SCIENTIFIC AMERICAN

October
1933
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a Copy

Is Disease Inherited?

By Charles B. Davenport, Ph. D.

Cancer, Tuberculosis, Goiter, Syphilis

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MUSCLE SHOALS ACTIVE AT LAST

By William Benjamin West

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THE GREATEST CATASTROPHE ON RECORD

By Henry Norris Russell, Ph. D.

•

DO "NEON" TUBES USE NEON?

Volume
149
•
Number
4

Gems and Gem Materials

By E. E. KRAUS, *Professor Mineralogy and* E. F. HOLDEN, *Univ. of Mich.*

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SCIENTIFIC AMERICAN

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EIGHTY-NINTH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

Of General Interest

Aviation

Chemistry in Industry

Health Science

An index of articles appearing in back numbers of *Scientific American* is to be found in The Reader's Guide, Industrial Arts Index, Engineering Index, and Dramatic Index. These can be consulted in any large library.

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ACROSS THE EDITOR'S DESK

IN a recent letter to the writer, Hiram Percy Maxim expressed his views regarding the articles on sexual abstinence and birth control which have appeared in SCIENTIFIC AMERICAN. With Mr. Maxim's permission, we quote from his communication: "I have been a reader of the magazine for nearly 60 years, my father, the late Sir Hiram Stevens Maxim, having started me. He used to explain the pictures to me before I was able to read. . . . I desire to urge that you do not falter in your time-honored policy of printing all the important truths of Nature as they become known. It is what several generations of Americans have been taught to expect of SCIENTIFIC AMERICAN. . . ."

After some discussion of the change in manners and customs during the past half century which has made it possible to publish the above mentioned articles, Mr. Maxim concludes: "May I inquire if a magazine is to be criticized because it leads? I am sure that SCIENTIFIC AMERICAN readers would prefer to see SCIENTIFIC AMERICAN bring the subjects to the front before any other scientific magazine did. And thus I am moved to salute you, Mr. Editor, and to urge that you falter not in those grand old policies which have prevailed in SCIENTIFIC AMERICAN since before either of us was born."

●

"The poisons'll get you if you don't watch out," seems to be the by-word of certain people who would scare the public with half-truths and much ballyhoo about poisons from foods cooked in aluminum, and from sprayed fruits and vegetables. SCIENTIFIC AMERICAN has frequently shorn the locks of the aluminum utensil bugaboo, but the head repeatedly reappears for further shearing. This time T. Swann Harding, whose articles in the past have been received with acclaim, takes up the cudgel of truth and tells the whole story about "How Much Poison Can We Eat?" He shows why no one need be unduly influenced by cries of "Wolf! Wolf!" when the "wolf" is so small that its teeth haven't developed. This article, scheduled for next month, is one which everyone will profit by reading.

●

When Colonel Lindbergh made his historic transatlantic flight, he was figuratively gambling with fate. In the few years that have elapsed since that time, technicians have been steadily working to reduce the element of gambling in long-distance flights. How well they have succeeded is strikingly indicated by recent achievements: The British flight over the Himalayas; Wiley Post's sensational circling of the globe; the new straight-line, non-stop record of 5341 miles; and other outstanding feats of the past few months. Why are records falling so fast? The answer is simple: Development of planes and equipment. Reginald M. Cleveland has prepared an article on these advances which sums up the whole situation as it stands today. See our next number.

●

"Dowsing"—the word brings to mind a certain mysticism, a sort of medieval rite that has lapped over into an enlightened civilization. But is the background of dowsing—the operation of the divining rod—entirely mystic, to be placed in the same category with alchemy and witches? Apparently not, at least until the whole subject has been entirely investigated from every angle by competent scientists. We have, scheduled for early publication, an article on the subject which reveals that serious study of dowsing is being conducted, and that there appears to be more to it than has generally been thought.

●

That even those who reside in urban districts rely on the farmer for something more than mere food is a truism that is not generally realized. "Prosperity of the farmer is basic to prosperity in every other line of business, no matter how remote it may be from the farm." Thus writes the author of an article in which a parallel is graphically drawn between farm efficiency and machine methods. "The farmer," continues the author, "who clings to the methods of two or three decades ago, finds his costs abnormally high, while the one who has availed himself of the labor-saving equipment now obtainable is producing at a cost which will leave him a profit." This article is scheduled for a forthcoming issue.

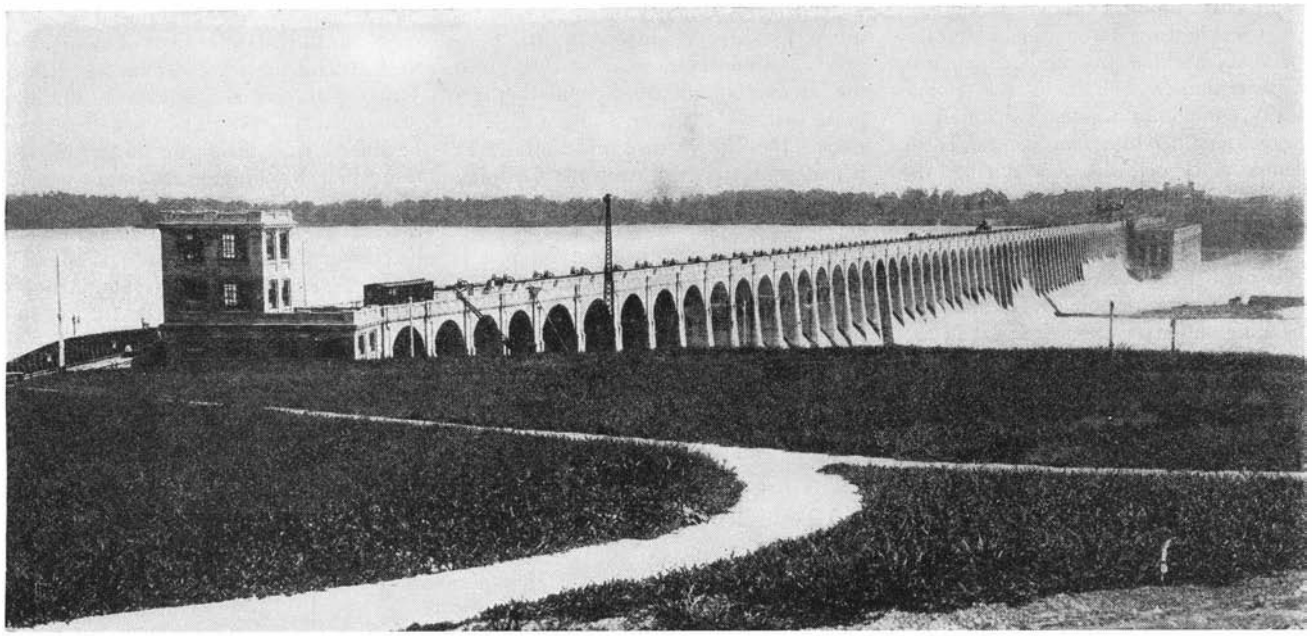
●

The need for a larger reserve water supply in the Panama Canal is being met by the construction of the Madden Dam on the Chagres River, nine miles from the Canal. The advantages of this dam, the problems that have been met in its construction, and the engineering methods employed are all told in an authoritative article, to be published in our next issue, prepared especially for SCIENTIFIC AMERICAN by E. S. Randolph, Construction Engineer on this important project.

Editor and Publisher

THE SERVANT THAT HAS TRANSFORMED THE WORLD

"ENERGY is the substance of all things—the cycles of the atoms, the play of the elements are in forms cast as by a mighty hand to become the world's foundations." Thus reads the inscription on one of the huge bas-relief panels, illustrated above, that decorate the sides of the Electrical Building at the Century of Progress Exposition. Here the modernistic sculptor has been given a unique opportunity to secure effects symbolical of the sciences. Whether or not we approve of this type of art, it must be admitted that the forceful results drive home the story which is being told.



View of Wilson Dam from the north bank of the Tennessee River, showing navigation locks on left

Muscle Shoals Active At Last

Tennessee Valley Authority Act Provides for Operation of Muscle Shoals and the Development of a Wide Area

By WILLIAM BENJAMIN WEST

WHILE the Congress granted many unusual and extraordinary powers to President Roosevelt during its first, or special, session, all but one of the several measures enacted were of comparatively recent origin and may, therefore, be largely attributable to the prevailing world economic conditions as they affect the United States. The one exception is the Tennessee Valley Authority Act of 1933 which granted the President the power to appoint a body of three members to develop the natural resources of the Tennessee River basin. This includes the completion of the Muscle Shoals project which, as is well known, was started in 1918 as a World War explosives plant with the expressed intention of Congress that the project should be used for fertilizer manufacture during peace time.

The history of the national controversy over Muscle Shoals would cover the entire period since the signing of the Armistice. It became particularly heated in 1921, when Honorable John W. Weeks, then Secretary of War in the Harding cabinet, advertised the Muscle Shoals plants for sale. Immediately a storm of protest arose from those who wanted to see the original intention of Congress carried out. On the other hand, Mr. Henry Ford came forward with his famous offer which was countered with an offer from a group of power companies operating in the southern part of the United States. From that time on, the Muscle Shoals controversy raged almost continuously in Congress until the Tennessee Valley Authority Act of 1933 was enacted and signed by the President.

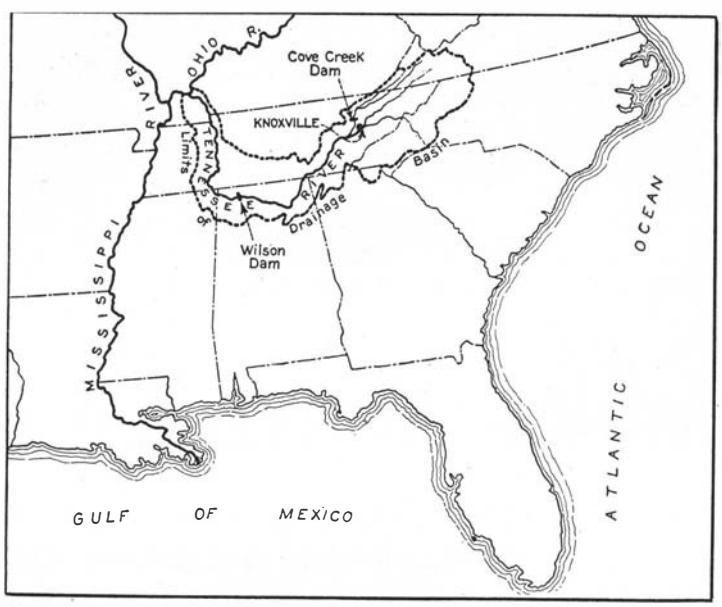
THE subject has been so complicated and so interwoven with our domestic policies that a brief discussion of even the major points becomes difficult without running the risk of leaving out important points. However, it must be recalled that our Government is committed in its Constitution to the protection and encouragement of private initiative of its citizens and individual enterprise in general. To that policy, all Federal administrations since the Wilson second term and up to the present régime have been unalterably committed. Under the protecting wing of the Harding, Coolidge, and Hoover administrations, the nitrate industries in the United States were able to contend successfully that it was unfair for the Government to enter their field in competition with them, to the alleged ruin of their business and, consequently, loss of their investment. To this must also be added the fact that of the two nitrate plants at Muscle Shoals, one of them—the larger—has become practically if not entirely obsolete, while the other is admittedly of little value since its very existence was due to experimentation in an effort to follow the Germans in their atmospheric nitrogen exploits of 1913-18.

While no provision was made in the National Defense Act of 1916—which called the Government properties at Muscle Shoals into existence—for the distribution of surplus power from the Wilson Dam at Muscle Shoals, yet soon after that development was undertaken, the subject of electrical energy distribution began to grow into a national conflict which has not yet subsided. Senator George W. Norris of Nebraska, known as a Progressive Republican in politics, became aroused over what he considered excessive rates of the privately owned electric public utilities and has constantly cited the operations of the Hydroelectric Power Commission of Ontario as a rebuke to American methods of utility rates and regulations.

Senator Norris has long wanted to have Muscle Shoals water power facilities set up along the lines of the Canadian enterprise so that this project, located in the heart of the southern part of the United States, would act as an economic "yard stick," by which the rates of the public utilities might be measured. Naturally, this idea was

steadfastly opposed by the National Electric Lighting Association which has for years wielded powerful influence in Washington in behalf of the public utility companies which constituted its largest membership. The Federal Trade Commission investigation during the Hoover administration, however, practically broke the back of this Washington lobby. This investigation was sponsored by Senator Norris and his associates, and revealed vast and far-reaching activities upon the part of the N.E.L.A. and several of its member companies in an effort to forestall any favorable Congressional action in regard to Muscle Shoals.

To the credit of the Coolidge administration, it must be said that a sincere effort was made to arrive at a satisfactory solution of the controversy which had then been raging for several years. Mr. Coolidge appointed his "Muscle Shoals Inquiry Commission," which was headed by Dr. William McLellan, a former President of the American Institute of Electrical Engineers, and entrusted it with the responsibility of studying all phases of the Muscle Shoals situation and advising the President and Congress how best to proceed. The report of this Commission was submitted toward the latter part of the Coolidge Administration and after various Congressional hearings based thereon, was at last almost entirely laid aside. Meanwhile, Senator Norris was successful in driving through both houses of Congress a bill providing for government operation of the nitrate plants at Muscle Shoals and federal transmission and distribution of power from the hydroelectric developments, both constructed and projected, in the Tennessee River basin. This bill was vetoed by President Coolidge.



Heavy dotted line indicates the boundary of the huge drainage basin area that will be affected by the Tennessee Valley Act

WHEN Mr. Hoover became President, he sponsored a movement looking toward the placing of Muscle Shoals in the hands of local state agencies such as to include representatives of the states of Alabama, Georgia, Mississippi, and Tennessee. To this end, he appointed what was to become known as the "Muscle Shoals Commission" which was composed of prominent citizens of some of the above mentioned states and a representative of the United States Government in the person of an army engineer. The report of this body met with an even worse fate than that which had previously befallen the report of the Coolidge Muscle Shoals Inquiry Commission, since very little Congressional consideration was ever given the Hoover-appointed Commission report. Instead, however, Congress again passed the Norris Bill substantially as it had been passed during the Coolidge Administration, only to see it receive another presidential veto.

All these efforts, it must be noted, were more or less direct in character in that each commission appointed was specifically held to the problem of providing a solution for the Muscle Shoals controversy. This, however, left the way open, for those agencies which were unalterably opposed to anything and everything at Muscle Shoals, to attack the various reports and bills looking toward the utilization of the Government properties there without in any way hurting their own interests.

While the efforts of the former Presidents Coolidge and Hoover to solve the problem through Commissions seemed to be perfectly logical when engineering and economics alone were concerned, yet when politics must be considered, some other avenue of approach was evidently necessary. Apparently, if a president could come forward with some plan which would not concentrate public attention on Muscle Shoals as such, but would scatter public interest over broader areas, and at the same time embrace the possibility of later extending the whole idea over other large sections of the country, then he would probably be able to obtain at least silence, if not indeed their active support, from large numbers of those who have heretofore opposed Muscle Shoals.

Between the election in 1932 and March 4, 1933, when President Roosevelt was inaugurated, he devoted considerable time to the study of Muscle Shoals and finally announced a proposal for the establishment of an agency to deal with the whole Tennessee River Valley with special reference to the improvement of navigation which would be linked with flood control, reforestation which would embrace improvement of the unemployment situation, utilization of so-called marginal lands which had been overworked for agricultural purposes, and finally the development of great blocs of power for the further industrialization of the entire Tennessee River Valley area. Admitting that this would be a gigantic federal experiment upon a scale never heretofore undertaken, he further suggested the possibility of carrying the idea farther into other regions if the Tennessee River basin project indicated that it would succeed.

THE Tennessee River legislation as finally enacted follows closely the original idea of Senator Norris so far as nitrate manufacture by the Government and power generation and possible power transmission, also by the Government, are concerned, but decidedly outdistances the Norris ideas when it comes to reforestation and marginal lands, as nobody ever before suggested such a comprehensive scheme as Mr. Roosevelt put forward. The idea of dealing with an entire river system as a whole for power purposes is not a new one, however, since it is well known in engineering circles that utilities and other water users have developed entire river systems, or have projected and started such enterprises by building several dams and control works on one stream and its tributaries. Never before, however, has a Government taken hold of a stream for such purposes and no private agency could justifiably undertake work of this character.

The effect of forests on stream flow and the desirability of reforestation of lands formerly cut over in order to prevent excessive flood peaks as has been proposed in the Tennessee Valley Authority Act of 1933 has been the source of much popular interest as well as controversy. Opinions go to the extreme on one side, claiming that forests are sources of great natural reservoirs which conserve and regulate the disposal of high rainfall, to appear later on as stream flow. Other opinions hold that forests not only decrease stream flow but increase flood tendencies as well. Several authorities agree, however

that the effect of forests on stream flow is due not only to the growing trees and vegetation but also to the so-called "forest floor" or layer of leaves, litter, roots, organic material, and so on, on the surface of the ground which holds back the flow and increases the opportunity for seepage.

Fortunately, large areas of public lands lie in the mountains of eastern Tennessee and other sections of the Tennessee River drainage basin and as much of this land has heretofore been cut over for lumbering operations, it is possible that reforestation of these areas may have at least some effect upon flood flows in the Tennessee River. The lowlands nearer the river, however, have long since been given over to agricultural purposes.

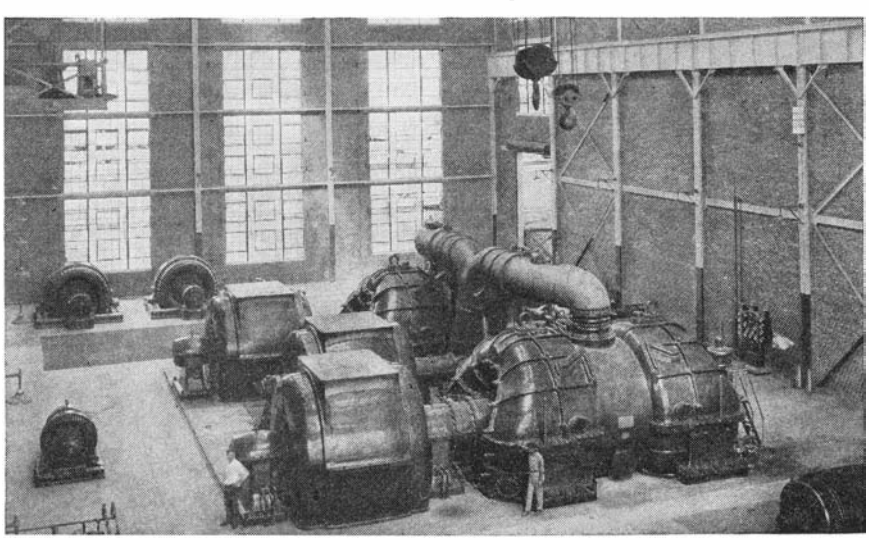
WHILE from a strictly financial consideration there might be some doubt as to the justifiable value of the proposed reforestation operations in the Tennessee River Valley for flood control purposes only, yet when one considers that a national policy of reforestation had already been embodied in the reforestation bill with one of its objectives being the provision of employment for thousands of young men in reforestation work, it may be concluded that certainly some of the reforestation might well be carried on in the mountainous portions of this territory, and that is exactly what is now being done.

President Roosevelt has announced the appointment of three men who will compose the Tennessee Valley Authority under the Congressional Act for its creation, these being Dr. Arthur E. Morgan, President of Antioch College and member of the A. S. C. E., Dr. H. A. Morgan, President of the University of Tennessee, and Mr. David E. Lilienthal, member of the Wisconsin Public Service Commission and a lawyer by profession. Dr. Arthur E. Morgan has been designated as Chairman of the group which will have immediate charge of all the government properties at Muscle Shoals and will construct or supervise the construction of the Cove Creek Dam on a tributary of the Tennessee River near Knoxville, Tennessee, at an estimated cost of 34,000,000 dollars. This dam is important as a regulating reservoir for the entire Tennessee River below Knoxville, both as an aid to navigation and to increase the primary power at Wilson Dam, and is expected to reduce the peak flow of large Tennessee River floods.

In 1929, there were 23 hydroelectric plants with installed capacity of 370 kilowatts or more, within the Tennessee River Basin, the total installed capacity being 413,470 kilowatts. The government plant at Dam No. 2, Muscle Shoals, has an installed capacity of only 184,000 kilowatts while with auxiliary steam installation it should have 340,000 kilowatts installation. It has a power house designed for the installation of plant of 444,000 kilowatts.

The Aluminum Company of America is developing on the Little Tennessee River, and the Tennessee Electric Power Company is developing on the Toccoa River, a number of projects under authorities obtained prior to the passage of the Federal Water Power Act. The total installed steam electric plants within the basin is 179,880 kilowatts. The total installed capacity of hydro and steam electric plants in the basin, is, therefore, 593,350 kilowatts.

A co-ordinate scheme of water-power development comprising 141 separate projects within the basin has been worked out, suggested designs presented, and an approximate cost estimate made. Also, an exhaustive economic study was made of the transportation facilities, other than river traffic, in the basin and of the possible uses that might be made of the river if completely improved.



Turbine room of the power plant at Nitrate Plant No. 2, Muscle Shoals, Alabama. Here may be seen only one of the 60,000 kilowatt compound turbines

The area covered by the survey and also to come under the jurisdiction of the Tennessee Valley Authority, covers most of central and western Tennessee, extends widely over northern Alabama, includes portions of North and South Carolina and Georgia, and touches small portions of Virginia, West Virginia, Kentucky and Mississippi.

In regard to flood control, the report holds that flood control works on the Tennessee River would have practically no effect upon the Mississippi River floods and that to operate reservoirs on the former with the idea of reducing floods on the latter would seriously impair the value of the Tennessee as a power producing stream.

This places the Corps of Engineers of the United States Army on record as being in disagreement with one of the expressed objectives of the Tennessee Valley Authority Act, namely "to control the destructive flood waters in the Tennessee River and Mississippi River Basins."

THE Tennessee Valley Authority is authorized to produce, distribute, and sell electric power and the Act declares that, so far as practical, the Government shall distribute the surplus power generated at Wilson Dam equitably among the states, counties, and municipalities within transmission distance of the plant. For this purpose, the Board is authorized to lease or construct transmission lines and to contract with states, counties, municipal organizations, or private corporations for the sale of electricity for a period not exceeding 30 years. The Board is authorized to maintain control over the resale price of current sold by it.

Five percent of the gross income from the sale of power generated at plants in Tennessee is to be paid into the treasury of that state with a like provision for power generated at any plant in Alabama. Two and one half percent of the gross income from power generated at stations below Cove Creek and resulting from the use of water stored at Cove Creek Reservoir or other government-owned reservoirs is to be paid to each state. This provision was included in order to offset the advantages claimed for privately owned electric public utilities because of the large amount of taxes they pay to the states in which their properties are located.

The Act authorizes the Board to complete the power plants at Muscle Shoals by the installation of additional hydraulic turbines and generators in the hydroelectric plant and steam-electric generators in the steam power plant situated there. It authorizes the Board to produce fertilizer or to contract with commercial producers for the production of fertilizer at the nitrate plants.

Is Telepathy Indicated As Being a Factor in the Events Described Below? Experiences of Readers That Thus Far Have Not Been Explained

IT is unfortunate that, because of the rigid limitations of space, we cannot publish more than a few of the many letters that have been sent to the Editor on the subject of telepathy. Inspired by the investigation of the subject which is now being conducted by SCIENTIFIC AMERICAN, hundreds of our readers have taken the time and trouble to set down in writing some of their experiences that appear to be linked with telepathy. In our August number we published some of these letters. We have now selected a few more and are presenting excerpts from them below.

"WHEN we were married," writes a correspondent from New York state, "my wife and I each retained our jobs in different towns. This arrangement kept us separated six days out of the week. Since her position gave her more freedom than did mine, she used to visit me week-ends in the town where I worked. One week-end she told me that she had moved; had found a less expensive room in a better environment. We were just falling off to sleep together when a picture of a room came into my mind with such startling vividness that I jokingly told her that *I* would tell all about her new room. An example of the detail of my description was that I said she had left her closet door open and that something was hanging on a hook on the door. My wife laughed at me, but agreed that my 'mental picture' was accurate in every detail.

"I have checked every possible point that might permit personal deception to account for the uncanny completeness of my description, but can find none. My wife had not told me anything more about the room than that she had moved. Furthermore, my description contained many things that would have been foolish for my wife to have taken the trouble to mention. There also was no clue in the two letters which I had received from her since she had moved."

Here is a case that may offer grounds for the oft-repeated claim that telepathy will exhibit itself spontaneously only under favorable conditions. The couple were relaxed, mentally and physically, at the time of the "mental picture," the room was presumably dark, and the parties concerned might be considered more *en rapport* than could be the case under laboratory conditions.

ANOTHER reader from Illinois writes of a series of experiments that may suggest work along similar lines for others. "A young lady and myself," writes this man, "conducted several 'sittings' in which she acted as percipient and I as agent. We were located in towns several hundred miles apart and at an appointed hour I would write a message and mail it to her. On her part, she would endeavor to receive the message, write it down, and in turn mail it to me. Thus the records of the transmission and reception passed in the mail and there was no opportunity for anything other than fairness and honesty in the procedure. We obtained some remarkable results."

If any other reader tries a similar experiment, we shall be glad to examine the collected data if it is sent to us.

"UNCONSCIOUS telepathic power" is the way in which a reader residing in Florida characterizes whatever it was that at one time apparently saved his life. "When I was a lad," he writes, "the water supply on our farm was furnished by a driven well, the pumping mechanism for which was located in a pit 12 feet deep and covered with two sets of trap doors, one above the other with a 12-inch air space between them. During extremely cold weather we kept an oil lamp burning in the pit to prevent freezing and it was my job to see that the lamp was taken care of.

"One very cold morning immediately after breakfast I started for the village to get the mail. After leaving the house, I suddenly thought of the lamp and decided to see that it was burning before going farther. I turned back and entered the pit. A high wind was blowing and I had no sooner descended into the pit when the trap doors blew shut. It was impossible for me to raise them from my position on the ladder, and I knew it was useless for me to call for help as the pit was a quarter of a mile from the house, so I put out the lamp, sat down and started to think of the people in the house.

"My sister told me afterwards that my mother was sitting in her chair sewing when suddenly she dropped her work, looked at my sister for a few seconds and then rushed out of the door and straight for the pit. She raised the heavy doors, something she had never done before and could not do again, and released me. My mother's statement was then that she had seemed to hear me calling her and that then she 'saw' me in the pit with the doors down. There was absolutely no reason for her to know that I had gone to the pit instead of to the village for the mail."

