Charles F.

Kettering: INDUSTRIAL RESEARCH

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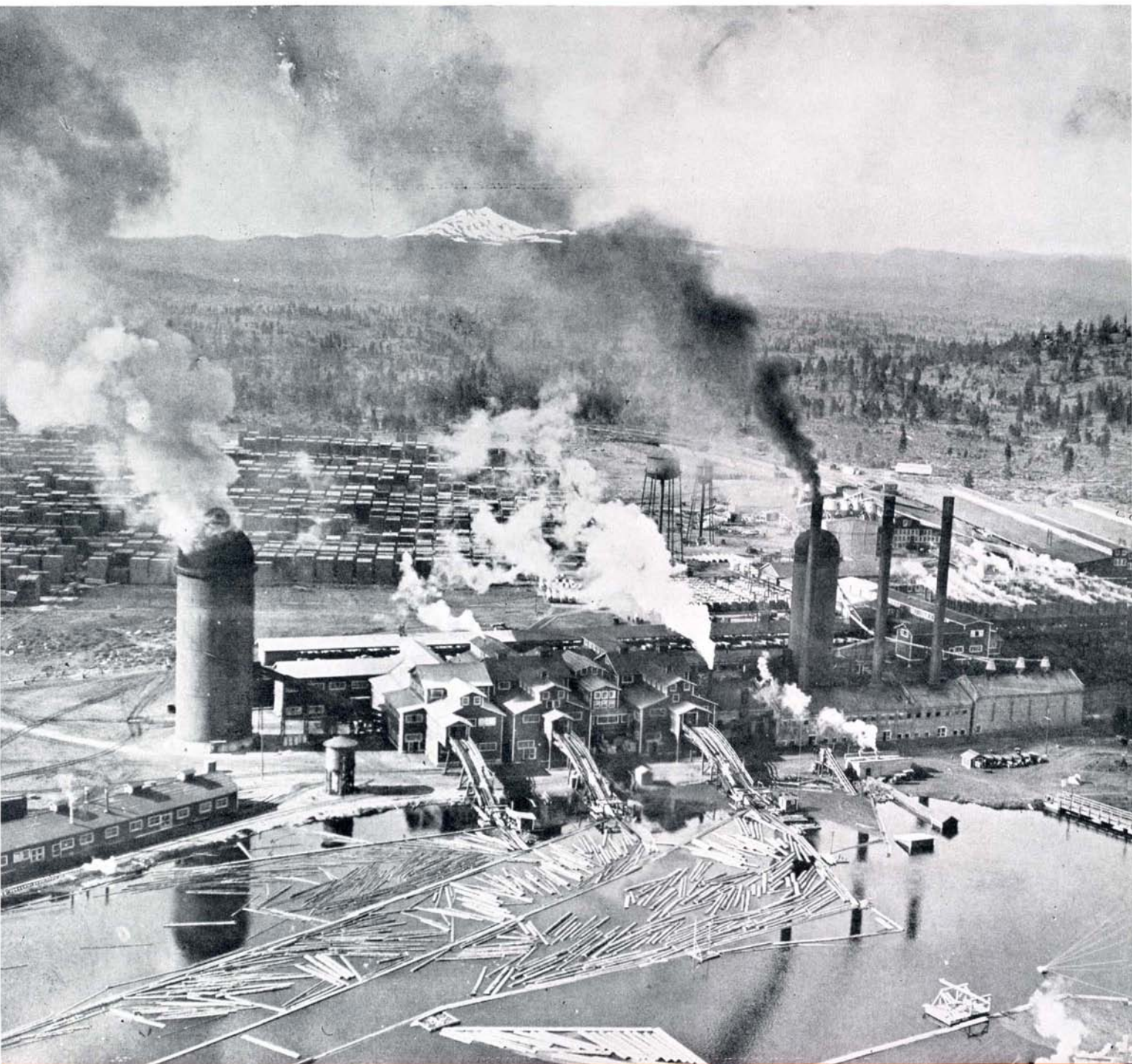

Why Reforestation is Needed (See page 225)

Scientific American's

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TO PRESENT OWNERS OF "AMATEUR TELESCOPE MAKING":

THE new edition contains what was in the old, plus the following: A new ten-chapter part entitled "Contributions by Advanced Amateurs," which contains the Hindle monograph (Cassegrainian and Gregorian), and chapters on flotation systems for larger sized mirrors; flat making; solar spectroscope making; celestial photography; accuracy in parabolizing; new Ronchi test (clearly explained); new test for Gregorians; simple clock drive. In Part IX, Dr. Hale's instructions for making a solar observatory (spectrohcliograph) have been included. The Miscellany has been greatly extended by notes both short and long, based on actual difficulties reported by workers—especially on lap making and silvering. The new detailed instructions and digest of scattered literature on silvering represent an attempt to cover all of the fine details of the process and anticipate all of the pitfalls, and are the longest ever published anywhere. Other notes cover: the diffraction ring tests (long); slit test; test for strain (polarized light); new strokes in grinding; whipping pits; Hindle's method of testing at zonal foci; calculating size of diagonal; conic sections; binocular telescopes; turret telescopes; eyepieces; finders—these are only a few. Many new drawings by Porter, and selected photographs of telescopes already made, are included. Errata in earlier editions corrected. New book lists, new materials list, new directory, 496 pages, but the price remains the same three dollars. Keep up with the advances in the art—Possess this new edition!

"AMATEUR TELESCOPE MAKING"

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NINETIETH YEAR • ORSON D. MUNN, Editor

CONTENTS · MAY · 1934

Cover

THE striking aerial view of a large lumber mill is used through the courtesy of The Shevlin-Hixon Company of Bend, Oregon. This organization, with commendable foresight, has long realized that lumbering cannot go on indefinitely without replacement. Acting on this thought, they have conducted extensive field experiments in selective cutting and reforestation, to the end that they may have a constantly replaced source of supply.

SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN, May, 1934. Vol. No. 150, No. 5, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

FROM the earliest days of naval activities, modernization of battleships has been a familiar process in the progress of nations. Today, modernization has assumed aspects not dictated solely by considerations of cost, as in the past, but primarily by the prohibition against new construction contained in the provisions of the Washington Conference of 1921-1922. That this provision has been particularly hard on the United States, because of the almost obsolete ships with which it left us, can not be denied. The situation has been met, at least in part, however, by modernization of old ships. Capt. W. D. Puleston, U.S.N., a writer whose work is familiar to our readers, has prepared an article, scheduled for next month, on the procedure followed in bringing up-to-date the U.S.S. *Mississippi*. The modernization of a battleship involves so many considerations, and calls into play so many of the sciences that the article mentioned will interest every reader.

●

"THE world at your fingertips" is no figment of the imagination when the phrase is applied to modern short-wave radio. The antipodes is at the greatest distance from which radio messages can be received, and thus is placed the only practical limit on the range of a well designed short-wave receiver. Here is a new field for entertainment; an opportunity to recapture those old thrills of DX of the early days of broadcasting. An article in an early issue will tell of the results to be expected with short-wave receivers, and something about the sets themselves.

●

THE average angler thinks that he is applying scientific methods to his sport when he tries to put himself in the place of his quarry and assumes that fish see, hear, and smell as does a human being. As a matter of fact, this assumption, and the consequent course followed, may be the very reason why the angler has to rely on "fish stories" when telling of his success. We quote the following from an article, to be published very soon, by J. E. Nielsen, B.Sc.: "Due to a difference between air and water the sensory organs of fishermen and fish have developed along different lines. Fish do not see nor hear nor smell . . . as we do." Mr. Nielsen goes on to make an excellent case for putting scientific angles in angling.

●

NITROGEN, the inert gas that constitutes about three quarters of our atmosphere, is an absolute necessity to civilization in both peace and war. In usable form it becomes the basis of fertilizers that make possible yearly crops from land that otherwise would be completely exhausted in a few years; it also is indispensable in the manufacture of war munitions. Thirty years ago 63 percent of the world's nitrogen supply came from Chile. In 1933, less than 10 percent came from that source. Just what has been the process by which Chile lost her hold on this world market? The story of the determining factors in the case is told in an article to be published soon, in which the author takes up the economics of the situation, and points out certain facts that must be taken into consideration when looking to the future of nitrogen in world affairs.

●

"WHAT is human sterilization? Are castration and human sterilization alike? What effects has sterilization upon the individual, particularly on the sexual life? What people should be sterilized? What countries now practice compulsory sterilization? What are their experiences with this type of legislation? These and many other questions come to mind as one cogitates about eugenic sterilization as a social therapeutic agency." Thus writes J. H. Landman, Ph.D., in an article on sterilization to be published next month. A survey of sterilization and its possibilities is highly desirable at this time, due to widespread agitation for its use in many quarters, and Dr. Landman has attacked the subject in a calm and unprejudiced manner.

●

NOW that much of the furor of the Army-airmail fiasco has calmed down, it is possible to view the entire subject from a sane perspective. To get just this angle, Reginald M. Cleveland, whose aviation articles are familiar to SCIENTIFIC AMERICAN readers, has been asked to gather data and render as complete a report as possible in time for our June issue. Watch for this article; we guarantee that it will be worth reading.

●

AND next month, as always, the Scientific American Digest. Ten pages or more of short, accurate, articles on all branches of applied science, profusely illustrated.

Editor and Publisher

NEXT MONTH

¶J. H. Landman, Ph.D., J.D., J.S.D., will write on the aspects of racial betterment by human sterilization.

¶Capt. W. D. Puleston, U.S.N., contributes an important article on the modernization of the battleship *Mississippi*.

COMING

¶Hon. Henry A. Wallace, Secretary of Agriculture, on the social implications of scientific research.

¶Scientific angles of angling, by J. E. Nielsen, B.Sc.

¶Logan Clendening, M.D., noted author of accurate and interesting medical articles for the layman.

¶Victor W. Eisenstein, with a provocative article entitled "The Oddest Thing About Jews."

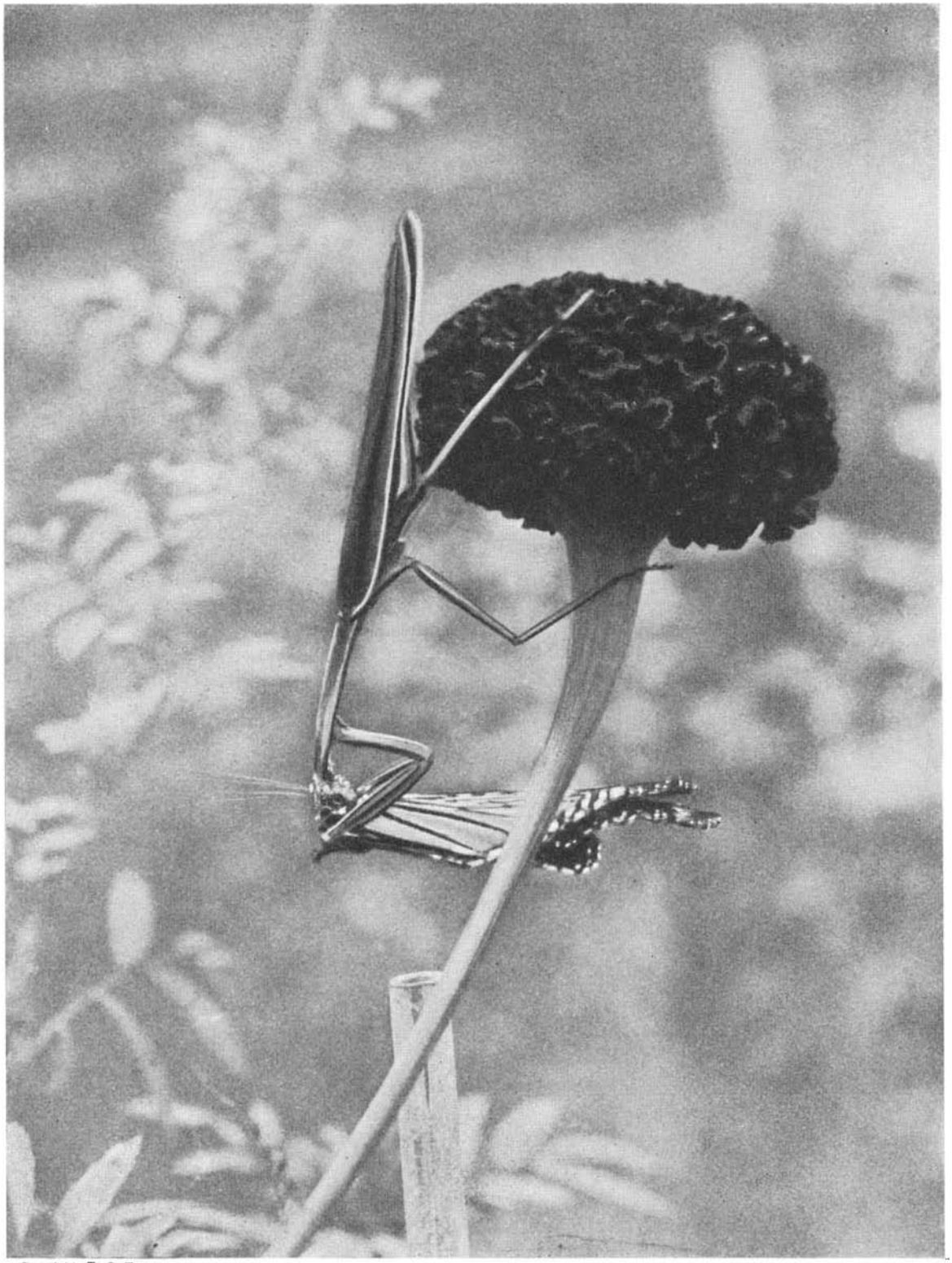
Photo by Bachrach

P. W. BRIDGMAN

RECENTLY the Comstock Prize of 2500 dollars was presented by the National Academy of Sciences to Dr. P. W. Bridgman, Professor of Mathematics and Philosophy at Harvard University, because of his brilliant achievements in advancing our knowledge of the behavior of matter. The National Academy says of his work:

