C. Bishopp, of the United States Department of Agriculture.

This spider bites humans infrequently,

(*Please turn to page* 45)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

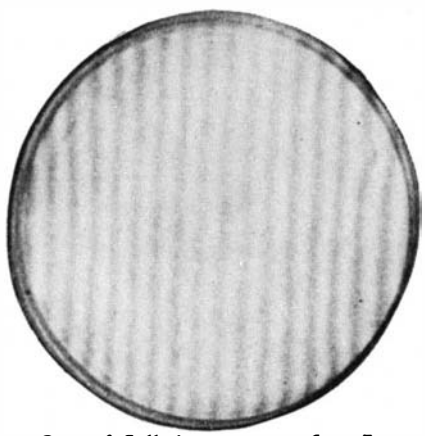
IS it some kind of big bug, or is it a Mesozoic dinosaur, all set to spring at you? These are some of the things which the unique telescope shown below looks like when you are dreaming of it. Horace H. Selby, a chemist for Hage's, a dairy products company at 9th and K Streets, San Diego, Calif., sent the photographs, with the following letter:

"For many years I have been interested in optics. I have computed and constructed two microscope objectives, one condenser (N.A. 1.32), two photographic lenses, and one 60 mm. apochromatic, three-element telescope objective. All this before last year. Then I chanced to meet the Lowers, local Tychonians, and my downfall was assured. They had a 12-inch reflector. I decided to build a 12-inch, and to do it backward. First, I made the mounting, placed in it two flats which I had made long ago, and used the 60-mm. objective. See photograph."

And now it is time to explain this telescope a bit. The picture at the left shows the counterweight turned up, and the temporary telescope in its baffled hood turned down. When in use, these are reversed, as in the right-hand picture, and the objective, shown turned earthward in the left-hand picture, is turned heavenward, as in the other. The optical train is: Through dark hole to a 60-mm. O.G., to a diagonal flat behind O.G., down to a second diagonal flat in the big pipe cross, and back up to the eyepiece which you see in the picture, on the head end of the dinosaur's body (the polar axis). Now imagine a 12-inch Cassegrainian mounted in place of the temporary box and O.G. part, and you have the job as Selby intends to complete it. This is the first time we have published an unfinished job, but it is an interesting one. Now to return to Selby's letter:

"Next," he says, "I made three 31-cm. flats on Pyrex, five surfaces of which were flat to about 0.1 wave, except for quarter- and half-wave edges. That was three months ago, and these surfaces have now changed, one by 0.4 wave. I then made eight more flats, for fun. Next I made an *f*/1 sphere for testing the Cass hyperboloid, à-la-Hindle."

We wrote to Selby for more details about his telescope and here is the answer: "The base is of 3 : 2 : 1.5 concrete, in two piers, 3 by 1.5 by 4 feet deep. This holds the grasshopper legs, of 2″ extra-heavy wrought iron (E.H.W.I.) pipe, which support the mount proper. The polar axis is of 4″



One of Selby's numerous flats. Its edge has *not* been diaphragmed out

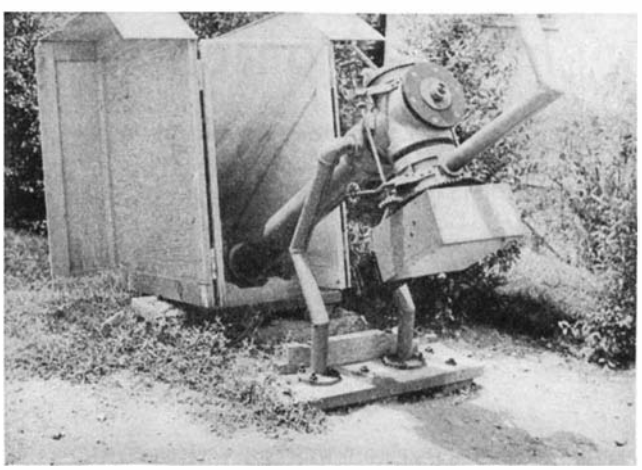
E.H.W.I., within the 6″ E.H.W.I. body, and runs on two roller and two ball-thrust bearings. The bearings contain 160 quarter-inch rollers and 160 quarter-inch balls. They are housed in two 6-6-2-2 crosses. The head is constructed of one 6-6-6-6 cross, one 6-6-2 tee, one 6″ close nipple, one 4″ by 6″ nipple, which is the declination bearing, a 4″ by 15″ flange and a 6″ to 4″ bushing with lock nut. The counterpoise, a 4-4-2 tee with plugs and lead, is carried by 2″ E.H.W.I. pipe. All construction and design are my own, but such heavy lathe work, done at night on a borrowed lathe, caused me many a back- and headache. No machinist, I took a hundred hours to do what an expert would have done in 25, but it was fun, and the finished job is rock-steady at 300 diameters, even when slapped, and the movements are very smooth and precise. By means of four hand-wheels, which are always within reach, the fine and coarse declination adjustments can be performed while observing, as can the fine polar movement.

"The optical system comprises a baffled hood, 12″ long, a 7-cm. apochromatic triplet, two flats, and a series of eight oculars from 50 to 2.5 mm. *e.f.l.*, all of my own construction and computation, save two oculars —a 2.5 mm. Beck and a 7 mm. Tolles. The performance is good. Dawes' limit can be reached with the greatest ease. Using a microscope giving 200 diameters per inch of aperture, star disks are round at focus, and on the rarely-found fine evening the extra-focal images show clean, sharp ring structure.

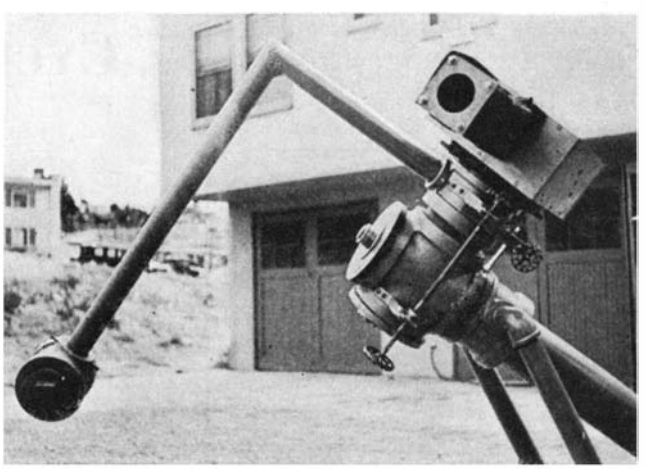
"The mount is for the 30-cm. Cass, which is not finished, and is a hybrid embodying some features of the Coudé, Repsold's overhung astrograph, the Springfield, and Ritchey's 60″. The stationary eyepoint is Coudé; the counterpoise is Springfield; the undercut mount, which will clear the Cass in any complete revolution, is Repsold, as is the complete visibility of every point in the sphere; and the hollow polar axis, for very long equivalent focus work, is Ritchey."

Commenting on Selby's telescope, Harold Lower says: "The present objective is a triplet, and is a fine job. Selby knows his stuff. He has also built a grinding machine."

A NEAT, unusual job is a reflector, apparently of about 12-inch aperture, made by Chester A. Howard, president of the Dallas Astronomical Society, 3120 Princeton Ave., Dallas, Tex., assisted by C. H. Huvelle, N. E. Bucklin, and Dr. Langenour. "The whole job," Howard writes, "is just like Gibraltar, so far as vibration is concerned. Both axes rest on double rows of SKF ball bearings, self-alining and made for thrust as well as bearing. Size of polar axis 2⅞″, dec. axis 2¼″. The weight is 640 pounds, not including the concrete pier. The castings are iron, except the saddle and prongs, which are aluminum. The hand wheels are brass and the one at the upper right rotates the tube on ball bearings—one of the greatest features, I

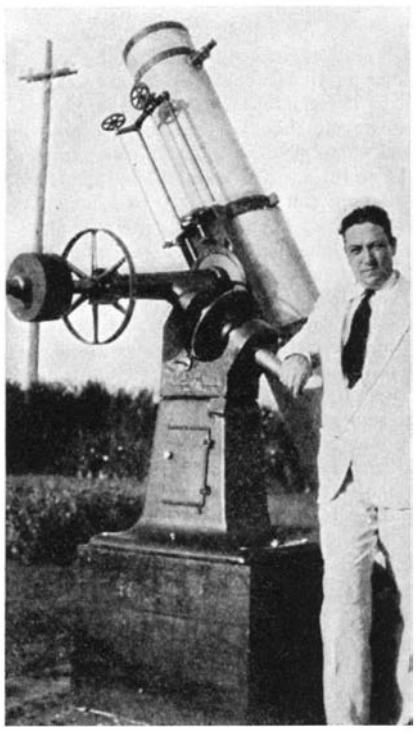


Selby's tame dinosaur, with its head down and tail up



The same telescope in working position. A rigid mount

believe, to be had on any reflector. I see very little if any of this feature on the many instruments shown in the magazine." This handwheel, which Howard mentions, works a longitudinal shaft, through bevel gears, and this shaft in turn works a spur gear which shows in the picture, the latter turning the tube by means of an encircling spur gear. It is all very professional—the



Howard and the Dallas telescope

whole job commendable—particularly those heavy 2¾″ axis shafts. And—"rock steady."