Emotion again—and an opportunity to link the possibility of telepathy to close and intimate relationship. This linkage is evident in many of the letters describing apparent telepathic experiences which we have received from readers.

WE quote from these letters for their interest only and not in any attempt to prove or disprove any phase of the subject under discussion. Incidents of the types described above are subject to all sorts of criticism from the standpoint of science. Obviously, they were not and could not be conducted under ideal experimental conditions. They were of the spontaneous sort that can only be accepted on faith if at all and cannot be explained satisfactorily unless and until criteria for telepathic communication are established.

Testing Telepathy

HAVE you conducted *Scientific American's* Second Test of Telepathy? It is easy to do, requires no complicated equipment, and your results may be of great assistance. Complete details were published in our June, 1933, number, and further pertinent pointers appeared in September. If you have not already undertaken the experiment, we would be glad to receive your results at this time.

Detailed study of the data accumulated in our Second Test of Telepathy will begin on October 1st. Thus there is sufficient time available for you to co-operate. The test can be completed quickly, and is more interesting than a rubber of bridge. Try it with a friend or relative, or have several couples try it the next time they get together for a social evening. Then send the written results to the Editor, *Scientific American*, 24 West 40th Street, New York, N. Y.

OUR POINT OF VIEW

Muscle Shoals Real Estate

HIGH-pressure real estate operators and salesmen now have, in the Muscle Shoals-Tennessee Valley Act discussed on pages 149-151, more ammunition with which to deceive a gullible public than they've had in recent years. Ever since the World War, practically worthless land in the Muscle Shoals section has been sold for fabulous prices by unscrupulous persons who represented the present and potential value of the land as being many times its sale price. With the government finally making decisive moves toward the development of the Muscle Shoals properties, the get-rich-quick exhortations of silver-tongued salesmen now find more willing listeners than ever before.

We therefore sound this warning: Practically everything any salesman tells the prospective purchaser of Muscle Shoals lots about the size and state of development of Muscle Shoals is either a misstatement or an exaggeration.

In the past, prospects have been shown cleverly done "bird's-eye" views showing neat rows of houses and factories in the "city" of Muscle Shoals. Most of these developments do not exist; the "city" was incorporated in 1923 through the efforts of real estate operators by a total vote of 42 inhabitants. According to a bulletin from the Better Business Bureau of New York City, Inc., uninformed school teachers and wage earners have paid as high as 5000 dollars a lot for vacant Muscle Shoals land with a tax valuation of 50 to 100 dollars a lot. Not content with such robbery, the operators have charged 6 percent on the unpaid balance when the lots were not paid for in full. In the event of a default for 30 days or more, the contract is cancelled and the money already paid in is retained by the seller as liquidated damages.

The Tennessee Valley is indeed rich in natural resources but lots bought from promoters may benefit very little from the government's development work for this is to be spread over a very wide area. As for an influx of industries to the region, this is as yet a very uncertain thing. No matter what mathematics one uses, it is out of all reason to calculate on a profit from a 5000-dollar investment in a 100-dollar lot at Muscle Shoals, and the public are advised to utilize a little intelligence before contemplating such waste of their money.

Science and Mysticism

IT is being asserted widely that science has at last "seen the light," and that it has abandoned its early materialistic taint, swinging strongly within the past half dozen years toward religion and mysticism. This unanticipated reform of a brilliant youth who had always been regarded by religion as a bit wayward has already given joy and cheer to millions of mystics. Newspaper editorials and magazine articles have been devoted to the new trend. Preachers have written sermons about it. What, then, is it all about?

The furore "started small," in a corner of physical science. It was discovered a few years ago—at least some thought it was—that things as small as electrons and protons do not individually obey the Law of Cause and Effect; their conduct was seemingly capricious. Only larger bodies, made up of many such particles, obeyed this law, and then only as a sort of average—that is, statistically.

Specifically, this capricious phenomenon is known among physicists as the "principle of indeterminacy" or "the principle of uncertainty," and its discovery came about thus: Professor Heisenberg, a brilliant young German, showed the world that it is impossible to ascertain both the position and the speed of an electron; we can ascertain the one or the other singly, but not both. No experiment can be invented which will circumvent this dilemma.

Evidently, then, the behavior of an electron is indeterminable, and right here a number of thinkers made false deductions and, as Eddington puts it, "science went off the gold standard." They said that, since electrons and protons obeyed some caprice and that, since the whole tangible universe is made up of such particles, the universe itself must also obey caprice. Therefore there is no longer any reign of the supposedly immutable Law of Cause and Effect.

What these thinkers failed to grasp was that mere indeterminability—that is, ascertainability by our laboratory experiments—does not in itself establish indeterminacy. A thing may be indeterminable but not indeterminate. Nature knows what she is doing, and does it, even when we can't find out.

The next leap into the dark, and a wilder one, carried the subject to the wide world outside the limited realm of physical science. It involved the old question of the freedom of the human will. Exact science had held that there was no freedom of choice. If we thought there was, we imagined it. Our minutest action was determined by an endless chain or pattern of causes and effects, big and little. Our conduct was the resultant of these complex forces.

It did not take the mystics long to discover that science itself, in its new principle of uncertainty, apparently had inadvertently blundered on a loophole of escape from this unwelcome predicament. If we could no longer predict, at least in theory, the entire future of the universe, given the position and velocity of every particle in it, then perhaps there was freedom in it after all, especially since our very brains were made of these particles.

This was the rickety structure which the mystics built, and which has given them such obvious satisfaction.

Who are these mystics? They are legion. Many who are temperamentally inclined to accept anything containing an element of sloppy thinking are among them. Many whose desire for wish-fulfillment stands higher than their powers of pure reasoning are also numbered. Many who actually rejoice whenever man, in his scientific conceit, is defeated in his search for ultimate truth, are to be found there. Very many more are genuine. Then there are the High Priests of the new cult. Of these Jeans and Eddington have stood at the summit.

Perhaps the world outside of scientific circles may be pardoned for taking these voices, as it apparently has, as mouthpieces of science in these matters (mainly of theology) and for drawing the logical conclusion that science has "gone mystic," for their prominence is great. Yet science has no mouthpiece. These men, when dealing with such questions are theologians, not men of science, and among the rank and file of scientific men there has been no little grumbling about the false appearances created by their championing this kind of thought—though few such men care to take the unpopular side of a public controversy about it.

The return of science to some sort of modern mysticism would be essentially a slip in man's hard-won progress away from one of his most ancient bad habits —that of ascribing to the supernatural whatever he did not yet understand.

Making the pattern from which a gaseous tube sign will be laid out

How Rare Gases

• "Neon" Tubes Do Not Always Contain Neon: Argon, Krypton, Xenon, Helium, and Mercury are Also Used •

VIVID tubes of glowing gases spread their messages to the people of almost every village, town, and city throughout the country. Based on the action which takes place when an electrical current passes through certain gases, these tubes have grown from a laboratory curiosity only a few years ago to a point where they occupy a definite place in the fields of advertising and illumination.

Years ago a German physicist named Geissler found that if certain rare gases, then recently discovered in the atmosphere, were confined in a glass tube in which electrodes had been sealed, they would glow when a high-voltage current was applied to the electrodes. Geissler also found that the results depended largely on the voltage, the pressure in the tube, and the distance between the electrodes. But here he stopped. Some time later the French scientist-inventor, Georges Claude, turned his attention to the same phenomenon and particularly studied the effects obtained when the gas in the discharge tube was neon.

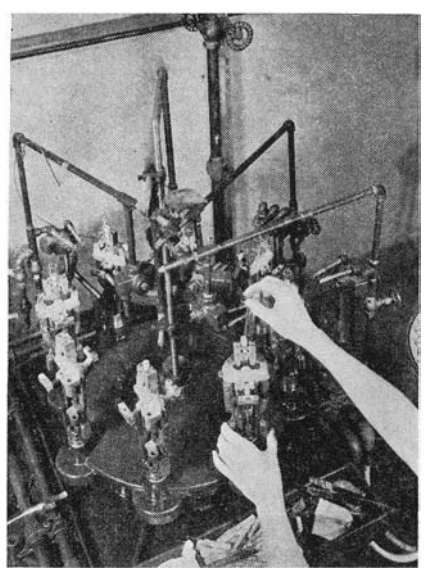
One of the first definite steps toward the realization of commercially successful gaseous tubes for illumination was the discovery that the life of the tubes depended in large measure on the electrodes. From that point onward, the progress has been steady, until today the "neon" tube is a familiar object to all.

ADVISEDLY the word "neon" is placed between quotation marks in the last sentence above, because in many cases the tubes do not contain neon at all. Other rare constituents of the atmosphere—argon, krypton, xenon, and helium—are also used, as is mercury in some cases. Because of this fact, as stated by R. E. Barclay, Director of Research of the Federal Electric Company, manufacturers of these tubes are making an effort to correct the error of nomenclature and to popularize the designation "Gaseous Tubes."

In the manufacture of gaseous tubes, the first essential is cleanliness of all material and purity of the gas. The glass tubing is washed thoroughly in a chromic acid solution and then kept in absolutely dust-proof containers until the time arrives to make it up into letters or designs.

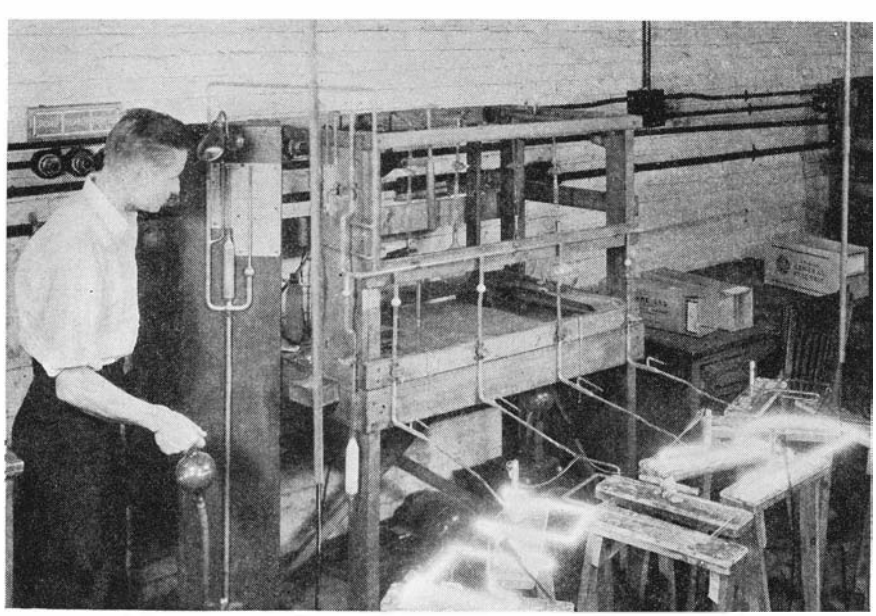
When an order for a tube sign is received and preliminary plans for its layout have been approved, full-size layouts are made as guides for the metal-working shop and for the glass blowers. While the frame and backing that will hold the tubes are being constructed, a pattern, drawn on asbestos, is laid out on a table and the glass blowers go to work. With consummate skill, they heat certain parts of a length of tubing and quickly bend it to shape, placing it on the pattern to make sure that the curves conform to the desired design.

At the same time, the electrode makers have been busy. The electrodes proper that are wholly surrounded by the gas in the tube are made of a secret alloy that will not decompose or throw off particles when the tube is placed in operation. One of the troubles with early tubes was that the electrodes were not of the proper material and that they "sputtered" under operating conditions and caused a black deposit to form on the inner walls of the tube. The electrode is further treated by dipping into a special chemical solution that also helps to reduce sputtering to a minimum.



Sealing the electrode connecting wires into short pieces of tubing

In assembling the electrodes, two current-carrying wires are sealed into a short piece of glass tubing and the electrode proper is attached to the wires. It is absolutely necessary that the operator's hands do not touch the



Exhausting tubes and filling them with purified rare gas

Give Beauty to Lighting

By A. P. PECK

Bending sign tubes to shape on a full-size pattern drawn on asbestos

metal of the electrodes during assembly, as any foreign matter that might thus be deposited on the metal would tend to shorten the life of the tube. The special machine shown in one of the photographs holds the various parts during assembly so that speed of operation may be combined with the required precautions. The electrode, which may be considered as the shell of metal which is in contact with the gas in the tube, has an area of at least 11 square decimeters per ampere of current used.

When the letters or design of a tube sign have been formed, the short glass tubes holding the electrode assemblies are sealed to the longer tubes of the

The short glass tube (see photo at left) is sealed to a glass sign tube

sign proper, as shown. Then, by means of two pumps—an aspirator and an oil pump—the tubes are evacuated and the desired gas is introduced. The finished letters or designs are then connected to a source of current, whereupon they will glow if there are no air leaks.

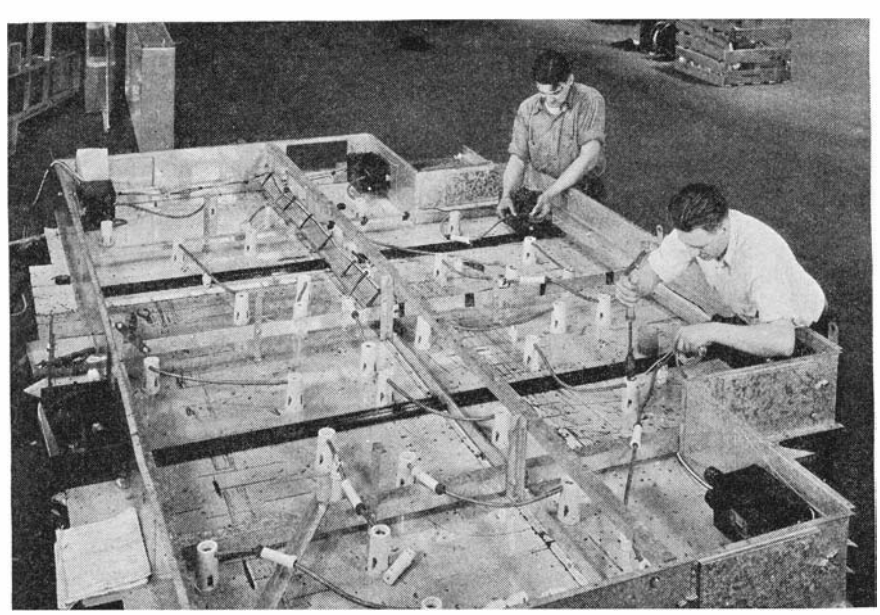
The reason why different kinds of rare gases are used is to obtain varieties of colors in the finished tubes. Neon, the most familiar of the gases, gives a red glow. For blue tubes, argon is used, with mercury acting as a catalyzing agent. A blue glow in an amber colored tube gives green. Helium used alone gives an approximation of white light; helium in a yellow tube glows with a warm golden color.

What makes these tubes of gas glow when an electrical current is applied to the electrodes? Under these conditions, a stream of electrons is shot through the gas and when an electron strikes an atom of the gas with sufficient force, it knocks an electron momentarily from that atom. This loosened electron, however, immediately returns to its original position in the gas atom and the equilibrium of the atom is restored. When this action of ionization takes place, the gas gives off its characteristic glow.

BECAUSE it is necessary to impel the electrons from the electrodes at high speed, high voltages must be used in operating the tube signs. Special transformers with current limiting features have been designed for the work. The largest transformers now in use deliver 30 milliamperes at 15,000 volts. This transformer will operate 60 feet of tubing filled with neon, but the footage capacity of the transformers varies according to the diameter of the tubing and the gas used. The various letters of a sign, or different parts of the design, are connected in series up to the footage that can be operated from one transformer. When longer lengths of tubing must be used, two or more transformers are employed. The current-limiting features of these transformers are such that, under test, they have been left on a dead short-circuit for 48 hours without burning out.

By means of refined designs in tubing and transformers, it is now possible to erect gaseous tube signs without the necessity of using long electric cables carrying high voltages. For example, what is called a "double bore" tubing has been developed by the Federal Electric Company in which the transformer may be directly coupled to the ends of the tubes, thereby reducing to a minimum the fire hazard and the possibility of cable breakdowns due to damaged or otherwise faulty insulating materials.

One of the peculiarities of the light emitted from gaseous tubes is that a surface of brushed aluminum is the best reflector and that a chromium plated surface is not good. In fact, any white surface is generally as good a reflector as any metal, and this feature is frequently used to good advantage in architectural lighting with the tubes, where a plastered surface may be used as a reflector without any special preparation.

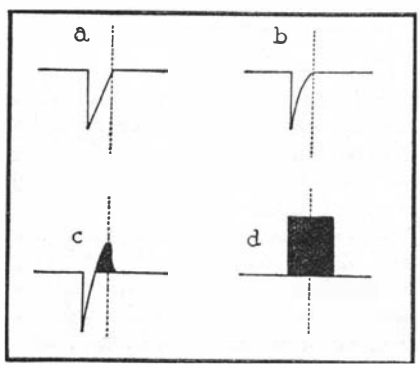


The rear of a gaseous tube sign, showing sockets and connections

THE GREATEST CATASTROPHE OF ALL

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
President of the American Association for the Advancement of Science

FEW if any objects in the heavens are so remarkable as the temporary stars, or novae. The sudden appearance of a brilliant star where nothing has been known before would hardly be credited if it was described only in ancient records, but it has happened not once but often in modern times. Five novae, at least, since the beginning of the present century have been conspicuous to the naked eye, and one of them for a day surpassed all the stars but Sirius. Fainter ones are observed almost yearly, and many more must fail of recognition.



Types of dark and bright lines in the spectrum of a rapidly expanding star. Reproduced from the *Proceedings of the National Academy of Sciences,* July, 1933. The central portions of the disk are approaching us most rapidly, and give the greatest Doppler shift. With a disk of uniform brightness the line appears as at *a,* with a sharp displaced edge and shading off gradually toward the undisplaced portion indicated by the dotted line. If the disk appears darker toward the limb, the less displaced components are weaker, and we get *b.* Later, when the lines begin to appear bright at the limb, we should have *c,* in which the black portion indicates the bright line. Finally, when the shell becomes transparent, we should have the wide bright band *d*

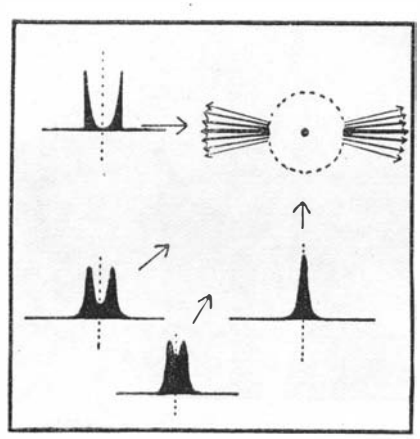
Though the individual outbursts are wholly unpredictable, these strange objects show a strong family likeness. They are not actually *new* stars but faint stars which suddenly blaze out, increasing in brightness thousands or even hundreds of thousands of times. The rise in light is very rapid, often completed in a day or two. Maximum light lasts only a day—occasionally more—and is followed by a decline, fast at first and then gradually slowing, which leaves the star, after a decade or two, of nearly its original brightness. Their distances are too great for direct measurement, but by other methods it is found that even the brightest of modern novae are hundreds of light years away. Before their outbursts they were of commonplace luminosity, some brighter, others fainter, than the sun. At their best they appear to average about 10,000 times the sun's brightness, while some of them reach ten times this.

Spectroscopic observations show an extraordinary series of phenomena following one another in very similar order from star to star. The few stars which, by good fortune, have been observed during the rapid rise in brightness showed dark-line spectra, generally similar to those of stars of the hotter types but with all the lines greatly shifted toward the violet. Just after maximum, wide bright lines appear, changing in intensity almost from day to day, while the displaced absorption lines remain visible. Later on, the bright lines characteristic of the gaseous nebulae appear and strengthen, while the others fade. Years afterward the nebular radiations also vanish and the star, now a little brighter than before the catastrophe, shows the Wolf-Rayet type of spectrum characteristic of the very hottest stars.

THE general explanation of this has been realized for some years. At the time of the outbreak the star ejects gaseous matter in all directions at such enormous velocity that it flies off, despite the star's gravitation, and forms a shell expanding into empty space at a speed some times as great as a thousand miles per second. Absorption of the star's light by the part of the shell in front of it gives the dark lines displaced to the violet, while emission by the rest of the shell (which is approaching as a front but receding at the rear) gives the bright lines widened equally on both sides of their normal positions.

For Nova Aquilae, at least, this expanding shell is not a hypothesis but a fact, for a nearly circular nebula centered on the star has been seen to expand at a uniform rate year by year, while spectroscopic observations show that the widened bright lines originate in this. The observed rate of expansion shows that the distance of this nova is about 1000 light years, so that it is hardly accurate to speak of it as the Nova of 1918, though this is the year in which we saw it.

The outburst of a nova is evidently by far the greatest catastrophe of which we have any knowledge, yet it is rather puzzling that it should be as great as it is, and not greater. The whole amount of light given out even by Nova Aquilae during its whole apparition was of the order of that which the sun radiates in a few thousand years. The corresponding output of energy is enormous, measured by ordinary standards, but an equal amount would be liberated from gravitational sources if a star like the sun contracted by only a couple of hundred miles—an utterly insignificant fraction of its diameter. After the paroxysm, indeed, the star is still there—about as bright to the eye as before. The evidence is, however, that it is much hotter, and hence it must be smaller since otherwise it would be much brighter.



If the gas is ejected in certain favored directions, as indicated by the sketch at the upper right-hand corner, the appearance of the lines will vary with the direction in which the body is viewed. Along the line of ejection (upper left) two widely separated bright lines will appear. For an oblique view (lower left) these lines will be close together. An observer at right angles to the line of ejection will see a single undisplaced line, as indicated at the right

We recall these facts to serve as a background for the newly published and

beautiful work of Professor Donald A. Menzel and Miss Cecilia Payne of Harvard, who have correlated almost all the known data in a consistent theory. They suppose that suddenly the main interior body of a star increases enormously in brightness, probably contracting at the same time, while the surface layers are simultaneously blown outward and start a career as an expanding shell.

If this shell stood alone in space it would cool down and disappear in a very short time, but its inner surface is exposed to a terrific flood of radiation from the enormously hot core. At first the shell is thick enough to be opaque —a few hundred miles of the material just below the sun's photosphere would be amply so. It absorbs the radiation of the nucleus and would itself be rapidly heated if it were not expanding so fast, losing heat by expansion and also by radiation from its ever-increasing surface. An approximate balance between these influences is possible, and appears actually to happen, so that the outer surface of the shell keeps at about the same temperature. The shell acts as a sort of radiation transformer, receiving the "far ultra-violet" radiation of the core on its inner surface, relaying the energy through, and sending it out from the cooler exterior surface largely in the form of visible light. The color of the star's light at this stage will be normal, and the spectrum not unfamiliar in appearance, except for the shift to the violet caused by the rapid approach of the expanding surface. But the brightness of the body as a whole will increase enormously as the area of the surface increases.

A TIME will come, however, when the shell, growing less dense hour by hour, begins to become translucent and then nearly transparent. In the case of Nova Aquilae this appears to have occurred about two days after the start, when the shell was about the size of the earth's orbit.

After this has happened a great part of the ultra-violet radiation from the core escapes into space. It may reach the earth's outer atmosphere but not its surface. Only a small fraction of the radiation of the core is in the visible, and this, with the part of the ultra-violet radiation which is transformed to visible light within the gaseous shell, will supply the visible light of the nova, which will therefore decrease.

The spectrum will now exhibit the characteristic bright bands and displaced dark lines, as described above, but which bright bands will appear most strongly will depend on its density. An atom which emits an ordinary spectral line normally does so within a ten-millionth part of a second after it has been loaded up with the necessary energy. But there are forbidden lines which an excited atom will not emit until it has been let alone for thousands or even perhaps millions of times as long.

Photograph by Knowles Ryerson

Amateur telescope makers and astronomers informally hobnobbing at "Stellafane," near Springfield, Vermont, during their last "get-together," held on July 15. In the foreground is the Porter turret telescope with its long coelostat arm extending to the right, and in the background is a steel tower which was erected to support a coelostat for an instrument which has not yet materialized

In the early stages of the gas shell it will be of fairly high density, like the outer atmosphere of the sun or a star. It will absorb or emit ordinary spectral lines, but its atoms will be disturbed by collisions too frequently to permit the appearance of forbidden lines. As it expands it will gradually develop the extremely low density characteristic of a nebula, and the forbidden lines should make their appearance. Those for which the prohibition is least drastic—that is, for which the latent time before the atom unloads by radiation is shortest—should be the first to show.

Now, among the forbidden lines of the light elements which appear in novae there are two great classes, which our authors call "auroral" and "nebular." On general spectroscopic principles the former should be less severely forbidden than the latter. We might expect them to appear earlier in the development of the nova spectrum, and Menzel and Miss Payne find that indeed they do, while the more exacting nebular lines come up later. The same principle was applied some time ago by Bowen to explain why the green forbidden line of neutral oxygen appears in the aurora, and a pair of red forbidden lines of the same atom in certain nebulae. Every atom which emits the green line should subsequently emit one of the red ones if left alone, and a great many more should emit the red lines only. Hence, in a very rarefied nebula, the red lines should be much the strongest, but in the upper atmosphere, where the auroral streamers appear, collisions between atoms may be frequent enough to interfere with the long latent interval for the red line, but not much with the shorter one for the green line.

Just the same thing happens in the flying shell of gas surrounding the novae—comparing different times instead of different places. The detailed study of the recorded changes will be a fascinating task, which our authors already have in hand.

Finally, as the expanding nebula becomes thinner and thinner, it fades from view and only the central mass is left. By this time its terrific radiation has diminished, but it is still hot enough to blow atoms off its surface by radiation pressure, producing the wide bands characteristic of the Wolf-Rayet stars.

HERE is a very satisfactory theory of what happens in a nova—except for the greatest question of all. What causes the tremendous initial outburst?

A noteworthy suggestion has been made by Professor Milne; namely, that the main inner part of a star may become unstable as regards its internal equilibrium and suddenly collapse to a state of much greater density and smaller diameter. His calculations dealt with a particular model, simplified so as to make it amenable to mathematical treatment; but the principle is doubtless of more general application. It is possible that, in such an event, practically the whole of the enormous amount of gravitational energy liberated by the contraction might be stored up in one form or another in a collapsed mass, leaving but a relatively small amount to be got rid of by radiation. The new and smaller core, however, would at first be exceedingly hot, and the stage appears to be well set for the first act of the Harvard play.

The rapid progress of nuclear physics in the last year makes it reasonable to hope that, before many years have passed, we may know enough to say whether such suggestions are to be accepted.—*Clark's Island, Plymouth, Mass.*, Aug. 3, 1933.