"Bridgman is both an experimenter and a theorist. Working indefatigably in a field of great experimental difficulty, he has derived an enormous array of fundamental facts, while new insights and physical concepts have come from the keen analysis of his theoretical studies. Most of Bridgman's work falls into three categories: the first, so peculiarly his own, the behavior of materials under high pressure; second, the properties of single crystals at normal pressures; and, third, the application of thermodynamics to electrical phenomena."

It was Professor Bridgman who devised and used apparatus for applying pressures up to 600,000 pounds per square inch, the highest pressures ever attained artificially. This research was described in his book "The Physics of High Pressure." Regarding his philosophical work the National Academy of Sciences continues: "In addition to his many contributions to the form and substance of his own special branch, Bridgman has served the broad field of science in a most significant way. It has been an unusual and gratifying experience to read, from his pen, scientific philosophy that is both philosophical and scientific. Such contributions could perhaps be made only by that rare person who is at the same time a gifted experimenter, an able theorist, and a sensible man."



THE AGE-OLD SURVIVAL OF THE FITTEST

A PRAYING mantis (*Paratenodera sinensis*) hangs from an African marigold, calmly lunching on a butterfly, while the photographer, with an ordinary view camera, takes its picture. The forelegs of the mantis, with which it is holding its meal, might more properly be called arms, since they are usually used for holding, rather than for locomotion. This particular mantis, introduced into this country from China some 30 years ago, is now becoming quite plentiful in the Middle Atlantic and southern New England states. They are valuable for controlling insect pests.

Taking blood from the finger for the blood tests for paternity—two drops are enough

WHOSE BABY?

Determining Parentage by Blood Groups

By LAURENCE H. SNYDER
Professor of Zoology, Ohio State University, Columbus, Ohio
Author of "Blood Grouping in Relation to Clinical and Legal Medicine"

IN South Dakota, a man claims that he is the father of one of a pair of twins, but not of the other. In Illinois, a mother contends that she has been given the wrong baby to bring home from the hospital. In Connecticut, a man denies being the father of an illegitimate child when accused by the mother. These and similar cases offer opportunities for using the blood group tests.

The past few years have seen the discovery of many new and interesting facts about human inheritance. Among the many characters which are transmitted from parents to children by heredity, none is more fascinating than the blood groups, represented by those curious substances called agglutinogens found in the red blood cells. With the microscope and the proper test serums, the scientist can now determine to what blood group any person belongs. From a knowledge of the blood groups many questions concerning individuality and paternity can be answered. To understand the nature of these tests it is necessary to go back to the beginning of the present century.

In 1900 Dr. Karl Landsteiner, working in a medical laboratory in Vienna, discovered that when he mixed the red blood cells of one person with the serum, or clear part of the blood, of another person, a surprising reaction sometimes occurred. This reaction was the clumping, or gathering, of the red blood cells into little bunches. The clumping reaction is technically known as agglutination. This reaction did not happen in every combination of serum and cells, but only when the cells of certain people were mixed with the serum of certain other people.

THE agglutination, or clumping, is due to a substance in the red cells being acted upon by an antibody in the serum. The substance in the cells is called an agglutinogen. It soon became apparent that there were two such substances in human red cells, acting very much alike. For convenience, the two substances were named A and B.

It was found by Landsteiner and others who took up the investigations that a person whose blood was examined might have one of these substances in his blood, or he might have the other, or he might have neither of them, or he might have both. There were thus four kinds of people in respect to these substances. A person having substance A in his red blood cells is said to belong to group A; a person having substance B belongs to group B; a person having both substances belongs to group AB, and a person having neither of them belongs to group O.

Originally the four groups were designated by numbers, I, II, III, and IV, but it so happened that two different scientists, one in America and one in Europe, each proposed a numbering system, and groups I and IV were just opposite in the two systems. To do away with the resulting confusion, the letter system was adopted, and the groups are now called O, A, B, and AB.

The first practical application of the knowledge of blood groups was in blood transfusions. It can be seen at once that if a man loses blood in an accident, and needs to have blood given him, that it would not do to have the blood cells clump up into bunches as fast as they were given. For one thing, they could not go through the fine capillaries which connect the veins and arteries. Therefore, before every transfusion a test is made to make sure that the blood given will not have its cells agglutinated by the serum of the patient.

Shortly after the importance of blood

groups in transfusion was recognized, students of human inheritance began to pay serious attention to the possibility that the groups might be inherited. The blood groups of families were studied in laboratories all over the world, with the result that a large body of knowledge was accumulated on the behavior of these blood substances in parents and children. This behavior

TABLE I

Blood Groups of Parents and Children

Blood Groups of Parents	Blood Groups which may occur in Children	Blood Groups which can not occur in Children
O x O	O	A, B, AB
O x A	O, A	B, AB
A x A	O, A	B, AB
O x B	O, B	A, AB
B x B	O, B	A, AB
A x B	O, A, B, AB	
O x AB	A, B	O, AB
A x AB	A, B, AB	O
B x AB	A, B, AB	O
AB x AB	A, B, AB	O

was found to be very definite, and to obey fixed hereditary laws. It was found, for example, that substance A never appeared in the blood of a child unless it was also present in the blood of at least one of the parents. Likewise substance B never appeared in a child's blood unless it was present in the blood of the father or mother, or both. These two laws form the basis for the use of the blood groups in legal cases.

Other laws are also known in the inheritance of the blood groups. For example, if one parent is group AB, that parent must give either A or B to each child. Therefore a parent of group AB could not have a child of group O. Likewise if a child is of group AB, he always receives the substance A from one parent and B from the other, so that a child of group AB could not have a parent of group O. These laws are known as a result of the study of many thousands of families, and they carry added weight because they represent a type of heredity well known to students of inheritance.

THE various combinations of blood groups which can occur in parents, and the kinds of children they produce, are shown in Table I. It may be seen from the table that the blood groups of the children are not always like those of the parents, nor are brothers and sisters always of the same group.

From Table I it may easily be seen that babies who were mixed in a hospital might in many instances be untangled by means of the blood groups. For example, in a recent case two mothers went home from the hospital at the same time, each with a new baby. Upon bathing her baby, mother number 1 found the name of mother number 2 on a tag on the baby's body. A court case resulted, and after various attempts to settle the question had failed, the blood tests were made. The parents of family number 1 were both of group O, and the baby they took home with them was group A. In family number 2, the father was group O and the mother was group AB, and the baby they took home with them was group O. A glance at Table I will show that neither family could have produced the child they took home, while each could have produced the other. Clearly, then, the babies had been given to the wrong mothers, and the court ordered the babies exchanged.

TABLE II

Medico-legal Applications of Blood Groups

Blood Group of Child	Blood Group of Mother	Blood Group to which Father must belong
O	O	O, A, or B
O	A	O, A, or B
O	B	O, A, or B
A	O	A or AB
A	B	A or AB
B	O	B or AB
B	A	B or AB
AB	A	B or AB
AB	B	A or AB
AB	AB	A, B, or AB

IT may easily be seen that in some instances both babies might be of the same group, or both families might be of the correct combination to produce either child. In such cases, the blood tests would not prove anything. It has been computed, however, that these blood tests can solve about one third of the cases of mixed babies.

Another legal use to which the blood groups may be put is the question of disputed paternity. The laws of inheritance stated above may be placed in the form of another table, as shown in Table II. The fact that an agglutinogen never appears in the blood of a child unless it was present in the blood of at least one of the parents may be used as follows. Suppose a child has substance A in his blood, and the mother does not have this substance. Then we know that the child's father must have substance A in his blood. Therefore a man who does not have substance A in his blood could not be the father of the child. In this way a man of group O or group B would be cleared in the charge of the paternity of this child. A man of group A, or of group AB, having substance A in his blood, *might* be the father of the child, but could never be proved to be the father, as there are many men in the world of group A or group AB. Thus a man may be exonerated by the blood tests, but he could never be incriminated.

In a recent case under my observation, a man was accused of being the father of an illegitimate child. He denied this, and had a blood test made. The mother was group A and the child was group B. The child thus had substance B in the blood cells, and the mother did not. The substance B must therefore have been inherited from the child's father. The man in question was of group A, like the mother, and therefore could not have been the father of the child.

IN another instance which I recall, the mother and child were both group O, and the accused man was group A. Thus he could have been the father of the child, but so could any other man of group A, or any man of group B, or any man of group O. In this case the accused man could not be proved innocent, but neither could he be held guilty by these tests. To repeat, a man may in certain instances be proved *not* to be the father of a given child, in certain instances it may be said that he *could* be the father, but it can never be proved by the blood tests that any man *is* the father of a certain child.

Recently two new substances, similar in many ways to substances A and B, have been discovered in human blood. These new substances have been named M and N. They, too, have been studied in families, and laws have been found for their inheritance. It is found that some persons have substance M in their blood, others have substance N, and still others have both substances. No one ever lacks both substances. These

TABLE III

M-N Reactions in Parents and Children

Parents	Groups to which Children may belong	Groups which can not occur in Children
M x M	M	N, MN
N x N	N	M, MN
M x N	MN	M, N
M x MN	M, MN	N
N x MN	N, MN	M
MN x MN	M, N, MN	

TABLE IV

Medico-legal Applications of the M-N Reactions

Child	Mother	Group to which Father must belong
M	M	M or MN
M	MN	M or MN
N	N	N or MN
N	MN	N or MN
MN	M	N or MN
MN	N	M or MN

substances occur quite independently of the longer-known agglutinogens A and B, so that 12 combinations are possible. Thus every person belongs to one of the following groups:

O, M	B, M
O, MN	B, MN
O, N	B, N
A, M	AB, M
A, MN	AB, MN
A, N	AB, N

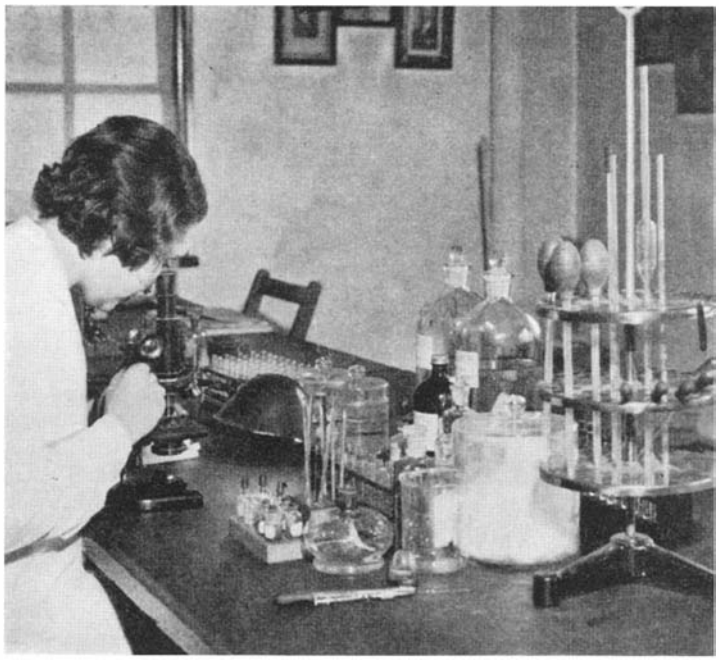
As in the case of the substances A and B, we find that substance M never occurs in a child's blood unless it is present in the blood of at least one of the parents. The same is true of substance N. Tables III and IV show the possibilities of legal applications in the case of these agglutinogens.