PARTS like those described by Selby and by Howard—extra heavy wrought iron pipe legs and six-inch pipe fittings, also 2¾″ axis shafts—mean real rigidness, rigidity, or "rock-solidity." In a recent letter, Ellison mentioned that some of the mountings he had seen described in this department seemed to be "whippy," and he is right. A telescope which magnifies 50 or 100 times, also magnifies vibrations in exactly the same measure; so that the builder should always think of the vibrations caused by the breeze as if the telescope tube were extended to about 100 feet in length, and he were trying to obtain a steady look. Some of the mountings we have seen might as well be built on a buggy whip tied to a fish pole, as on the thin little axes, skinny and anemic, which they have. Wallie Everest got us stirred up enough to write these ugly comments, saying "Give 'em Hell about it," and this is it.

While we are at it, we will get off our chest another pet peeve that burns us up and temporarily wrecks our sweet (?) disposition every now and then. This is the matter of photographs. At a casual glance the average photograph seems to be in focus, but close scrutiny of many show that this is not true for the whole depth of the telescope photographed. A dodge for this is simply to stop down to about 32 and take a time exposure. Result: whole telescope in sharp focus.

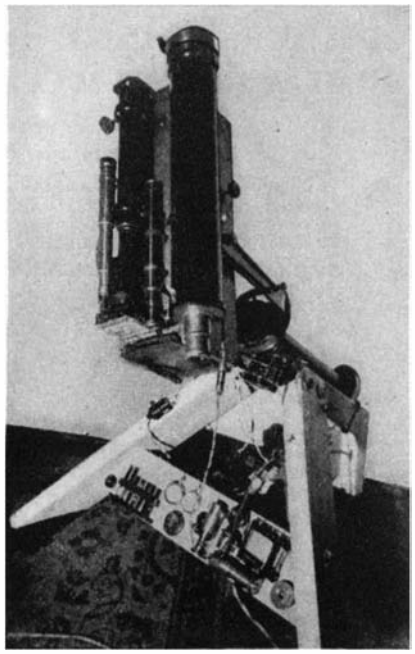
AND now, while we are speaking about rigidity, look at the forks on the two

telescopes shown in the photographs below. W. A. (Bill) Mason writes from 1303 Lakeview Ave., Lorain, Ohio, that the Cass with the short finder (left) belongs to John Clouhessy, a machinist, and the other is his own. They are nearly the same, John Clouhessy's having 190″ f.l. and the other 170″. "I did all the machine work," he says, "and made the castings, all being of aluminum. We also made our own patterns." Co-operating with these two were Jim Clouhessy, machinist, and Dick Curran, molder.

The main features of these jobs are: 12½″ Pyrex primaries, 39″ f.l., and 3¾″ secondaries. Pyrex diagonals 0.1 wave. Screw-focusing eyepiece holders with ⅛″ double acme thread. These swing around ends of tubes, for convenience. They will take up to 2″ O.D. eyepieces. Lower half of tube of each telescope screws off the trunnion ring, and contains the cell. Slow motions in dec., worm gears—same for R.A. Drive: governor-controlled induction motor ("Green Flyer"); worm gear reductions, made by John and Jim, 30:1 and 24:1. Timken roller bearings. Polar axes, 2¾″ diameter. [Ha! Same size as on the Dallas job. This one won't quiver, either.] Both axes can be slipped on the slow motions. Weight of each job about 180 pounds, 125 of this being aluminum.

WILLIAM S. VON ARX of 573 Monroe St., Brooklyn, New York, writes: "Several years ago I purchased my now well-thumbed and tattered copy of A.T.M. Greedily I soaked up its contents and set to work on the inevitable six-inch Newt. Success greeted my first attempt at parabolizing and I immediately branded myself a born optician. With the heavens plopped in my lap, so to speak, I spent many hours feasting my eyes on the splendors above. Then I was suddenly gripped with the desire of photographing these wonders. Night after night I lay awake planning a suitable equatorial drive and camera. Finally I reached what I considered a perfect solution and set to work. Within the year I had completed the drive, camera and other necessaries and found on trial that I didn't know two twits about what I was trying to do, so I took the whole thing apart and started all over again. This has occurred five times within the past four years [which means he started at about 14.—*Ed.*] and now I think I have achieved my goal in the result which you see in the enclosed picture.

"It is a fork type mounting, driven by a disk motor and an elaborate gear speed reducer. In the fork are two cameras and three telescopes. A three-inch glass of short focus for guiding, whose triplet objective made me recant my former pride as an optician, and a one-inch finder for it, then a 1½-inch telephoto camera giving an equivalent focus of 37½ inches and a finder for it. All these things are mounted on the primary camera, which is an *f*/4.5 of 12 inches focus. This lens is the only one I bought; all the others are home-made, because I found with experience that lenses are expensive.



Bill von Arx's collection, mounted on a wooden "saw horse." See story

"With this equipment to start with, I gradually added gadgets, such as flap shutters, objective prisms, and so forth, for the cameras, and a polariscope, Zollner eyepiece spectroscope, iris diaphragm, micrometer eyepiece, a set of filters, zenith prism, and several high-power and one ultra low-power eyepiece for the three-inch guiding glass. With things arranged in this way my equipment is equally effective, either visually or photographically. And, too, with the accurate drive, diaphragm and trick eyepiece, it lends itself admirably to both lunar and planetary detail.

"This trick eyepiece I believe deserves a bit of explanation. In essence it is a disk with eight lenses in it, each lens of higher power than the one preceding it. Thus it might be called an octo-revolver. The lenses of the whole series are negative, thus making the telescope Galilean. When the power of the negative ocular gets as high as those I have put in this turret, the field is not reduced, as is usually the case in the low-power negative ocular. The angle of the field is as large if not larger than an equivalent Huygens ocular. The lenses in this turret are double concave, with radii of curvature ranging from 1½ mm. to less than ½ mm. Needless to say, I nearly lost those pinhead lenses under my finger nail a score of times, but after much sweating and rather noxious language, they found their way to their respective cells. With a bit of stopping down with the diaphragm, and careful focusing, lunar and planetary detail pops out surprisingly well for such a small glass. Then, too, the accurate driving helps enormously by keeping small objects accurately centered in the field.

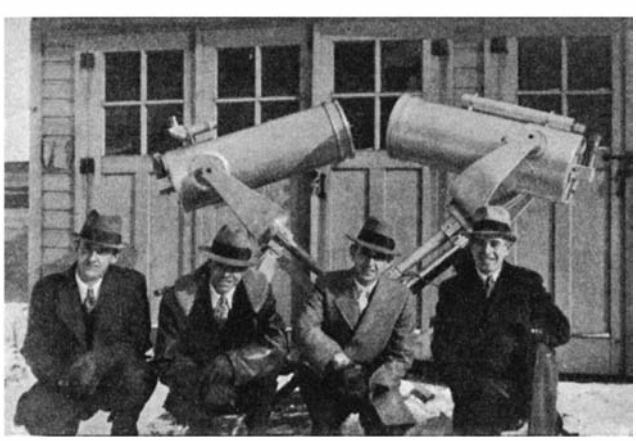
"This drive, which I have fashioned after much experimentation with varied forms, is the most satisfactory I have ever used. It will keep a guide star centered accurately enough to get round images with the 12-inch camera up to two hours exposure. The 37½-inch holds true for three quarters of an hour or more without guiding.

"One ever-present difficulty in photographing the heavens is dewing. I overcame this difficulty by placing a 1000-ohm resistor in the hood over the lens. The heat of the resistor was sufficient to keep the air above its saturation point, and thus prevented dew from forming on the cold surface of the lens. Now, when I find dew forming, I merely throw a switch and it clears within two or three minutes.

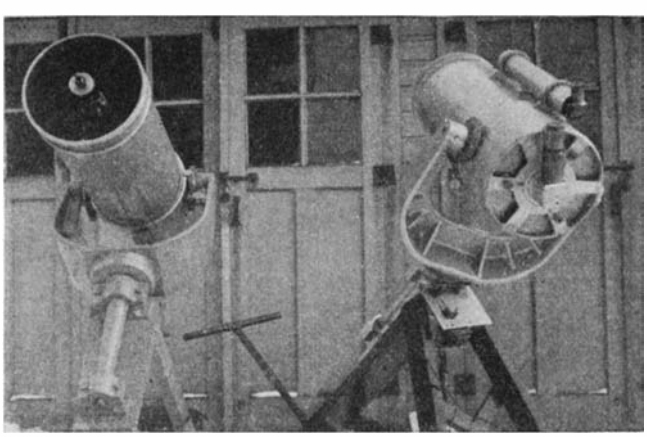
"Another gadget is a field illuminator which facilitates seeing the spider lines in the reticule of the guide telescope. I have a little variable resistor that doctors use for opthalmoscopes, and so on, that gives from 0 to 6 volts variable output. This, in connection with a 6-volt bulb in the tube of the telescope, gives any light brilliancy desired."