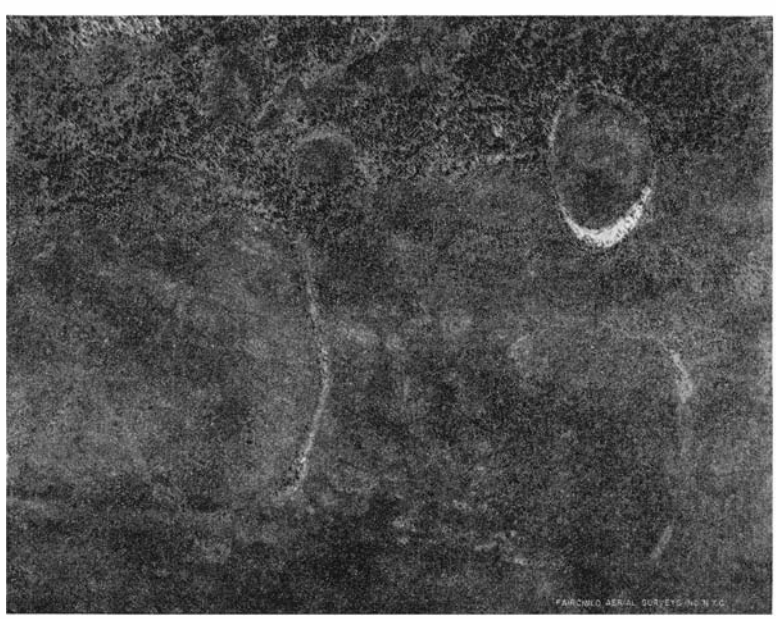
THE CAROLINA BAYS—ARE THEY METEOR CRATERS?—II[1]

By
F. A. MELTON
and
WILLIAM SCHRIEVER
School of Geology, University of Oklahoma

(Concluded from September)

THE depressions in the area under discussion cannot be younger than the Pamlico shore. On the other hand, they cannot be older than the youngest strata in which they have been excavated. From the geological information now available the authors conclude that these beds belong to the Waccamaw formation, of Pliocene age. The time of origin was, therefore, between that of Waccamaw-Pliocene and of late Wisconsin Pleistocene.[2]

In the limited time available for field work it was possible to study only in a reconnaissance fashion beyond the vicinity of Conway and Darlington. This investigation revealed that the area in which these features occur exceeds 10,000 square miles. The limits of this region are shown on the accompanying map; they include the lowland between Cape Lookout and the Savannah River. Judging from the density of distribution in the photographs, one may estimate that the states of North and South Carolina contain at least 1500 easily recognizable bays. Several features which resemble those under discussion were seen within a few miles of the "fall line," but nothing has been found on the crystalline rocks of the Piedmont upland. Aerial photographs are not available, however, to facilitate a search of this higher terrane. The elliptical shape and elevated rims were found to be developed typically throughout the region. Furthermore, the major axes of the bays seem to maintain, at least approximately, a direction of S. 45° E. Exact surveys must be made, however, before one can be sure that there are no important exceptions to the average alinement.



Some of the bays are partially obscured by beach ridges

It is probable that the bays of the entire coastal plain were developed during or prior to the formation of the well-known surfaces of marine planation. On the older and higher terraces essentially the same relationship exists between volume of rim and area of bay that is found on the relatively young Pamlico surface, where the beach ridges are still clearly seen.

It is significant that these features are not known to exist elsewhere on the earth's surface. Apparently they form a unique and limited cluster. A careful examination of aerial photographs of other coastal plains has failed to reveal them, though large areas remain unexplored by photographic means. They should not be confused with the numerous "sink holes" or solution basins, of more or less irregular shape, which dot the southern coastal plains. This mistake has often been made, however, so inconspicuous are the bays to an observer on the ground. Even the topographic engineers, if one may judge from published maps, have failed to see the most significant relationships.

Facts which any theory of origin must explain: 1. Elliptical plan. 2. Nearly parallel alinement. 3. Elevated rims completely encircling some of the bays. 4. Elevated rims invariably predominating at the southeastern end. 5. Ellipticity increasing with size. 6. Double and triple rims. 7. Intersecting bays; integrity of shape being maintained by either large or small bays in different cases. 8. Similarity between the sand in the rims and that found by drilling through the carbonaceous soil in the bottom of the bays. 9. Probable absence of bays in the Piedmont upland.

ELLIPTICAL indentations in a shore, or elongate submarine depressions similar to the features under discussion, never have been found in process of formation so far as the authors have been able to determine. Glenn suggested that the origin may have been due to the construction of bay-mouth bars by shore processes, though he at once pointed out the weakness of this hypothesis, which did not explain the symmetrical shape.

Wind action may be eliminated for several reasons. The direction of the longer axes of the bays, approximately S. 45° E., is not parallel to the main wind direction of the region at any season of the year. Only a prevailing northwesterly wind could have built the rims of sand around the southeastern end of the bays. In the monthly average wind directions for the entire state of South Carolina during the 528 months from 1887 to 1930 inclusive, there was a northwest average in only 24 instances. During the year from May, 1930, to April, 1931, inclusive, in northeastern South Carolina, an average direction from the northwest was reported only three times, though each of the five stations in this area reported monthly. The prevailing winds of the region are without doubt from the southwest, 90 degrees from the mean direction of

[1]Reprinted by courtesy of the *Journal of Geology*, University of Chicago Press, and the authors.

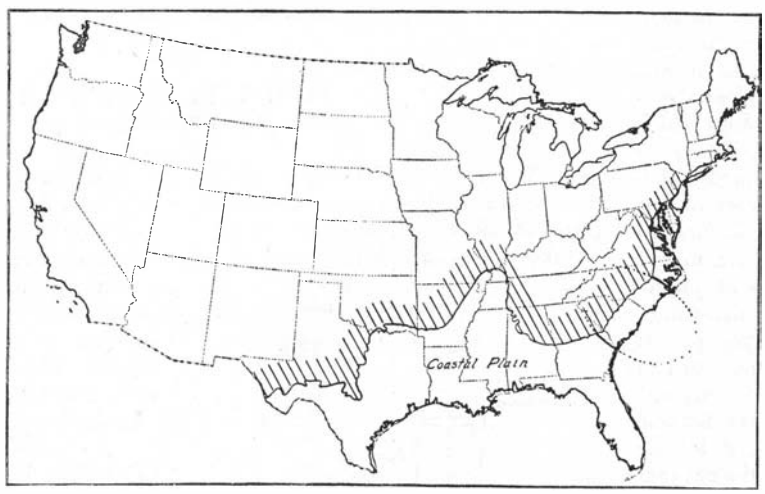
[2]That is, something like 2,000,000 to 10,000 years ago.

[3]*Op. cit.*, p. 474.

the long axes of the bays and from the chief direction of sand movement in the construction of the rims.

The formation of such regular and smooth depressions is not known to be characteristic of wind scour; and, moreover, sand is not now being moved to any noticeable extent by the wind, except in special and restricted localities such as the shore. Even if the prevailing winds were from the appropriate direction this hypothesis would not suffice to explain the formation of a rim completely encircling a bay.

L. L. Smith recently has assigned the origin of the coastal plain depressions to the dissolving action of ground water, charged with organic acids, upon minerals containing iron and aluminum.[4] The authors are of the opinion that Smith has demonstrated the existence of this dissolving action, at least in the case of sink holes, but they question that it has been the cause of the typical bays here discussed. An increase in the leaching power of ground water beneath the depressions could well be a result of the existence of these features, but not necessarily a cause.



Map of the coastal plain in the southeastern part of the United States, showing approximate limit of the bays. The surface included by dotted oval is believed to represent the minimum area in which similar features originally existed. The authors have stated elsewhere that "a hypothesis involving impact by a globular meteor 400 miles in diameter seems to account for the existent surface conditions in a qualitative manner." A real comet! Since this map was drawn, bays have been found over a much wider area, extending the spread from Norfolk on the north to Georgia, and the area to 40,000 square miles

THE process of solution does not explain the existence of rims of sand. That these have been built of material removed from the depressions is apparently shown by the close relationship between their size and that of the enclosed bay. How can solution alone be offered to explain the uniform and regular ellipticity of the basins unless another hypothesis be presented describing the development of soluble masses of this shape? The exceptional, small bay which is almost entirely enclosed by a larger one seems to present a situation which could not be explained by solution under any reasonable assumptions. At least two such cases may be found within the area which has been photographed and others are known to exist.

Intrusive or extrusive processes can hardly be presented to explain the formation of bays, because of the regular shape. Volcanic fragments are not in evidence; furthermore, recognized manifestations of vulcanism have been practically absent in late geologic time along the eastern and southern Atlantic coast. The action of glaciers or of floating ice seems to be beyond consideration. Glaciers worthy of note probably did not exist even in the highest mountains of the Blue Ridge during the Pleistocene period. Some phase of submarine scour by large fresh-water springs, by undertow, by oceanic eddies, or by any combination of these activities might possibly be suggested, but the authors doubt that such processes could produce the results found. Many bays which are now free from dense vegetation, and are thus open to examination, show no evidence of springs. The effects of undertow should bear some relationship to the trend of the shoreline; yet between Georgetown, South Carolina, and Cape Fear, North Carolina, the bays maintain the orientation independently of a change in the direction of the shore amounting to 70 degrees. The extent to which oceanic eddies may erode the bottom is unknown, but it is believed that the consistent shape, alinement, and rim relationships, as well as the great variation in size, eliminate this unknown and perhaps highly irregular process. The authors are unable to conceive of the nature of a submarine activity which could produce such depressions on the ocean bottom. The situation which existed here while the surface was under water was similar to that found on many other coastal plains; yet the bays appear to be a unique phenomenon restricted to this region.

Since the origin of the bays apparently cannot be explained by the well-known types of geological activity, an extraordinary process must be found. Such a process is suggested by the elliptical shape, the parallel alinement, and the systematic arrangement of elevated rims. Consider for example the collision of a shower of meteors with the earth and determine if such an event is capable of explaining those facts which any acceptable theory of origin must explain.

1. Meteors striking plastic material at angles between 35 and 55 degrees from the vertical would produce indentations elliptical in outline.

2. The meteors in a single shower would move toward the earth along nearly parallel paths and would leave indentations with major axes approaching parallelism.

3. The material of the earth would be thrown out in all directions by the impact and would gather around the depressions. Hard strata would probably be shattered into fragments both large and small, though it is doubtful that pieces of large size could form in fine-grained, unconsolidated, and water-saturated clastic sediments.

4. If the cosmic masses approached this region from the northwest, the major axes would have the desired alinement. More material would be thrown toward the southeast than in any other direction, thus making the rims larger at this end.

5. As the meteors approached the surface, small bodies would be retarded by the earth's atmosphere more than would the large ones. The former would thus spend more time in the atmosphere than the latter and would be given a greater vertical-component velocity by gravitational attraction. The small bodies would therefore, strike more nearly vertically than the large ones and their impact scars would have the observed relationship of smaller ellipticity.

IF the region in which the bays are found is of the same order of size as the entire area subjected to this supposed bombardment, the meteors must have struck the surface during a period measurable in minutes, probably within half an hour. At this latitude a point on the surface rotates through an arc approximately 850 miles in length during one hour. A distance as great as the breadth of the coastal plain would thus be traversed within ten minutes.

6. Multiple rims could be produced

(*Please turn to page* 188)

[4] L. L. Smith, "Solution Depressions in Sandy Sediments of the Coastal Plain in South Carolina," *Jour. Geol.*, Vol. XXXIX (1931), pp. 641-53.

THE AMATEUR AND HIS MICROSCOPE—IV

USE AND CARE OF THE INSTRUMENT

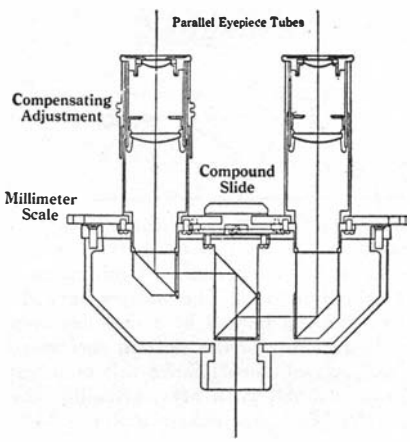
By
FRANK CHALLIS
and
JOHN F. BRANDT
Bausch and Lomb Optical Co.

(Continued from September)

WHICH eye do you use? The matter of eyes is always a most troublesome point to beginners. There are on the market binocular eyepieces for standard microscopes which allow both eyes to be used. But a binocular eyepiece adds from 25 dollars to 50 dollars to the cost of the instrument, hence very few of us will have these. No, we shall have to use one eye, just as thousands of microscopists have done before us. Either eye will do—whichever one you prefer. But, from the very beginning, learn to keep both eyes open. There is only one way in which microscopy can become harmful to vision, and that is by the practice of squinting closed the eye that is not being used. This practice causes a strain which will eventually do harm.

At first, when you keep both eyes open because of habit, the image in the microscope and the other things seen outside it by the other eye will be superimposed on one another. If, though, you persist, very soon you will learn to concentrate only on the image in the microscope and the field of view of the other eye will not be noticed. It is surprising how quickly the brain learns to cut out this unwanted image. To make it easier, place the 'scope on a dull black piece of paper. However, if you would rather not go to the trouble of learning this little trick there is a way around it. Cut a small rectangle of dull black cardboard of a size large enough to cover both of your eyes. In one side on this rectangle cut a hole just large enough for the eyepiece of your microscope to pass through but not large enough to pass the upper end of the eyepiece, which is always larger. Now place the eyepiece back in the tube and swing the cardboard around, so that when you look in the microscope it will block the vision of the eye you are now using. You still keep both eyes open but the dull black cardboard will not interfere with the image in the microscope.

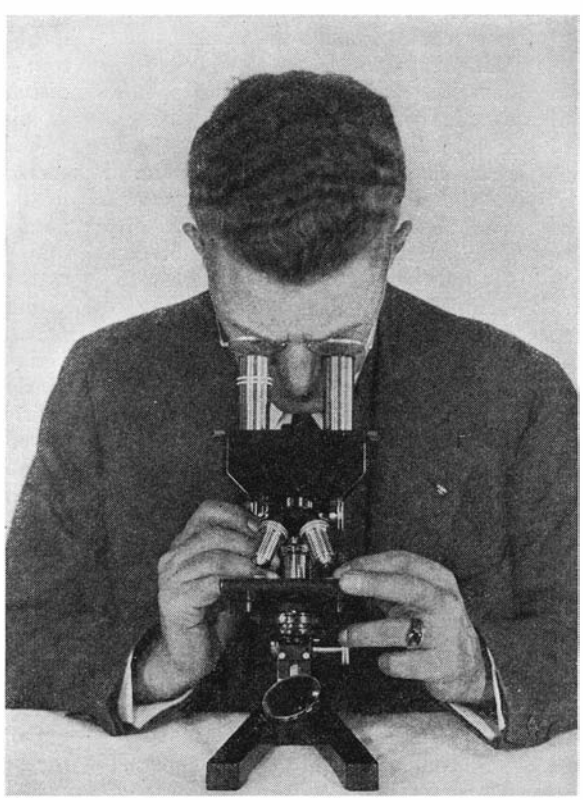
HOW can you determine when the microscope is in proper focus? Here again only experiments can give the answer. When the specimen is seemingly in exact focus, if we turn the fine adjustment one way the specimen suddenly takes on a dark border, and as we turn the fine adjustment the other way this dark border moves in towards the center to form a black line. Where does this dark area belong? I can't tell you—you will have to find that out for yourself by many observations and by comparison of your observations with pictures which will appear in these articles and which you may find in books on microscopy.



How the binocular eyepiece at the bottom of the page is assembled

TO most beginners this variation in focus appears to be merely focusing on different planes of the specimen, but this is not the case. When you have a specimen in liquid there will probably be several air bubbles under the cover glass. Bring one of these under the objective and focus the fine adjustment up and down. The rings moving in and out certainly would give anyone the impression that he was focusing right up and down through the globular bubble, but in fact only the upper surface of the bubble, where the tension of the water refracts the light rays, is seen. What is being observed, as we focus up and down through the bubble, is the appearance of refraction rings at different distances, and not the sides of the bubble. The same thing happens with any specimen.

How are the hands placed? The pictures can tell the story better than words. You will find that if your microscope has a fine adjustment you will be constantly twiddling it back and forth to adjust for the split-second changes in the focus of your eye or the movement of your specimen. Notice in the picture that the right hand is placed so that it is braced by the last three fingers, the little finger resting on the stage. The arm should be bent at a comfortable angle, so that it will not tire and cause those minute spasms in the muscles which make your hands shake when you are fatigued. The left hand is also braced on the stage with



The proper position of the hands and head when using the binocular type of mon-objective scope

the thumb and forefinger grasping the slide, in order that it may be moved around slowly and smoothly. Remember that any movement under the microscope will be multiplied by exactly the power of its magnification.

Of course, movements under the microscope are all in reverse, and at first are just about as troublesome as trying to arrange a bow tie in front of a mirror. After a week or so, however, you will get used to this reverse movement and it will seem quite natural to move the slide towards you when you want the specimen to move away from you.

Incidentally, it might be of interest to learn that microscopists have fallen into the habit of referring to the different sections of the image in accordance with the position they would have on the face of a clock. If a specimen is at the top and a little to the right we refer to it as being at about one o'clock, or between one and two o'clock.

How the right hand is rested on the stage for the easy manipulation of the fine adjustments. It gives accurate and steady control

What care does a microscope require? First of all, always cover your microscope when it is not in use, and make sure that it is free from dust at all times. Allowing the microscope to stand uncovered will not only harm the appearance of the stand, but, more importantly, will in time affect the lenses so that they become corroded and consequently cloudy. Also, if you continually have to wipe harsh and gritty dust from the lenses they will become scratched. If you do have to wipe dust from the stand, first use a camel's hair brush, and then wipe gently with a chamois skin in the direction of the grain of the finish.

Showing the correct method of bracing the left hand when moving the slide: thumb and forefinger are grasping the slide, the middle finger on the stage

When handling the stand always grasp it by the pillar or the curve in the arm, never by the body tube or the stage. The former will quickly ruin a good focusing adjustment, and the latter is likely to loosen the stage or throw it out of the exact alinement which is absolutely necessary.

The microscope does not need to be oiled. Microscopes are precision instruments with each part fitted exactly and friction reduced to a minimum. Oiling them, even with watchmaker's oil, will eventually cause trouble. However, it is advisable to clean out the teeth of the coarse adjustment with a soft toothbrush now and then.

REMEMBER that the lenses of your microscope are made of a very soft glass and can easily be scratched. Only the lens paper, sold by your microscope dealer or photographic supply store, should ever be used in cleaning them. The location of dust on the lenses is very easily determined. If black spots appear on the image which you believe should not be there, first examine the mirror to make sure that it is free of dust. If it is not, wipe it off with lens paper. Next, turn the eyepiece slowly in the tube. If the black specks move with it you can be sure that the dust is on one of the lenses of the eyepiece. Remove the eyepiece and wipe gently with the lens paper. If all the black spots have not now disappeared there is only one remaining place for them to be: in or on the specimen. Dust particles, and so on, on the objective lenses never show as black spots in the field, but simply cloud the image. Therefore, examine the objectives periodically. Do not clean these unless necessary. If they do require cleaning, wipe both the top and bottom lenses with the lens paper. Objectives are so made that no dust could possibly get inside of them.

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¶ *Next month look for an article telling the amateur how to culture bacteria in his own home, written by Dr. J. D. Corrington of Ward's Natural Science Establishment. There is nothing difficult about the cultivation of bacteria; they are simply a crop of vegetables. For example, a piece of lettuce or some dry grass is dropped into a quart jar and left to stand for a few days, and there you have it—bacteria and fun. There are other ways of accomplishing similarly fascinating results with a modicum of simple equipment, mostly available 'round home.*

Some of the best results in scientific research have been accomplished by real enthusiasts who were forced to economize, while the "most impressive collection of fancy materials on earth" may actually have the effect of diverting the worker's enthusiasm from real things to a sort of worshipful attitude toward it as a collection. But one must have one thing—a microscope.

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¶ By an arrangement with SCIENTIFIC AMERICAN, the Bausch and Lomb Optical Company has kindly offered to send their microscope instruction book free of charge to our readers. This book, "The Use and Care of the Microscope," is the one they regularly enclose with their microscopes. Address, Bausch and Lomb Optical Company, Dept. FF-1, 635 St. Paul St., Rochester, New York.

THE INHERITANCE OF DISEASE

To What Extent and in What Circumstances are Cancer, Tuberculosis, Goiter, and Syphilis Inheritable?

By CHARLES B. DAVENPORT, Ph.D.
Director of the Department of Genetics of the Carnegie Institution of Washington

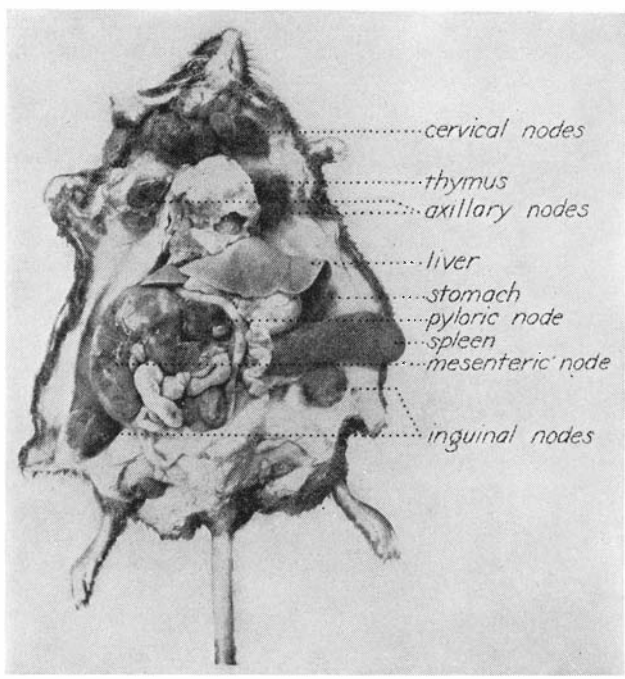
A DISEASE is the reaction of the organism to some physiologically detrimental agency which interferes with the vital processes by chemical or mechanical means.

From this definition it appears that a disease depends both upon the nature of the inciting agency and the nature of the organism. This dual aspect of disease is too often neglected—even medical men may assert that tuberculosis is due to the bacillus tuberculosis, and that is all there is to it. A moment's consideration, however, will show that this is not the whole story, for bacillus tuberculosis can be grown in a nutritive medium without causing in the culture medium the symptoms of tuberculosis as we know them in humans. Also, the germs of tuberculosis may be inoculated into a horse without symptoms of tuberculosis, as we know them in humans, appearing.

Now, it is true that different human diseases may be due to different parasitic organisms, like the bacteria. The bacillus that causes typhoid is a relatively large, elongated flagellate organism; the organism that causes pneumonia is a vastly smaller, spherical body. These two kinds of bacteria cause, respectively, typhoid fever and pneumonia because they live in different organs of the body. They multiply in diverse fashion, they kill by somewhat different fashion. But not only are the disease-inciting bacteria different, but humans are different. Even in a territory where goiter is exceedingly common not all of the inhabitants are affected by goiter, even though the conditions of life are for them the same as those whose thyroid gland becomes enlarged. Persons differ in their reaction to disease-inciting agents. This is a fact that we are apt to lose sight of. We speak of a child, a man, a woman, as though all children, men, and women were alike, but human beings have as many different constitutions as have the different races of dogs.

The foregoing general principles may be illustrated by reference to the relation of constitutions and disease-inciting agents in the case of two or three of the commoner diseases, such as cancer, tuberculosis, and goiter.

Cancer is the name applied to a cell proliferation beyond the normal process of development, or repair, of the individual. The growth, if not interfered with, may progress until vital tissues are involved and eventually destroyed. Cancer occurs in all races of mankind and also in many of the lower mammals. As the lower animals can be more readily studied experimentally, we know more about cancer in them than in humans, but there is every reason for believing that the same laws of inheritance of cancer hold for mice and men.



A mouse, used in the study of the inheritance of disease, affected with leukemia, opened up to show the effects on the viscera. The spleen is increased to many times its normal size and the lymphatic nodes, ordinarily small, are huge. Leukemia is nearly always fatal

Among the tumors that have been most carefully studied, in mice, is one known as "leukemia." It is a tumor of the white blood cells and is found also in humans. These cells multiply enormously in the spleen and other essential organs and cause them to enlarge to many times their normal volume, destroy their function, and cause death.

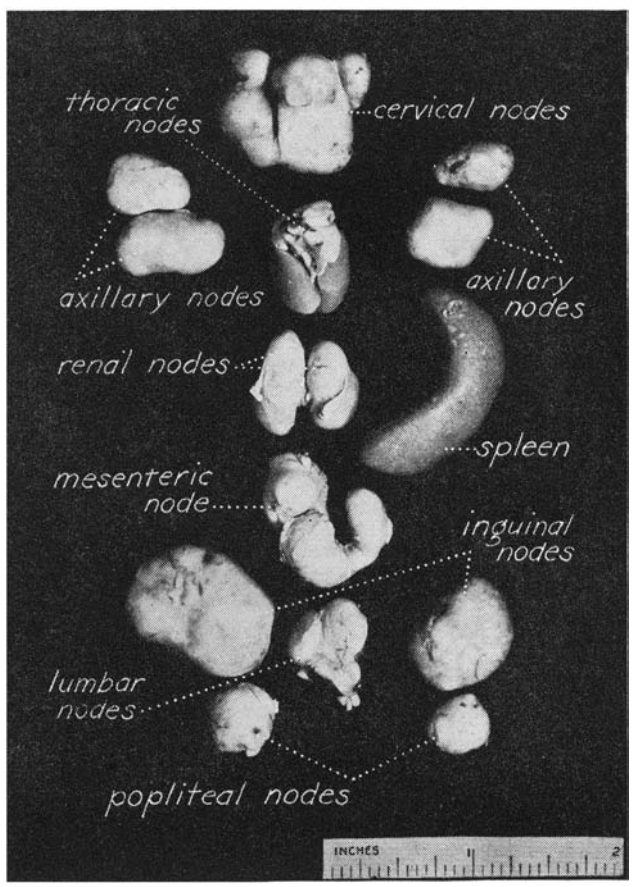
Now there are certain strains of mice in which leukemic individuals, from time to time, appear. In such strains of mice the leukemic white blood cells may be taken from an individual dying of leukemia and inoculated into a young mouse of the same strain. Ordinarily, so young a mouse would not die of any form of cancer, yet if inoculated it will probably quickly succumb to the transplanted cancer. If, however, the cells be taken from the same leukemic mouse and transplanted into a mouse of another strain in which leukemia has never appeared, then nothing will happen. The mouse will continue to live and behave normally.