By using the new tests for M and N, as well as the tests for A and B, an even larger number of disputed paternity cases or mixed baby cases may be settled. The use of all the tests will exonerate a man who is falsely accused of paternity in about a third of the cases, and will untangle mixed babies in about two thirds of all cases.

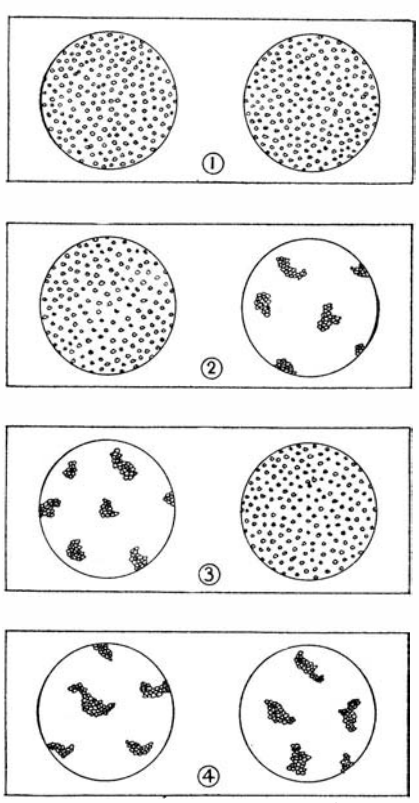
The substances M and N do not have to be taken into consideration in transfusions, since no one has any natural antibodies against them in his serum. Therefore the diagnostic serums for these substances are prepared by injecting M blood or N blood into rabbits. In the case of the substances A and B, some people have the antibodies against them occurring naturally in their serum. A person always has the antibody against the substance which is lacking in his blood. Thus a person who has B in the cells has no antibodies against B, but does have the antibodies against A.

THE test to determine which of the substances A, B, M, or N a person has in his blood is made by mixing some of the person's cells under the microscope with various serums each of which is known to have a particular antibody. If any serum produces agglutination (clumping), the cells must contain the substance which the particular antibody agglutinates.

Thus, if we were to examine a person for his blood group, we would first take a few drops of his blood from the finger or the lobe of the ear. In the case of a very small child the blood is usually taken from the heel. The drops of blood are collected in a tube containing isotonic saline solution. This makes a pinkish suspension of the red blood cells. Then, to make the test for the presence of substance A or B, a drop of the cell-suspension is placed on each end of a small glass slide. To the left-hand drop is added a drop of serum containing the antibody against substance B. This serum would be previously prepared from persons of group A, who have the antibody against B naturally in their serum. To the right-hand drop of cell-suspension is added a drop of serum containing the antibody against substance A. This serum would be previously prepared from persons of group B.



Examining the blood through the microscope after the test serums have been added. The four typical appearances are shown below



Diagrammatic appearance of the A-B blood groups under the microscope. On each slide the unknown cells are mixed with group A serum on the left, and group B serum on the right. Slide 1, group O; slide 2, group A; slide 3, group B; 4, AB

The drop of cell-suspension and the drop of serum are thoroughly mixed at each end of the slide, and then the mixture is examined through the microscope. The results are shown in the drawing. If, for example, the cells are agglutinated by the antibody against A, they must, of course, contain substance A.

The test for the presence of M or N is similar, but somewhat more involved, as the reaction is slower and must be speeded up to be of any value. The mixture of cells and serums in this case, therefore, is whirled for five minutes in a centrifuge at 1800 revolutions per minute and then shaken thoroughly in a shaking machine. The mixture is then examined under the microscope, and again it can be determined which substance is present in the blood cells. If the cells are agglutinated by the serum containing the antibody against M, for instance, the cells must contain substance M.

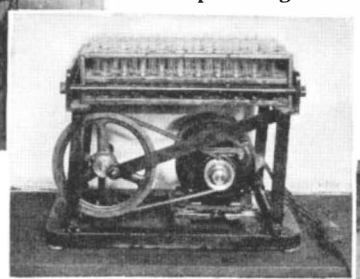
The serums containing antibodies against M and N are not taken directly from human blood as are the A and B serums. Instead, they must be made by means of a long series of injections of human blood containing M or N into rabbits. In this way the blood of the rabbits produces antibodies against M and N, and from this immunized rabbit blood the serums are prepared.

TURNING now to the possibility of twins having two fathers, we are again involved in a problem of biological inheritance. First of all we may say that the occurrence of such an event is perfectly possible, but would be almost impossible to prove in human beings. In animals, many such cases are known.

It occasionally happens that after a female animal is mated and conceives, she may mate a second time, perhaps with a different male, at which time another conception takes place. The two embryos develop together and are usually born together, although one of them may not be at full term. Thus mares which were bred first to a stallion and then to a jack, or vice versa, have been known to produce twins, one a horse colt and the other a mule colt. Similar instances are recorded in sheep, where a ewe, having been bred to two

Left: **Placing the tubes of blood in the centrifuge where they are rapidly whirled in order to accelerate the reaction for the M-N tests**

Below: **The apparatus, a simple shaking table actuated by a crank and electric motor, for thoroughly shaking the blood for the paternity tests. The portion of the apparatus on top is a reciprocating rack containing the test tubes**



Injecting blood into a rabbit, to produce the test serum for the M-N tests. The blood of the rabbit produces antibodies against M and N, and from this immunized rabbit the serums are prepared. The test first described does not require any animals. The M-N test always does

rams of different breeds, produced twin lambs, one of which clearly was of one breed, the other having every evidence of blood of the other breed. Female rabbits have been bred to two males in rapid succession, the two males being so chosen as to transmit different color qualities to the offspring. When the baby rabbits were born, young from both males were found in the litters.

Thus it would appear to be biologically possible for human twins to have different fathers. The proof of such an occurrence, however, would involve long and careful genetic tests, and it probably could never be conclusively proved in the last analysis. Such evidence as we might obtain would be collected in the following manner: First of all it would have to be proved that the twins were fraternal and not identical, since identical twins could not possibly have different fathers.

THERE are two kinds of twins among human beings: fraternal twins, which may consist of two boys, or two girls, or a boy and a girl; and identical twins, in which the two members of the pair are always of the same sex. Fraternal twins result from the separate fertilizations of two eggs by two sperms, and so the twins are just ordinary brothers or sisters who happened to be developed and born at the same time. They are no more alike than brothers and sisters born at different times. It is such twins, of course, who might conceivably have different fathers. Since a different sperm fertilizes each egg in these cases, the sperms might be from different men. Fraternal twins occur once in every 75 or 80 births.

Identical twins, on the other hand, are those who developed from a single egg fertilized by a single sperm. Usually, of course, a fertilized egg develops into a single individual. In about one case out of 300, however, the single fertilized egg starts to develop, then for some reason not thoroughly understood, divides, and continues its development as two individuals, who are identical not only as to sex, but in all their hereditary characters. Since only one sperm is responsible for both twins in these cases, it is obvious that they could not have two fathers.

In the case of twins said to have two fathers, then, we must first prove that the twins are fraternal. To do this is not so simple as it sounds. It requires a series of genetic tests, including not only the blood groups, but the study of the finger prints, taste deficiencies, *I.Q.*, anthropomorphic measurements, iris color, and so on. These tests might prove that the twins were different in some of their hereditary factors, and therefore fraternal and not identical.

When and if the twins should be proved to be fraternal, the next step in the investigation would be to make blood tests of the whole family, including the twins, the mother, and the husband. Of course both the A-B tests and the M-N tests would be made. If the blood groups showed that one twin could be the child of the husband, while the other could not, the evidence would suggest the possibility of two fathers.

However, neither twin might be the child of the father; that is, they might both be the children of the other man. To test this, a blood analysis should be made of the supposed father of the other twin. If the blood tests showed that one twin could belong to the husband but not to the second man, while the other twin could belong to the second man but not to the husband, then the evidence would favor the theory of two fathers for the twins.

However, even this would not prove the case, as it would be perfectly possible for both twins to belong to still a third man who may not even have been mentioned in the case.

RESEARCH work on blood tests such as these is going on in many laboratories in all parts of the world. More and more laws of inheritance are being discovered, and the number of cases which can be settled by such laws is increasing. Recent work makes it probable that a sub-group of group A may shortly become added to the medico-legal tests.

When the blood groups are examined in various races of mankind, it is found that while the inheritance is the same in all cases, different races have differing proportions of the A-B groups. The M-N groups have not as yet been studied in many races. The variation in proportions is quite striking, and a classification of races on this basis not only conforms very well to the standard racial divisions, but even allows the analysis of the relationships of certain otherwise obscure peoples.

American Indians appear to be entirely of group O, except where the other groups have been introduced by white admixture. Europeans and Americans are largely of groups O and A, with small proportions of groups B and AB. Asiatics, on the other hand, have more of group B than of A. The negro races have approximately equal proportions of groups A and B, with a large proportion (about half) of group O, and very little AB. From these facts certain laws of serologic race classification have been derived, which are of use to the anthropologist.

Work on the taste-producing qualities of certain synthetic chemicals is uncovering a set of hereditary taste deficiencies in people, so that the ability to taste or not to taste certain compounds may soon be added to the paternity tests. No more fascinating field for research exists than that of the inheritance of human characteristics.

OUR POINT OF VIEW

R. A. F.

WITH threatening war clouds gathering over Europe and ugly rumors appearing in the press of the world, it came as no surprise when England recently announced that in 1934 she would spend 89,000,000 dollars in building up her air force. British statesmen hastened to explain that this air construction—a part of a general building program for army and navy parity—would not, they hoped, "prove to be a starting gun in a race for air armaments." England apparently is looking solely to national security in the only way that she knows how—by securing and maintaining defensive forces capable of coping with any emergency.

We sympathize with Great Britain in her desires; we, too, hold the belief that parity of armament is the safest insurance against war. But we must disagree when her government officials hold up the United States military air forces as an object lesson in development. The recent Army airmail fiasco has shown a deplorable lack of efficient equipment in the Army Air Service. True, our commercial lines have been developed to a commendable degree, but these are not military forces any more than Army planes and pilots constitute a mail-carrying system.

If any country needs adequate aerial armament on parity with other nations, it is the United States; a start has been made and it is to be hoped that satisfactory arrangements can be made in the near future to assure such equality. If complete co-operation can be obtained between government officials, commercial airlines, plane and engine manufacturers, and our military departments, without the intervention of petty politics and unscrupulous business tactics, the United States need never worry about adequate aerial defence forces.

Sex and Sanity

SEX in the human species is the only subject in the whole realm of science concerning which science has shown the least timidity, and the only corner of human knowledge in which the human race has hesitated to pool its individual knowledge. In a sense and in large measure each of us has gone about all his life as a sort of separate "compartment," withholding or largely withholding from his fellow "compartments" most of his own immediate experience. It is true, some of us do now and then let slip a few of our sex thoughts—more or less judiciously dressed up for the occasion by our censor (more so than less) but the picture or pattern of human thought and conduct thus gained must be quite different from the true fact—inadequate and in places blank. As a result of this poor liaison between minds many persons naïvely assume that others are like themselves, while others—very many of these, it would appear—have gone about imagining that certain kinks in their own makeup were peculiar to themselves, and have always maintained a discreet but worried silence concerning them.

It has been the aim of psychologists, particularly within recent years, to open up and explore all of these hidden recesses—to pool the contents of the sealed compartments, as it were, so that each could at least partake of knowledge of the rest. In this way humanity would gain a better idea of what average human sex thought and conduct is. One by-product, no doubt, would be a much more charitable attitude toward others, for if we are all more or less peculiar does not the peculiar become the norm again? A second by-product would be less of the kind of worrying which, rather than the actual thing worried about, has put so many into insane asylums.