Harold Lower says von Arx's photographs are the best he has seen.

THE tenth annual get-together and convention of amateur telescope makers will be held at *Stellafane*, near Springfield, Vermont, on Saturday, August 3. For details, if you don't know about these informal pow-wows already, write to R. J. Lyon, secretary, The Springfield Telescope Makers, 252 Summer St., Springfield, Vt. Come, if interested in telescopes, but leave your tail-coat in moth balls.



Messrs. Clouhessy (John), Mason, Clouhessy, Curran



The same two Cassegrains as are shown at the left

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 41)

but its bite is more poisonous than that of any other North American spider. As the insect has recently extended its range westward and northward from the South, where it is better known, and as it is hard to tell a hungry spider from one that has just had a good meal, Dr. Bishopp offers a few suggestions for destroying the black widow spider. The best thing, he says, is to spray with creosote oil the spots she frequents—garages, woodsheds, privies, and other outbuildings, as well as wood, brick, and stone piles, and manholes and culverts. She seldom enters houses. Gloves are a great protection in working around places where this poisonous pest may lurk.

[See also page 184, October, 1934, and page 228, May, 1935, SCIENTIFIC AMERICAN.—*Ed.*]

LIGHT METER HAS RANGE MULTIPLIER

A DEVICE now available for increasing the range of the Westinghouse light meter consists of a light absorbing screen which absorbs nine tenths of the normal light and transmits the other 10 percent to

A screen for light meters that multiplies the range to 10 times normal

the photo cell. To increase the scale range of the instrument to 10 times its normal capacity for the purpose of measuring higher light intensities, it is only necessary to clamp this translucent screen in front of the exposed surface of the photo cell.

"INVISIBLE GLOVES" KEEP HANDS CLEAN

CHEMISTS have now invented invisible gloves that anyone may put on with assurance that they will keep his hands clean even while he is doing the dirtiest of jobs. These "invisible gloves" come in a can and look like cold cream. But when you rub this cream over your hands it disappears, forming an invisible film which prevents dirt, grease, paint, and so on, from entering the pores or adhering to the skin. You won't know you have the invisible gloves on, for your skin feels dry and is free from any feeling of stiffness or greasiness. Then, when you have finished your work, you remove the "gloves" by rinsing

your hands in water, thus removing dirt and "gloves."

This unique invention is to be sold under the name of "Pro-Tek." It is not a soap, but a protective cream, entirely harmless and non-irritating to the skin. It is being widely adopted by plant physicians and executives for use by mechanics and factory workers, and is also filling a need for painters, printers, garage mechanics, service station attendants, railroad men, pipe fitters, coal handlers, miners and others. There are also expected to be many uses for "Pro-Tek" around the home—for odd paint jobs, polishing the auto, cleaning out the furnace, gardening, and general housework.—*A. E. B.*

CANARIES

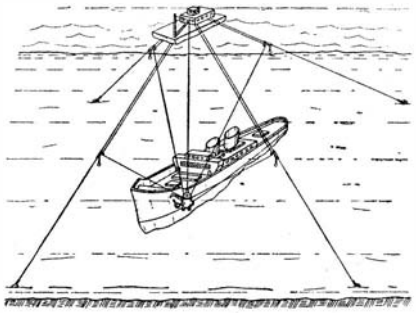
CONTRARY to popular opinion, canaries do not have to be taught to sing by an adult male songster. This is shown by an experiment at the University of Southern California where 12 roller canaries were hatched and raised in sound-proof cages. All developed an adult singing ability.

SALVAGE BATHYSPHERE

DOCTOR BEEBE'S now famous bathysphere permitted a visual exploration of the depths of the ocean. A new one recently tested at Washington, D. C., seems to give promise of extensive salvage operations at great depths. This new one, shown in the accompanying illustration, was developed by the Romano Salvage Corporation of Seattle. It has already been tested at depths greater than 800 feet and, according to reports, Navy inspectors called it "the greatest invention since the diving suit."

The Romano diving ball is made of steel sufficiently strong to stand pressures at a depth of half a mile. It owes its usefulness to a variety of arms and searchlights, all operated from within. Twelve different attachments can be used in connection with these arms with which, it is said, the operator can lift objects weighing half a ton, tie knots in one and one-half inch steel cable, drill holes up to three inches in diameter through ships' plates, and perform a variety of other tasks under water.

In operation, four anchors with attached cables are sunk at the four corners of a given area which may be 1000 feet on a side. Four lines thus fixed meet at the mother ship. From the underwater tent-like cable structure hangs the diving ball. With this control the ball can be moved up, down, or sideways.

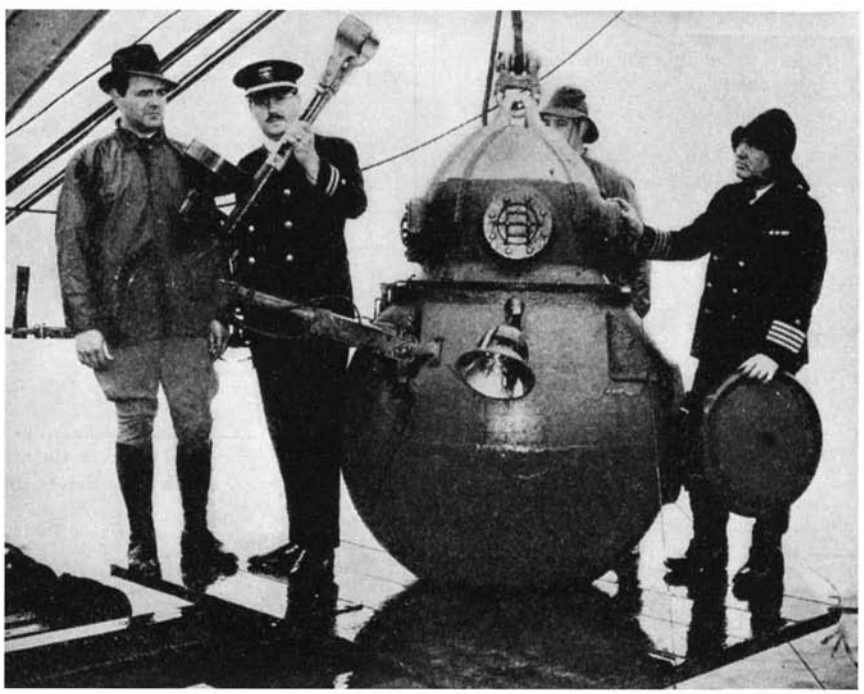


How the mother ship of the salvage bathysphere is anchored over a wreck

Already there has been much talk of going after some of the billions of dollars' worth of golden treasure that have been lost at sea in years gone by.

NEW TECHNIQUE IN RADIO STUDIOS

A "PICK-UP" technique entirely new to radio is now being employed by the Columbia Broadcasting System in one of the main studios of its key station, WABC, in New York. The studio is of the so-called "live-end, dead-end" type, but is revolutionary in its use of a special echo plane instead of a mere reverberating surface on the rear wall of the "live end." All three wall surfaces of the "live" portion are covered with wood paneling designed in ac-



The salvage bathysphere, showing the flexible arm and one of the attachments

Scientifically designed walls make possible a new technique in broadcasting

cordance with acoustic principles, a construction technique never before used in a broadcasting studio.

The studio's "dead end" walls are covered with two grades of perforated metal designed to permit the sound to penetrate to the 4 inches of absorbent rock-wool beneath. The windows of the control room and client's booth, situated in this end of the studio, are long and narrow in design to cut to the minimum any reflections that might be set up by the glass surfaces.

The wooden panels of the echo plane, instead of being fastened solidly to the wall surface behind them, are secured only at their edges, leaving their centers free to vibrate as the sound strikes them. The action of these panels, in reflecting the sound coming to them from the performers at the other end of the studio, tosses the sound waves back to the "pick-up" point as an echo. The time required for this return, however, is only a small fraction of a second and results in an unusual brilliance of tone. The fact that the sound vibrations drop off more abruptly than they would if reflected by reverberating walls also enhances the tonal brilliance.

In addition to the single echo plane, other reverberation surfaces are provided and built in undulating surfaces so that the sound waves will be diffused as they are reflected from side to side of the room.

The use of wooden paneling for the live surfaces was suggested by the fact that musicians have for many years claimed that their music sounds better to them when they play in wooden paneled rooms than in any other kind. The paneling performs much the same service as the sounding board of a piano or the back of a bass viol. In planning the studio the technicians decided to treat the entire room as though it were a single large musical instrument.

How Many Alcohols?

HOW many kinds of alcohol are there? The average layman will probably reply: "Two kinds—grain alcohol and wood alcohol." Actually there are more kinds of alcohol than industry knows what to do with. Many new types have been developed since the depression. Allyl, cetyl, lauryl, octyl, are a few of them. In the aliphatic family alone there are 23 different alcohols now commercially available, all of which can be made synthetically. Uses for many of them are now being worked out in the laboratory. Alcohols that were either unknown or were only of academic interest a decade or two ago are now being produced on a large scale and are indispensable to hundreds of industries.—*A. E. B.*

EXPLOSIVES

FOR the eleventh consecutive year, enormous tonnages of explosives were carried in 1934 without injury to a single person. The amount of dynamite and black powder, both commercial explosives, transported last year was something more than 300,000,000 pounds.