THE conclusion to be drawn from this experiment is that the constitution of the individual is quite as important for the progress of the disease (cancer) as the internal factors that promote abnormal growth. At the same time it must be said that different lines of tumor-inducing cells have varied virulence, and some are able to overcome the individual resistance which is sufficiently strong to overcome the ordinary type of tumor cell.

The results from mice may, as stated, be applied to humans insofar as the general results go; namely, both constitution and inciting agent are important in the result. However, while it is comparatively easy in highly inbred strains of mice to find strains which are resistant, or, on the other hand, susceptible to tumor growth, this is not at all the case in humans. For humans are bred in such random fashion that any resistant strain is constantly being mixed with non-resistant

strains, so that the resistance and non-resistance come out again in the offspring in the most mixed possible fashion. The most that can be said is that the incidence of resistance in the offspring is higher where parents belong to highly resistant strains, or, on the other hand, the susceptibility of the offspring is higher where both parents are themselves susceptible to tumor growth.

The hereditability of tuberculosis has been long debated. The doubts on the matter may be resolved by the general principles already set forth. The symptoms by which we recognize human tuberculosis appear only when the bacillus tuberculosis of a certain grade of virulence is growing in a human being that is non-resistant to it. First of all it must be recognized that non-resistance to tuberculosis is a widespread phenomenon. Observations at autopsies reveal that nearly every adult carries lesions that indicate an active infection at some time of tuberculosis, and the subsequent encystment of the germs in an innocuous state. When a person in middle life, who has shown no active symptoms of tuberculosis, suddenly succumbs to the disease we are not to think of him as having just become inoculated by the bacillus tuberculosis, but rather that he has lost resistance and the germs which have hitherto lived symbiotically in his body have gained the upper hand. Of course, a possibility exists that he may have just acquired some extraordinarily virulent form of tuberculosis to which his constitution is not as resistant as it has been to the forms of less extraordinary virulence.



The lymphatic nodes and spleen of the mouse shown opposite, slightly reduced from the original in size. The enormous increase in size of the nodes was due to infiltration of the rapidly multiplying white cells of the blood

VARIOUS attempts have been made to demonstrate the effect of inheritive susceptibility to tuberculosis. It has been shown that, where one of a married pair has tuberculosis, the consort is less liable to show the symptoms of tuberculosis than one of their children. The inference drawn from this fact is that the constitution of the host is as important as the parasite. The married pair are usually not blood relatives, and hence have a different constitution, whereas the affected parent and his children are blood relatives and may well inherit the same constitution. Were tuberculosis merely a matter of infection then one would expect that the consorts, living in close association, would be more apt to show the symptoms of the disease than the parent and children who are in less intimate association. Some objections have been found to this line of argument because of the different age of consorts and children. Thus, the children may be more susceptible, just on account of their age, to infection from the affected parent, whereas the consort would be more resistant on account of his greater age.

The most convincing evidence of the inheritance of tuberculosis is found in a study made recently by Diehl and Verschuer in Germany. These authors have studied 16 pairs of twins. In one group of seven pairs, which were uniformly and similarly exposed to tuberculosis and in which only one pair showed tubercular symptoms, six are of dissimilar heredity and only one of identical heredity. Of nine pairs of twins, in which one member of the pair has presented to the other, often over many years, a most severe danger of infection while the other has remained (during the period of observation of from 5 to 15 years) healthy, eight are of dissimilar and only one pair of identical heredity.

From these facts the conclusion is drawn: If we expect, on the basis of environmental and infectional conditions, the illness of both members of the pair, and despite this find only one member of the pair ill, this is in consequence of the fact that in the great majority of the cases the pairs of twins have a dissimilar heredity.

In pairs of twins with similar heredity the authors found similar relations to tuberculosis in 70 percent of the cases. dissimilar in 30 percent, while in pairs with dissimilar heredity there was a similar relation to tuberculosis in only 25 percent of the cases, and a dissimilar relation in 75 percent. That is to say, the dissimilarity in reaction of twins both exposed to infection was two and a half times greater when the heredity of the twins was dissimilar than it was where the heredity was quite certainly identical. The authors conclude that the difference between one-egg twins and two-egg twins, in their relation to tuberculosis, is almost exclusively a consequence of the similar heredity constitution of the one-egg twins on the one side and the dissimilarity of constitution of the two-egg twins on the other side. This dissimilarity of the two types of twins in their reaction to tuberculosis is so great as to bring definite proof that the heredity constitution is of determinative significance in the incidence of tuberculosis.

HERE again, as in cancer, the constant mixture of resistant and susceptible strains makes it difficult to assert that any given individual is susceptible or resistant. Where, however, both parents are thus susceptible and belong to susceptible strains it is clear that the danger of tuberculosis in the offspring is much greater than where both parents, and their near of kin, have resisted the ubiquitous germs. The acceptance of this fact should not be regarded with pessimism. Just as the realization of inherited susceptibility should lead the individual, who suspects his susceptibility, to build up by the most approved methods his individual resistance, so a person who has reason to suspect that his constitution is highly resistant to tuberculosis can afford to be less careful in this respect.

Goiter is an enlargement of the thyroid gland in the neck which may often attain such a size as to be disfiguring, and may interfere with breathing so as to be a menace to health and even to life. Near the eastern seaboard of

our country goiter is relatively little known, but in certain mountain valleys of the Appalachian system, in the region of the Great Lakes, and in the north-west the incidence of goiter rises to alarming figures, 25 percent to 30 percent, or more of grown persons may be affected with this disease.

In regard to the causes of goiter there has been much difference of

Susceptibility to goiter runs in certain families but not in others

opinion. Some have ascribed it to the insufficiency of iodine in the water and food. Since the amount of iodine in the intake is very high along our eastern and Gulf coasts the thyroids are supplied with sufficient iodine, but where the iodine content of the environment is low the thyroid gland responds by enlargement to overcome, as it were, by quantity the insufficiency in the quality of secretions. For one school this variation in the iodine content is sufficient explanation of the variation in the incidence of goiter.

BUT this explanation is not sufficient, for if one travels in a region where goiter is endemic (that is, arises in large numbers in the locality), one finds that a certain proportion of the population are unaffected, and that unaffected individuals belong to particular families. On the other hand, affected individuals generally belong to families with high incidence of goiter. A study of the incidence of goiter in such a region leads to the conclusion that individuals differ in the efficiency of their thyroid glands, and certain families are characterized by high efficiency of the gland. In such families, even if the iodine supply is small, the thriftiness of the affected thyroid gland enables it to meet the bodily demand for iodine without enlargement. On the other hand. in other families, the thyroid gland is so inefficient, possibly so wasteful, that in these cases the iodine supply is insufficient to enable the thyroid to meet the demands of the body, and so it enlarges.

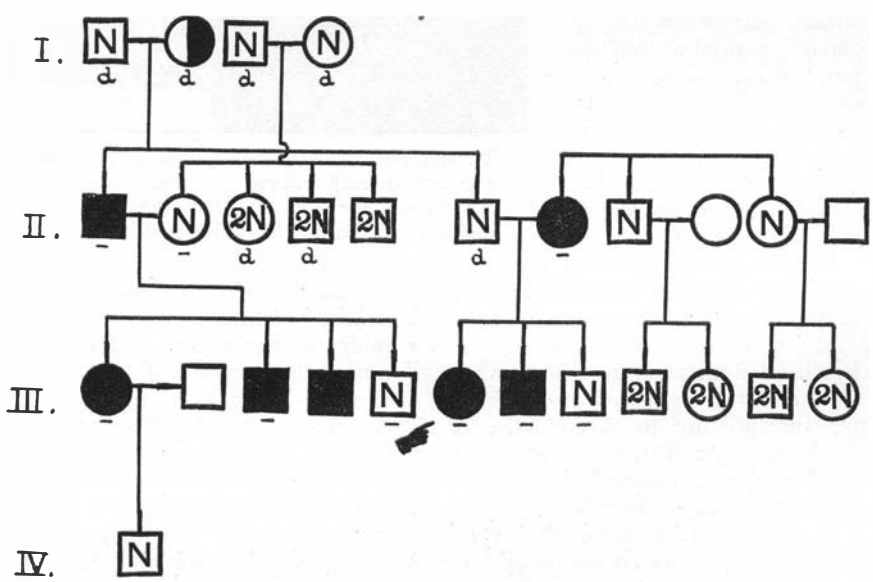
The symptom, enlarged thyroid gland, occurs when the iodine in the environment is insufficient to supply the prodigal thyroid gland, though it may be sufficient for the thrifty thyroid gland. It is thus seen that constitution plays quite as important a part in the result as environmental conditions.

Syphilis is often cited as a hereditary disease, but from the genetical point of view this is a mistake. The symptoms of syphilis are due to the reaction of the body to a form of bacteria known as Spirocheta. The Spirocheta penetrates into all parts of the body and causes destruction of tissues. An infected person, who becomes a parent, may infect not only his consort but the infected consort may, through the placenta, infect the embryo. It has even been asserted that if the embryo thus affected develops to maturity and becomes a parent that infection may be handed over to a third generation. The demonstration of this assertion is, however, inadequate.

It appears, therefore, that in the recurrence of syphilis in the offspring of syphilitic parents we have not to do at all with heredity in the ordinary sense, but only a case of infection of offspring from the parent. In the same way the germs of white diarrhea are carried in the adult hen without causing her much discomfort, but they may be passed into the egg at the time of secreting the egg yolk, so that the chick that develops from the affected egg early shows the symptoms of white diarrhea, which is a widely fatal disease. There are a number of other diseases that may be passed from generation to generation by infection that belong to quite a different class than hereditary diseases, for true hereditary diseases depend on special organic particles called genes, which are passed from generation to generation in the germ cells, and in no other way.

THE conclusion of the whole matter is that in the production of disease the relation of environment and disease-inciting agents to the constitution is such that only when a balance between them is disturbed do the symptoms of the disease appear. It is for those who suspect a weakness to maintain, by such methods as are available, such constitutional resistance as they may command. It is for those who recognize their own constitutional insufficiency to avoid intermarriage into a family with a similar constitutional insufficiency, in order that the children shall not get, as it were, a double dose of this susceptibility from both sides of the house.

This is the teaching of eugenics in respect to hereditary diseases. As a distinguished pathologist has recently stated, "pathology and genetics must henceforth work hand in hand. The physician must consult with the eugenicist."



A pedigree chart which illustrates the variation of the inherited tendency to enlargement of the thyroid gland of different members of a family complex living in the same valley under similar conditions. The males are represented by squares and the females by circles. The second generation (marked II) shows, at the left, the effect of the inter-marriage of a goitrous man (black symbol) with a normal woman (white circle) having unaffected brothers and parents: they have four children, three goitrous. A brother of the goitrous father marries a goitrous woman and they have three children, two goitrous. Two siblings (brother and sister) of the goitrous mother just mentioned marry unaffected consorts and have eight non-goitrous children

FROM THE ARCHEOLOGIST'S NOTE BOOK

A Ctesiphon Stucco Wheel

THE Sasanian dynasty, 226-637 A.D., inaugurated one of the most brilliant periods in the history of Persian art. The excavations at Ctesiphon, one of the capitals

of the Sasanian empire, revealed some of the splendors of the famous palace. See SCIENTIFIC AMERICAN for November, 1932. One of the stucco wheels, three feet in diameter, shown above, which was repeated in a balustrade, has found a home in the Metropolitan Museum of Art.

Etruria the Mysterious

THE Etruscans were a peculiar people living in central Italy in the historical classical period. Their origin is still disputed, their language is undeciphered, yet they played an important part in history. They were a people of foreign origin, who enriched Italy with their heritage and at the same time identified themselves with their adopted country. At the beginning of the 6th Century B.C. they became the greatest power in Italy. Two terra cotta warriors—seven and eight feet tall—now displayed in the Etruscan gallery of the Metropolitan Museum are shown at the *left* and *right*.

A Pheidian Amazon

PLINY'S well-known tale of the competition of the three great Greek sculptors, Polykleitos, Pheidias, and Kresilas, has arrested the attention of archeologists for over 80 years. The Lansdowne Amazon, illustrated in SCIENTIFIC AMERICAN for June, 1933, was of the Polykleitos type; now the Metropolitan Museum of Art has acquired a beautiful little Greek or Roman copy of Pheidias's conception of the same subject. The Amazon below is supposed to be leaning on a spear as indicated by a drawing on a gem, since lost. The material is Pentelic marble. Should the Museum acquire a copy of the statue by Kresilas, the cycle would be complete. The originals are all unfortunately lost, but we know that the copies are faithful.

A Plaited Straw Helmet

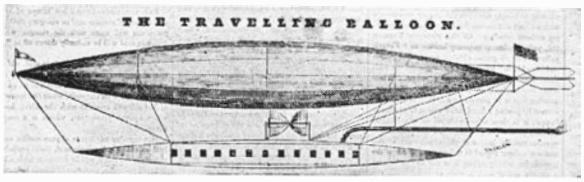
WARM weather and the weight of armor caused the Emperor Charles V (1519 to 1556) to have a milliner or an armorer fashion a light and cool substitute for the contemporary steel helmet which it resembles in shape and ornament. At a distance the general effect is of an elegantly ornamented and gilded helmet as shown below. The hat still possesses its original silk lining.

SCIENTIFIC AMERICAN

and its Intimate Connection with

THE PROGRESS OF AVIATION

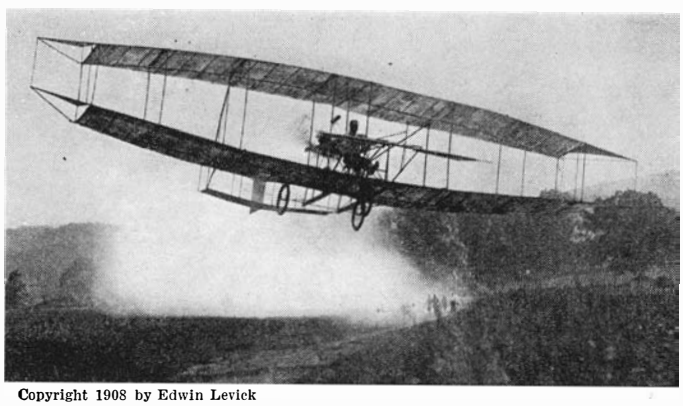
THE first aviation article published in SCIENTIFIC AMERICAN appeared in the September 18, 1845 issue, and described a "travelling balloon" designed by Rufus Porter, then editor of this publication. In view of the present-day development of lighter-than-air craft, this forerunner of the Zeppelin is of interest because of the many features which it presented. A greatly reduced reproduction of the original engraving appears on this page. The gas container, held in shape by longitudinal metal struts running the entire length of the bag, was covered with varnished linen cloth and inflated with hydrogen. The gondola was provided with water-tight tanks so that it would float in case of a forced landing on water. For other emergencies, parachutes were provided for the passengers. The propulsive means was a steam engine of two horsepower, operating spiral "fan wheels" placed amidships. Steering was to be accomplished by means of rudders located aft.



1845—The dirigible of Rufus Porter

THIS brief description of the "travelling balloon" touches only the highlights; the reports in the old issues went into far more elaborate discussions of the various details. In the same manner, the editors of SCIENTIFIC AMERICAN have constantly kept its readers in touch with the latest developments in man's conquest of the air. The work of Langley, the Wrights, Curtiss, Bleriot, Zeppelin, and other pioneers has been spread before the reading public through these pages. But SCIENTIFIC AMERICAN has not been content to act merely as a reportorial medium for aviation activities. The editors have felt it to be their constant duty to encourage, both by word and by act, further progress in aerial activities. Thus there have appeared from time to time articles that tend to stir the imagination, that serve as food for thought. Also, there have been trophies offered for certain feats or for developments which would indicate that forward steps had been taken in the art.

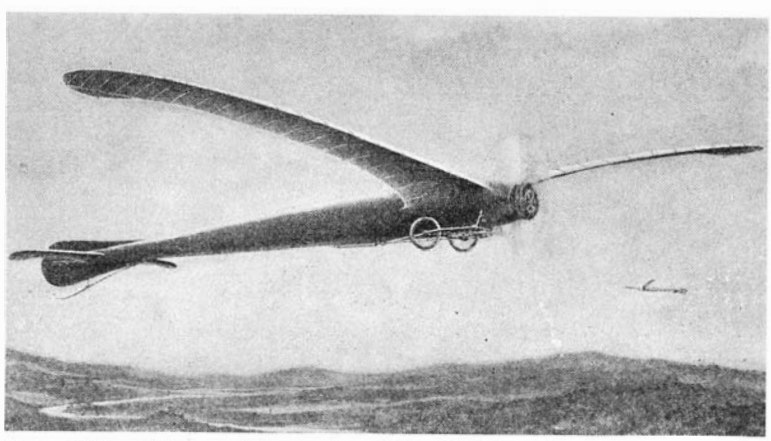
In 1907, the first SCIENTIFIC AMERICAN Trophy was offered for the longest cross-country flight of the year, the rules making it necessary for one contestant to win the trophy three times in succession in order to obtain permanent possession. This was the first prize of any kind ever to be offered in this country in connection with aviation. In 1908, 1909, and 1910, Glenn H. Curtiss made brilliant flights that each year earned the prize; and so, in the January 14, 1911 issue, SCIENTIFIC AMERICAN announced that the Trophy had become the permanent property of Mr. Curtiss. We reproduce here photographs of Mr. Curtiss taking off on one of his flights, in the *June Bug*, and of the Trophy.



Copyright 1908 by Edwin Levick

1908—The Curtiss *June Bug* in flight

The October 22, 1910 issue was a special Aviation Number, devoted almost entirely to the subject of flight in all its phases. One of the most significant articles to appear at that time was written by J. Bernard Walker and was entitled "The Racing Aeroplane of the Future—A Study." Remembering that this was written in 1910, when aviation was still very definitely in its infancy, note the following quotations from that article: "The present wood-canvas-and-wire construction will have to go. It is makeshift work at best, and was adopted because . . . it offered a cheap and light combination of materials. . . . Its place will be taken by some one of the many remarkable alloys ... metals of enormous strength and toughness in proportion to their weight. The use of these, coupled with careful designing by the skilled engineer, will make it possible to produce an aeroplane of much greater strength that will weigh no more than the present machine and present far less resistance. . . . Fast flying birds fold their legs snugly beneath them in flight. The racing aeroplane must do the same. We show a suggested arrangement for a folding



1910—"The aeroplane of the future"

chassis ..." Page 317 of issue mentioned.

All-metal construction and retractible landing gear in 1910! Truly this was a glimpse of the future of the airplane, even though the author of the article did underestimate the possibilities of future speeds when he wrote: "It is conservative to expect from such a machine, after it has been developed by experimental work, speeds of from 100 to 125 miles an hour."

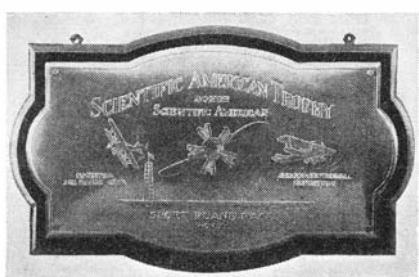
In 1925, the SCIENTIFIC AMERICAN Trophy race in the National Air Races was restricted to planes with engines of less than 80 cubic-inch piston displacement. With these tiny engines of less than 20 horsepower, some remarkable speeds were made, the Trophy being awarded to "Jerry" Dack, who drove his little Powell biplane at an average speed of 76.41 miles per hour over the 50-mile course.

THE Trophy awarded by this magazine in 1926 was for a race between larger planes than the previous year. This time engines of 300 cubic-inch displacement were allowed, and the planes had to carry a minimum load of 170 pounds, exclusive of gas, oil, and water. The course was a closed triangle, five miles around, and the race consisted of 12 laps. The winning pilot, A. H. Kreider, was awarded the bronze plaque for completing the race at an average speed of 94.5 miles per hour.

The 1929 contest was of an entirely different nature from any other that we have sponsored. This time the aircraft designer was given an opportunity to demonstrate his ability to make working plans for a plane that would meet certain requirements. The first prize consisted of a gold medal and 500 dollars. Out of a group of complete designs for small planes, which represented a tremendous amount of labor on the part of the entrants, the one submitted by James P. Rigby was finally selected as the winner. The prize was made possible by the co-operation of Col. R. Potter Campbell of the American Cirrus Engines, Inc., with SCIENTIFIC AMERICAN.

The *Scientific American* Trophy of 1933

Above: **The first *Scientific American* Trophy, awarded to Glenn H. Curtiss in 1911.** ***Left:*** **The Trophy awarded at the National Air Races in 1925.** ***Below:*** **The plaque won in 1926 by A. H. Kreider in a race for sport planes.** ***Right:*** **Two of the three medals awarded for light-plane designs entered in the *Scientific American* contest in 1929**



A still different type of contest has been arranged for this year. Another SCIENTIFIC AMERICAN Trophy will be awarded at the National Charity Air Pageant, under the auspices of the United States Amateur Air Pilots Association, to be held at Roosevelt Field, Mineola, New York on October 7th and 8th. In the contest for this prize, sports plane pilots will be given an opportunity to demonstrate their ability to make improvements on their own planes. Only manufactured planes are eligible for this contest, in which the award will be made to the pilot who, in the opinion of the judges, has made the most outstanding improvement on his or her plane since its purchase. The judges will take into consideration three factors when making their decision: safety, scientific advancement, and improvement over manufacturer's advertised performance.

THIS latest trophy to be offered will become the outright property of the winner. There are no restrictions on entrants other than that they be members of the sponsoring pilots association. The committee for this award will consist of Prof. Alexander Klemin of the Daniel Guggenheim School of Aeronautics, chairman, James B. Taylor, Jr., and Jerome Lederer.

Minor awards that have been presented by SCIENTIFIC AMERICAN this year consisted of subscriptions to the same publication, which were given to three winners at the 1933 National Championship Model Airplane Meet, and to one model builder at the State Model Airplane Meet held in Connecticut.

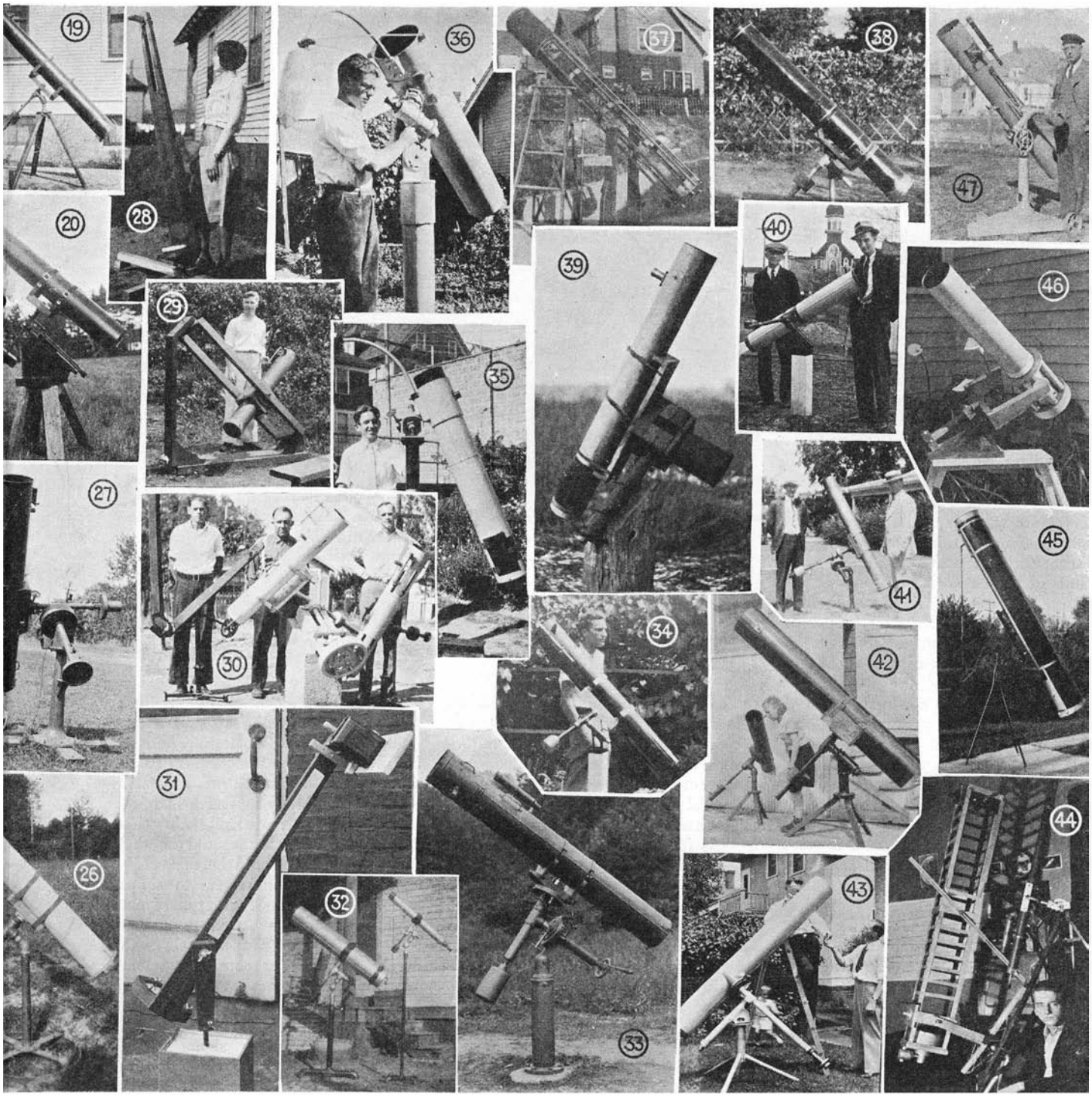
Just as SCIENTIFIC AMERICAN has pioneered in the past in reporting the outstanding achievements and developments in aviation, and has lent its support to worthy projects whenever feasible, so will it continue in the future. In the SCIENTIFIC AMERICAN Digest department of each issue we shall, as always, describe the latest advances in the art of flying with the same eye to accuracy that has prevailed in the past. Longer articles on aviation will continue to be featured whenever the importance of the subject warrants such treatment.

A Recent Crop of Reflecting Telescopes, Made by Readers of Thi

MARTIAN "astronomers" equipped with telescopes that magnify "trillions" of diameters must wonder what has happened on earth within recent years. Telescopes in every Earthian's back yard, on his roof. Excited Earthians making more telescopes by day, hardly time enough left to use them at night. The very Earth bristling with tubes pointed skyward. Big as the Martian's telescopes are (in the fiction yarns, anyway) they cannot find the real Incitant: a single volume bound in red, "Amateur Telescope Making." That book started a real hobby, and above are some of the real hobbyists with their handiwork.