Even at best, however, such an opening up is difficult business, and in fact it doubtless never will occur directly between persons. A simpler way is through the medium of the written word—scientific books on the sex life of the human being, books which record the actual life experience of enough persons to provide a norm. Such a series of books is being made available one by one at intervals of a year or two by the National Committee on Maternal Health, a committee composed of noted physicians and psychiatrists. Conceived on a high scientific plane, the advanced research of this committee has raised the whole subject of sex out of the realm of the sensational or emotional, with which it has so often been associated, and placed it on the plane of rational, scientific undertaking.

As H. G. Wells points out, when light and air have been let in on the various aspects of sex, the present human preoccupation with that corner of our being doubtless will be relegated to a position of much more secondary importance than at present. Its mystery will have departed. Perhaps unsatisfied curiosity has been the mainstay of prurience.

Free Ports

FOR some years there has been considerable agitation for the establishment in this country of "free port" zones for foreign trade. The Port of New York Authority, in recently affirming its support for legislation establishing such zones says that it sees no panacea for foreign trade or shipping in such zones but believes Congress should permit experimentation "with this type of trade stimulator."

The free port, one of which has been urged for Staten Island, down the bay from Manhattan, is a sort of vestibule to a port of entry, a section surrounded by a customs barrier but not subject to customs. In-transit or trans-shipment trade may land in these sections, be unladen, repacked, stored, manipulated, processed, and reshipped to foreign countries with no red tape and a minimum of expense. Such zones would stimulate the use of American ports by trade moving between two foreign countries, and would, therefore, furnish employment to additional thousands of port workers. To show why this is so, the Authority says that "in Great Britain the so-called trans-shipment trade makes up from 15 to 20 percent of the total foreign trade of the country. The free port of Hamburg, Germany, is reported to have handled in one year 22,000,000 tons of freight, utilizing 11 miles of piers, 2000 cranes, and 6000 workmen."

There are many ports in the western hemisphere that have better steamship service via the United States than they have directly. This is because we are strategically located to handle products between Europe and the Orient, and between Canada and the countries south of us. Even under the difficult and expensive "in bond" trans-shipment plan, the Department of Commerce reported for 1930 approximately half a billion dollars worth of goods imported into the United States and trans-shipped, or stored, smelted, or combined with domestic products for foreign consumption.

It seems to us, therefore, that the plan of establishing a number of free ports in this country would be good business; it would attract trade.

SOUTHERN PINE FOR

By CHARLES H. HERTY

OF all our natural resources—and they represent fabulous wealth!—our forests are one of the greatest. The tremendous demands for newsprint — among other things — has, however, pushed the newsprint pulpwood "front" almost entirely across our northern border. Thus Dr. Herty's successful researches, culminating as they have in the discovery of a process to utilize a hitherto overlooked resource in young southern pines, have enormous economic value.

It is logical to envision, upon reading Dr. Herty's excellent interpretation of this important work, the gradual development of a great southern industry combining reforestation, "cropping" of young pines, and the manufacture of huge tonnages of newsprint paper.—*The Editor.*

ECONOMICS sometimes goes awry —for example, in the newsprint industry.

A few years ago hundreds of millions of dollars of American capital emigrated from the United States to Canada where it was used for building great newsprint mills. From one point of view that was natural, and, of course, artificial stimulation of one sort or another accelerated the rate of this emigration.

It was natural because the industry was following that type of wood (spruce) which was admirably adapted to the purpose and which was given preference over all others in newsprint manufacture. Therefore the tide changed, and, whereas the United States mills had formerly manufactured two-thirds of our newsprint consumption and imports were limited to one-third, these figures are now reversed.

In pursuing such a policy, financial interests followed the beaten path, oblivious to the fact that where logs are cut and conditions for reproduction are unfavorable costs must increase, and, eventually, the industry become extinct. On the other hand, a permanent industry under continued low costs must be sought in a region where reproduction of logs keeps pace with consumption, and where raw material can be worked up into a finished product under favorable conditions and with accessibility to consuming centers.

The conditions of such an ideal location point clearly to the South Atlantic and Gulf states, which have within their borders more than a hundred million acres of cut-over lands, and more than twenty-five million acres of abandoned farm lands.

On much of this cut-over land, left from the lumbering of the former magnificent forests of yellow heart pine, there has sprung up, despite the carelessness of the owners in protecting against ground fires, a forest of young pines (longleaf, slash, loblolly, old field and Virginia pines). Latterly, intensive fire control in several southern states has added enormously by natural reforestation to the potential pulpwood supply of this southern region.

All the real economics of the situation, free from any political or financial bias, point to the southern states as the section for a permanent newsprint industry to supply adequately the entire needs of the United States and provide for a large export business. Cheap wood, lower-priced labor under the NRA and nearness to sulfur, salt, limestone, alumina and clay make the purchase of necessary supplies less expensive; and hydro-electric power, cheap coal and cargoes of fuel oil along the coast assure reasonable expense for power and steam.

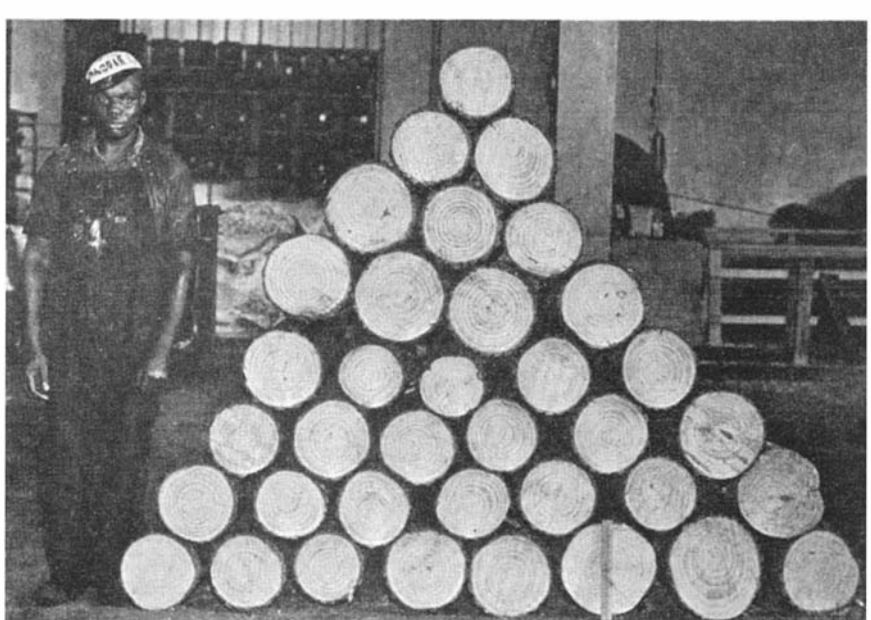
FREEDOM from ice and snow makes logging possible throughout the year, and therefore removes the heavy interest charges of the great investments in wood made necessary by conditions in colder climes.

Abundant water, from the clarified rivers or from the "ready-to-wear" artesian wells, insures ample quantities of the most necessary reagent in a paper mill.

Proximity to the Atlantic Ocean and the Gulf of Mexico insures easy access to the large consuming markets of the East, and ample rail facilities make possible close touch with the Middle West markets, each of these and, in addition, the home market now being supplied by imported newsprint.

The one point in doubt, or, rather, completely disbelieved, was the suitability of the wood of the most common tree of this southern section, the pine, for newsprint manufacture.

A preliminary experiment showed a very low resin content in pine free from heartwood, which begins to form in these trees only after they reach about twenty-five years of age. Next, a small-scale digestion of this wood by the standard sulfite process showed that it was readily pulped, giving a very light-colored product which was easily bleached. Another rough preliminary



Pulpwood logs from 10-year-old loblolly pine grown in Georgia. These logs, from natural reforestation, show what can be expected from proper thinning

White Paper

The immense pine forests of the south are penetrated by paved and hard surface highways, thus assuring low-cost yet high-speed transportation for pulpwood

experiment indicated that this wood readily adapted itself to the manufacture of groundwood.

These results were vitally interesting to only those with a most enthusiastic bias in favor of national self-containedness, and particularly in the development of a section of the country long left in neglect, whose people wring with great difficulty a bare subsistence from nature's resources.

It was necessary to provide a semi-commercial laboratory where results could be obtained on an adequate scale to be convincing as to commercial feasibility. This was made possible by four factors: The contributions amounting to about $60,000 from The Chemical Foundation, Inc., of New York City; an appropriation for two years of $20,000 each by the State of Georgia; contributions through The Industrial Committee of Savannah of a suitable building, power, fuel oil for steam, water, wood, etc.; and by the co-operation of equipment manufacturers, who gave large discounts on equipment because of the strictly research character of the undertaking.

ON January 1, 1932, the staff assembled and entered the building filled only with the soft, delicious mid-winter air of Savannah. By the middle of May the equipment was completely installed and experimental work begun. The first results obtained were necessarily crude and unsatisfactory; but by constant study of the defects and constant application of the simple fundamental principles of research steady progress was shown as the weeks went by.

It was immediately evident that nothing was to be feared from the standpoint of color, in spite of the name "yellow" pine brought down from the old days of heartwood lumber. These all-sapwood pulps showed themselves brighter and lighter in color than the corresponding pulps from spruce. This was attested by numerous comparisons with spruce samples furnished by northern paper mills.

It next became important to determine what differences, if any, existed among the pulps from the five commercial varieties of pine grown in Georgia. Sulfite and groundwood pulps were made from each of these. Fibers from each were studied carefully under the microscope and measurements made. Paper runs were made of the usual commercial mixtures of sulfite and groundwood from each. No differences could be detected; and in later work in the laboratory these species have been mixed indiscriminately. (This is of particular importance in woods operation because no selective logging is required.) Preliminary bleaching tests showed that these pulps bleached easily with a low chlorine consumption.

The most startling development, however, was the fact that a large lot of wood cut for the experimental work began to show in July, 1932, marked evidence of blue stain, or sap stain, a fungus growth. Many weeks were spent in trying to overcome this blemish on the young wood which produced a darkened pulp. Dipping added expense even if thoroughly successful. Finally it was found that logs left with the bark on them showed no signs of stain until after a lapse of about three weeks. It was therefore decided to pulp and grind the wood less than three weeks after it was cut.

Apprehension as to the incomplete pulping and the prevalence of pitch proved to be perfectly groundless, the groundwood pulping beautifully and showing no sign of pitch in any of the equipment.

Varying conditions of the cooking operations and trials of various burrs on the pulpwheel resulted in constantly improved sheets of newsprint, the fibers felting excellently on the wire of the Fourdrinier.

In the Spring of 1933 a truckload of logs was delivered to the laboratory by Mr. James Fowler of Soperton, Ga. These logs were thinnings from his land on which slash pine seedlings had been set out. They were all seven years old. From them an excellent grade of newsprint was made which proved to be lighter in weight but stronger than regular newsprint when tested in comparison with paper furnished by one of the leading metropolitan dailies. On this paper was printed the first edition of a newspaper (*The Soperton News*) on material made entirely from young Georgia pine by the standard methods characteristic of the newsprint industry.

Next came the test as to the surfacing of the paper and its printing quality. The very first run of a roll of newsprint made from Georgia pine on the presses of the *Savannah Evening Press* immediately following its regular edition showed a beautiful printing with little show-through and an excellent reproduction of cuts and illustrations of all sorts.

THE most interesting experiment was that carried out on small young pine trees which had been worked for naval stores for three years and abandoned by that industry. After sawing off these logs just above the scarified portion of the trunk, high-grade newsprint was made from the unscarified part. This adds an enormous quantity of raw material standing ready and waiting for the pulp and paper manufacturer, for it is estimated that not less than thirty million cords of such wood are now standing in the South—the great bulk of which is concentrated in southeast Georgia and northern Florida.

The one remaining criticism against the excellent newsprint produced during the Summer of 1933 was that it had not yet been demonstrated that the same quality of paper made on our laboratory machine at the rate of one hundred feet per minute could be produced on a fast commercial machine.

It was a justifiable criticism and had

to be met. After a long search and many disappointments arrangements were finally completed with the Beaver Wood Fibre Company, Limited, at Thorold, Ontario, Canada, a subsidiary of the Certain-teed Products Corporation, which has a branch plant at Savannah, Georgia. Under the arrangement twenty-five tons of air-dry pulp manufactured in the laboratory, consisting of one-fourth sulfite pulp and three-fourths groundwood, were shipped to Thorold and run over a commercial

The experimental corn-pine plantation of Mr. Renfroe, in Georgia

paper machine at the rate of seven hundred fifty feet per minute. The pulps, mixed with two percent size and one percent clay, ran for eight and a half hours over this machine without a single break.