Liver Extract Low in Price

A MARKED cut in the cost of the liver extract treatment for pernicious anemia was announced by Dr. William P. Murphy of Harvard Medical School before the last meeting of the American Chemical Society. Dr. Murphy also described how the technique of liver treatment for pernicious anemia has gradually changed.

At first he said the patients had to eat large quantities of liver each month. The dislike of many people for the taste of liver then led, he said, to the development of a powdery extract, which could be taken by mouth. The taste was not as obnoxious as liver itself but because it was only about 60 percent as potent as liver, large amounts had to be taken.

The new development which Dr. Murphy described consists of a highly potent and concentrated liver extract fluid which can be injected directly into the body muscles of the legs or arms, as insulin is injected

for diabetes. Clinical tests indicate that average patients need but one such injection a month to live a normal life.

The relative costs of the three methods of treating pernicious anemia, Dr. Murphy declared, run as follows: 5000 grams of whole liver a month at a cost of about $5.50; the extract in an amount equal to 8400 grams of liver at a cost of $17.00; the injections at a cost of $1.17 a month.—*Science Service.*

Treating Cloth to Shed Water

FABRICS that rival the traditional duck's back in ability to shed water are now produced by the use of a new chemical product developed by E. I. duPont de Nemours and Company, and marketed under the name "Aridex." It is a white, waxy emulsion for use in producing a water-repellent finish on textiles of all kinds; also for impregnating silk, rayon, cotton, linen, or wool and for treating leather and paper. It is an outstanding development in this field and is being rapidly adopted by textile processers who have a demand for water-proofing of any sort.—*A. E. B.*

All-Wave Hotel Radio

AN elaborate all-wave radio reception antenna designed by the engineers of the Bell Telephone Laboratories is one of the unusual features of the all-wave radio receiving system now being installed in the Waldorf-Astoria Hotel, New York City. Two strands of wire in this antenna cross to form a huge "X", while a third resembles an inverted "U". The strands are of different length and each responds to waves in certain bands.

The aerial has been designed to reduce to a minimum any interference which might ordinarily be experienced in all-wave reception. It is so orientated that the wires are strung broadside to those parts of the globe where the majority of the short-wave stations are located, this being the best position for reception. The accompanying map, a gnomonic projection, shows the antenna located at New York and the true, straight-line distance and direction to any point on the globe.

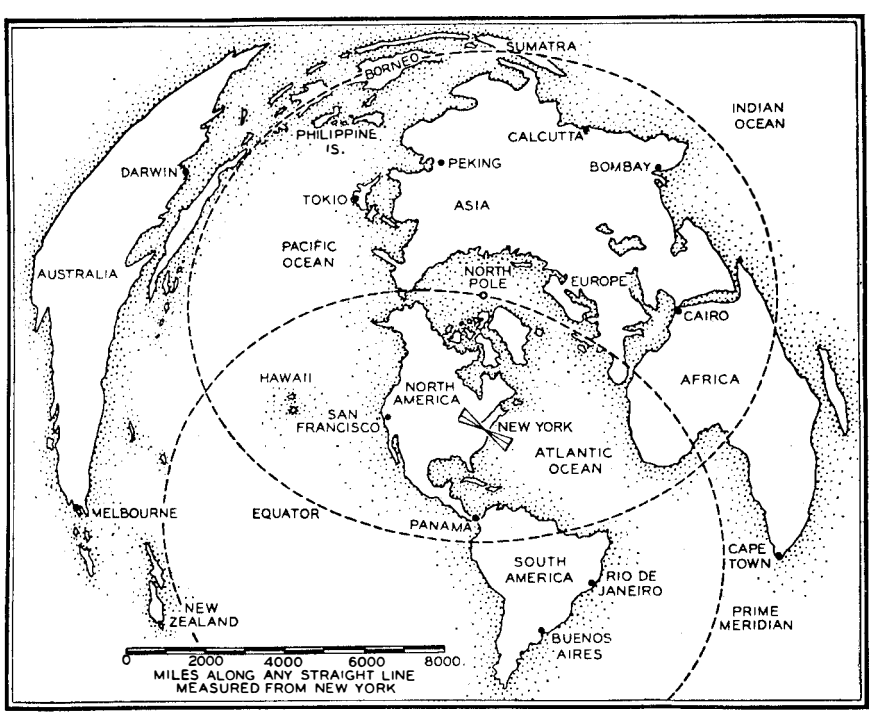
DERMAL NITRATE

DETECTIVES may now identify the hand which has fired a gun by the "dermal nitrate" test. Almost invariably tiny particles of unburned powder, largely nitrate, are deposited in the hand of the person who has fired a revolver. These can be "developed" as violet spots by means of chemicals.

Fire-Proofing Airplane Fabric

A SIGNIFICANT contribution to safety in the operation of aircraft was revealed by Gordon M. Kline of the United States Bureau of Standards at a recent meeting of the American Chemical Society, when he announced the perfection of a fire-proof "dope" for the treatment of airplane wing fabric. Cellulose nitrate dope is now commonly used to cover the fabric on the wings and fuselage of airplanes. Being made from nitrocellulose, or guncotton, this coating is extremely inflammable. The newly developed treatment consists of the application of a three to seven boric acid-borax mixture to the airplane cloth and subsequent "doping" with cellulose acetate.

During the World War, consideration was given to the use of cellulose acetate as a substitute for inflammable cellulose nitrate for doping airplane wings but because of the higher cost of the acetate and because of the remarkable technical development of nitrocellulose lacquers, cellulose acetate gained little acceptance. Recently,



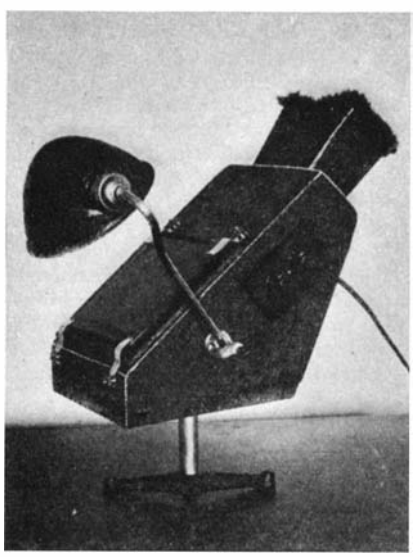
A gnomonic projection of the continents, showing how the new hotel radio aerial, described above, is located for best reception from the majority of transmitters

however, technical improvements in the manufacture of cellulose acetate have brought about an improved and much cheaper product so that today the acetate dope is only slightly more expensive than the nitrate.

The borax-boric acid mixture is the best fire-retardant so far discovered by the Bureau of Standards in a long series of experiments with such substances. Tests on actual planes have established the fact that this treatment has no deteriorating effect on the airplane fabric. —*A. E. B.*

Fluorescence Cabinet

THE fluorescence of substances under ultra-violet radiation is a valuable method of laboratory analysis. It is particularly suitable for identifications of dyes and detection of adulteration of oils, forgeries, and secret writings. The instrument illustrated is a very flexible piece of equipment for this work. It consists of a light-proof cabinet with a fur-lined opening for viewing the interior. It is equipped with a window over which is placed a filter which permits only the invisible ultra-violet rays to fall on the sample which is placed on the floor of the cabinet.



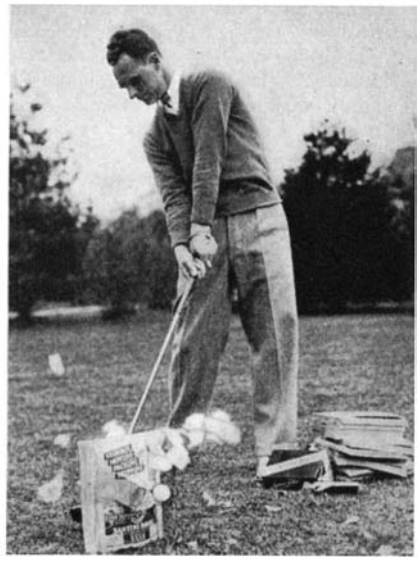
New laboratory cabinet for use in examining fluorescent substances

A very small incandescent lamp is placed within the cabinet. This lamp, controlled by a rheostat, makes it possible to illuminate the sample with very faint visible light, while the more powerful ultra-violet rays are falling on the sample after coming through the filter. This makes it easy to locate fluorescent particles. The outfit is provided with a lamp which supplies considerable energy in the near ultra-violet region of the spectrum.

Drives Golf Ball through 'Phone Book

ALEX EDNIE, pro at Shelter Rock Country Club, Long Island, recently drove a Spun-Latex ball through a 'phone book almost an inch thick and containing more than 500 pages.

Standing the book on end without support, four feet in front of the tee, Ednie sent the ball through with such force that it carried and rolled 100 yards beyond. Traveling at the rate of approximately 114 miles an hour, the ball was averaging 167 feet a second when it hit the book.