It is regretted that more space cannot be given to the individual descriptions, but this would fill a special magazine. How many would subscribe to one?

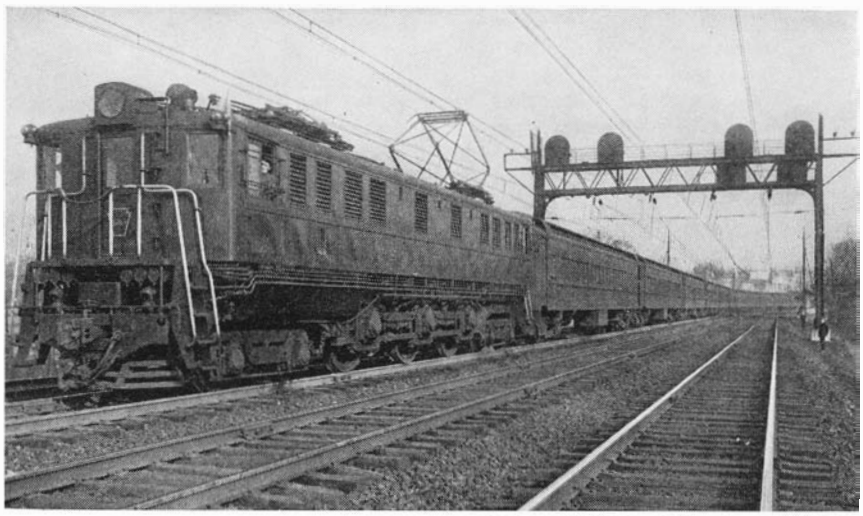
(1) Six-inch skeleton tube Newtonian type, made by Edward Shapranski and Michael Stopen, 540 Sayre Ave., Perth Amboy, N. J. Cost, ten dollars. (2) Henry Schoultz and Homer Hagstrom of the Minnehaha Academy, Minneapolis, Minn., and six inch telescope with finder. (3) The seventh of a series of telescopes made by Ralph Menke, 625 Jefferson Ave., Hebron, Nebraska. (4) Myron A. Elliott, 1120 W. Prairie St., Taylorville, Ill., used a wooden tube and obtained better seeing than with a previous metal tube. (5) An old Ford rear axle, two worms from an Essex window, and a finder made of a spectacle glass and a linen tester are embodied in this telescope, made by Horst Irmer, 1137 S. 73 St., Milwaukee, Wis. (6) F. C. Keniston, Natick, Mass., made this one for spotting rifle targets. (7) Edward Katyll, 3416 N. Keating Ave., Chicago, and a 4-inch refractor. The objective is by Bausch and Lomb. (8) A five-inch reflector made by Baxter Eaves, 265 S. Hirst St., Philadelphia, and a friend. (8A) Glynn Reavis, 148 S. Olive, Pittsburg, Kas., and a 7-inch reflector. Mounting made of Ford parts and pipe fittings. (9) A tubeless reflector made by C. C. Carter, State's Attorney, Winchester, Ill. (10) Niilo Koivisto, Wadena, Minn., and a 6-inch telescope magnifying 110 diameters. Demountable two-part portable tube for transportation in a car. (11) Custer C. Baum, 904 Eleventh Ave., Helena, Mont., and telescope, which he says "works admirably." (12) Telescope built in a remodeled chickencoop, by C. F. Welsh, 1120 S. King St., Honolulu. "How this telescope-making 'disease' does spread" he writes. (13) Arthur De Vany, 929 Grand Ave., Davenport, Ia., says, "I have made at least ten mirrors of sizes 6 to 16 inches. Give me a junk yard and I will build you a good telescope." (14) D. R. P. Coats, manager of broadcasting stations CJRW-CJRX-CJRM, Winnipeg, writes, after making this telescope, "I never tackled anything which made such demands on my patience, and I have rarely completed anything which has given me such a happy feeling of worth-while accomplishment." (15) L. St. John Hely, M.D., Richmond, Calif., with one of several telescopes he has made. (16) Dr. E. L. Price, Jr., 1802 Jefferson Ave., Nashville, and 6-inch telescope which "gave excellent results." (17) "Building a telescope from the instructions in *Amateur Telescope Making* is a pleasure which one will not soon forget," writes T. L. Pettigrew, 904 N. Acacia St., Compton, Calif. (18) Joseph Leerman, 3019 East Baltimore St., East Baltimore, Md., with his skeleton tube telescope. (19) "The entire outfit cost me 35 dollars," says J. E. Nuquist, 1417 Q St., Lincoln, Neb. "Mars is very plain, the moon most interesting." (20) Andrew Beneker, 166 South St., Concord, N. H., says, "The entire telescope cost me only 20 dollars." (21) J. C. Elkins, high school teacher, 229 Carillo St., Santa Rosa, Calif., and his 10-inch telescope. (22) A little 4-inch Herschellan telescope, with hemispherical base to facilitate swinging, and adjustable "scissor" control, made by John H. Hindle,



SCIENTIFIC AMERICAN AND THE BOOK "AMATEUR TELESCOPE MAKING"

Haslingden, Rossendale, Lancs., England. (23) H. P. Matthews, 107 East Main Highway, Copperton, Bingham Canyon, Utah, with a portable telescope which, he writes, "shows the polar caps on Mars very distinctly; the bands on Jupiter are remarkably clear." (24) "I have read fine newsprint at a distance of four city blocks with this 8-inch telescope," says A. H. Hearn, 1004 S. W. 25 St., Oklahoma City, Okla., "and headlines three miles away." (25) A 6-inch reflector made by Robert S. Stewart and John H. Nelson, 256 East 37 St., Brooklyn, N. Y. (26) Portable telescope made at a cost of ten dollars by Cecil Olmstead, of Armona, Calif. (27) Arthur E. Chennell, 4804 Algonquin Road, Des Moines, with Alfred Anderson, made this instrument. In it are: "three brake drums, two valve handles, a marking machine pedestal and gears from a cream separator." (28) A "spinal column" telescope made by Bob Burns, 326 Courtland, N. E., Atlanta. Mrs. Burns is in the picture. (29) James Babcock, State College, Pa., states that this 6-inch reflector was made at a cost of $17.70. (30) Jack Wells, Walter Hanisch and Carl Wells, 417 Oak St., Roseville, Calif., and their three reflectors. (31) A six-inch tubeless mounting, with camera attached for lunar photography, made by Keith K. Kimball, Fairways Apts., Pelham Manor, N. Y., for use on a roof. (32) Two telescopes—a 2½-inch refractor and 6-inch reflector—made by Paul R. Weise, 3308 Cobb St., Dallas, Texas. (33) The mirror in this telescope is the eighth made by Clarence T. and Arthur H. Jones, 210 Glenwood Drive, Chattanooga, Tenn. (34) George A. Tirpak, 68 Jackson St., Passaic, N. J., says this telescope "has been worth the time and labor spent." (35) "This telescope has exceeded in every respect all expectations as to its capacity, lack of distortion, magnification and so on." So says its maker, Leo G. Glasser, Jr., 160 Madison St., Wilkes-Barre, Pa., who continues: "A never-failing source of delight is the look of wonder on the faces of visitors at their first glimpse of the rings of Saturn seen through it." (36) Lawrence Davenport, 743 Pacific Ave., Long Beach, Calif., constructed this entire instrument at a cost of 27 dollars. The mounting is welded throughout. (37) A 9¼-inch telescope with skeleton tube of channels and angles, made for 35 dollars, by Joseph A. McCarroll, 521 Palisade Ave., Teaneck, N. J. (38) H. F. Bachman, 203 E. 12 St., North Platte, Neb. says that, with this telescope, "the craters of the moon, Jupiter's satellites and the rings of Saturn can be seen very plainly." (39) Made by Orville Guthrie, Route 2, Mukwonago, Wis. (40) Bert Felsburg and his father, of Frackville, Pa., and their six-inch telescope. (41) J. B. Witherspoon, banker, and Dr. J. M. Browder, dentist, of Weatherford, Texas, made this one at a cost of $22.95, largely from discarded materials. (42) Latest of several telescopes built by H. E. Devereaux, 253 Horton Ave., Lansing, Mich. The mounting is made of standard pipe fittings. Mirror, 9 inches. (43) Dr. Bert R. Carlson, 3756 27th Ave. S., Minneapolis, Minn., with Theodore Haeussler, musician, made this 10-inch reflector. Magnification, 320 diameters. (44) Skeleton tube reflector made by Edwin P. Martz, Jr., 726 N. Elmwood Ave., Oak Park, Ill., who used a four-dollar microscope for his eyepiece, giving powers of 130 and 220 diameters. (45) A 10½-inch reflector made by Vince Stasny, 4724 South 13 St., Omaha, Neb. Cost, about 25 dollars. The light mounting is merely temporary—it would be too light for permanent use. (46) A little 3½-inch portable "motor car" telescope made by Charles A. Lower, 1032 Pennsylvania St., San Diego, Calif. The mounting is entirely of wood. (47) Carl Elias (address lost) and an 8-inch reflector. Mr. Elias, a true enthusiast, has about ten telescopes, one being a homemade 4-inch refractor.

THE PENNSYLVANIA ELECTRIFIES



Powerful electric locomotive of the type used on the electrified portion of the Pennsylvania Railroad. Overhead trolleys and other details are shown here

By J. V. B. DUER
Electrical Engineer, Pennsylvania Railroad

THE Pennsylvania Railroad is engaged in what is one of the greatest, if not the greatest, single electrification project ever undertaken in this country, or in any other. It consists in the electrification of 1082 miles of railroad track, serving the great cities of the eastern seaboard from New York to Washington, and extending westward to the Susquehanna River, in the heart of Pennsylvania. This project was announced by the management of the railroad in the latter part of 1928, and was planned to extend over a period of years, various sections and extensions to be constructed as conditions warranted. It was planned to handle not only passenger trains, thus adding to the comfort and convenience of the thousands of passengers carried in this territory, but freight trains as well, thus improving the reliability of this most important service, and expediting the handling of millions of tons of freight annually.

Just as Rome was not built in a day, this tremendous project was not decided upon overnight. There were many important questions to be decided before it could be known whether such a major undertaking could be justified.

THE function of a railroad is to serve the public, as far as transportation is concerned, in the way the public wants to be served, and this problem is being continually studied with a view to so developing the art that a better and greater service can be rendered. Also, as in any other business, the railroad must make some returns on the capital invested if it is to survive.

In considering the electrification of a steam railroad, therefore, two of the vital questions that must be answered are: 1—How and to what extent will this improve the service rendered the public? 2—Will the expense of the electrification be justified by the returns received from the investment?

The service to the public is composed of passenger and freight transportation. As has been mentioned, electrification brings added comfort to passengers and may, in some cases, reduce the scheduled time of trains. Electric operation of freight trains will decrease the time of freight in transit, as well as improve the reliability of prompt delivery of material. It is, of course, imperative that both of these services be rendered the public at as low a cost and at such speed as is consistent with safety, convenience, and reliability of operation.

In order to reach a decision as to the use of electric power for the handling of this transportation, it was necessary to be sure that adequate and reliable electrical equipment was, or could be made, available. And in order to have a basis for determining this all-important question, it was necessary to decide what system of electrification would be best suited for the needs of the traffic in the territory involved. These two questions had to be decided before the time and expense of estimating the cost of this major project could be justified.

There are two systems of electrification in use in America for trunk line service. One is the direct-current system, with 600, 1500, or 3000 volts impressed upon the third rail or trolley wire. The other is the alternating-current system, with a voltage of 11,000. At the time the study was undertaken, The Pennsylvania Railroad had in service for suburban traffic 89 route miles, or 275 track miles, of the latter system of electrification—that is, 11,000 volts alternating current. Ever since the electrification to Paoli, Pennsylvania, in 1915, the engineers of the railroad had been studying this problem, and it had been decided that the alternating-current system was best suited to the requirements of The Pennsylvania Railroad service.

With this as a basis, it was possible to proceed with the study of the equipment situation, with which the engineers were, of course, continually in touch. There were many angles to this study. Could satisfactory locomotives, both for freight and for passenger service, be produced? What type of substation would best suit the needs of the service? How frequently should these substations be spaced, and what should be their capacity? What should be the voltage of the transmission system to supply these substations? What type of construction should be used to support these transmission lines as well as the overhead trolley or catenary system? What would be the effect of the electrification on the railroad's own and other neighboring communication systems? What would be the best signal system? Where should the tremendous amounts of energy required be obtained? What would be the demands of the service 10, 15, or 20 years in the future? These and many other important questions had to be considered. Needless to say, each of these problems, in itself, required a careful and exhaustive study, including consideration of relative cost and reliability, the state of development of the art, and the trend of future developments.

THE study on locomotives disclosed that developments in motor design would permit the use of smaller motors than had heretofore been used to provide the same or greater horsepower. This was important as it permitted placing the motors between the driv-

ing wheels, thus eliminating the necessity for side rods and jack shafts. These and other improvements in design and materials were sufficient to warrant the decision that satisfactory locomotives would be available.

Studies of the other questions resulted in the decisions that the voltage of the transmission system should be 132,000 volts; that the transmission circuits should be carried on the same structures that support the catenary system; that, in general, four such circuits should be provided for; that, while inductive interference with communication circuits would be present, it could be adequately taken care of; that adequate sources of power would be available at convenient points; and that it would be entirely possible so to design and construct the system as to provide for expected future growth.

WITH these questions decided, it was necessary to make a detailed and careful estimate of the costs of the project and of the savings to be expected. After the entire study was completed, the decision was reached and the announcement made by the management that the railroad would proceed with the electrification.

At the time this announcement was made, the only non-electrified suburban service operating out of the Philadelphia terminal was that between Philadelphia and Trenton, and between Philadelphia and Norristown. The railroad had inaugurated extensive improvements in the Philadelphia terminal area, including a new underground suburban station, and it was necessary to complete the suburban electrification in time for the opening of these new facilities. This was done, and electric service was inaugurated on the above sections in the summer of 1930.

While construction was still in progress on the suburban electrification, work was started between Sunnyside yard on Long Island and New Brunswick, New Jersey. This section of the railroad, which includes the Pennsylvania terminal area in New York, presented some of the most difficult problems of construction and operation. Sunnyside yard consists of a multiplicity of tracks with many switches, cross-overs, and so on. It is here that most of the trains leaving Pennsylvania Station are made up. The Pennsylvania Station area in Manhattan is likewise a complicated network of tracks, as well as being an exceedingly busy terminal. A total of 521 trains, including those of the Long Island Railroad, leave and arrive at this station daily.

Pennsylvania Station is served from the east by four tunnels between Manhattan and Long Island. These tunnels presented an important and difficult problem, as clearances were small and a catenary system carrying a pressure of 11,000 volts requires most careful utilization of space when such space is at all limited. Furthermore, the entire area between Sunnyside yard and Manhattan Transfer, a distance of approximately 13 miles, was already electrified with a direct-current, third-rail system, and this, in itself, presented many problems which would not otherwise have been met.

There were, of course, other busy terminals, such as Philadelphia, Baltimore, and Washington; but none of them presented all of the difficulties which had to be overcome in New York. This work has been successfully completed as far west as Manhattan Transfer, and trains have been operating with alternating-current locomotives in this area for some months.

The next step in the program was closing the gap between New Brunswick and Trenton. This section of the railroad presented no major problems which are not met in any large electrification project. This work, as well as that between Manhattan Transfer and New Brunswick, is now completed, and passenger trains are being operated electrically between New York and Philadelphia. This electric operation will include New York-Washington trains as far south as Wilmington, Delaware, and trains from New York to the west as far as Paoli, Pennsylvania.

The construction between Wilmington, Delaware, and Washington, D. C., has been started, but is not, at present, actively progressing.

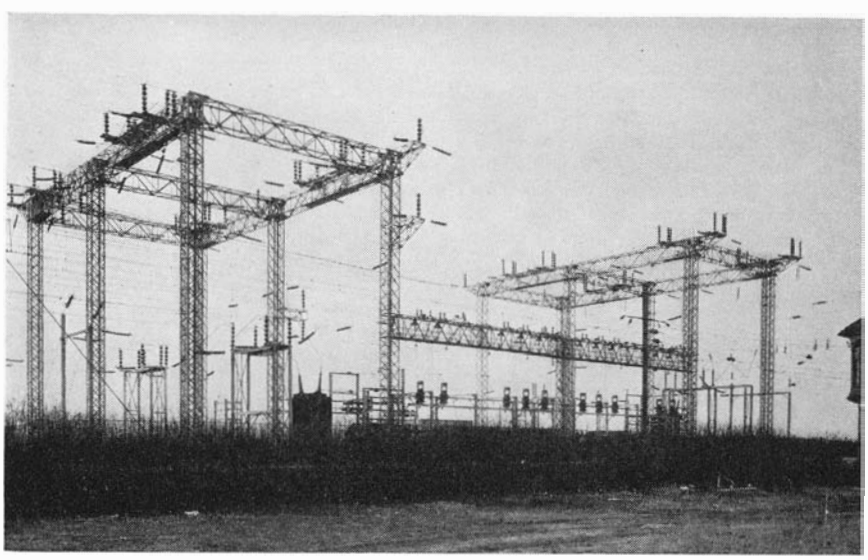
AS has been mentioned, the 132,000-volt transmission lines are carried along the railroad on the structures which supply the catenary system. At the sub-station locations, which are at intervals of from six to ten miles, these circuits are arranged so that they may be sectionalized and taps are taken from them through disconnecting switches to the transformers. These transformers step the voltage down to 11,000 volts.

One of the most interesting considerations concerns the locomotives, which have been already mentioned briefly. In the first place, those for passenger service must be fast, relatively light, and powerful. Two types of engines will be used for this service—one with four driving wheels and one with six. They will develop 2500 and 3750 horsepower, respectively, and are both capable of speeds up to 90 miles per hour.

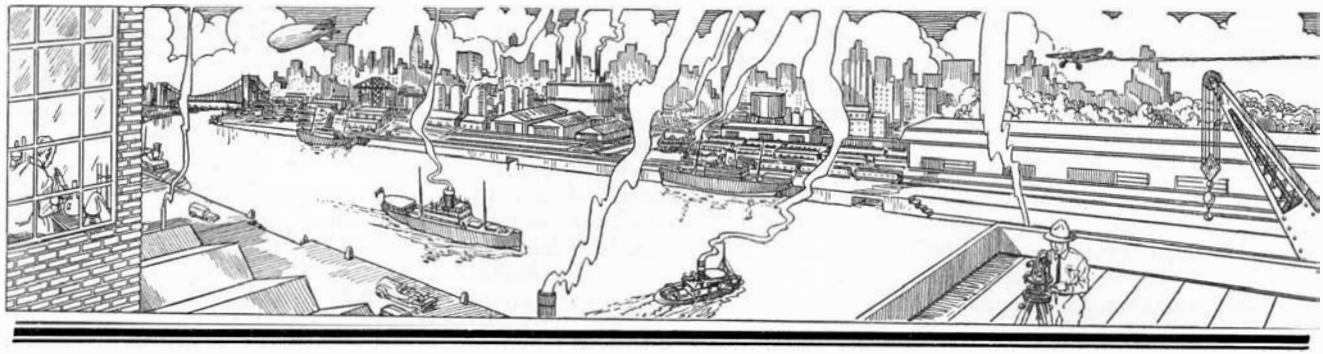
The freight locomotive, designed for lower speeds, has eight driving wheels and will develop 2500 horsepower, with a maximum speed of 54 miles per hour.

It is expected that approximately 816,000,000 kilowatt hours per year will be required for the operation of trains when this project is completed. This is probably sufficient energy to furnish light for over one million small homes.

It would, of course, be possible to quote numerous statistics covering the vast amount of copper and steel and cement and other materials which will be used in this project, as well as the amount of freight and the number of passengers which will eventually be transported by electric power, but such statistics would be of primary interest only to a few. From the engineer's standpoint, the project presents the opportunity for the realization of an ideal of service. Its magnitude and its possibilities are great enough to stir the imaginations of the most prosaic. The accomplishment of harnessing that giant modern slave, electricity, to the great fleet of trains of The Pennsylvania Railroad and forcing it to perform the arduous labors of transporting thousands of passengers and millions of tons of freight is one of which those who have helped with the project may feel justly proud.



Typical step-down sub-station, showing the transformers, the high-tension lines over the sub-station, high-tension switches, lightning poles, and other details



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

Photography With Semi-Invisible Flashes

BY specially coating the inside of Mazda photoflash lamps with a peculiar dark blue dye, the glare or visual annoyance of flashlight photography is reduced to a practical minimum and the really brilliant flash remains visible to the camera but hardly noticeable to the eye, according to J. H. Kurlander, engineer of the Westinghouse Lamp Company, Bloomfield, New Jersey.

The dye coating on the bulb reduces the

Dyed photoflash bulbs reduce glare for certain photographic effects

ordinarily visible light emanations by some 50 to 75 percent, making the flash appear as a soft blue glow instead of the familiar brilliant white light from the standard clear bulb photoflash lamp. Yet the photographic effectiveness of the remaining blue light for some photography is not seriously impaired as it falls in that region of the light spectrum having high actinic value.

"Where a photograph for record and not so much for artistry of color is the important aim, the combination of a photoflash lamp emitting only the very short wavelengths of light together with a plate of the ordinary kind that is sensitive to these wavelengths, suggests a photoflash lamp of this unusual quality," Mr. Kurlander said. "Many lamps of different colors are being studied for their effects on different subjects and, while not commercially available, are of interest in showing how, with the photoflash bulb, there can be a color control heretofore impossible with flash paper and powder."

Aluminum Welding Flux

A NEW all-purpose aluminum welding flux, Oxweld Aluminum Flux, has just been announced by The Linde Air Products Company. This new flux is intended to replace the two fluxes previously marketed, one for welding pure aluminum and the other for welding aluminum alloys, and is said to do everything that they would do.

Submerged Shotgun Bursts

USERS of shotguns have for many years discussed the question of whether or not a shotgun will explode when the entire gun is held beneath water. Recently we were asked this question but it appeared that no definite answer had ever been obtained by test. We therefore asked our friends, the Remington Arms Company, Inc., if they would conduct such a test for us so that we might settle the question once for all. This test was recently conducted by their ballistic engineer, Major W. E. Witsil, and he reports as follows:

"A 12-gage Remington double-barrel shotgun was used in the test. The gun was totally submerged in water to a distance of approximately 24 inches. One shell only was fired, this being a 12-gage 'Arrow Express' 6c loaded shot shell. Firing of one barrel resulted in the opening of that barrel longitudinally for a distance of 10⅛ inches, the burst beginning 16¼ inches from the breech. It is concluded from this test that the water was responsible for the shotgun burst.

"When the shot was fired, a report not unlike the sound of a 22-caliber cartridge being fired, was heard. No unusual disturbance of the water was noticeable. A series of air bubbles of very short duration was observed."

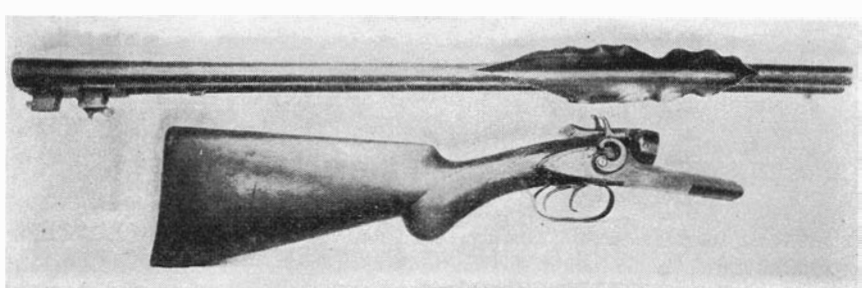
Metals in Teeth May Generate Electricity

IT is well known that when teeth are repaired or replaced with different kinds of metals, electricity may be generated in the mouth just as in the cell of an electric battery. Cases in which this electricity caused pain and sores in the mouth were recently reported to the American Medical Association by Dr. Everett S. Lain, professor of dermatology and radiology at the University of Oklahoma School of Medicine.

Human saliva is a good electrolyte, Dr. Lain has found from repeated experiments. Thus every mouth in which there are plates, bridges, crowns, or fillings of dissimilar metals may become a complete galvanic battery.

If all the crowns, amalgam fillings, and other dental material in a mouth are made of the same metal, or of metals nearly alike in electromotive force, there is no trouble. Gold and silver and copper, for example, are not so different in this respect, so that when their ions are dissociated by the saliva, hardly any current is generated.

But the difference between gold and certain other common dental metals, such



When this shotgun was discharged under water, the barrel burst

as aluminum and zinc, or the recently suggested chromium, is quite large. When two such dissimilar metals are used in the same mouth, they may act as the two opposite poles of an electric battery. The current generated is sufficient to cause serious trouble, Dr. Lain has found.

Dentists have for many years recognized the possibility of electric shocks and nerve soreness resulting when dissimilar metal dentures happen to come in contact, Dr. Lain pointed out in his report. To avoid such occurrences, they have made a practice of grinding short one of the metallic contacts. Dr. Lain suggested that manufacturing dental laboratories should try to supply dentists with materials of the same electro-potentiality to avoid producing in the mouth a current strong enough to cause trouble.

Dr. Lain examined more than 300 mouths which contained dissimilar metallic dentures. Nearly three fourths of them showed some signs of the electric current action.—*Science Service.*

Gulf Stream Overrated as Maker of Weather

THE Gulf Stream is not responsible for the changes in America's climate popularly attributed to it, says the Weather Bureau, United States Department of Agriculture. The true course of this "river of the sea" is shown in a chart recently prepared by the bureau's marine division from its long-time records of the temperature of north Atlantic waters. Although the current preserves its identity in the Florida straits, it merges more and more with the vast north Atlantic circulation as it goes north.

The contrast between the high temperature which the Gulf Stream carries up from below Cape Hatteras and the low temperatures coming in from the open Atlantic around the Grand Banks of Newfoundland produces a rather sharp margin in current and temperature, the warmer water flowing northeast past the colder water that moves more sluggishly southwest. This contrast is most marked in winter.