The resultant paper was shipped to Georgia and distributed among the nine Georgia dailies which had contributed the funds for freight on the pulp and the returned paper. On November 20, 1933, the *Albany Herald*, *Athens Banner-Herald*, *Atlanta Constitution*, *Atlanta Georgian*, *Atlanta Journal*, *Brunswick News*, *Macon Telegraph*, *Savannah Morning News*, and the *Waycross Journal-Herald* appeared simultaneously on paper made altogether from young Georgia pines; and the testimony of the publishers as gathered and made public by the Associated Press on the following day showed a uniformly satisfactory behavior of the paper in the press rooms.

The paper had a marked velvety feel, required less ink for printing and was more pliable than the average commercial newsprint. In connection with this last point, we have now made in this laboratory the paper for the *Soperton News*, which was stiffer than average newsprint; the paper on which was printed the *Savannah Evening Press* test run, which was practically normal; and the paper at Thorold, which was more pliable. Experiments are now in progress to determine just how to control conditions so that any quality of newsprint desired may be produced. Preliminary indications justify the belief that this point will be readily worked out.

As a result of the data accumulated during the year from all experimental work, there was published in the special issues of the nine Georgia dailies the laboratory's estimate of cost of manufacture of newsprint in the South in a mill of 150 tons daily capacity, or 45,000 tons annual production, as follows:

Conversion Costs per Ton:	
Alum	$0.10
Color	0.06
Wrapper	0.30
Sulfur	0.60
Limestone	0.10
Clay	0.04
Wood (1.15 cords, rough)	4.60
	$5.80
Labor, inc. administration	5.08
Pulpstones	0.20
Felts	0.60
Wires	0.25
Belting	0.10
Lubricants	0.08
Steam	1.50
Electric Power	4.00
Finishing	0.50
Liability Insurance	0.15
Teaming	0.15
Misc. Materials	0.15
Repair Materials	0.50
	13.26
Total Conversion Cost	$19.06
Capital Charges (based upon a total investment of $4,027,500):	
Interest at 6%	$5.37
Sinking Fund at 2%	1.79
Depreciation at 5%	4.48
Taxes and Insurance	0.25
Selling Expense	0.75
	12.64
Total Cost per Ton	$31.70

The last Georgia state legislature voted unanimously to continue for two years the appropriation of 20,000 dollars per year for maintenance and operation of the laboratory. Unfortunately this item in the appropriation bill was vetoed by the governor after the adjournment of the legislature. Almost faced with the necessity of closing the doors of the laboratory in the midst of the most important stages of the experimental work, The Chemical Foundation, Inc., appreciating the bearing of the work on national self-containedness and the vast economic interests at stake, came to the rescue with an offer to The Industrial Committee of Savannah to provide adequate funds for an enlarged experimental program for two years, and, if necessary, for a third year, provided The Committee could lease the equipment from the State of Georgia for that period.

This lease was negotiated at one dollar per year; and at the present time the work is under full way.

WHILE this work is going on in the laboratory, reforestation in young pine is going forward at a tremendous pace in Georgia. A large number of Civilian Conservation Corps camps are making a new picture of Georgia. Many miles of fire-strips are being cleared, and lookout towers erected which communicate by recently constructed telephone lines. This work and the demonstration of the value of pine fiber for newsprint by this laboratory, together with the work of the state forest service, has already brought more than five million acres of abandoned cut-over lands under intensive fire control; and on these protected areas where seed trees have been left natural reforestation is taking place on an enormous scale. Thus billions upon billions of young pines are springing up under stimulating conditions.

Meanwhile, a young Georgia pioneer, Marion Renfroe, of Brooks County, is probably making history in pointing the way to a rational utilization of the twenty-five million acres of abandoned farm land in Georgia. Believing that pines planted in cultivated ground would grow more rapidly than had previously been recorded, and, in his financial straits, hoping to take care of all expense in connection with these pines through reaping a food crop, he conceived the idea of planting pine and corn in alternating rows on his farm. For three years he has carried on this work with marked success. The corn has paid for the seedlings and their planting, and yielded an additional revenue. It is confidently expected that newsprint from his pines can be made when they are five years old.

One cannot help but be an optimist in the midst of such happenings, and, while present interests may oppose for the time being the providing of capital for a southern newsprint industry, no one can doubt that eventually the means will be found for the development of a great white paper industry in the South.

The world will be supplied with a continuous output of cheap pulp and paper; the South will reap a rich harvest from a great source of wealth which through ignorance on the part of all parties concerned has been completely overlooked; and economics will no longer be awry.

THE NEWER PHOTOGRAPHY

• Later Year Trends in the Development of Cameras and Films Have Revived Interest in Photography as a Serious Hobby. In Coming Months This Page Will be Devoted to the Peculiar Problems Thus Brought to the Fore, Authoritative Discussion of Which is not Available Elsewhere

WITHIN the memory of some of us who are as yet not so old, photography enjoyed a great wave of popularity as a hobby for serious-minded people. In those old days camera enthusiasts were not content simply to snap-shot their way about the country and let someone else do the developing and printing. The genuine lover of this quite new art had his own dark room, often in the cellar, in which, under the rays of a ruby light, he spent many hours enthralled with his hobby oblivious alike to the calls of his family or the wailing of baby. The sheer joy of mixing his own developer, preparing his pan of rinsing water, and then of painstakingly watching his picture "grow" beneath his hands, first on the film or plate as a negative and then on paper as an artistic finished print, was sufficient to make of him a devotee.

THEN, for a period of decades, the hobby of photography found favor among fewer and still fewer people, although the number of pictures taken increased steadily, as well as the number of picture-takers. Perhaps the steadily increasing "speed of living" had much to do with this growing lack of interest in a hobby requiring patience, but the fact remains that camera enthusiasts largely ceased the study of photography and confined their activities to the taking of snaps. The vast improvement in commercial processes for developing and printing pictures must also be held accountable, for the convenience and rapidity of "store photo finishing" cannot be discounted.

In the last few years, however, there has been observed a widespread renascence of the photographic hobby. The ruby light, in den or cellar or perhaps in the otherwise unused and darkened kitchen of a modern apartment, again has become the shrine before which literally thousands worship. What's more, the green light is making its appearance, saying "Go" to amateur photographers interested in using panchromatic film.

FOR this revival of serious interest, the camera and film industry may justifiably compliment itself. Research has done the trick—research and ingenuity in developing new camera films and lenses. For several years the trend has been toward the miniature all-purpose camera and camera manufacturers have entered this new field with a fine competitive spirit which has resulted in the availability for comparatively modest prices of cameras that take tiny pictures so perfect in detail as to make possible extreme enlargements.

The small, original "vest pocket" Kodak, by Eastman, seems to have been the fore-runner of these small cameras. This has been popular for years. Ansco produced, a few years ago, a "Memo" camera which took a still smaller picture; and E. Leitz turned out the Leica which took a "spool" of tiny pictures and had the added advantage of having interchangeable lenses. Later the Leica added a combination finder-focusing "telescope." Eastman's Pupille and Vollenda came along to take 16 pictures on an eight-exposure roll of "vest-pocket" film. The Pal-Ko, a larger camera, used roll film for convenience but boasted ground glass focusing and other innovations including the capacity for varying at will the size of pictures from 1/3 to 2/3 to full frame size. Follmer Graflex, of Rochester, New York and later Exakta, of German manufacture, gave, in roll-film types, practically all the conveniences to be found in any of the others.

The improvement of film and of photographic printing papers has also had much to do with the awakening of interest in photography, finer grained film emulsions being necessary before tiny negatives may be greatly enlarged and still retain their detail. These have come as a result of intensive research. For general use there was also placed on the market by Eastman, a faster and more efficient roll film under the trade mark Verichrome. This was followed sometime later by a similar film—Plenichrome—by Agfa-Ansco. Only a few months ago, Eastman produced a new roll-film that is panchromatic, the first time this principle has been available in rolls suitable for the smaller, amateur cameras. These panchromatic rolls have the advantage of also being super-sensitive, like the film used in Hollywood for three years. The combination of faster lenses, Photoflash and Photoflood lamps, and super sensitive panchromatic film is perhaps most significant because it permits untutored snapshotters to take snapshots indoors; but that fact by no means excludes the use of this possibility by advanced amateurs.

DUE, therefore, to popular demand—climaxed by a talk we recently had with several camera enthusiasts at General Electric in Schenectady—SCIENTIFIC AMERICAN will set aside space in each future issue for this reborn hobby. Details of cameras; films; lenses; filters; picture composition, developing, printing, and enlarging; and the thousand and one other problems to be encountered will be taken up. This subject will be treated primarily from the standpoint of interest and helpfulness to the advanced amateur photographer, but will also be sufficiently elementary to assist the serious beginner.

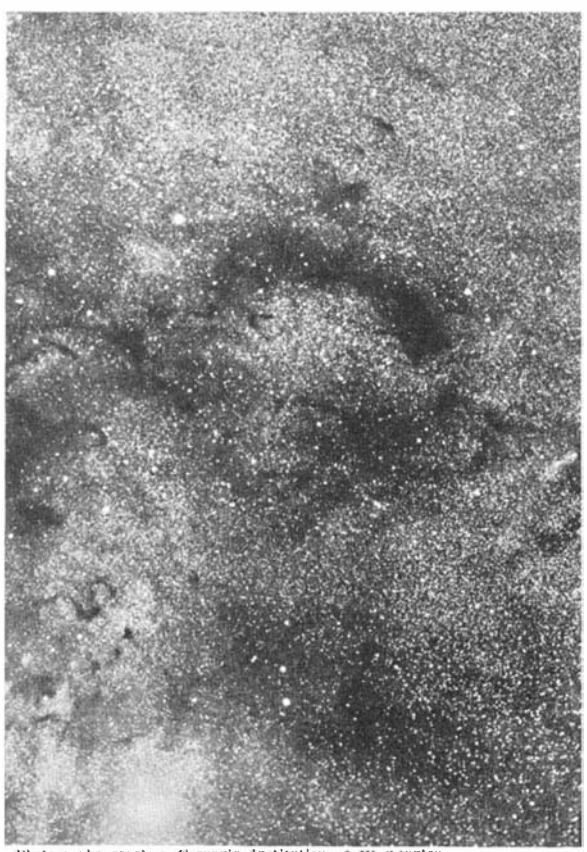
In order that this series may be developed to the greatest possible advantage, kindly tell us your problems and let us know what phases of photography you would like discussed in future.

BARNARD'S BLACK NEBULAE

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
Retiring President of the American Association for the Advancement of Science

ON a clear summer evening—or after midnight at the present season—as we look northeastward and up into the sky, we may exclaim, "Why, there are clouds about, after all. Look at the dark strip across the Milky Way." Sure enough, in the constellation Cygnus, a narrow band lies athwart the luminous background. But this is no common cloud; it is there every night and all night; as Cygnus swings to the west and drops toward the horizon the dark region travels with it. Whatever it may be it is clearly not on earth. Moreover, a telescope, or even a good field glass, shows stars scattered here and there over the darker area, so that its cause is to be sought far away in space beyond our nearer stellar neighbors. This dark spot in Cygnus is by no means unique, though it is perhaps the most conspicuous thing of the sort which is visible in northern latitudes. In Sagittarius and Ophiuchus there are many such areas, some of them very dark but less conspicuous to the eye because they are on a fainter background. Most notable of all is a smallish region in the Southern Cross which stands out against a bright region of the Milky Way so prominently that it has been known for centuries to mariners, who call it the Coal Sack.



Photographs courtesy Carnegie Institution of Washington

One of Professor Barnard's photographs, showing various irregular patches of dark nebula in the constellation of Ophiuchus. Note the "S" which Professor Russell mentions. This photograph was made at Mount Wilson, with a camera-telescope having a 10-inch portrait lens of 50 inches focal length. The time of exposure was 3½ hours. The area shown is about 15 by 18 degrees in overall extent

IT was long supposed that these dark areas represented actual gaps in the star clouds of the galaxy, through which we looked into the inky depths of empty space. The distinction of discovering their real nature belongs to the late Professor Barnard, who advanced and conclusively proved the thesis that they are produced by actual clouds of absorbing material far out in interstellar space, and of prodigious dimensions. The existence of clouds with a length and breadth of many light-years is so startling an idea that good evidence was needed, and it was amply available. Some of the obscured regions are small, black, and sharp-edged and, if interpreted as real starless regions, would demand belief in a tunnel of empty space piercing a great star cloud and pointed directly at the sun. Another, almost as black, had an irregular narrow S-shaped outline, which is even harder to explain as due to an empty region. To a long list of evidence of this sort was added the still stronger testimony of several regions where the obscured area—still void of faint and distant stars—brightened up into visible nebulosity near certain bright stars, showing clearly that the cloud could reflect light as well as absorb it, and that the bright star was actually immersed in it, and lit up the surrounding haze.