A striking demonstration; a golf ball driven through and beyond a book

The drive, declared impossible by golfer and non-golfer alike, was made to test the new Spun-Latex golf ball, a U. S. Rubber product. Made of materials never before used in golf ball construction, the new ball is notable for its power and distance. These qualities are acquired primarily from a high-power winding of thread spun direct from liquid latex, the natural milk of the rubber tree.

MUSKRATS

ONE American visitor which Scotland does not like and which, in fact, has become a pest, is the American muskrat. Introduced to the British Isles some years ago, these animals have become so numerous and so destructive of dams and railway embankments that war has been declared upon them.

"Reach for a Sweet"

THE old slogan about reaching for a cigarette instead of a sweet may be all right for those who want to lose weight but for those who want to do some heavy thinking, it should be reversed. Experiments showing that the brain gets its energy for thinking from glucose or sugar were reported to the American Physiological Society by Drs. H. E. Himwich and J. F. Fazikas of Yale University. The brain takes sugar from the blood, breaks it up into simpler chemical combinations, and burns the lactic acid thus obtained to get energy.

Dr. Himwich and his associate found accidentally that when nicotine is mixed with brain tissue in a flask, the brain cannot burn lactic acid but the burning (oxidation) goes on just the same if glucose is present. So it appears that the brain has two ways of getting energy for thinking from glucose or sugar. Ordinarily it gets the energy via lactic acid, but if this is impossible, it gets the energy directly by burning the glucose.

The amount of nicotine that gets to the brain when a cigarette is smoked, however, is probably too small to affect the burning of lactic acid, Dr. Himwich explains. Incidentally, nicotine is not responsible for the increased sugar in the blood caused by tobacco smoking, Dr. Ephraim B. Boldyreff of Battle Creek Sanitarium reports.—*Science Service.*

EXIT "TURPS"—ENTER "DEC"

"TURPS," the painter's old stand-by whose full name is turpentine, is now challenged by a synthetic product of reputed superiority known as "Dec," whose full name is decahydronaphthalene. Although not a new compound, "Dec" has only recently been prepared on a commercial scale at prices competitive with natural wood turpentine. Its chemical formula is $C_{10}H_{18}$. It is a water-white liquid with an odor similar to turpentine.

According to the manufacturer, Imperial Chemical Industries, Ltd., it may be used with advantage to replace turpentine as a paint thinner, and also, in many cases, the most costly solvents which are today becoming increasingly employed. Such intrinsic properties as a very high flash-point, leading to a reduction of the fire risks normally run with the more usual thinner; an absence of toxicity shown by prolonged tests and practical use; and a solvent power of exceptional range where paint and varnish materials are concerned, are claimed for it by the manufacturer.—*A. E. B.*

NEW PORTABLE PUBLIC ADDRESS SYSTEM

A NEW portable public address and sound amplification system for moderate sized public places, compactly self-contained in a carrying-case and weighing only 28½ pounds, has been introduced by RCA-Victor.

This unusually adaptable unit, which anyone can put into operation in less than a minute, is particularly suited to the steadily growing market for an inexpensive though efficient portable sound system for such applications as window demonstrations in dealers' stores, counter-to-kitchen restaurant call systems, and for local fairs and carnivals.

The equipment has been designed so that actual operation is as convenient and foolproof as that of an ordinary radio receiver, it is said. It is only necessary to connect the power plug to a 110-volt, 50-60 cycle current supply, and plug in the microphone and speaker cables to set the system in operation. The loudspeaker, which is imbedded in the cover, may be separated from the rest of the carrying case and suspended from a hook within a 25-foot radius of the speaker cable. The microphone is of the close-talking type with 12 feet of extension cord to assure the minimum of wiring and the maximum of adaptability to varying conditions.

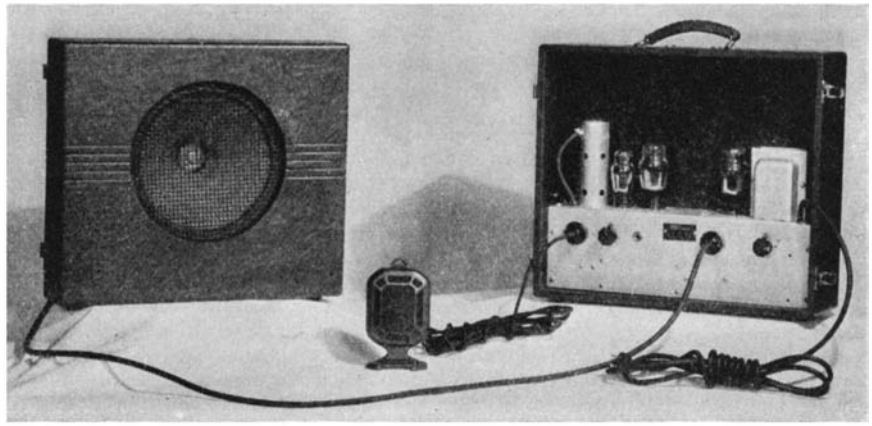
"BRAIN WAVES" AND EPILEPSY

"BRAIN waves" tapped electrically are providing a new clue to the mystery of epilepsy, the first fresh lead to this disease problem that scientists have had in a long time. Drs. F. A. Gibbs, H. Davis, and E. L. Garceau of Harvard Medical School have reported to the American Physiological Society that an electrical hook-up to the brain producing wavy lines traced on paper gives a new clue to what goes wrong in this malady. They find by this means that epilepsy is probably a neurological storm which results in great piling up of electrical discharges.

The tracings of the small waves of electricity which come from the brain are similar to the now familiar electro-cardiagrams which give physicians information about the action of the heart. Normally these small waves come from the brain at the rate of about ten per second. When a person is sleeping, in a faint, or loses consciousness temporarily in the strange sleep disease called narcolepsy, the brain waves are slowed down to about three to five per second and have about double the normal voltage.

In minor epilepsy, just before and during an attack, the brain waves come about every three seconds and in a strange pattern of large round waves with a spiky wave between the round ones. In major epilepsy, both fast and slow waves of much greater than normal voltage are found. Even more important, the disturbance in brain activity as shown by these tracings of the electrical waves from the brain goes on even when the epileptic patient is not having a fit or seizure and is in one of his apparently normal periods.

These changes probably hold the clue to what is going on in the brain at the time of a seizure and if they can find just what the waves mean in terms of nervous activity, the Harvard scientists believe they may be able to find out what an epileptic seizure

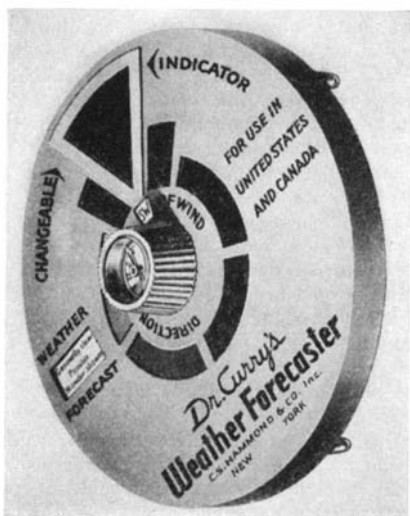


All the equipment of this new public address system weighs only 28½ pounds

is and how it starts. If they find that in some cases it starts in a part of the brain which the surgeon can get at, there might be a chance that the part where the disorder starts could be removed. This prospect is far in the future, however, Dr. Gibbs emphasized.—*Science Service.*

Weather Forecaster

IT used to be that few people considered tomorrow's weather; they accepted it as it came. Some exceptions were, of course, fishermen and hunters, and, at harvest time, farmers. Forest service men or others in similar occupations were also vitally interested in weather because forest fires depend upon weather over long periods of time. Nowadays the motorist and the airplane pilot have changed the picture as both are vitally interested in the weather that tomorrow may bring.



An instrument with which anyone can make approximate weather forecasts by following directions

It is interesting to note, therefore, that Dr. Manfred Curry, a meteorologist and aerodynamist of note, an author and lecturer well known internationally, has perfected a simple and inexpensive instrument which is claimed to forecast accurately eight to 15 hours in advance. It is a pocket-size disk which sells for only two dollars and may be used by anyone.

This new instrument consists of a hygrometer employing a chemical which indicates the degree of moisture of the air by change of color. (Each color grade corresponds to a change of about 20 percent in the degree of moisture of the air. Of the five comparison colors, blue, for example, corresponds to an atmospheric degree of humidity of 0-20 percent and light pink to 80-100 percent.) Great humidity of the air, as a rule, brings rain, snow or fog; slight humidity, on the other hand, fine, dry weather. As, however, the degree of humidity in its effect upon the weather has to be estimated differently, according to the direction of the wind, a compass is provided, by means of which the cardinal points and hence the direction of the prevailing wind may be ascertained.

The changeable indicator is affected some 8 to 15 hours before a change in the weather sets in. By this means, you can forecast the weather for the next day. The barometer involves only one factor, the atmospheric pressure; Curry's Weather Forecaster bases its weather prediction on two factors, the atmospheric moisture and the direction of the wind.