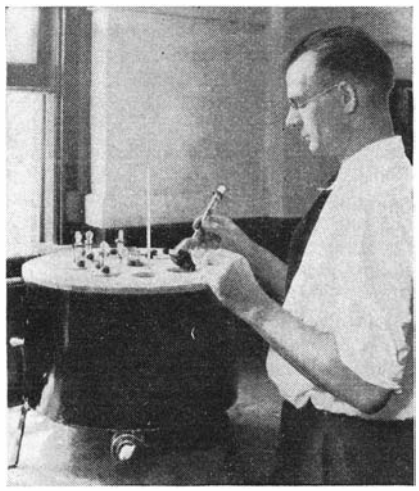
Only in winter is the Gulf Stream accompanied by temperatures far above those of the surrounding waters, the map shows. The effects of the Gulf Stream on the weather are more pronounced in Europe than in the United States, although it does exert some influence along the southern part of its course. The Gulf Stream is not responsible for the predominance of mild winters along our eastern seaboard since about 1905. The climate there, the Federal weathermen point out, is the result more of what happens over the land to the north and west than of what happens over the sea to the south and east.

A Correction—Gladly Published

WE learn that our statement on page 112 of the September number—that the 40-inch refracting telescope at the Yerkes Observatory was nightly used for opening the Century of Progress Fair at Chicago, in connection with a photo-electric cell and relays—was wrong, in that the big telescope was used thus but once—on the opening night. Director Otto Struve of the Observatory advises us that "it would have been entirely contrary to the purpose and spirit of a research institution to continue these performances nightly. . . . The Yerkes Observatory did not participate on any of the nights following the opening ceremony."

Aluminum Oven for Chemical Laboratory

ONE chemist who isn't taking any chances with test tubes and bottles exploding in his laboratory is J. G. Ford of the Westinghouse Electric and Manufacturing Company. His invention, primarily a safety device, now appears to have other advantages which may recommend it as a standard piece of chemical laboratory equipment. Mr. Ford has designed an oven made of a solid block of aluminum in which he heats such samples as *may* explode. The new testing oven is designed for the Sligh oxidation test of oil samples, a test to determine the tendency of an oil to "sludge" or become "gummy." A small quantity of the oil under test is placed in a flask and the space over the oil filled with pure oxygen. The flask is stoppered, then placed in an oven which is maintained at 392 degrees, Fahrenheit. At this high temperature, the pressure of the oxygen increases and the oil sample becomes highly volatilized. Though very seldom, the test sample sometimes explodes.



An aluminum casting is used as an oven in the chemical laboratory

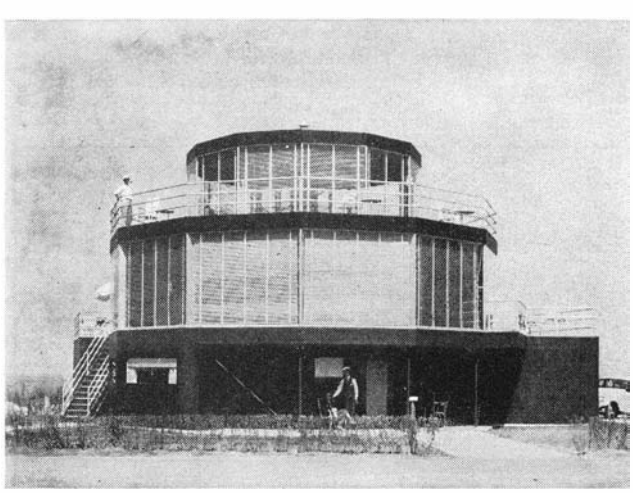
By the former method, the test flasks were heated by inserting them in a bath of hot castor or mineral oil. If the test sample exploded, it invariably ignited the oil and showered the burning fluid about the vicinity. On several occasions, attendants were severely burned. To eliminate the possibility of such accidents, Ford has substituted for the oil bath a solid block of aluminum in which holes have been drilled for the insertion of the test flasks. In case the sample explodes, there is no possibility of fire and attendants are not endangered.

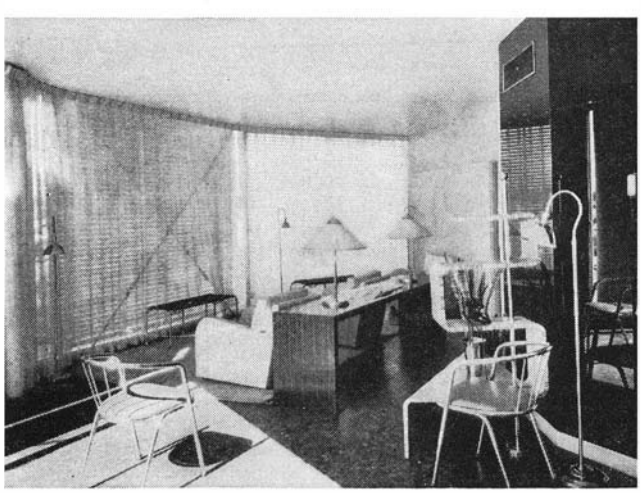
Other advantages of the aluminum oven are cleanliness of the test flasks and elimination of the necessity of frequent change of oil bath.—*A. E. B.*

A Scientific Padded Cell

IN the general engineering laboratory of the General Electric Company at Schenectady there is a padded cell—a room within a room, of such construction that outside sounds, and even building rumble, cannot enter.

The outer wall is of sound-absorbing plaster; next within is hollow tile; then an air





A glass house, built by Century Homes, Inc., demonstrates the home of the future as visualized by the architect, George Fred Keck, and reduced to an actuality by that company. The ground floor, including garage, airplane hangar, and recreation room, has opaque walls. The living quarters, and the solarium on the top deck, have all-glass exteriors, privacy being obtained, when desired, by means of shades and Venetian blinds. Even the interior walls are of black and opaque glass. There are no windows, ventilation being obtained by air-conditioning equipment. Living room is shown at right

space; felt; another wall of sound-absorbing plaster; more air space; sheet iron; air space; lath-work; and then a thick layer of cotton waste—with a total thickness of about 18 inches. The ceiling of the inner room is similarly constructed; and the floor is supported on a felt blanket. Heavily padded double doors isolate the room.

Within the room—where lack of reflections causes one's voice to sound strange—are conducted experiments to determine the amount and type of noise produced by motors, fans, and many other kinds of equipment. The measurements are made with a noise meter which is a product of the same laboratory.

Possible Airlines Across the Atlantic

AS the newspapers have told us, Colonel Lindbergh is mapping and surveying in the north Atlantic, particularly over Greenland, for possible emergency flying fields. Colonel Lindbergh is not resting on his laurels by any means and is constantly rendering professional services of the highest value to American aviation. As usual, Lindbergh is employing his Lockheed Sirius seaplane. We have described this machine previously in our columns, but a drawing, which we reproduce through the courtesy of *Aero Digest*, showing the arrangement of the various components, is of special interest.

It may be asked why Pan-American and Colonel Lindbergh are for the moment concentrating their investigations on this northerly route. Writing in *Aviation*, the well-known pilot, Roger Q. Williams, ably discusses the question of the three alternative routes as drawn on a map prepared by the Topographical Survey of Canada.

There are a number of problems which have to be solved before scheduled service across the Atlantic can be counted upon. Adequate flying equipment must be provided with sufficient useful load, over and above the huge fuel load, in the form of passengers, mail, or express to give the possibility of commercial exploitation. Flying speeds must be stepped up to offer the greatest possible advantage over fast and comfortable steamers. Problems in navigation and radio aids have to be thoroughly considered. Piloting personnel of long experience in ocean flying will have to be highly trained. Weather hazards must be met, particularly in winter flying in the north. Engine reliability has to be practically perfect. Engine failure followed by a forced landing in mid-ocean will always be hazardous.

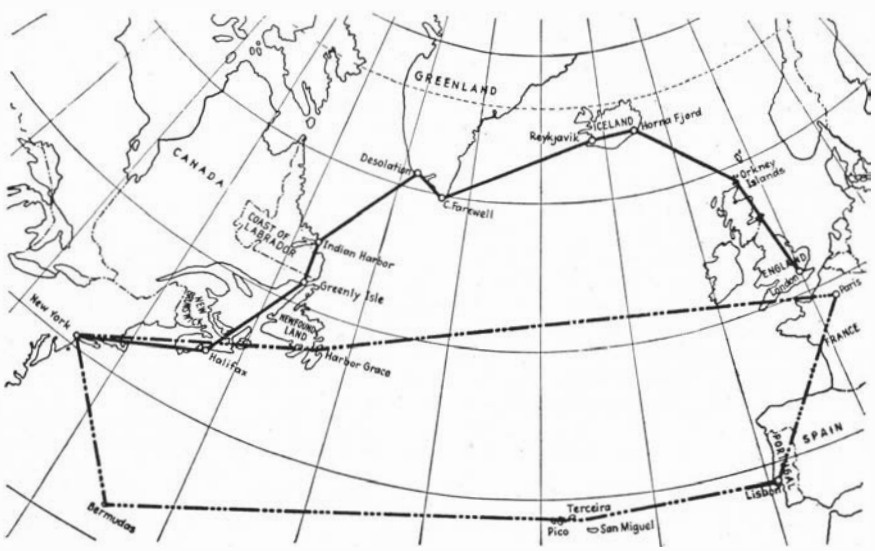
The southerly route from New York to Portugal via the Bermudas and the Azores has much to recommend it. It is an all-year course with almost ideal flying conditions. The average temperature is around 70 degrees, Fahrenheit, which is just right for both passenger and engine. The longest water jump, 2000 miles between the Azores and Bermuda, is approximately the same as the distance over water between Newfoundland and Ireland, but without the fog conditions to be found on the more northerly route. Also, the New York to Portugal flight is a two-way trip. Airplanes can go either east or west without waiting for ideal winds. The difficulty with the route is that it is 4000 miles long, 600 miles longer than the Great Circle route from New York to London.

Nevertheless, the southerly route is infinitely preferable to the shorter Great Circle airlane from New York to Halifax, Newfoundland, and then to Ireland. Here fogs, storms, and winds form great hazards and since the water jump is still 2000 miles—a great bar to commercial payload—it may be authoritatively said that the Great Circle route cannot be preferred to the southerly route for many years to come.

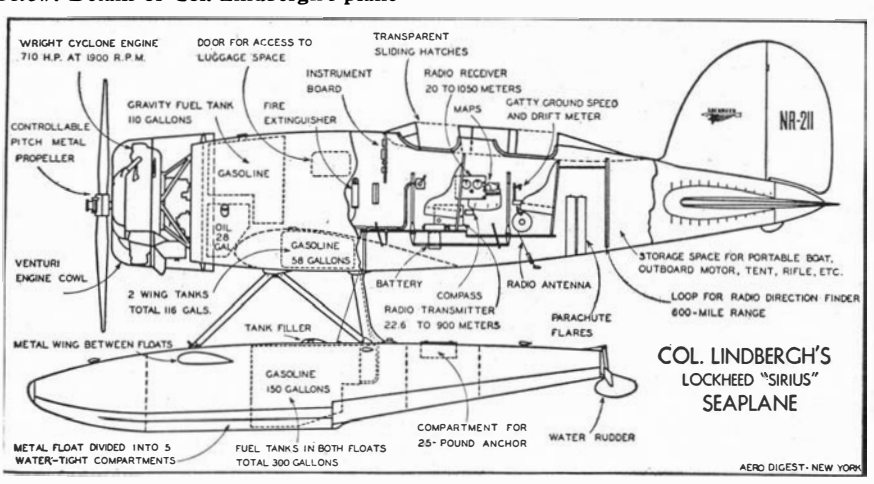
When we come to the Arctic route, New York-Halifax-Labrador-Greenland-Ireland, the survey of which Lindbergh is now concentrating on, we find a number of difficulties. The total distance on this Arctic flight is 5200 miles, which is a serious handicap for speedy operation. Fogs, storms, cold, snow, bad landing facilities on water and on land resulting from freezing conditions for a large part of the year are other difficulties. Darkness for 22 hours daily may be expected for six months of the year. In the case of a forced landing, the Eskimos must be depended upon for shelter and help. The greater part of the region flown over on the route is barren waste land, and ice floating upon the sea. The great advantage of the Arctic route is that it has ten refuelling stops and no long water jumps.

Williams, a competent Atlantic flyer, favors the southerly route. Pan-American evidently favors the northerly route.

It can be seen what tremendous importance the Colonel's present expedition has for the future of transatlantic transportation. He is perfectly aware of all the difficulties and his report, supplemented by investigations made by Pan-American Airways and various expeditions to Greenland and Labrador, will give the last word on the subject. If his findings are favorable, Pan-American hopes to put its large flying boats, now under construction at the Glenn L. Martin and Sikorsky plants, in operation by the spring of 1935.—*A. K.*



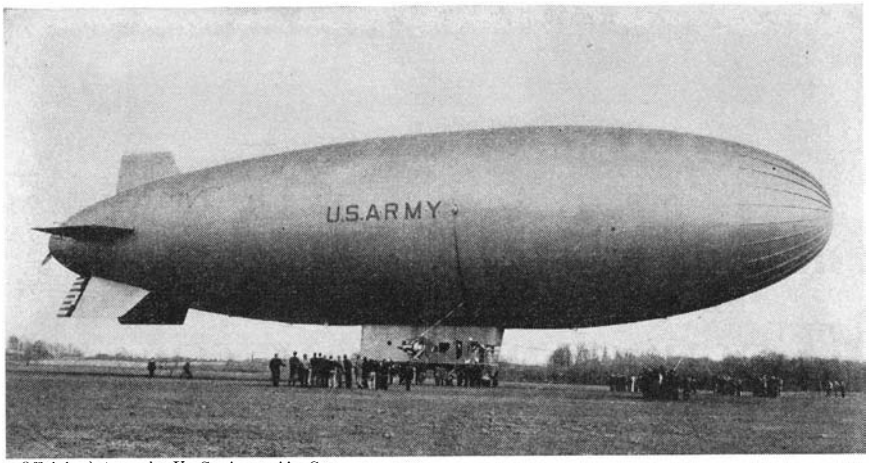
Above: **Three transatlantic air routes drawn on a projection that gives almost a true scale over the entire area shown.** ***Below:*** **Details of Col. Lindbergh's plane**



Safety Hints for Private Pilots

THE Department of Commerce in its various bulletins gives many hints on safety to private pilots. Specialized knowledge is particularly needed by the private pilot who is too ambitious merely to fly around an airdrome but wishes to fly cross-country. Such ambition is natural and praiseworthy. The private pilot who wishes to undertake cross-country flying need not be thoroughly familiar with the mechanics of airplanes and engines, since the services of skilled mechanics can now be obtained readily at most airports. He should, however, acquire at least an elementary knowledge of navigation and meteorology.

Our readers are advised never to take a cross-country hop with a friend who may be an excellent flyer but who cannot plot and follow a course, or detect and inter-



Official photograph, U. S. Army Air Corps.

The latest Army airship, discussed in the columns below

pret significant weather signs. There are plenty of opportunities of acquiring such an elementary education. There are many excellent text books available; ground schools provide short courses for private flyers; the government departments furnish many maps and information bulletins. For the private flyer to acquire a knowledge of Air Commerce regulations is not out of place. Here are some of the simple questions which inspectors of the Department require to be answered:

What is the minimum altitude in flying over open country? Is it a violation to stunt over an airport? Is it necessary to take off into the wind? In what order must craft give way—airships, airplanes and balloons?—*A. K.*

Army Lighter-than-Air

THE joint Congressional Committee has reported to the effect that Navy construction of large rigid airships should be continued. We believe that the Army's lighter-than-air work, less spectacular and less well known to the public, is equally meritorious in its appropriate sphere. The Army builds a far smaller type of airship than the *Akron* or the *Macon;* the biggest Army dirigible has a displacement of only 400,000 cubic feet, is far slower than the *Macon* type, and is non-rigid, relying for maintenance of its shape on internal gas pressure rather than on structure. These comparatively small Army airships are utilized in coast patrol or defense.

Paul B. Smith, an Army airship expert, makes an excellent case for this type of coast patrol aircraft. With a crew of six men, 6000 pounds of fuel, and 2400 pounds for armament, bombs, and special equipment, they can remain on duty for some 50 to 75 hours, while cruising at more than 50 miles per hour. No airplane could possibly give the same type of service. The airship has plenty of bombs for submarine attack and the spy-basket can be lowered for close observation of submarine bases or floating mines. Owing to the ability of the airship to hover practically without forward speed, it can be useful in the foggiest weather. It does not require a profound knowledge of military tactics to see that the small airship has real utility in time of war.

The latest Army airship, the *T.C. 13,* is over 200 feet long, has a displacement of approximately eleven tons, of which four and a half tons are available for crew, equipment, fuel, and armament. The car is over 40 feet long, and contrary to usual practice is directly beneath the envelope, thus avoiding the resistance of suspension wires. An interesting feature is that the bottom of the car is in the form of a boat, permitting alighting on water.

The airship is powered with two Pratt & Whitney Wasp 375 horsepower air-cooled engines mounted on outriggers. These engines are geared to 12-foot propellers. Besides the two engines for propelling the airship, three small marine-type engines are utilized for driving various items of equipment. One of these small engines is used for supplying air to the ballonets maintaining the shape of the envelope. Designed by the Army Air Corps in its Materiel Division at Dayton, Ohio, the airship was built by Goodyear-Zeppelin.—*A. K.*

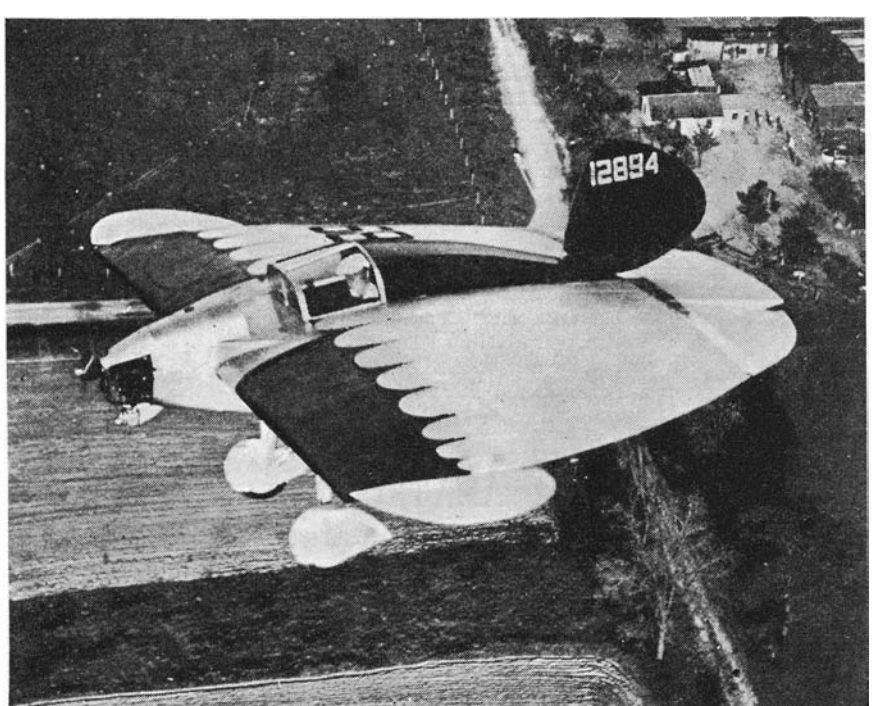
The Arup; a Flying Wing

MOVIE fans have recently been shown a novel flying machine, the Arup, which looks just like a flying wing. Invented by Dr. C. L. Snyder of South Bend, Indiana, the Arup, equipped with only a 37 horsepower engine, has apparently developed fine flying qualities, a top speed of 97 miles per hour as a single seater, and a good speed range; that is, a good ratio of top speed to slow speed. The Arup has a wing area of 211 square feet, but a span of only 19 feet. The chord is enormous, namely 14 feet. The aspect ratio is thus very low. By aspect ratio is meant the ratio of the wing span to the chord. In conventional machines, this aspect ratio is much larger, varying between five for a monoplane, to as much as seven or eight for a biplane. Outside of this startling departure in aspect ratio, the design does not vary greatly from the conventional. There are the usual ailerons, rudder, and elevators, and an enclosed cabin for the pilot.

There is not the slightest doubt that the craft has performed satisfactorily. Does this mean that decided progress from the conventional has been achieved? That is not at all certain. Such a low aspect ratio inevitably militates against aerodynamic efficiency. The tip losses at the ends of the wing are bound to be far larger than with the conventional long span wing. On the other hand the short wing span makes for very light construction. The low aspect-ratio wing has this great advantage, however, that it stalls at an angle far above that of the conventional long wing. Our guess, pending more technical information, is that the low aspect-ratio wing will be safer at the stall, but less efficient in cruising. Perhaps the increased safety will be worth some sacrifice in efficiency. At any rate it is interesting to see such an experiment made.—*A. K.*

A Portable Airplane Engine Starter

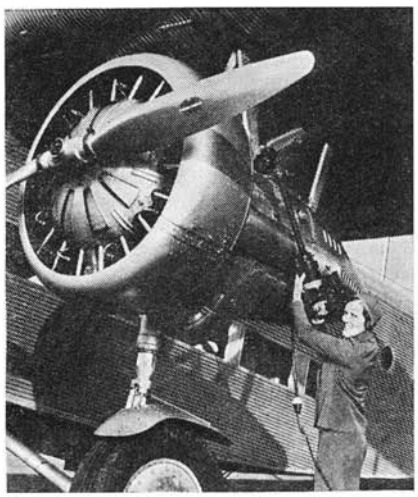
A VERY common form of starter for the airplane engine is the so-called inertia type. This consists of a comparatively small flywheel which is brought up to an enormous speed of revolution. The starter is then clutched to the engine, and its high energy of revolution turns the engine over. This is simple, ingenious, and effective. But



The Arup: A close approach to the highly desirable flying wing

the flywheel has to be brought into action by an electric motor, which in turn has to be driven by an electric battery. To meet the demands of the starting process the battery has to be heavy, and the strain of starting is so high that the battery loses its reliability as the source of current for radio and lighting.

Now the Eclipse Aviation Corporation has met these difficulties by devising a

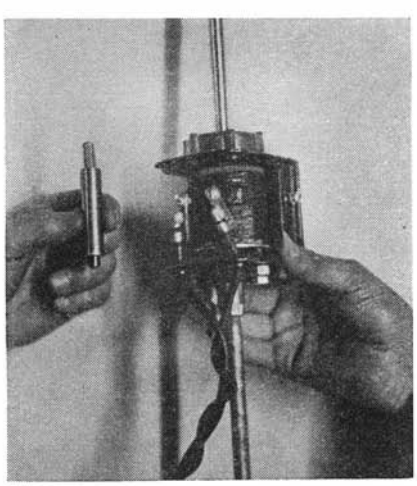


The portable device that "winds up" the inertia starter of an engine

portable electric energizer for the inertia starter. This consists of an electric motor, operated on either D. C. or A. C., with an appropriate drive connection to the flywheel. The young lady in the photograph has brought the portable starter to the side of a United Airliner, and is bringing the flywheel up to 12,000 revolutions per minute without the slightest effort! This is another useful wrinkle for the airline operator to adopt. The process of bringing up to speed, incidentally, takes only 13 seconds.—*A. K.*

A Safety Fuel Valve

AT present, when an airplane lands and the ignition is turned off, the gasoline tank valves must be closed by hand. Since crashes are sometimes followed by fires, even when the ignition switch has been



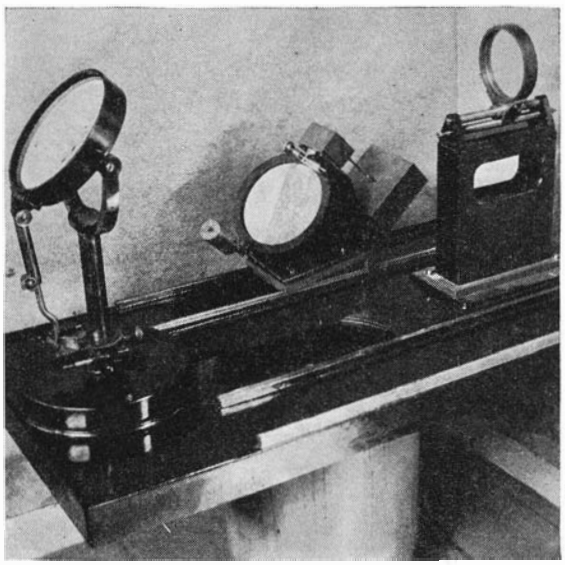
The electrically operated fuel valve

turned off, a valve to shut off the fuel supply automatically should be a decided safety feature. A new electric valve for

(*Please turn to page* 180)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS



The coelostat unit and the lens

THE first amateur in the solar system to complete a Hale spectrohelioscope and get it working is Henry B. Prescott of Wells River, Vermont. Prescott conducts a garage and is the agent for the Chevrolet car. He has been plugging away at this job for a year or so, and he will tell you it is a year's job—something to extend you, perhaps to the limit.

First, a long time ago, he sent in a photograph of the fringes of the two Anderson square rotating prisms (See "Amateur Telescope Making," page 200, bottom line, and Fig. 19). From it you may judge for yourself what sort of workmanship he puts up. In this picture (on opposite page, below), the top fringes represent the top of the prisms against a strip flat. The edge of the latter shows just below these. The bottom set of fringes represents reflections on the bottom surface of a six-inch flat on which the prisms rested, and are a combination of the two, badly distorted. The test shows that the prisms are flat but are off in thickness by one fringe. "Making these prisms," Prescott wrote, "is one hell of a job." But he added, "I am getting quite a kick out of this business."

Some time later he wrote, "The unit that carries the brains of the outfit is now in process of getting the works. This unit is an intricate proposition, believe me, and one that I shall have some trouble with. The mirrors are both six-inch flats, instead of three-inch and four-inch, as called for."

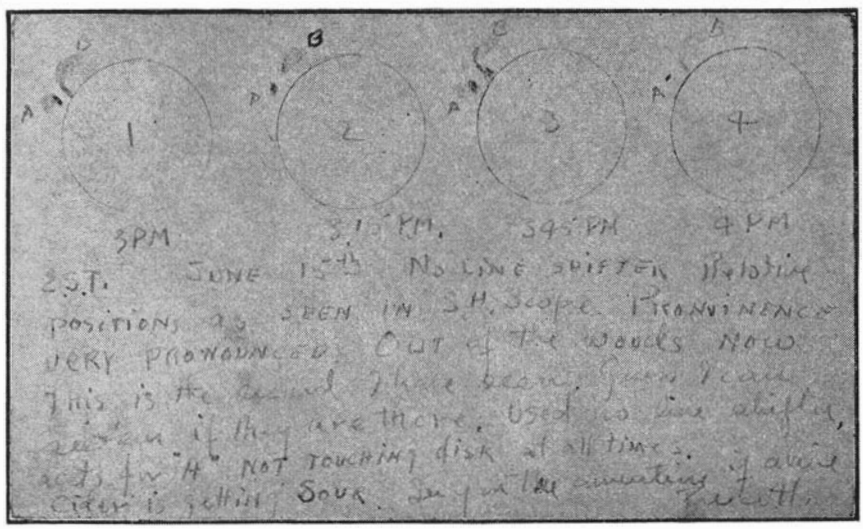
A few months later he sent in a picture of the said "brains" of the thing, all finished, and isn't it a beauty! (opposite page, at top).