Since Barnard's convincing presentation of the evidence no one has doubted that obscuration by opaque or partially translucent clouds is the true explanation. A reminiscence of this which has probably never been published may be of interest, especially to those to whom it recalls the personality of one of the most lovable of American men of science. Professor Barnard, at the annual meeting of the American Philosophical Society, was giving the first general public account of his investigations, and illustrating it by a long series of lantern slides of the superb quality which always characterized his photographic work. Most of them were positives, on which the regions of obscuration stood out dark on a background thickly powdered with stars. Suddenly one field appeared on the screen for which, owing to lack of time, no positive was available, and the negative was shown with dark star points on a white background. Professor Barnard, used for a lifetime to interpret both positives and negatives and usually the latter, was in the full train of his discourse and blissfully unconscious of the change. Pointing to a large unsullied area of white screen he went on, "This conspicuous dark patch . . ." The writer, familiar enough with astronomical photography to recognize the situation, heard a gasp from a very distinguished biologist in the row in front, which subsided on the whispered words, "That's a negative!"

ONCE the existence of obscuration was realized, it was found to be widespread. The great majority of the sharp details of the Milky Way arise from it. What is more, the division of the galaxy into two branches, which begins in Cygnus and extends southward past Sagittarius far below our horizon, as far as the Southern Cross, is itself recognized as due to a host of clouds—probably more or less irregularly scattered and behind another. The face of this cloud belt must be thousands of light-years long. Its widest portion lies right between us and the galactic center about which the ro-

tation of our system takes place. Could these clouds be brushed away, the southern Milky Way would look much wider and many times brighter—indeed the brilliant star clouds which adorn the southern sky in summer are probably only the edges of a far larger and perhaps brighter mass which is hidden from us.

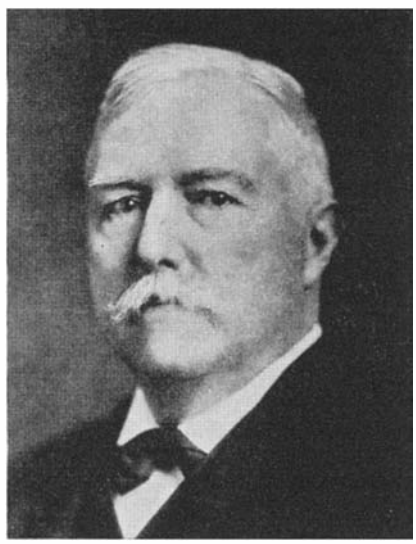
Beyond these remoter stars and on the outer fringes of the galaxy is the still vaster zone of obscuring matter. It has been known for a century that the white nebulae—spirals and spheroidal—apparently avoid low galactic latitudes. As soon as it was realized that these nebulae are themselves galaxies, though smaller than ours and far, far beyond its limits, it became clear that this avoidance must be not real but apparent, and due to the presence of obscuration upon a gigantic scale.

Obscuring clouds are therefore one of the most noteworthy features of the physical universe. Indeed, when it comes to size they far exceed anything else we know of except the galaxies themselves and, unlike the star clouds, they appear to be continuous.

OF what are these tremendously bulky bodies composed? From the start it is clear that like the clouds in our own atmosphere, they must consist of scattered fine particles—drops of liquid or grains of dust. No continuous medium, not even the thinnest gas, could extend over such enormous volumes without attaining an altogether prohibitive mass.

A cloud of gas—indeed, even if free from haze—would well-nigh blot out the stars behind it if it were thick enough, as the atmosphere at its very clearest weakens the light of the setting sun. Pannekoek, applying this hypothesis to the well-known and extensive obscuration in Taurus, found that a mass of gas sufficient to produce the observed obscuration would have a billion times the mass of the sun! All the neighboring stars would long ago have fallen into it unless they were moving much more rapidly than they actually are.

But a cloud of dust or a fog of fine drops is incomparably more opaque, pound for pound. (Compare the puff of steam from an engine with all the miles of air above our heads.) Within certain limits a pound of stuff produces a thicker cloud the finer the particles are into which it is divided, their greater number more than compensating for their smaller size. When, however, the particles become considerably smaller than the wavelength of the light, the light waves go by with less disturbance and their total stopping power diminishes, even though there are more of them. At the same time another important change occurs. Large particles which act merely by stopping light mechanically (so to speak) produce the same effect on long and short waves. A cloud or fog of such particles is gray—it weakens light of all colors to the same extent, like a neutral glass. But fine particles have a better grip on the shorter waves, which are nearer their own size and scatter them more effectively. A cloud of these, viewed by transmitted light, is yellow—for the blue and violet rays are most weakened in passing through it. (Viewed by reflected light it would look blue, for most of the light which these fine particles take out of the direct beam is scattered laterally.) For intermediate sizes the cloud would be yellowish gray, the proportion of the two influences depending on particle size. If, then, we have a partially transparent cloud, and can find out what effect it has, both in weakening and in yellowing the light of the stars which shine through it, we may arrive at some estimate of the size of the particles, and then of their total number.



The late Edward Emerson Barnard, loved personality of the world of astronomy, who was born in Nashville, grew up in poverty, worked as photographer's assistant when a boy and youth, saved and bought a small telescope, studied, made observations that attracted the attention of astronomers, won positions at Lick and Yerkes Observatories

An interesting study of this sort has just been published by Schalén of Upsala. From a series of carefully made and discussed plates of regions in Auriga, Cygnus, and Cepheus, including heavily obscured regions and apparently clear skies outside them, he finds that none of the clouds is opaque, but that the stars behind shine through with diminished brilliance. For the cloud in Auriga the absorption is 1.9 magnitudes, so that only 17 percent of the light gets through. Careful studies of spectra show that in the near ultraviolet the transmission is only four fifths as great. The cloud in Cygnus lets through some 25 percent of the light of stars behind it, that in Cepheus about 40 percent, and both of these turn the light yellowish in approximate proportion to the whole depletion.

THE theoretical effect of a cloud composed of uniform particles depends not merely on their size but on their material. Data for the calculations (which are intricate) are best available for metallic particles. On the assumption that they are composed of iron, like tiny meteorites, Schalén finds that the observed relation between the weakening and yellowing indicates a diameter of about 1/10,000 of a millimeter. Results from the different clouds are very similar.

It is then possible to calculate how many particles there must be per square centimeter in a column extending right through the cloud. If the depth of the cloud can be estimated, we then get the average distance between particles. Schalén's studies show that the effect of the Auriga cloud comes on gradually as one passes to more distant stars, and he concludes that the haze begins at a distance of only 200 light-years from us and extends for 1000 light-years. From these figures he concludes that the individual particles, tiny as they are, are about 40 meters apart. The results for the other clouds are similar.

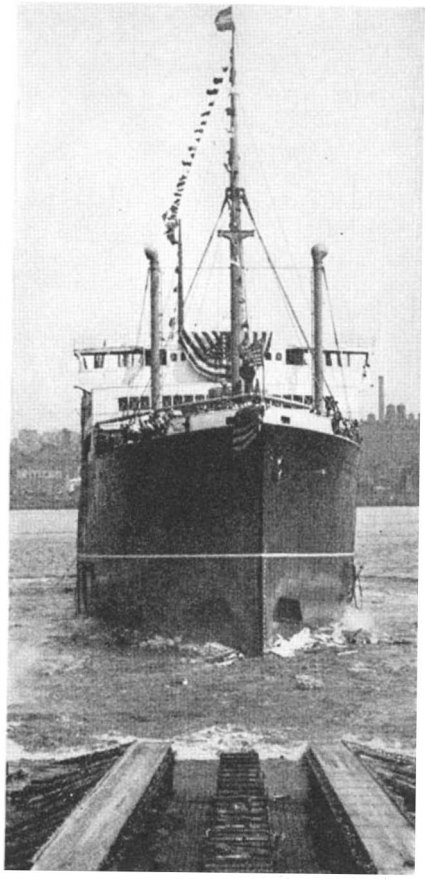
On the small scale of ordinary observation, such a region would appear to be a perfect vacuum. A cubic mile of it would contain 70,000 particles which, fused into one mass, would be less than 1/6000 of an inch in diameter, and that is all!

Though we could not detect such a cloud nearby if we were immersed in it, its total mass may be considerable. A cubic light year of it would include stuff enough to make five planets like the earth. The Auriga cloud itself has probably a volume of a couple of million cubic light-years, and the total quantity of matter required to form it would be 30 or 40 times the mass of the sun.

The values computed for the cloud, however, are minima. Particles much larger or smaller than the computed size have much less light-stopping power per ton, and a mixture of these, while producing a yellowish gray cloud of the same general appearance, might be much denser.

It is really very remarkable that so much of the matter in space is condensed into luminous stars. Whether the obscuring clouds represent something that never concentrated into stars, or that has once formed part of a star and been ejected in some way, we do not yet know. When we know more about them we may be able at least to guess.—*Princeton University Observatory*, March 2, 1934.

DOWN THE



A Grace liner floats free after successfully sliding down the ways

IN launching a ship, her ponderous mass must be moved downhill, and the work must be done so smoothly that no damaging stresses shall be set up in her structure. A liner, for example, representing at the time of launching a dead weight of several thousand tons, is equivalent to a sizable skyscraper in weight; and sturdy as she will prove when water-borne, still she may be rather easily injured before launching by a momentary lack of proper support of her keel or backbone. The strength of the entire complex fabrication of steel is dependent upon the integrity of the fundamental keel. It is this fact that makes the moving of a big ship from the shore to the water a truly momentous and exacting task.

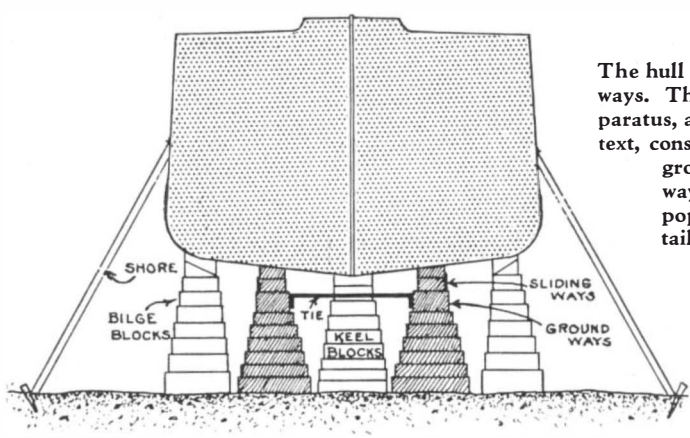
Shipyards are naturally located close to the shore of some body of water. If the ground beneath the shipway is not firm, piles are driven into the ground to stabilize it so that there will be no subsidence as a building craft increases in bulk and weight. With this precaution taken, then the keel blocks can be assembled to form a foundation on which to construct a vessel. Keel blocks are heavy, rectangular timbers that are laid one above another at intervals of three or four feet and at right angles to the length of the ship to be built. The highest stack of keel blocks is inshore and beneath the point where the stem or bow of the vessel will rise, and the blocks diminish regularly from that point to the water's edge, where the stern frame will be erected. Between these extremes will be laid the connecting keel plates, resting directly upon the keel blocks. The slope upon which the craft is thus built is designed to facilitate putting her overboard at the time of launching.

Weeks before the date set for launching, the launching ways are prepared. To a certain degree these ways must be constructed to suit the ship they serve even though much of the material can be used time and again.