This instrument is operated in a very simple manner by turning the knob of the disk shown in the accompanying illustration to match certain colors in the color segment, by determining wind direction as indicated by clouds, smoke, weathervane, or the compass, and then keeping the matched colors together and turning the knob slightly until the correct wind direction appears in the small window below the indicator. The correct weather forecast for the next 12 to 15 hours may then be read in the window on the left of the instrument.

Young Bio-Chemist Wins Recognition

THE first Eli Lilly and Company Award in Bio-chemistry, by unanimous vote of the American Chemical Society's committee, has been awarded to Willard Myron Allen of the School of Medicine and Dentistry of the University of Rochester, Rochester, New York. The basis for the award is the outstanding work done by Dr. Allen in developing a sharply defined biological test for the action of the corpus luteum, the use of this test to isolate in crude form a potent extract, and then the complete purification of the hormone now called "progestin."

Dr. Allen was born at Macedon, New York, November 5, 1904, took his B. S. degree at Hobart College in 1926, and was awarded a fellowship in chemistry at Brown University, which he declined in order to undertake studies at the University of Rochester in the School of Medicine and Dentistry.—*A. E. B.*

A Book of Prize Photographs

AS a result of a large photographic competition to be held in Europe, there will be published later this year "The Golden Book of the Rolleiflex." This book will contain the prize winning photographs and also outstanding examples of work done with Rolleiflex and Rolleicord cameras. Although the competition itself is limited to European photographers, American operators of the above-mentioned cameras are invited to submit photographs for publication in the book. The photographs submitted should be on glossy paper and should reach Burleigh Brooks, 127 West 42nd Street, New York City, not later than July 15th.

Glass Etching

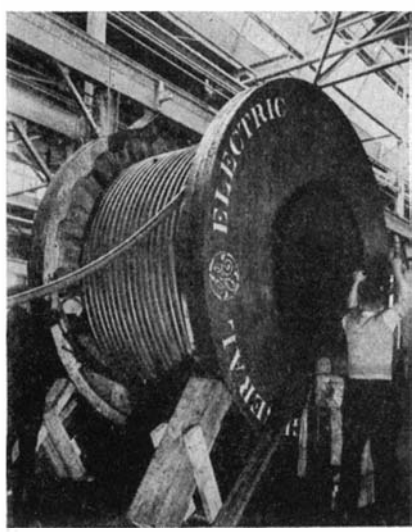
WE have just been having a lot of fun! Having purchased some attractive but plain table tumblers, we proceeded to etch a long-desired monogram upon them with new materials recently developed. First we cut a stencil of our monogram in aluminum foil, the back of which was coated with a sort of gummy cement. This stencil was pressed tightly to the glass and from a tube, resembling those in which dental cream is sold, a ribbon of glue-like substance was squirted over the stencil openings. After a matter of two or three minutes

the substance was washed off with plenty of warm water, the stencil was lifted, and we found beautifully frosted upon the glass an exact copy of the monogram which had been cut in the stencil.

The new material used in this case was Etchall, a product which seems to be as harmless as its manufacturers claim. Hitherto, as far as we know, there has been available no chemical other than the fluorides, which give off dangerous fumes and which should be handled only by chemists, to do such a job of etching. Sand blasting and other abrasive methods, of course, do the job satisfactorily but require rather elaborate equipment. Etchall, however, is about as simple and safe in most respects as tooth paste and is just about as cheap.—*F. D. McH.*

Long Oil-Filled Cable

WELL over three-quarters of a mile long, the reel of oil-filled cable shown in the photograph is the longest of its kind ever made. Shown while being reeled in the General Electric cable factory at Schenectady, it is 4200 feet long, of 450,000 circular mils cross section, for 132,000-volt operation, and with an oil-filled hollow core. It weighs 22 tons net, with a shipping weight of 25 tons on its reel, which is 134 inches in diameter.



A three-quarter of a mile long oil-filled cable being placed on its reel

Fiction of Indian Chiefs

THERE have been few, if any, real Indian "chiefs," according to specialists of the Bureau of American Ethnology of the Smithsonian Institution. There are plenty of living Indians, of course, who have had the title thrust upon them. Some of them may even have thrust it upon themselves. But the fact remains that—at least until well along in the last century when the tribal political concepts were coming under white influence—there probably was no such thing as a chief from the Arctic Circle to the Rio Grande. South of that, in the supposed absolutisms of Mexico and Peru, the "chief" status is somewhat doubtful.

Certainly such men as Massasoit, Powhatan, Tecumseh, Sitting Bull, Geronimo, and other notable Indians whose names have survived in history, were by no means chiefs, in the sense of being rulers with legal sanction, either conferred or hereditary, for governing acts, according to Bureau of Ethnology specialists on the various Indian peoples. The Indians, so far as known, had no civil rulers. The organization of Indian society through much of North America was essentially anarchical—the anarchy being profoundly modified in different directions by religion, tradition, influence of individuals, and so on, but not by governing powers vested in any individual. Public opinion was the great determinant of conduct.

In the various tribes, certain individuals doubtless had very great influence because of strength of character, colorful exploits, exceptional intelligence, oratorical ability, wisdom acquired with age, or supposed supernatural visitations. Such a man often attracted many followers, who, because of their great confidence in him, may have accepted his word as law. Men like Massasoit and Powhatan probably were in this class. They were the outstanding individuals in their communities. Other Indians may have sought or accepted their leadership because they admired or feared them. But it was all purely voluntary. Such a man held no political office. He had no police power to enforce his commands—if he ever had the audacity to give any. Anybody—even his squaw in most cases—had a perfect right to disobey him at any time, and there was nothing he could do about it other than through his own personal prowess, or the purely voluntary assistance of some of his friends.

In war it was somewhat different. An individual, usually a man with various colorful exploits to his credit, would announce that he contemplated a war expedition for some specific objective. Those who trusted his leadership and who saw an opportunity for much plunder or many scalps might "enlist" if they chose. There could be no legal compulsion. Once they joined the war party they were under a loose sort of discipline, implied rather than laid down in any regulations. But a military office was not continuous. The leader's authority ceased abruptly once the campaign was over. He had no permanent title. The "general" this month might be the "buck private" serving under one of his former warriors next month.

The whole idea of an executive branch of civil government seems to have been foreign to the Indian concept of things. This is shown clearly in what was probably the most advanced Indian political establishment north of Mexico—that of the Six Nations of the Iroquois. It is, at least, the one about which the most is known. But, says Mr. J. N. B. Hewitt of the Bureau of Ethnology staff, who has made intensive studies of the Iroquois system, there was no man in the Six Nations entitled to be called "chief," or given any corresponding Indian title. There was nobody with legally constituted power to command in civil affairs and to punish disobedience of his commands.

Among the Muskhogean peoples of the Gulf States there existed what, at first glance, might seem to have been absolute monarchies. But analysis of these shows that they were not civil governments at all, in the accepted sense of the term. The status of the supposed rulers was that of high priests, or even actual gods. But they did

not exercise the functions of civil government. The same was probably true of such a man as Montezuma among the Aztecs. He was high priest, not emperor.

In actual practice among these southern Indians the line between spiritual and civil overlordship may have been very tenuous. But in theory they were not administrators of civil law. There were no executive offices in their governments.

Actually, Bureau of Ethnology specialists point out, the average Indian had very little freedom. The weight of tradition and tribal attitudes restrained his free behavior even more than laws restrained the behavior of the peoples of Europe. But there was no tribal policeman to attend to it. There was no need of any.

Above all, there was no hereditary transmission of civil or military authority. Every Indian stood on his own feet. The idea of hereditary rank was utterly foreign to the thought processes of the Indian. The beautiful Pocohontas may have been received in England as a princess, but in Virginia she was just another woman.