By May of the present year we again heard from him, when he had got the job far enough advanced to do some preliminary playing with it. He wrote, "You really can't appreciate the kick I got out of it the first time I brought out the sun's disk. I did not have a motor at hand and so wound some string on the rotating prism shaft, gave her a spin, and there was Old Sol in all his glory. Boy, I'll get the best of the devil yet!"

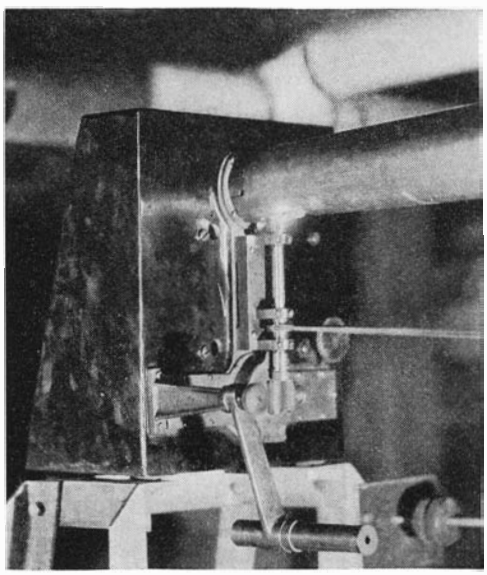
On June 17 we received an enthusiastic postal card, which we reproduce in these columns—the spectrohelioscope was then in regular use.

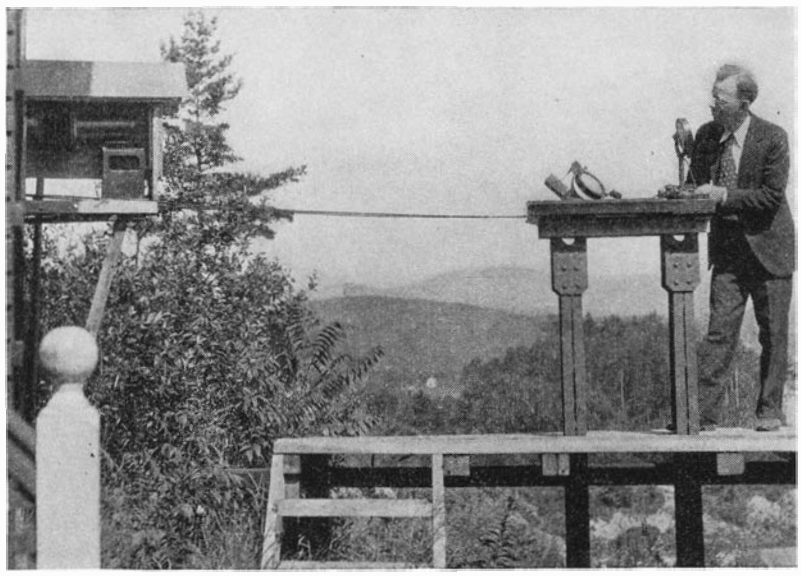
Finally, on July 20, we heard:

"Enclosed are the photographs of the spectrohelioscope, as set up and 'a'wukkin'. Total cash outlay 42 dollars, so one should not be frightened by the financial aspect.

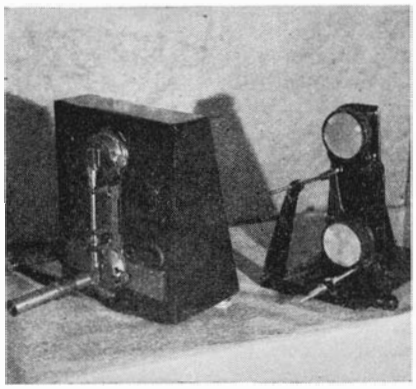


An enthusiastic postal card mailed after the first successful observations





Two pictures which, together, show the indoor and outdoor parts of the spectrohelioscope in their approximate relations. At left is the spectrohelioscope proper with eyepiece swung down to show the second slit. At right, in the little coop, is an 18-foot condenser lens connected by a camera bellows to a tube (to keep out the cold) extending inside to the first slit



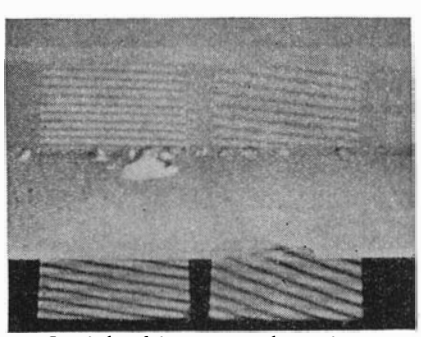
The "brains" of the outfit—the spectrohelioscope part, proper

Somehow the Lord will provide the grating.

"This job is something that offers a true test for dyed-in-the-wool amateurism—13 surfaces optically flat to ¼ wave; two 3-inch, 13-foot focus spherical mirrors, and one convex surface to figure, with plenty of machine shop work thrown in.

"The making of the flats and square prisms is the most interesting work of all. Here one deals with measurements of the order of a few millionths of an inch, and you are dead sure, *if successful*, that no professional optical worker can do better. Pride in accomplishment gets in its work here, and repays you in full.

"The real kick comes in using the instrument. The first prominence you see will blow you down. The first one I saw stood out from the limb of the sun like two gigantic willow trees in a gale of wind. In 15 minutes they were gone, only to reappear a short time afterwards. Here is action on such a gigantic scale that earthly spectacles are pygmified. Right now Satan is stoking up the fires again and many spots and prominences will appear. Build one of these machines and break into a study that is still in the diaper stage.



Straight fringes on the prisms

"I cannot yet report very much about this outfit, as all I have been able to see thus far are prominences, except one small spot. It works O.K. however."

Smooth as Prescott's workmanship appears in the illustrations, these do not do it half justice. The original photographs show his instruments to be equal in grade and quality and finish to professional instrument makers' work. We are still mystified, however, about the grating. Did "the Lord" really provide one—or possibly help him who . . . ?

Another spectrohelioscope is being brewed in Chicago, or rather in Wilmette, Illinois, a Chicago suburb, by A. Klapperich, 412 Central Avenue, and may be finished before this account appears.

THE SCIENTIFIC AMERICAN DIGEST

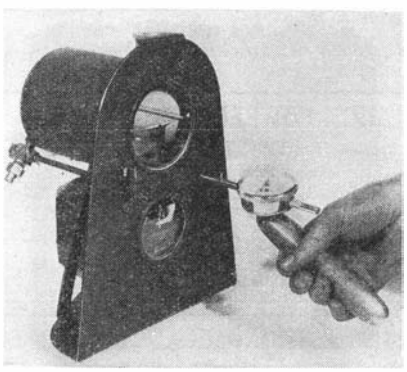
(*Continued from page* 177)

this purpose, developed by the Westinghouse Electric & Manufacturing Company, is illustrated in one of our photographs. The valve consists of an inner steel core and a hollow outer tube, which becomes an integral part of the gasoline line. As long as electric current passes through the coil of wire wound around the outer tubing, a magnetic pull is exerted upon the inner core piece, and holds it open against spring pressure. When the pilot shuts off the ignition switch the current to the electric valve is also cut off, and the inner core, no longer held back by the pull of the magnet, closes under the action of the spring and seals the tube.—*A. K.*

Avoiding Instrument Vibration

THE instrument board on Colonel Lindbergh's airplane is equipped with an instrument board which is almost entirely free from vibration as the result of some skilful engineering by the Sperry Gyroscope Company.

In an airplane, the engine, even if it be a 12-cylinder one, will always impart certain forced vibrations to the structure of the ship and to the mounting of the instrument board.

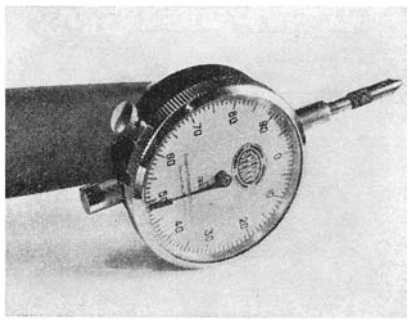


Checking the degree of vibration of an airplane instrument panel

The instruments of an airplane must be extremely sensitive, light in weight, and comparatively small in size. Sensitivity and performance cannot be sacrificed for ruggedness. As a result of innumerable tests by the Sperry engineers, it has been found that the delicate airplane instruments will function correctly only if the amplitude of the instrument panel vibration is less than four thousandths of an inch. Only then will the delicate bearings of such an instrument as the gyroscopic artificial horizon function indefinitely.

The Sperry engineers devised, first of all, a simple vibrometer to measure the amplitude of vibration. This instrument consists of a relatively heavy handle (about five pounds in weight) and a precision indicator gage graduated in thousandths of an inch. When measuring the vibration, the instrument is held in the hand and the end of the shaft is lightly pressed against the panel. The hand of the observer, weighed down by the heavy handle of the vibrometer, has sufficient inertia to be considered as immovable in space. As the panel vibrates, the shaft of the vibrometer will follow the panel faithfully and the pointer will describe an arc. Owing to the very fast motion of the pointer (about 30 oscillations per second) this arc appears as a solid grayish sector and can be easily read against black graduations on the white dial. With a little training it is possible to read as close as .0005 of an inch.

With the vibrometer it was found that the vibration amplitude of the average instrument panel was .020 of an inch, or about five times larger than that which is considered permissible.



The "vibrometer"

From these experiments, engineers decided that the instrument mountings violated the fundamental principles of vibration engineering and had too high a frequency of free vibration.

Evidently the instrument board had to be mounted through rubber, strong enough to hold the board, yet resilient enough to accomplish the purpose. In the mounting which has been designed, the panel is mounted entirely through bonded rubber units which are put in shear by vibration. The center of gravity of the panel is in line with the rubber mountings. The insulation units are compact, small, and easily installed.—*A. K.*

Synthetic Houses

THE "house that chemistry built" is truly a dwelling that came out of a test tube. A full-size bungalow built entirely of synthetic chemical materials is exhibited on the ground floor of the Hall of Science at the Century of Progress Exposition in Chicago.

During the past years of slackened business, the research chemist has been busy devising new methods and new processes looking to new products to help in the restoration of the world's industry. Expansion of the uses of vinyl resins is one of the important results accomplished.

About one hundred years ago a French chemist discovered a white powder which formed in sealed tubes of vinyl chloride left in the sunshine; this discovery, in the hands of later chemists, became a plastic known as vinyl resin. This resin has been developed into a product known as vinylite, the earlier uses of which were for the manufacture of such articles as ash trays, cigarette boxes, water tumblers, and other small containers. Later it was found an excellent material for the denture of false teeth, and for coating phonograph records; in this latter it demonstrated a durability theretofore unknown and, further, it was unbreakable.

Now, with the application of heat and pressure this resin is being molded into great slabs and panels, usable in the construction of the major part of an apartment or house. Experiments show that the heat loss through three-inch vinylite walls is less than through a 16-inch construction of brick, air space and lath and plaster.

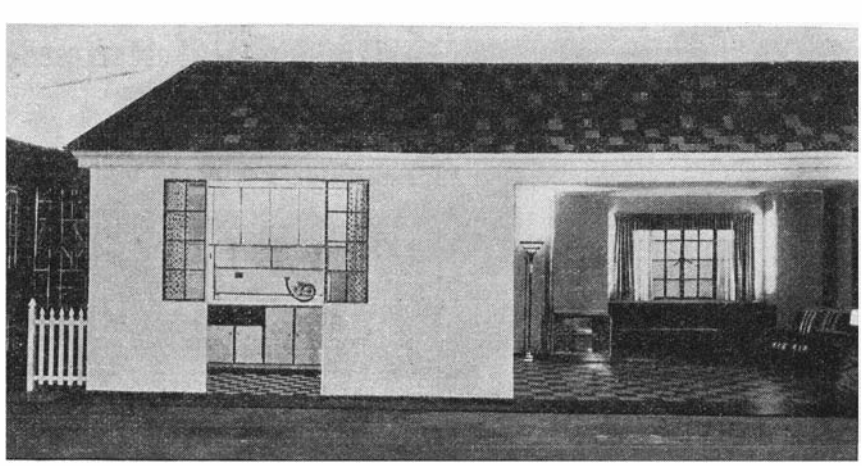
There are two rooms and bath in the bungalow at the Exposition. The floor blocks, door panels and knobs, the inner and outer walls, the kitchen cabinets and even the tile-like walks for the flower garden in the rear of the kitchen are made of the resin. Adding much beauty and convenience are the vinylite window panes which permit softened light to penetrate the apartment but which shut out any possible ugly views. It is stated, however, that completely transparent panes also may be made of the same substance.

The chemists who have perfected these latest developments state that vinylite is altogether impervious to either acids or alkalis and that the problem of cleanliness for all parts of the house is rendered simple. It is weather-resistant and when colored is not subject to fading, since the coloring is made to permeate the materials. —*A. E. B.*

Photography Without Light

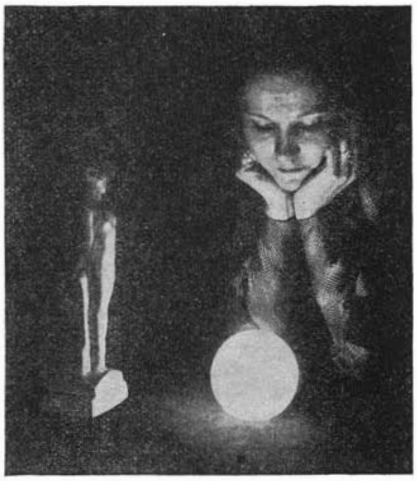
A NEW source of artificial ultra-violet rays may make it possible to take some classes of photographs without the aid of visible light, according to R. L. Zahour of the Westinghouse Lamp Company, Bloomfield, New Jersey.

Experiments in this direction have cen-



The "house that chemistry built." A full-size model on display

tered around the type G-5 ultra-violet treatment lamp which for this particular purpose has been constructed with a bulb of black glass that filters out nearly all visible light and permits only the transmission of long-wave ultra-violet rays which in the pure state are invisible. These rays are strong in actinic quality, that property of



Ultra-violet radiating from the globe furnished the "illumination"

radiant energy which produces the chemical changes on photographic plates, so that it is possible to take photographs in the dark.

The accompanying photograph was made with only the ultra-violet radiations emanating from one of these lamps, there being no other visible light present in the room. The black bulb of the lamp screens out approximately 99 percent of visible light generated, as noted by the almost complete absence of halations. The exposure, which required ½ second, using a fast press plate and a lens stop of *f* 4.5, depended only upon the actinic value of the ultra-violet radiations.

Iodine in the Diet

EVER since it was discovered that goiter is caused by a deficiency of iodine in the system, chemists have been interested in the best method of including that element in the normal diet. Some doubts have been expressed about the safety of using "iodine salt"—table salt containing iodines. As a matter of fact, says T. Von Fillenberg in a recent issue of *Chemisch Weekblad*, much larger quantities of iodine are administered in other ways without harm, and there is no valid evidence of adverse effects arising from the use of "iodine salt."

The iodine content of milk can be notably increased by controlled feeding of cattle: cows which are pastured near the seashore customarily give milk which is relatively rich in iodine. Vegetables such as spinach, carrots, and beets can be made rich in iodine by fertilizing the soil with materials containing iodine and by adjusting the soil acidity to a point at which it favors iodine assimilation by the plant. Fresh-water plants contain more iodine than land plants; marine plants contain still more. Similarly, fresh-water fish and animals contain more iodine than land animals, but marine fish and animals contain still more; hence the well known value of a sea-food diet in the prevention and cure of goiter. In estimating the iodine

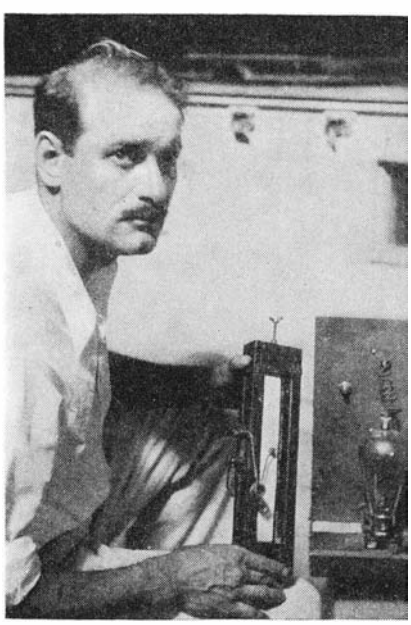
value of a food product for dietary purposes, however, it must be remembered that quantity of iodine is not a sufficient criterion, because different foods differ in the assimilative properties of their iodine content, and it is only the assimilated iodine which is effective.—*A. E. B.*

New Wood-Element Hygrostat

A SENSITIVE and accurate hygrostat for use in the kiln drying of wood has been developed by W. K. Loughborough and R. C. Rietz, engineers of the United States Forest Products Laboratory, Madison, Wisconsin. In principle the new instrument is considered potentially useful in the drying of a large class of organic materials.

Its general design is indicated in the drawing. Two slightly bowed strips of veneer 10 inches long and ⅛ inch thick, with the grain running crosswise, are held in a frame. The distance apart of the contact points at the middle of the strips is determined by the setting of the thumbscrew bearing at the top.

The self-operation of the hygrometer is such as to hold the bowed strips in a virtually fixed position corresponding to the maintenance of their own moisture content constant. Thus, if the strips come initially into moisture equilibrium with a desired atmospheric condition in the kiln and the contacts are then set slightly apart, any subsequent decrease of relative humidity will cause the strips to begin to dry and shorten. Their shortening tendency, mag-



The wood hygrostat with contacts to operate a vacuum tube circuit

nified almost 40-fold in lateral motion at the middle, quickly brings the points into contact, and by suitable relay action vapor is admitted to the kiln to restore the humidity lost, whereupon the thin strips again quickly take up moisture, the points separate, the circuit is broken, and the vapor is cut off.

In case excess humidities are to be guarded against, a back contact on one of the strips must be provided.

The wood-strip control element effectively maintains its own state of moisture (and the ultimate state of the kiln contents) *independently of the temperature.* If the temperature remains constant, it will maintain a constant relative humidity of atmosphere; but in case of a "runaway" temperature it will provide for the supply of enough additional moisture to keep the length of element, and consequently its moisture

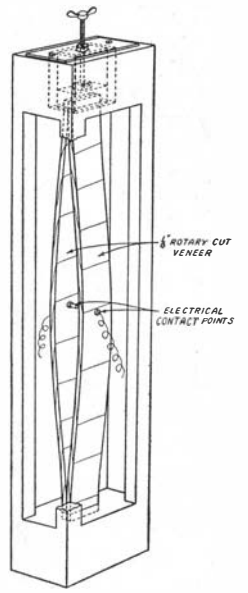
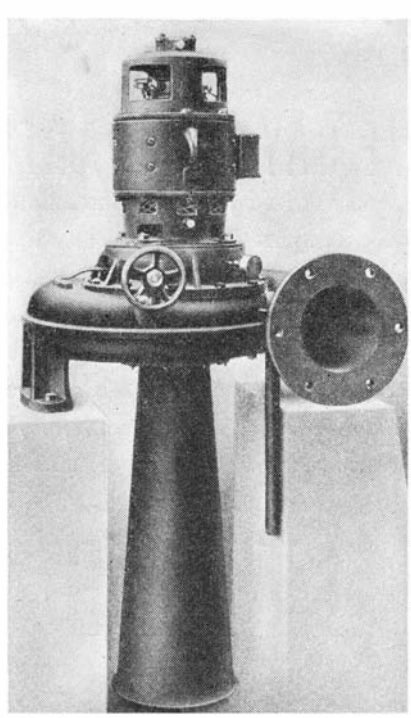


Diagram of the wood hygrostat

content, constant. In this way the moisture boundary condition of the kiln contents remains the same in spite of the increased kiln temperature. Therefore the drying stresses and resultant "checking" tendencies in the lumber are not increased by faulty temperature control.

Automatic Turbine-Generator

THE self-contained water turbine-generator set shown herewith is ready to run when connected to a pipe coming from a dam. It will furnish 115 or 220 volt current for electric lights and other electric appliances, without the use of storage bat-



A water turbine-generator unit

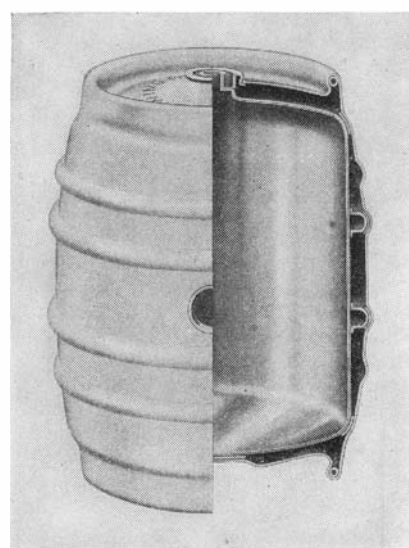
teries, and does not need frequent attention.

The water turbine and generator unit is built in all sizes required by greatly varied conditions of fall and water quantity, and to give capacities from ½ to 80 horsepower. The generator is of standard manufacture. the voltage remaining sufficiently constant no matter what the current drain, within the capacity of the machine.

Streams that heretofore could not be developed economically on account of the wastefulness of previous types of units, now offer greatly enhanced possibilities. The Voith Hydroelectric Unit is sold complete, ready to run.

Beer Barrels of Steel

ARRANGEMENTS have been completed with the Krupp works of Essen, Germany, for the quantity production and sale



Cut-away view of a metal beer barrel

of metal beer barrels in the United States. The stainless lined steel barrel is new to this country, but has been developed and sold by the Krupp works to the beer trade in Germany for several years. It is expected that the stainless lined barrel in time will displace largely the old fashioned wooden barrel, heretofore used almost entirely in this country for the transportation of draft beer.

Every part of the new barrel with which beer comes in contact is stainless steel. The outer shell is of ordinary mild steel processed to resist corrosion and has a baked enamel finish. It is stated that the necessary high cost of a barrel entirely constructed of stainless steel would be a serious handicap. The scientific combination of stainless with ordinary steel, as employed in the Krupp-Ingersoll design, results in a barrel that can be sold at prices that are commercially practical for the brewers.

Tannic Acid for Burns

A THREE-hour bath in tannic acid during which the burns become well tanned is a feature of the modern treatment of extensive burns as described by Dr. Donald B. Wells of Hartford, Conn., at a meeting of the American Medical Association.

The use of tannic acid relieves the pain

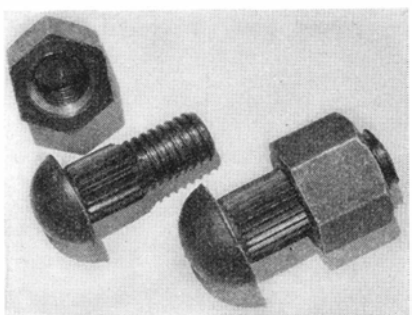
sufficiently so that the burned areas can be thoroughly cleaned. In this way infection can be prevented. Infection alone was the cause of the exhausting illness, many of the complications and a majority of the deaths from burns in the old days, in Dr. Wells' opinion.

The person with extensive burns is placed in a large tub of tannic acid solution, according to Dr. Wells' plan of treatment. "He receives quantities of liquids to drink, in order to balance the loss of water. As soon as his pain is somewhat relieved, several attendants begin to work. For three hours they remove burned tissue as the solution loosens it and clean unburned areas with soap and water. By the time the patient is ready to be placed in bed a tan has formed over the burned portions. Then for 72 hours warm air is blown on him from an ordinary hair drier, while he is more or less constantly sprayed with tannic acid solution. After this the blower is used alone until the tissue has become perfectly firm, for only a little perspiration may break it and invite invasion by germs," Dr. Wells explained.

The method is especially successful in burns from gasoline explosions, ignited clothing and extensive scalds, he said. It can be used in any well equipped hospital. —*Science Service.*

"Rivet-Bolt"

A NEW fastening for structural steel work is being used in a variety of construction which has heretofore called for rivets or fitted bolts. Made of high-tensile steel and installed with hand hammer and wrench, the "Rivet-Bolt" produces strong-



Views of the new "Rivet-Bolt"

er, stiffer, cheaper joints without the nerve shattering din usually associated with steel construction.

The new fastener has a standard rivet head. The neck is ribbed the length of the grip—that is, the thickness of the plates to be held. The outside diameter is slightly larger than that of standard holes and the root diameter slightly less than that of the threaded section. When the "Rivet-Bolt" is driven home, the oversize ribs deform and accommodate themselves to the hole, setting up a body-bound fit. If holes are offset, the depth of the ribs enables them to upset and fill the holes in each plate, so that full bearing is obtained.

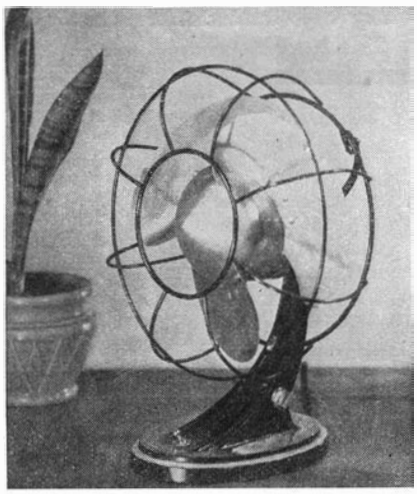
The threaded end and the nut have the Dardelet self-locking thread which locks the connection against vibration and shock, and assures permanently tight joints.

Results of tests made at Columbia University show that joints made with alloy steel "Rivet-Bolts" are materially stronger and stiffer than similar joints made with

ordinary hot-driven rivets. Though the initial cost of "Rivet-Bolts" is higher than that of rivets, contractors find them economical to use because of the ease with which they can be driven and the simple equipment required to install them. The value of quieter construction must also be taken into consideration.

A Noiseless Fan

THE hum of the motor itself is negligible and a greater circulation of the air has been attained without hiss of the air stream in a new type of electric fan produced by the general engineering laboratory of the General Electric Company and based upon principles radically different from those apparent in its predecessors.



Fan with "over-lapping" blades

The blades, of which there are three, are very wide and are so overlapped that in viewing the fan from the front it is not possible to see between the blades. They are so curved that, as the blades whirl, the current of air is not given a rapid and abrupt series of pushes but is uniformly and silently speeded forward.

Cosmetics Defended by Woman Physician

COSMETICS have found a new defender in an English woman physician. Dr. A. Carleton has investigated them and as a result has a good word to say for the cold creams and vanishing creams which continue to be used by women the world over, despite the frequent condemnations by "mere male" doctors. Dr. Carleton has reported her study of cosmetics to the *British Medical Journal*, published in London.