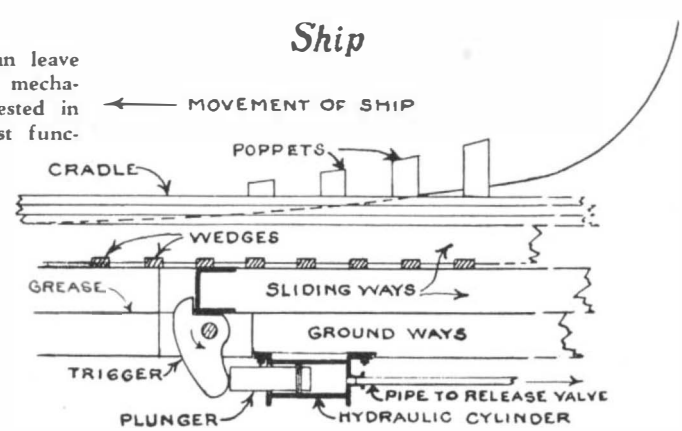
The launching apparatus consists in the main of groundways, sliding ways, cradle, and poppets. The cradle and the upright timbers, called poppets, surmount the sliding ways and are so constructed that they conform to the curves of the craft's body and afford a corresponding measure of intimate support. The groundways—one on each side beneath the ship—provide two broad tracks upon which the sliding ways can move. The groundways extend out into and under the water so that the vessel will be supported until she is entirely afloat. The dimensions of the sliding ways are determined by careful calculations, because if the pressure were too much localized it might squeeze out the lubricant—several thousand pounds of which are necessary—from between the groundways and the sliding ways and make it impossible to send the craft into the water.

THE groundways are composed of long pieces of timber squared to about 16 inches, and which, when joined together, form a smooth bearing surface about four feet in width. The slope of the groundways corresponds with that of the keel blocks, and the groundways also slant slightly inward toward the keel of the ship. This gives the groundways the effect of a groove that serves to offset any tendency of the vessel to swerve sidewise.

In addition to the foregoing provisions, the groundways have a slight arch—technically termed "crown"—



The hull of a vessel on the ways. The launching apparatus, as explained in the text, consists principally of groundways, sliding ways, cradle, and poppets. Certain details are shown here



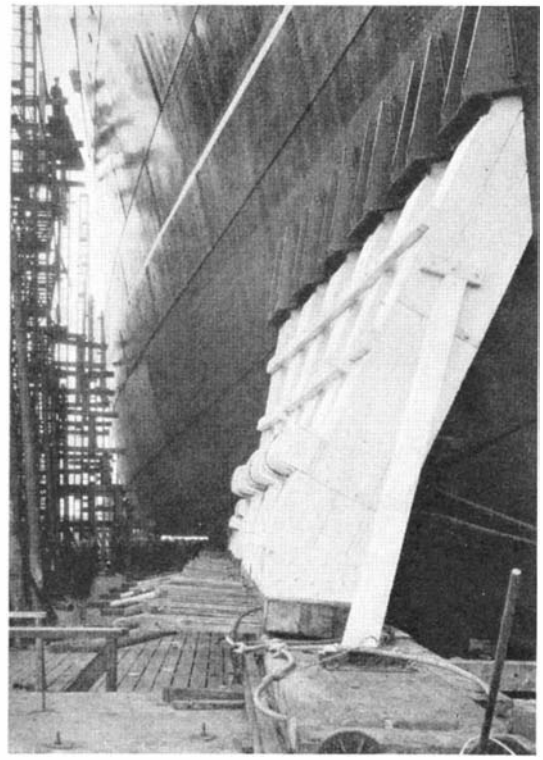
Before a ship can leave land forever, a mechanism carefully tested in every detail, must function flawlessly so that there will be no possibility of a slip of any kind in the actual launching

*Abstracted from *The Grace Log*.

WAYS

It Is a Difficult Engineering Job to Launch a Large Ship Successfully

By R. G. SKERRETT*



Poppets, cradle, and launching ways usually float free when the craft is water-borne

throughout their length, to prevent the groundways from sagging and arresting the movement of the ship waterward and, perhaps, straining her; and second, to make the initial half of the run comparatively slow and then to hasten her travel during the remainder of the sliding period, which is the most critical part of the operation.

The sliding ways are next assembled upon the groundways and their lower courses are made up of single heavy timbers similar in dimensions to those of the groundways. They are carefully and strongly bound together by lacings of chain and heavy rope. On top of the lower course of each sliding way is laid another line of heavy timbers, and between the upper and the lower courses are inserted many hundreds of white-oak wedges, arranged regularly and spaced a few inches apart.

SURMOUNTING the upper course of each sliding way are the timbers constituting the cradle and the poppets, which fit snugly against the curving form of the vessel's bottom and bilges. Again lashings of chain and heavy hawsers bind these units together and link those on one side with the corresponding parts on the other side of the launching structure. The poppets and the cradle, together with the launching ways, usually float free of a craft when she is water-borne.

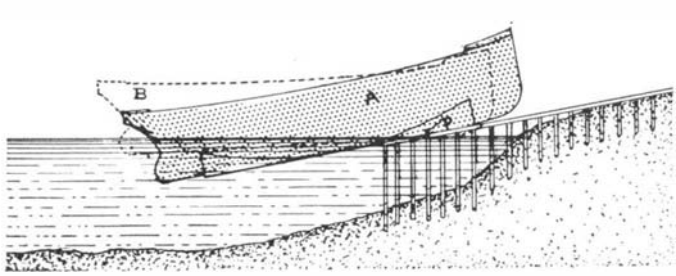
The general practice is to launch ships stern first. The reason for this is that the fuller form of the hull aft tends to make the vessel rise more quickly from her initial plunge than would be the case if she were sent into the water bow first, her sharp bow being a less buoyant section. This procedure makes the pivoting stress less when the burden of the ship's weight is thrown upon the forward poppets and cradle. This is the most critical moment in a launching; if the vessel has not sufficient stability in her light condition, and the poppets are unequal to the tax placed upon them, the ship may tip over and, possibly, sink. This has happened and has taken a heavy toll of life. Therefore, the forward poppets and associated parts are made especially strong.

Now let us see how the vessel to be launched is lifted from her keel blocks and her burden transferred to the launching equipment. Here is where the multitude of long and sharp oaken wedges come into play. Assuming that the time has come on the day of launching to effect this transfer, then the wedging-up operation is started at the lower or after end of the ways and continued progressively toward the bow. The wedges are driven inward with battering rams of hardwood, each ram being swung by a gang of four men. When the last of the wedges have been driven to a given distance between the two courses of the sliding ways, then the great weight of the craft has been lifted about an inch. This serves to take her weight from the keel blocks that have sustained her for many months; the blocks are then knocked out from under her. Before this transfer has been completed, safety chains have linked the sliding ways with the groundways, and at certain points on each side of the ship are placed stumpy timbers, or "dog-shores," with their lower ends resting on the earth and their upper ends canted against the sliding ways to arrest any movement. Also, before the wedging-up is started, the inshore or bow end of the sliding ways is anchored to the groundways by the powerful trigger of a hydraulically operated plunger.

These precautions are necessary to prevent the ship from launching herself prematurely.

WITH the keel blocks removed, with all supporting shores down and out of the way, with the dog-shores disposed of, and every workman out from under the ship, the safety chains are cast loose. Then, if everything has gone as planned, the massive trigger at the bow of the vessel is the only thing that restrains her movement waterward. The hour for the launching has come, the order to trip the trigger is given, and, just as the great craft quivers an instant following her release, her sponsor smashes a ribbon-bedecked bottle upon the ship's steel stem and repeats the formula: "I christen thee . . ."

The craft gradually gathers momentum, and by the time she has gone half the length of the groundways she is moving at a pretty good clip. A few seconds later, her stern enters the water, dips, and a moment later bobs upward. By the time this movement is completed the stem also drops into the water and bows with an easy motion as if acknowledging the noisy salutes of the crowd and the fleet of tugs waiting to take hold of her and to tow her to the outfitting wharf of the yard.



Stern first because the fuller form of the hull aft tends to make the vessel rise more quickly than if launched bow first

INDUSTRY—RESEARCH

Business Management Gets the Research Point of View

By CHARLES F. KETTERING
Vice President, General Motors Corporation
General Director, General Motors Research Laboratories

TIME was, not so long ago, when industry grew by a slow process of evolution and by sporadic invention. What developments were made came as a result, not of organized study, but of the undirected efforts of individuals or small groups. Conditions changed. Mr. Kettering tells the extent of the change, how manufacturers saw, as it were, the handwriting on the wall: the imperative need for intensive scientific study of the industrial problems of development, production, and expansion. His analysis of the industrial research situation provides an object lesson for dilatory manufacturers. It also may stand, to bankers and investors in general, as a guide to the manner in which they may judge the progressiveness and foresightedness of the companies in which they would invest.

To show how the scientific research of such companies as duPont, General Electric, Westinghouse, Chrysler Motors, International Nickel, Grasselli Chemical, and of similar ones has led to momentous advances would mean simply referring the reader to past issues of this journal. To show other advances still to come, we refer to future issues in which feature articles on industrial research will be published.

—The Editor.

I AM often asked, what is research? What does it accomplish? What place does it fill in modern business? Most everybody is interested in research because they have an idea it is full of deep, dark mystery and the things they can't understand fascinate them. But man has been interested in the Delphic Oracle, witches, and medicine men until he understood their workings. Your interest in research should not come from this superstitious source.

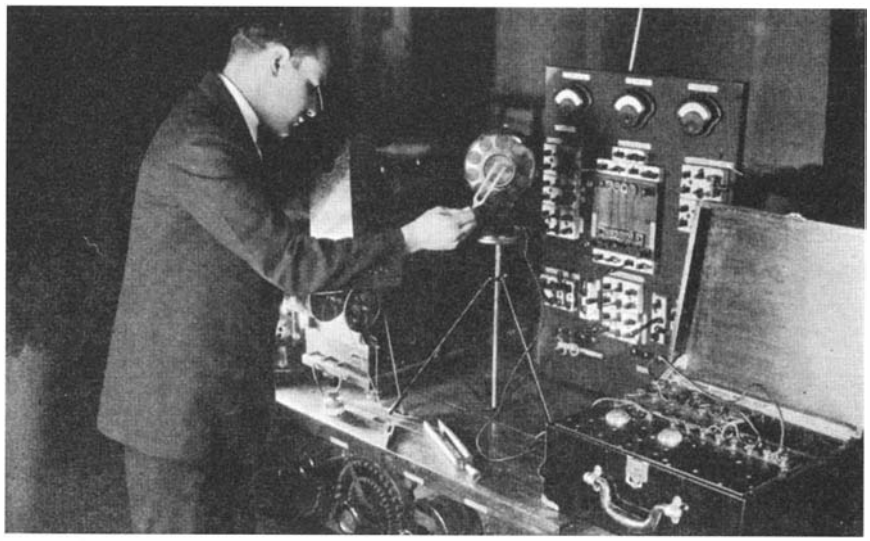
Let me give you a modern definition. Research is an organized method of trying to find out what you are going to do after you can't do what you are doing now. That definition applies to you as an individual, to industries or to governments. That is the one biggest reason for research in General Motors.

Industrial research may also be said to be a method of keeping the customer reasonably dissatisfied with what he has. That means constant improvement and change so that the customer will be stimulated to desire the new product enough to buy it to replace the one he has. You can't sell anything to anybody if he is perfectly satisfied with what he has.

Research also always has the job of selling itself to industry and keeping itself sold. All we have to offer are ideas and they are the hardest article in the world to sell or even give away. There is one thing we are always sure of in research: When we first present an idea it is sure to be turned down. Selling an idea is a time function. From long experience, I have learned that it takes at least four years to convince the "experts" that your idea is useful.

It is how people react toward an idea without thought that determines the success or failure of any proposition in the world today—it is not the thoughtful reaction. Therefore, you have to present it again and again until you get an unthoughtful favorable reaction. If I propose a new idea before any committee in the world, it will say, "It's no good." All right, that is behind me then. So I present it again after analyzing why it was said to be no good. Again it is thrown into the waste basket. Again I go around after the meeting and pull it out.

So I just keep presenting it and presenting it and finally somebody will say, "Where have I seen that before? There is something to that." But it usually takes four or five years before a new idea is accepted and used. That is about the speed with which people in general accept new things.



In the difficult task of locating and measuring the loudness of noises in automobiles, General Motors research engineers use radio and acoustic standards

IF you are a businessman and suddenly decide to adopt research into your organization, and go ahead and set up a committee of experts to handle the matter, then I can tell you the surest way to kill new ideas that are sprouting around your offices is to submit them to that committee. The best way to get that great, grand, epoch-making idea of yours reduced to simplest, lowest, most commonplace form of mediocrity is to get that committee to pass on it. Every single member will be able to see and will not hesitate to point out all the disadvantages that could possibly be found for your idea.