CURRENT BULLETIN BRIEFS

MANUAL FOR FOREMANSHIP DEVELOPMENT. The importance of adequately trained supervisory forces in present-day industrial organizations cannot be too strongly stressed. This 60-page process-printed manual is based upon practical experience and is intended for both group leaders and the members of conference groups in industrial plants. *Industrial Relations Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.—$1.00 postpaid.*

HAMMARLUND SHORT WAVE MANUAL. This revised edition of an already popular little booklet constitutes an authentic guide for the amateur and experimenter with high-frequency radio equipment. It comprises an introduction to the whole subject of short-wave transmission and reception, followed by many pages devoted to the actual construction of receivers. Thirty-two pages thoroughly illustrated. *Write for Bulletin 735A to Scientific American, 24 West 40th Street, New York City.—10 cents.*

POSTAL TELEGRAPH AND CABLE CORPORATION ANNUAL REPORT 1934. A résumé of the telegraph, cable, and radio systems of this organization, telling of the work accomplished in each phase. Pertinent financial information of particular interest to stockholders is also given. Of particular interest at this time are paragraphs concerning co-operation between the Federal Communications Commission and the Postal Company. *Postal Telegraph and Cable Corporation, 67 Broad Street, New York City.—Gratis.*

THE ENGINEERING FOUNDATION REPORT FOR 1934. This 52-page booklet outlines the objectives and policies of the Engineering Foundation, now in its twenty-first year, and gives a summary of resources and activities. A report on current work fills several pages and is followed by a transcript of speeches given by such personages as Dr. Frank B. Jewett, Dr. Karl T. Compton, and others. *The Engineering Foundation, Engineering Societies Building, 29 West 39th Street, New York City.—Gratis.*

1935 AUTOMOBILE BUYER'S GUIDE. Anyone contemplating the purchase of a new automobile this year will be interested in this entirely new booklet which gives in popular language the inside story of many phases of automobile design and construction. Thoroughly illustrated with easy-to-understand drawings. *Write for Bulletin 735C to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

COAL PREPARATION BOOK. Preparing coal of higher B.T.U. value at the lowest cost per ton by applying scientific washing methods is the theme of this new 32-page booklet. The Simon-Carves washing system is described in detail and thoroughly illustrated. One feature is the adaptation of the photo-electric cell to this work. *Write for Bulletin 735B to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

FOR A BETTER RADIO. Within the 12 pages of this thoroughly illustrated pamphlet will be found descriptions of many desirable units to be used in the construction of ultra-short wave, short wave, and broadcast receiving and transmitting sets. All of the units listed are of precision manufacture. *Write for Bulletin 735D to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

CURING OF CONCRETE PAVEMENT SLABS. A report of a committee which has conducted a thorough investigation of the curing of concrete as used in pavements. Various types of curing processes were thoroughly tested and the results are given in tabular and graph form. Request Part Two, Proceedings of the Thirteenth Annual Meeting, Highway Research Board. *The National Research Council, Washington, D. C.—Gratis.*

ANHYDREX RUBBER INSULATION FOR WIRES AND CABLES is the title of a 16-page pamphlet devoted to an engineering discussion of a newly developed rubber insulation which is particularly applicable to electrical work where water or excessive moisture is encountered. Illustrated with several graphs. *Write for Bulletin 735E to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

STOP GULLIES—SAVE YOUR FARM, Farmer's Bulletin No. 1737, tells of the tremendous wastage occasioned by soil erosion and what the farmer can do to keep his soil where he wants it so that it will be of the greatest productive value to him. *Superintendent of Documents, Government Printing Office, Washington, D. C.—5 cents, coin.*

THE NICKEL INDUSTRY IN 1934 is a survey of the entire field, covering distribution of nickel, its use in transportation and the heavy industries, as well as in other more generalized fields of usage. Prepared in printed form for quick and easy reference. *Write for Bulletin 735F to Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

Books SELECTED BY THE EDITORS

THE AIRCRAFT YEAR BOOK FOR 1935

WITH the sub-title of "The Only Official and Complete Record of American Aviation," this volume presents a complete picture of present-day aerial work including military and other government activities, the work of the transport lines and of private flyers, progress in such developments as blind flying, and so on, the status of airships and balloons, laws and regulations covering aviation, and a picture of the engineering and manufacturing side. The chapter entitled "Flying Facts and Figures" includes a series of tables giving information on all phases of aircraft, much too numerous to mention here.—$3.70 postpaid.—*A.P.P.*

ORTHOHYDROGEN, PARAHYDROGEN and HEAVY HYDROGEN

By Adalbert Farkas, Ph. D. (Frankfurt), Dr. Ing. (Vienna)

THIS is a translation of the first book about heavy water, originally written in German. It is not a popular or even a semi-popular book but is aimed at the well-instructed student of modern physics, who can handle mathematics. —$3.65 postpaid.—*A. G. I.*

PROGRESS OF ARCHEOLOGY

By Stanley Casson, M. A., F. A. S.

IN ten fascinating chapters the author, who is on the instructing staff at Oxford, takes his reader in turn to each of the centers of archeological excavation—Europe, Iraq, India, Asia Minor, Greece, Italy, Russia, Siberia, China, America, Africa, and the Far East—and gives a general conspectus of what is going on in each place. His approach is popular and readable, and should provide a good taking-off point for further reading in archeology.—$2.15 postpaid. —*A. G. I.*

THE LIFE AND LETTERS OF SEBASTIAN ZIANI DE FERRANTI

By Gertrude Ziani De Ferranti and Richard Ince

THE name of Ferranti, while possibly better known abroad than in the United States, is nevertheless closely allied with the development of radio communication. After a man who has contributed largely to some phase of science has passed away, it is possible then and only then to publish a complete survey of his work and of his personality. Such a book is the present one. In 240 pages, well illustrated with half-tones, line drawings, and excerpts from letters written by Ferranti, this book gives a picture of the man and his work which will undoubtedly take its place as a valuable contribution to the literature of the development of radio.—$3.20 postpaid.—*A.P.P.*

SOS TO THE RESCUE

By Karl Baarslag

SAFETY at sea is an absorbing topic which is all too frequently brought to public attention by news reports of disasters. The author of the present book has, after a vast amount of research, prepared a running story of practically every major disaster at sea in which radio has played a part. A short summary of the history of CQD and SOS, well-known calls of distress, prefaces the inside stories of the radio operators' parts in such disasters as the *Republic*, *Titanic*, *Antinoe*, *Vestris*, *Morro Castle*, and others. In many cases, there appear here for the first time in print the actual facts of certain situations, not as learned by hearsay, but as told by radio men who stayed at their keys in the face of almost certain death.

This thrilling story of radio and its battle with the sea is all the more thrilling because it is true. No fiction or fancy garnishes the pages; here is only fact supported by adequate evidence. The book makes an excellent case for the service which radio has rendered to shipping, particularly in the figures given, which show the reduction in loss of ships at sea from 1900 up to the present day.—$2.70 postpaid.—*A.P.P.*

THE PRINCIPLES OF HEREDITY

By Laurence Snyder, Sc. D., Professor Zoology, Ohio State University

CLOSEST to our own ideal of a perfect popular scientific article was one on the determination of parentage by blood group tests ("Whose Baby," SCIENTIFIC AMERICAN, May 1934) by Professor Snyder, and now the same Professor Snyder has written a textbook of the science of heredity—that is, genetics. This is not an easy subject, though it has become an important one now that the science of heredity has become almost an exact science and is seen to have so much bearing on practical matters. As we might have anticipated, Professor Snyder has written an attractive treatise on this subject, surrounding the more solid parts of it with comment that is to the point, accurate, and withal readable, warm in tone, applicable to life outside the classroom, and the opposite of everything dull and stodgy. This book is also suitable for the student outside the classroom.—$3.20 postpaid.— *A. G. I.*

THE GEOGRAPHIC PATTERN OF MANKIND

By John E. Pomfret, Ph.D., Princeton University

A 408-PAGE illustrated study of the geographic influence of environment, in its bearings on the interpretation of economics, politics, history, and the other social sciences; in other words, a book designed to enlarge the background of those who maintain an interest in foreign affairs, read current history, and so on. It might be called a "human geography," since its emphasis is on the responses of human society to environment.—$4.20 postpaid.—*A. G. I.*

GETTING ALONG WITH PEOPLE

By Milton Wright

IF you ask the average person to name the attributes of success, most likely he would talk vaguely of ability, education, and even pull; and would tell you that personality has much to do with success, without being able to tell you just what personality is. The title of this volume seems to us the best key for unlocking the doors of individual progress. To get along with people, as this author shows, does not mean necessarily that you must have a bright and witty personality, a thorough acquaintance with a five-foot shelf of books, or the formula of a go-getter salesman. Mr. Wright shows in carefully worked out detail how a man may find the greatest happiness, and success according to his ambitions, by learning how to understand people. To us this proved a most interesting psychologi-

cal study of the problem which faces many people today but we were particularly interested in the chapters entitled "Adjusting Yourself to the Other Fellow," "Attracting Attention," and "Establishing Right Relations." Other chapters such as "The Power in Suggestion," "How to Say No," and "That Inferiority Complex" also contain considerable food for thought.

We can see a real need for this book and we predict that it will enjoy a large sale.—$2.65 postpaid.—*F.D.M.*

THE FRUSTRATION OF SCIENCE

By Eight Men of Science

A SMALL book of separate chapters which show how mankind has been unable to make full use of the possibilities of science, while its destructive possibilities are developing too rapidly. —$2.15 postpaid.—*A. G. I.*

THE STORY OF DIAMONDS

By A. C. Austin, Geol. E. and Marion Mercer, E. M.

TWO graduates of the Colorado School of Mines wrote this little book, and it is not only an accurate piece of scientific writing but an excellent piece of reading. It explains the nature of diamonds, their occurrence and geology, their mining and their cutting, also their uses in industry. It describes and illustrates the world's famous big diamonds. We have seldom seen a happier concatenation of authentic statement and thoroughly fascinating reading than this 90 page, well illustrated book.—60c postpaid.—*A.G.I.*

TUBERCULOSIS, A BOOK FOR THE PATIENT

By Fred G. Holmes, M.D.