Dr. Carleton does not deny that injurious effects have been observed from the use of cosmetics; indeed she quotes a rather formidable record of undesirable results, but with a suggestion that the harm is confined to rare cases, while harmless or even beneficial effects have gone unreported.

The statement, made on good authority, that cold creams and vanishing creams "block the sebaceous and sweat glands" was tested experimentally, but could not be confirmed. The belief that vanishing creams are drying to the skin was tested on 40 women, who, every night for four weeks in the spring, applied a standard vanishing cream to one cheek, leaving the other half of the face untreated for comparison. While in 24 of the 40 no change was discovered from the use of the cream, 12 found that the treated half of the face justified all the claims of the advertisers for smoothness, while the cheeks that had no cream were distinctly rougher. In only one case was a drying effect due to the cream evident.

As to the argument that it is "unnatural" to anoint the skin with cosmetics reply is made that it is equally unnatural to treat the natural oils of the face with soap and water.—*Science Service.*

Salt Under Moscow

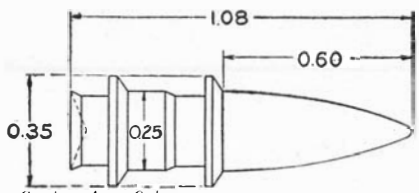
BRINE with a density of salt five times that of the Black Sea has been found to underly the city of Moscow. The discovery was made by a geological engineer, Dmitri Perkin, who, after three years of persistent work, brought in an artesian well. From a depth of 732 meters the dense liquid was forced to the surface and flooded the surrounding yard. Chemical analysis of this liquid revealed the deposit to be somewhat similar to the world-famous brine deposits of the northern Urals, but it also contains chemical properties identified with the equally famous Bakhmut mineral deposits.—*A. E. B.*

Mile-A-Second Bullets from New Rifle

BULLETS speeding at a mile a second, able at moderate ranges to drive through the tough steel armor plates of tanks, can be fired from a new type of rifle invented by H. Gerlich, an American-born German citizen now resident in England. Because of their potentialities as anti-tank and anti-aircraft weapons, the Gerlich rifle and ammunition are under investigation by the small-arms technicians of the United States Army, as well as by several foreign powers.

The Gerlich bullet is something of a paradox. It is of .35 caliber when it goes into the breech of the rifle, and when it comes out of the muzzle it is of only .25 caliber. That means that its diameter has been squeezed down a tenth of an inch as it has traveled through the bore.

This is done by having the bore tapered through a part of its length. The first section forward of the ammunition chamber is cylindrical and of .35 caliber. Then comes a section in which the bore tapers from .35 down to .25 caliber. Finally there is a third section, ending at the muzzle, that is cylindrical and of .25 caliber.



Courtesy *Army Ordnance*

Above: **The new bullet, described above, showing the flanges.** ***Below:*** **Type of barrel in which it is used**

This arrangement enables the bullet to start with a wide area to take the maximum push of the powder gases, and to leave the rifle with a small area, thereby suffering less loss of velocity from air resistance.

To obtain a "compressible" bullet that can be fired from a barrel of this type, Mr. Gerlich fashioned his projectile of .25 caliber, with two flaring bands or flanges of .35 caliber. These fit into the .35-caliber section of the bore, and as the bullet travels down the tapering section they are folded down, fitting into channeled spaces cut into the body of the bullet behind them. The bullet thus leaves the rifle as a smooth projectile coming to a sharp point at one end, not essentially different from the conventional rifle bullet.

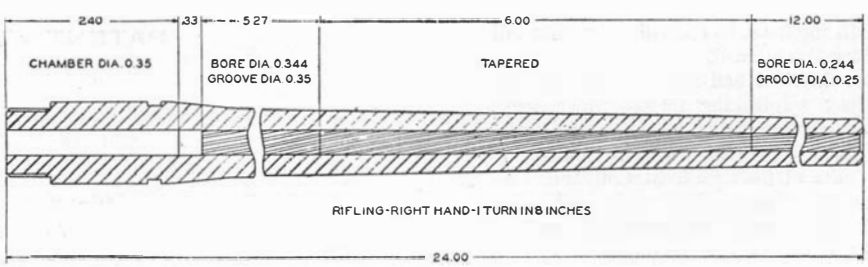
The terrific velocity of 5000 feet a second, nearly double that of standard army rifles, gives the new weapon several advantages. It naturally flattens the line of flight or trajectory considerably, so that the soldier using it need not trouble himself so much about having the right elevation. It shortens the time of flight from rifle to target, a highly important matter for anti-aircraft machine gunners. Finally, it enables the small-caliber bullet to drive straight through tank armor, even without the advantage of special armor-piercing devices, for at such velocities even soft projectiles have no time to "upset" on striking a hard target; they act like the straws that are driven through boards in a tornado.

All these advantages must of course be purchased at a price. The rifle barrel, with its somewhat complicated bore, is more difficult to make, and more expensive. The ammunition is considerably costlier also, and its greater bulk in transportation is something of a military disadvantage. The recoil is heavier. Whether the rifle will wear out faster under firing conditions is not yet determined.—*Science Service.*

Millions Wasted in American Factories

MILLIONS of dollars are flowing down the sewers of American factories because of failure to control and reclaim waste products, according to S. T. Powell, writing in a recent issue of *Chemical and Metallurgical Engineering.* In the paper industry, for example, it is estimated that over six million dollars worth of fiber is thrown away annually with waste water from the nation's paper mills. According to Mr. Powell, there are practical and economical processes available for the recovery of this fiber.

An industry on the Eastern seaboard has sustained a loss of salable grease amount-



ing to more than 500,000 dollars within a period of ten years, and has expended, in addition, upward of 100,000 dollars on legal and expert fees in the defense of damage suits resulting from the grease discharged into a tidal water. By a relatively simple recovery system not only the grease from this industry could be recovered, but also a large quantity of organic material for which a ready market exists.

Another interesting example of a needless industrial waste is an eastern steel mill where large quantities of pickling liquors are discharged into a stream from which cooling water was drawn for use in surface condensers by a large public utility. The electric company furnished power to the offending steel mill. The acid waste was responsible for a loss of condenser tubes to the extent of about 5000 dollars a year. The utility company refused to discuss the matter, since the mill in question was a consumer of power. An interesting phase of this situation is that the power company could have utilized the waste pickling liquor as a coagulant for clarification of the boiler feed water and thus have avoided the damage to their condensers.—*A. E. B.*

New Test for Cancer

EVIDENCE of the value of a new test for cancer has just been reported in Berlin by two scientists who dared to try the test on themselves by injecting into their own veins the blood from cancer patients. The courageous scientists were Dr. Hans J. Fuchs of that city, who developed the test, and his colleague, Dr. H. Kowarzyk. By a process similar although not identical to the new cancer test, such generalized infections as syphilis and tuberculosis may also be diagnosed, Dr. Fuchs has now found.

Dr. Fuchs observed that from the blood serum of patients with malignant tumors he could precipitate out a certain fraction which, when exposed in an incubator with the serum of a non-cancerous patient, undergoes a sort of digestion. The extent of the digestion can be determined by analysis of the amount of non-protein nitrogen in the mixture. But when the serum from a cancer patient is exposed to the action of serum from another cancer patient, no such action takes place. This is the basis of the diagnostic test for cancer.

In the latest investigation, Dr. Fuchs and his colleague repeatedly injected serum from a cancer patient into their own veins. After 26 days their blood, which had been normal, gave the reaction of a cancer blood. —*Science Service.*

Nobel Centenary

OCTOBER 21, 1933, marks the centenary of the birth of Alfred Bernard Nobel at Stockholm, Sweden. Volumes would be necessary to chronicle his life and adequately to appraise the tremendous contributions his work has made and continues to make to world progress.

In 1893, when the University of Upsala conferred upon Nobel the honorary degree of doctor of philosophy, the request for his autobiography resulted in this brief memoir: "The undersigned was born October 21, 1833; he acquired his knowledge in private studies, and did not attend any

secondary school. He devoted himself particularly to applied chemistry, and discovered explosives known under the names of dynamite, and smokeless powder, called ballistite and C. 89. Since 1884, he has been a member of the Royal Swedish Academy of Science, and is also a member of the Royal Society (London), and the Societe des Ingenieurs Civils in Paris. Since 1880, he has been a knight of the Nordstjarne Order. He is an officer of the Legion of Honor. Sole publication: a lecture in the English language, which was awarded a silver medal."

Equally as brief, but justly claiming more for Nobel than he did in the sketch prepared by himself, is the summary of his life and notable activities in the History of the Explosives Industry in America, from which is quoted as follows: "Alfred Bernard Nobel (1833-1896) was a world-renowned genius. He was born in Sweden; educated in America and Russia; the founder of the high explosives industry; the first successfully to manufacture and use nitroglycerine as a blasting agent; discoverer of dynamite, one of the greatest boons to the advancement of civilization the world has known since the printing press was invented; and resident dynamite manufacturer in Sweden, Germany, Great Britain, France, and Italy. The great need of improved explosives in his time is shown by the ease with which he established explosives factories in every prominent mining and industrial country of that date. Nobel also invented blasting-gelatine, gelatine-dynamite, and a smokeless powder called ballistite. . . ."

Nobel made a large fortune in Russian oil and, at his death in 1896, left 9,000,000 dollars for the founding of the Nobel Prize Fund. The interest on the money is used yearly for five awards of approximately 40,000 dollars each, to those judged to have contributed most to the benefit of mankind during the preceding year by achievements in chemistry, physics, medicine, literature, and peace.

Seek Beautiful Pictures of Trees

WHERE are the most beautiful photographs of trees in America?

The American Forestry Association from its headquarters in Washington, D. C., announces that it will bring them together in a single collection to be exhibited throughout the country for the purpose of stimulating interest in the beauty of trees in the American landscape. The pictures will be placed in competition for cash prizes; certificates of excellence will also be awarded.

The competition will be conducted on the basis of national and state awards—cash prizes totalling 450 dollars, supplemented by certificate awards, for the most beautiful photographs irrespective of location, and the Association Certificate Awards of Excellence for the most beautiful photograph from each of the forty-eight states. There will be ten national awards and forty-eight state awards.

Awards will be based on beauty in photographic effect, utilizing trees singly, in groups, or in mass. There will be no restrictions as to tree species, season, or location. The competition closes on October 31. Final announcement of the awards will be made in November.

CURRENT BULLETIN BRIEFS

THE ACTIVITIES OF THE MELLON INSTITUTE 1932-33 (reprinted from News Edition, *Industrial and Engineering Chemistry*, Vol. 11, No. 8, April 20, 1933) is a report that covers a period which has had a profound effect upon industrial research in general. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

FUNDAMENTAL SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT TO BE USED BY THE PUBLIC is a small pamphlet prepared primarily for use in the quality improvement program of the *Association of Edison Illuminating Companies, 80th Street and East End Avenue, New York City.—Gratis.*

UNIVERSAL CAST IRON PIPE gives installation pictures—pictures showing how this pipe requires no calking, no hot lead, no cold lead, no lead substitutes, no bell holes. Experienced workmen are unnecessary, wrenches being the only tools used. There are many pages of tables. *Central Foundry Company, 420 Lexington Ave., New York City.—Gratis.*

A STUDY OF THE DETERIORATION OF BOOK PAPERS IN LIBRARIES (Bureau of Standards Miscellaneous Publication No. 140), by Arthur E. Kimberly and Adelaide L. Emley, describes a source of worry to librarians and archivists for over a century. The system of collecting and inspecting specimens as well as the results are all noted. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

COMMERCIAL AND INDUSTRIAL ORGANIZATIONS OF THE UNITED STATES (Domestic Commerce Series No. 5) is a complete and comprehensive directory of 19,000 trade associations and non-profit organizations. The executive will find this directory valuable in locating the association representing any industry, as well as its address and secretary's name. 386 pages, bound in cloth. *Superintendent of Documents, Washington, D. C.—85 cents (money order).*

REVIEW OF THE ECONOMIC COUNCILS IN THE DIFFERENT COUNTRIES OF THE WORLD, (Section of Economic Relations, League of Nations). Prepared for the Economic Committee by Dr. Elli Lindner; a study of existing national economic councils. *World Peace Foundation, 40 Mt. Vernon Street, Boston, Mass.—75 cents.*

THE PROFESSION OF FORESTRY, by Dean Samuel N. Spring, gives an outline of the scope of required training and opportunities. *New York State College of Forestry at Syracuse University, Syracuse, N. Y.—Gratis.*

SOLAR CONDENSERS, WET AND DRY ELECTROLYTIC - CONDENSERS — PAPER AND MICA CONDENSERS gives much valuable material and many hints for the use of condenser material of all kinds. It is fully illustrated and prices are given. *Solar Manufacturing Corporation, 599-601 Broadway, New York City.—Gratis.*

THE CAROLINA BAYS—ARE THEY METEOR CRATERS?—II

(*Continued from page* 159)

by the successive impacts of two meteors in approximately the same place. Or should a meteor, on striking, push some of the soil ahead of it, there probably would result an upward bulging of the surrounding surface. If a separate elevation were formed from the soil which was ejected, two rims would thus appear from a single impact.

7. Neighboring scars formed at different times could overlap and produce the mutual interference of outline that is often seen. In a series of overlapping impacts, the most complete rim would be formed by the last meteor to strike the surface. Thus a small bay could partially obscure a large one, or vice versa.

8. If soil were thrown outward and upward by an incident meteor, some of it would fall back directly into the depression thus formed and some would slide down the steep inner slope from the elevated rim. Thus the deposits in the rim and in the bottom of the crater should be essentially of the same material.

9. In case the cluster were of globular shape much of the Piedmont and Southern Appalachian regions, in addition to the coastal plain, would be included in the area struck. Subaerial processes would attack the scars, leveling rims, and filling craters at a rate increasing with the height and relief of the surface. Erosion of the coastal plain would proceed slowly, except near the large rivers which could soon remove all topographic signs of the scars in their immediate vicinity. The advance of the sea in Pleistocene time would superimpose the effects of its action upon those already produced by weathering, by streams, and by wind. Should the impacts occur through the shallow ocean water during the marine invasion, the volume and velocity of the ejected material, as well as the area covered by the resulting rims, would probably be less than if the impacts occurred on land. In either case, whether the collisions took place prior to, or during the inundation, if there were strong ocean currents, such as the Gulf Stream, the water scouring at the bottom would further reduce the height and probably also the width of these protuberant rims. During this process the material which was too coarse to be carried away in suspension would be washed down the slopes and redeposited in steeply dipping sedimentary layers. If the currents were sufficiently vigorous, the ocean bottom might be eroded to such an extent that the resulting scars would be essentially horizontal sections of the original features.

The meteoritic hypothesis in a qualitative manner develops the origin of the facts which any acceptable theory must explain. Yet it should be tested in every way in order to avoid error. Is it possible that there are other logical consequences of the hypothesis which the observed facts cannot fulfil?

In at least one respect the authors are not convinced that the facts are adequate to substantiate theory. In the rims thus far examined there is a noteworthy absence

of bed-rock fragments larger than sand grains. There are, however, many hundreds of bays not yet studied in which such pieces may occur. Moreover, it is not a certainty that large fragments are to be expected in unconsolidated and water-saturated clastic sediments. The few thousands of years which represent the minimum age of the features are, perhaps, sufficient for weathering to eliminate the fragmental texture and reduce the soil to its ultimate mineral constituents.

This length of time would likewise permit the removal of meteoritic fragments of iron or basic silicate minerals which may have been exposed at the surface. At all events, the authors found nothing definitely of cosmic origin, though Olivier states[5] that: ". . . a very large number of meteorites have been discovered in the southern Appalachian region, in Virginia, North and South Carolina, Georgia, Alabama, Kentucky, and Tennessee." Referring to the sketch map, one sees that the probable area of bombardment includes most of the southern Appalachians. Thus the numerous meteorite discoveries in this region may be additional evidence of the reality of the shower which the authors have assumed. A meteoritic cluster having the dimensions indicated is probably of the same order of size as the nuclei of some of the smaller comets.

Known meteorites have been divided into three types: those consisting chiefly of iron and nickel, those composed largely of stony material, and others which are mixtures of metal and stone. If meteorites are present beneath the surface of this coastal plain, that portion of their mass which remains unaltered should possess a density greater than that of the sediments. It should be possible to detect such bodies with an Eötvös torsion balance. Nickel-iron meteorites would have a higher electrical conductivity and stony ones a lower conductivity than the wet material surrounding them. These conditions are suitable for several methods of electrical prospecting. Meteorites rich in iron should be readily detected with a magnetic field balance.

ASCHMIDT'S Vertical Field Balance (Askania Werke) was used to test the hypothesis. Of four bays investigated three proved non-committal; that is, there was no observable anomaly at the appropriate place. In the fourth instance a bay located near the inland edge of the coastal plain possessed a magnetic anomaly of 120 gammas. If these depressions are the result of meteoritic impacts, failure to find an anomaly in the first three cases may be explained by assuming that the bodies were of stone, or that they were composed of nickel-iron which has been completely oxidized to a relatively non-magnetic substance.

Further study of the magnetic and, if possible, of the electrical and gravitational conditions of isolated features will be attempted in the near future. A photographic examination of the lower Piedmont area, as well as a careful search for large fragments in the rims of bays situated near the "fall line," would aid in testing the hypothesis herein presented to explain the origin of these interesting features.

C. P. Olivier, "Meteors" (Baltimore: Williams and Wilkins, 1925), p. 240.

Books SELECTED BY THE EDITORS

THE VERDICT OF THE LEAGUE—CHINA AND JAPAN IN MANCHURIA

By M. O. Hudson, Prof. Internat'l Law, Harvard

AS the official record of the League of Nations this little book of 102 pages should find a place in every consulting or research library, for it gives the cold and clear-cut facts without embellishment and with only annotations to connect the various official documents and notes. Whatever future history may contain, this verdict will ever stand as a most important mile-post.—$1.10 postpaid.

THE VITAMINS IN HEALTH AND DISEASE

By Barnett Sure, Prof. Agric. Chem., University of Arkansas

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By Sir William Bragg, D.Sc., F.R.S., Head of the Royal Institution

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Sir William Bragg is an old hand at popularizing science; his work, "Concerning the Nature of Things," is a model of that difficult art and had a deservedly wide sale several years ago. The present book is similar in general tone—not written for case-hardened highbrows (such will enjoy it, nevertheless) nor on the other hand for children. If you fall between these extremes this is your book, and you will enjoy its manner of presentation, learning as well a lot about elementary optics and its common applications. It has 278 text pages and 134 illustrations.—$3.65 postpaid.—*A. G. I.*

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By Carroll Lane Fenton

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By Louis Roule, Prof. National Museum of Natural History, Paris

THEIR journeyings and migrations are told in most vivid English which is unusually descriptive and amazing in the extent of its vocabulary. Fishermen have observed these movements and depend on them. For years they have been set down as "instinct." Dr. Roule has spent a lifetime seeking out the real reasons behind these journeyings and here presents the sum of present day knowledge of these subjects. Foreword by Dr. Beebe, excellent format, 54 figures, 8 mo.—$3.90 postpaid.

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By Henry H. Rusby, Prof. Materia Medica, Columbia

THIS book is really a chapter in the reminiscences of a man who has lived one of the most varied and interesting lives in our time. Distinguished as a botanist, a leader in medical and pharmacological education, an associate with Harvey W. Wiley in the fight for pure food and drugs and even today, at the age of 78, one of the staunchest fighters for purity of drugs, Dr. Rusby is known throughout the scientific world. This book tells the story of one of the earliest of his adventures—a trip of exploration made in 1885 across the Andes and through the South American jungle in search of medical plants. Although mainly a story of adventure, it is filled with scientific observations.—$3.70 postpaid.

COMMERCIAL PROPERTY NEWS

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

Oil Burner Trademarks

IT has been held by First Assistant Commissioner Kinnan that Geo. D. Roper Corporation, of Rockford, Illinois, is not entitled to register the term "Insta-Matic" as a trademark for gas stoves and ranges and igniter attachments and time and temperature controls for regulators therefor, in view of the prior adoption and use by Williams Oil-O-Matic Heating Corporation, of Bloomington, Illinois, of the term "Dist-O-Matic" as a trademark for liquid fuel burning devices.

The grounds of the decisions are that the goods of the respective parties are of the same descriptive properties and the marks are confusingly similar.

After stating that it seemed clear enough that the liquid fuel burning devices of the opposer are automatically controlled and that its marks are built upon or constitute modifications of the word "automatic" and noting that applicants had sought to show by other registrations that the term "Matic" is *publici juris*, Dr. Kinnan said:

"It would seem immaterial here whether the opposer was first to form the type of notation adopted by it as a trademark. The question arising is whether the applicant has approached so nearly the opposer's marks, or any one of them, as to make it probable that there will be confusion or mistake in the mind of the public if applicant uses its mark upon its goods."

Rejection of Chemical Claims

AN interesting decision was recently rendered by the Board of Appeals affirming the rejection of chemical claims as being broader than the invention. Applicant disclosed a process consisting broadly in heating the addition compound of an organic substance with two specific metal halides (*e. g.* zinc and calcium halides). The attorney attempted to claim all metal halides in this process. The Examiner allowed applicant to claim metals of the second periodic group but refused to allow claims covering all metal halides.

In affirming the rejection the Board stated "where the reaction itself is not of a very well recognized type it is not permissible to go beyond the most obvious rules in determining the scope of the original disclosure. We believe this reaction falls clearly under the classification of those which cannot be reasonably foretold in relation to the large number of metals included and differing widely as to properties.

"We think applicant upon the mere disclosure of two metals, should not be entitled to cover up the field of research as to the possibility of discovery of the action of other particular metals having very unusual or efficient action in this respect . . . ."

". . . there is no disclosure as to what metal compounds would probably form addition products . . . and whether other metals generally beyond two specific instances would be operative in accordance with the claims, provided they did form additive compounds."

In answer to applicants' argument that the Examiner failed to cite examples which would be inoperative the Board said: "The Office is not in a position to show that some metals are inoperative in the relation as is sometimes done by defendants in infringement suits but that is not believed essential to the application of the rule (*i. e.* rule in Incandescent Lamp Patent case 1895 C. D. 675, Corona Cord Tire v. Dovan, 1928 C. D. 243, etc.) and does not relieve applicants from making a showing of a reasonable number of examples commensurate with the scope of the claims presented."—*Journal of the Patent Office Society.*

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

Preserving Proof of Invention

EVERY inventor who is working on a device which he contemplates patenting should first prepare sketches and a description of his invention, which should be dated and witnessed by at least two persons. The inventor has thus established the date of his disclosure, and such evidence should be deposited in a safe place from which it may be produced when needed.

When an invention has been completed, it is advisable to file an application for patent without delay. However, we realize that many inventors today do not have sufficient funds to meet this expense, nor have they safe places in which to keep their disclosures. Therefore, as fully outlined in our April, 1933, number, *Scientific American* will undertake to act as a depository for such documents. These will be held in safekeeping for two years (unless withdrawn by the depositors) and then destroyed without opening.

To take advantage of this offer, place your papers in a sealed envelope endorsed with your name and address and marked "Not to be opened." Then enclose this in another envelope addressed to John P. Davis, Treasurer, Scientific American Publishing Company, 24 West 40th St., New York, N. Y., and mail.—*The Editor.*

Silk Ribbons as Fan Blades

THREE loops of silk ribbon are used in a new electric fan which has been developed in Germany. The use of the textile blades does away with the necessity for a wire frame for protection as the textile blades are not dangerous while rotating.

A report to the Commerce Department describing the fan says that the ribbon blades move the same amount of air as 12-inch metal blades, but the stream of air is wider and not so concentrated. Therefore, no oscillating movement of the fan is necessary.

Problems of the Patent

NEWS NOTE: A London judge ruled that an invisible bacillus, discovered by Dr. Weitzmann, and used in the production of cordite, is his property by right of being a fully patented possession.

Can a man get a patent on a cow?
Mebbe so! But I'm sure I don't know how;
For its rich and fruity juice
Has been in "public use"—
Too long to get a patent on it now.

Can a man get a patent on a bee,
Upon proper application, with a fee?
I doubt it, for the features
Of the busy little creatures
Were known and used while men lived in a tree.

Can a man get a patent on a snail?
Not unless he put a lawyer on its trail
In that prehistoric time
When the world was mostly slime;
For now its basic principle is stale.

Can a man get a patent on a cod?
Its liver has been useful, but it's odd
That it too, is prehistoric,
And in Boston—allegoric,
And the man to get the patent's under sod.

Can a man get a patent on a yeast?
It's a useful and prolific little beast;
But it's been on sale for years
In this dismal vale of tears,
And the man to get the patent is deceased.

Can a man get a patent on a hen?
He might have if he'd tried to do it when
In the days of long ago
The first rooster tried to crow,
But the patent office wasn't open then.

EDWARD H. DAVIS,
in the *Journal of the Patent Office Society.*

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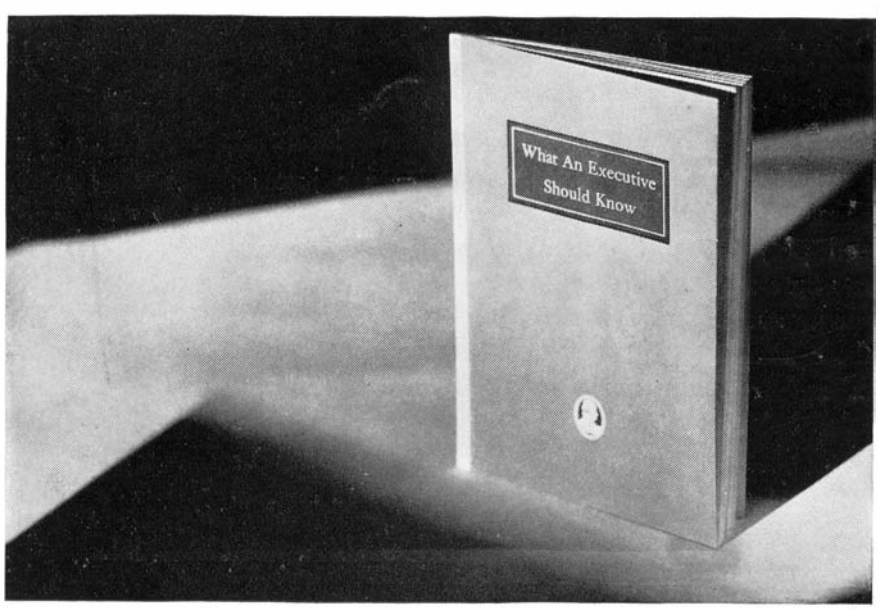

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