THE Chief of Staff of the Good Samaritan Hospital at Phoenix, Arizona, who is also Director of the National Tuberculosis Association, sets down in this book for the layman information about tuberculosis, its symptoms, the choice of a physician, planning and conducting the treatment, air and sun baths, modern treatments—just the facts which a person who may be tubercular, or think he is, should possess in order to make the next move intelligently. He goes into considerable detail, but this is by no means a self-treatment book.—$2.20 postpaid.— *A. G. I.*

FISHES AND THEIR WAYS OF LIFE

By Louis Roule, Professor at the National Museum of Natural History of Paris

"THE living world of the waters" is here shown in all its amazing diversity. While ostensibly prepared as a popular book, the present volume smacks more of a classroom text although it might be said to be a compromise between a heavy, scientific treatise and a popularized version. Anyone interested in the science of ichthyology will find this book fairly easy reading and highly informative. Fishermen who take their sport seriously will find much of value in these pages. Many line drawings of various types of fishes illustrate the text. Over 300 pages with a fairly comprehensive index. The Scientific Book Club selection for June.—$3.95 postpaid.—*A. P. P.*

MEN AND SHIPS OF STEEL

By Wayne Francis Palmer and Hanson W. Baldwin

SOMETHING like 200,000 photographs were studied by the authors to pick the 275 that were finally used. Their efforts have resulted in the production of a classic. As a history and description of the U. S. Navy from the days of sailor's pig-tails and bushy whiskers to the present-day big guns, airplanes, submarines, and so on, this book is a masterful job. And why not, since both collaborators are former Navy men and know intimately the traditions of the Navy? In this salty "poem in pictures" they express for lovers of the sea a fine feeling for that arm of American national defense of which we are justly proud.

This volume is recommended without reservation to those of our readers who frequently ask us for sources of Navy pictures.—$3.75 postpaid.—*F. D. M.*

WHAT MAKES PEOPLE BUY

By Donald A. Laird

THE professor of industrial and applied psychology at Colgate University now prepares a readable treatise for sales managers, advertising and business men. This book is a study of what the customer is like, what he wants, what are on the top layers of his mind, and what a successful salesman is like. This is a practical book for practical people and is not a thesis for closet students. It is based on the newer findings in psychology.—$2.65 postpaid.—*A. G. I.*

TOOLS OF TOMORROW

By Jonathan Norton Leonard

TECHNOCRACY about two years ago threw a scare into us. The glib statements of self-styled experts created much excitement and many people began to fear for the future of the machine age. Tools of Tomorrow discusses the same general theme but from a saner foundation of fact. In this extremely interesting volume we find but little of the sort of pessimism which motivated the technocrats; the only pessimism expressed by Mr. Leonard is in respect to man's intelligence in using the tremendous forces which he has unleashed through scientific research. "Tools of Tomorrow" gives facts and figures to show that we have available everything we need from fuels and natural resources to the knowledge of how to harness them in the creation of a greater progress for the future. He discusses applied science in all its forms in such a way as to grip the reader's imagination and create a feeling of optimism for the future.—$3.20 postpaid.—*F.D.M.*

THE CHANGING WORLD OF THE ICE AGE

By R. A. Daly, Professor Geology, Harvard University

A VERY compact book, full of sum and substance, regarding the ice drama of thousands of years ago, and written by a noted geophysicist. It brings together existing scientific knowledge, particularly about the changes of sea level caused by subtraction of water from the oceans to make great ice caps, also changes of land level, some of them complex, due to down-warpings and up-warpings, past and present, of the earth's crust because of the ice load on it. It also states the connection between these glacially caused sea-level changes and the growth of coral reefs. The amount of data presented is so great and so compact—certainly there is no padding—that if one were to try to mark the important parts he would have to mark most of the book.—$5.20 postpaid.—*A. G. I.*

WISH AND WISDOM

By Joseph Jastrow

IN this 389-page book a noted psychologist brings together 28 separate accounts which center about human credulity, and the kind of wishful thinking indulged in by about half of the living specimens of homo sap. For example: Conan Doyle's fairies; Madame Blavatsky's cult; ouija boards; psychic adventures; Patience Worth; numerology; phrenology; "N-rays"; auras; vibrations; ectoplasm. The treatment of these and other erratic episodes in human gullibility is quite dramatic, the form being mainly narrative. Good reading.—$3.70 postpaid.—*A. G. I.*

SCIENTIFIC AMERICAN ADVERTISERS

JULY · 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

Vol. 153, No. 1. 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.

"... UNIVERSAL FINGER PRINTING IS BOUND TO COME"

wrote that the incident had brought

CLUBWOMEN JOIN FINGERPRINT MOVE

406 at Convention of Jersey Federation Record Their Identity for Police.

Special to The New York Times.

ATLANTIC CITY, May 9.—The New Jersey Federation of Women's Clubs in convention in Chalfonte-Haddon Hall joined the fingerprinting movement this afternoon.

Following the lead of their president, Mrs. Thomas H. Grimley of Ridgewood, 405 delegates to the convention filed past the two fingerprint machines and with the aid of four New Jersey State Troopers and Colonel H. Norman Schwarzkopf, commandant of the State Police, were "printed."

Colonel Schwarzkopf, in a brief talk, said "We feel certain that universal fingerprinting is bound to come. It is the only positive personal identity of an individual and even identical twins or the Dionne quintuplets can easily be distinguished by the method. This may save you from the fate of an unknown identity."

It was the understanding that the

"WE feel certain," says Colonel H. Norman Schwarzkopf, commandant of the New Jersey State Police, who figured prominently in the Lindbergh kidnapping case, "that universal finger printing is bound to come. It is the only positive personal identity of the individual . . ."

As to that, we venture no prediction. It is a fact, however, that many law-abiding citizens are now registering their finger prints in police departments all over the country as a measure of personal protection and positive identification in the future. Perhaps later such finger printing of civilians everywhere will be made compulsory by law.

Certainly finger printing is of vital importance in criminal investigation. The Bureau of Criminal Investigation of the Department of Justice, in Washington, now has the greatest collection of criminal finger prints in the entire world; and they urge that the prints of every suspect picked up anywhere—simple vagrant or red-handed murderer—be forwarded to them for checking against old records. In this manner, many dangerous, "wanted" criminals have already been identified, and the system has proved its value many times over.

HERE, then, is a new profession—old but new in that its utility has been greatly expanded of late and, further, that it shows promise of a tremendous expansion in the future. For this reason, the text-book which for years has been the standard authority among expert criminologists and police departments throughout the world:

TO MEN WHO DON'T WANT TO WAIT 5 YEARS FOR A $10,000 SALARY

THERE ARE a few ambitious men in every company who have decided that it is 1935 or never. They are sick and tired of being spoken of as "men with a future." Whether their goal is $5,000, $10,000 or $20,000 a year, they want *this year* to begin to realize some of their financial ambitions.

These men feel equipped to contribute substantially to their company's problems. They understand their particular end of the business. They are of executive calibre. And they know there is a special need for sound, constructive thinking in every business today.

What is holding them back?

In most cases, very little. Usually nothing that they cannot acquire with a modest investment of effort.

There is a practical formula that has been of great value in helping men take on the increased responsibility of leadership. The Alexander Hamilton Institute offers it to you. Through its famous Course of business reading, the Institute will give you a sound perspective of all business. It brings you a working knowledge of banking and finance, of advertising and merchandising, of cost finding, and commercial law, and plant administration—the kind of all-round knowledge that a man must have for outstanding success in times like these.

Such an outstanding success is within your reach because the Alexander Hamilton Institute has put it there. It has assembled the experience of the great leaders of modern commerce and made it available to you in convenient, compact form. Among these men are such outstanding names as: ALFRED P. SLOAN, Jr., General Motors; C. M. CHESTER, Jr., General Foods; DAVID SARNOFF, Radio Corporation of America; LEE H. BRISTOL, Bristol-Myers; M. H. AYLESWORTH, National Broadcasting — plus many others equally famous.

What a Business Man Must Know Today

This helpful book is offered free to men who want to speed up their business progress. Over a million copies have been distributed. The coupon below will bring a copy to your desk.

What type of men use the Institute? You have a right to know. Of the 400,000 men whose business progress has been speeded by the Institute, more than half are Members of Boards of Directors, Presidents and Business Heads, Vice-Presidents, Treasurers, Secretaries, Controllers, General Managers or Professional Men.

For example, among the Institute's subscribers are: the president of one of the largest tobacco companies, the chairman of the board of one of America's biggest chain of newspapers, the chairman of the board of a leading food company, the president and general manager of one of the great motor car organizations, the president of a famous soap-producing company, to mention only a few.

Men who don't want to wait ten years for success are invited to take the first step toward a major executive position now. Send for "What a Business Man Must Know Today." This is the title of a recently prepared book that describes precisely how the Alexander Hamilton Institute's formula works.

If you are one of the men who are determined to get where they want to be *this year,* this book is for you. It comes without cost or obligation. The coupon is for your convenience.

Alexander Hamilton Institute
825 Astor Place, New York.

Send me "What a Business Man Must Know Today" FREE.

Name .....
PRINT HERE

Business
Address .....

.....

Business
Position ..... Age .....

ALEXANDER HAMILTON INSTITUTE