New things are too often shelved or abandoned because of objections exist-

ing only in the mind of some man who can block the adoption of it. He has set up a purely arbitrary and absolutely false set of conditions which would never occur and which no device could satisfy. If the new thing and the old are weighed in the same balance using the same scale of weights and the new is found better, it should be adopted.

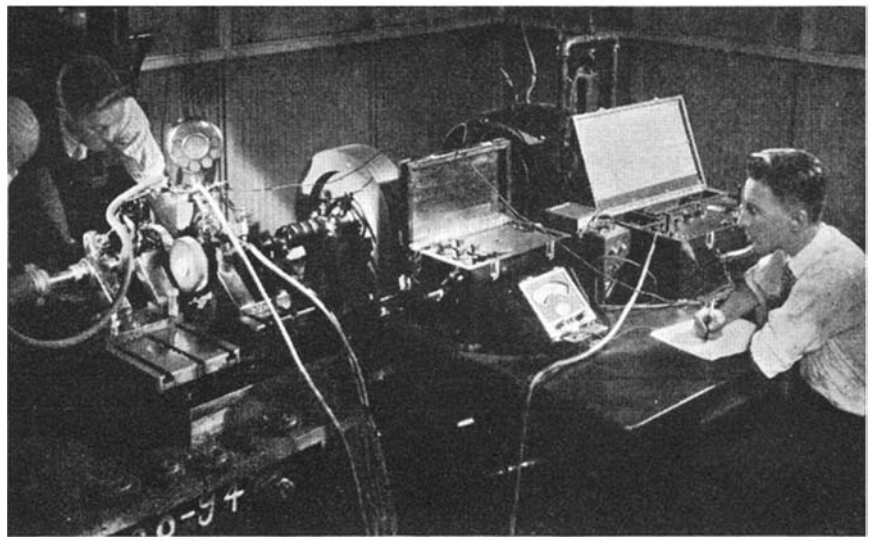
When I was first working on the self-starter we almost lost out because one man objected to moving the choke control from the front of the car where it had always been to the steering column where it could be used from the seat.

Charles F. Kettering

They told me that if put in the new position it would point out a deficiency in the starter and lead to sales resistance from the prospective purchaser. Because one man had an absurd idea on the choke, they were ready to throw out the whole self-starter even though there were no objections to the starter itself which worked just as we said it would. We finally convinced this man it would be all right to change the choke and got our starter installed.

That illustrates what I mean by false limitations and conditions. Go ahead and work out the principles first and then find ways of surmounting the minor details and limitations that come up. You will usually find that many of your first fears will have taken care of themselves.

I know of a man who cost his company a million dollars because he obstructed a proposed change that had to be made the next year anyway. Every company has men like that with little forward looking imagination but plenty of destructive negative imagination. It would be better to pay these men to get out—to keep them on the pay roll but to stop their checks if they ever came within two miles of the plant. It would be cheaper in the long run and the men remaining could accomplish things. If this man were getting 10,000 dollars a year, you could pay his salary for one hundred years on the 1,000,000 dollars he cost in just one year and he certainly wouldn't live that long.



By using a high-quality vacuum tube amplifier, research engineers record the noise produced by a pair of gears, and design others for quieter operation

A NEW thing has enough difficulty competing with the old without imposing on it limitations which we would never think of imposing on the old one. If more time were spent on making a workable device and less on finding out why we shouldn't use it, we would have more new things appearing on the market.

We had all sorts of unexpected problems handed to us when we got really started in applying the battery starting, ignition and lighting system. The first carbon filament lamps took some time to heat up the filament, especially in cold weather. This produced a heavy drain on the battery and caused the fuses to burn out when it was impossible to obtain new ones. This was annoying and inconvenient and made it necessary that spare fuses be always in the tool box. We suggested a small circuit breaker to replace the fuses. Then it would only be necessary to throw in the breaker when it was thrown out by an overload on the circuit. After we had made up a workable device and given demonstrations, one man was still against it. He had used his imagination to picture an improbable situation in which the motorist was driving at high speed at night on a winding road in a mountainous district. What would happen if, just as he was making a sharp turn with a two thousand foot precipice over the edge of an unfenced road, the circuit breaker should be thrown out? But he didn't worry about what would happen if the fuse burned out. Many of the limiting conditions we set up are no more foolish than this man's.

The fellow who opens up their minds and overrules their objections quicker than anyone else is the sheriff. There is nothing like the sheriff to make a man think and we have had more open-mindedness in the world since 1929 than in any period before in modern times. This is true not only in business, but in government and personal relations as well. That is one reason I have been optimistic about the future. When we open up the doors and let new ideas in, things are bound to come out right in the long run. When industries, government, transportation systems and others give research a fair hearing and trial a new order, better than the old, is sure to be the result. And we are beginning to see the results of this open-mindedness everywhere. In many lines of endeavor every month more new things are given a chance to prove themselves better than the old, than were in the entire period of so-called "prosperity". That is a healthy condition.

I THINK our difficulties of the past were due, at least partially, to a wrong way of looking at things. Our bookkeeping methods were antiquated and based on conditions which were no longer true. It is now a research job, looking at things in a new light, to straighten them out.

We should not think of our good facilities as assets unless they are used —and I believe the brains of our country are our best facility. Much of our trouble during the past few years has been mistaking facilities for assets. We were fooling ourselves when we thought our big surplus of bank credit was an asset. It was an unused facility. What good are all the natural resources of the country, the surplus of wheat, cotton, steel, and other products, unless they are made available for use. Part of our trouble has been in considering

(*Please turn to page* 275)

Another Job for the

CODFISH

It Assisted in Building Up Our Commerce and Industry; It Can Help Stamp Out a Widespread Disease

By BION R. EAST, D.D.S.

IN Boston, there is an ancient and honored memorial—the Sacred Cod—which bears witness to the debt of gratitude America owes the codfish.

This meritorious denizen of the deep saved the New England pioneers by providing them with a much needed supply of food, and later gave them an article of export which played an important part in building up our foreign commerce, our merchant marine and, indirectly, our manufacturing industries.

Today the codfish is being called upon to do another big job—to help in stamping out rickets, a disease that afflicts many if not most of our children to some degree.

Rickets is apparently a disease of civilization. It does not seem to have been known (or, at all events, noticed) until men began to congregate in cities, to darken their skies with smoke, to use glass in their windows and, with mistaken solicitude, to confine their infants indoors during the first years of their lives. Undoubtedly, it has become more and more widespread since 1645, when it was first definitely referred to a specific disease by English physicians.

Since then it has been and still is a health menace. Dr. A. F. Hess, an outstanding authority on the disease, states that "rickets is the most common nutritional disease occurring among the children of the temperate zone. Fully three fourths of the infants in the great cities, such as New York, show rachitic signs of some degree." Other investigators show that the proportion of children showing signs of mild rickets may be as high as 50 percent in many parts of the country.

RICKETS is characterized by the improper development of the bony structures. Severe cases may develop bowed legs, pigeon breast, and other malformations. Such cases are, fortunately, rare today, as they are almost certain to receive proper medical attention. The real trouble lies with the mild cases, not serious in themselves but often with serious consequences. Poor teeth subject to decay, malformed jaws, and pelves so small as to interfere with normal childbirth are among the ailments for which rickets is blamed.

The sacred cod of Massachusetts

The connection between rickets and civilization lies in this fact: It is now known that if a child is exposed to direct sunlight day by day all the year around, it will not have rickets. Civilized man in various ways contrives to shut himself off from the effective rays of the sun. Rickets is a direct consequence of this violation of Nature's intentions.

That sunlight was a cure for rickets was suspected as early as 1890 when it was noticed that, though infants in the tropics may be the victims of every possible error of care and feeding and the mortality rate among them is frightfully high, they rarely have rickets.

MUCH earlier than this, cod-liver oil was credited with the power of curing rickets. This evil smelling and tasting oil was originally introduced extensively in Europe for tanning leather. It was used by physicians for treating various diseases prior to 1800, and in 1826 it was being definitely prescribed in cases of rickets.

Since then, the career of cod-liver oil has been a checkered one. At times, it was believed to have properties that approximated the marvelous; at other times, it fell into disrepute and some even classed its claims for medical value as among the superstitions. Now we know that many of its alleged properties are non-existent, but it will prevent rickets.

The turning point in our knowledge of rickets occurred about ten years ago when methods of producing experimental rickets in rats were developed, thereby facilitating scientific research on that disease.

The early notions regarding the value of sunlight and cod-liver oil in the treatment of rickets were promptly verified, and it was also established that artificial ultra-violet light was effective in preventing rickets and that rickets-preventing properties could be imparted to certain foods by exposing them to the active wavelengths of light.

As soon as it was discovered that cod-liver oil really abolished rat rickets, Dr. T. F. Zucker undertook the task of ascertaining what part of the oil carried this activity. He quickly found that it was not the oil itself, but a certain material dissolved in the oil, that was the active portion. By applying suitable chemical methods a preparation 1000 times as potent as cod-liver oil itself was obtained. Later this concentrate was refined and made tasteless and odorless enough to be incorporated in foods—even as sensitive a food as milk—without altering the taste.

In the meantime, Dr. E. V. McCollum carried out a series of investigations on the rickets-preventing factor in cod-liver oil and called this factor "vitamin D."

THIS vitamin D is a thing very different from the other substances known as vitamins. All of the others occur widely distributed in plants. Plants are the primary food of animals, and any animal partaking freely of its own natural mixed plant diet will receive goodly amounts of vitamins A, B_1, B_2, C, and E. This is not so with vitamin D. In none of the ordinary food plants do we find, by our present standards, any appreciable amounts of vitamin D. The only dietary source of this substance in nature in amounts useful for our practical purposes is the fish oils. Some of it occurs in the eggs of birds, but only in comparatively small amounts. Were vitamin D as abundantly supplied in our common foods as are the other vitamins, rickets would never have become a health menace.

We now have at our disposal a number of means of combating this disease, including cod-liver oil, cod-liver oil concentrates, Viosterol, various irradiated food products, and ultra-violet ray therapy. But, in spite of this abundance of methods of meeting what is called the vitamin-D requirement, there is, according to an editorial published in the *Journal of the American Medical Association*, nearly as much rickets as ever in this country, except in certain centers where particular efforts have been made.

To avoid all the handicaps and evils resulting from having nearly 50 per-

cent of infants suffer to a greater or less extent from infantile rickets, the problem is not what to offer as preventive measures but rather *how* to get preventive measures to the thousands of infants who do not come under proper medical care or whose mothers have not been instructed in clinics how simple it is to avoid rickets.

If the proper amount of vitamin D reaches the infant population, rickets should become as rare as infantile scurvy. Not so many years ago infantile scurvy was a real problem. But, through an educational campaign which has made it a commonplace that infants should get orange juice, tomato juice, or some other form of vitamin C, scurvy, which is a vitamin-C deficiency disease, has been practically abolished.

Fruits and vegetables—the vitamin-C carriers—are relatively inexpensive, and are palatable and readily obtainable almost everywhere. Unfortunately, the same cannot be said of cod-liver oil, the vitamin-D carrier. To many, it is one of the most disagreeable substances human beings are called upon to consume. Hence it is hardly suitable as a means of combatting rickets on a nation-wide scale.

ON the other hand, it is practicable to distribute to the public, by the regular milk dealer, milk fortified with the purified concentrate of vitamin D from cod-liver oil. This type of milk is palatable and as long as it is supplied to the home and consumed by infants in normal amounts no precautions other than the regular feeding need be taken in order to prevent all but the unusual cases of rickets.

The concentrate as supplied to the dairies contains at least 900,000 Steenbock units per pound. At the dairy, the concentrate is finely dispersed in the milk, prior to pasteurization, in the proportions of one pound of concentrate to 6000 quarts of milk. Each quart of milk, therefore, contains 150 Steenbock units. The finished product differs from untreated milk in no way perceptible to the senses.

The potency of the concentrate itself is checked by means of biological assays before being given to the dairies. The plan for assaying the finished product as produced by the different dairies varies in different localities but the preferred plan is to have monthly assays made, unknown to the producer, in the laboratories of the local state agricultural college or other acceptable laboratories. As an added safeguard to the consumer, bio-assays are made by laboratories co-operating with the state and city control officials.

The number of Steenbock units per quart was first set at 150 because, considering the varying amounts of milk consumed by infants of different ages, it seemed to be the opinion of authorities that translating the rickets-preventing activity of cod-liver oil into vitamin-D concentrate, 150 units would protect the average child.

A large amount of work has been, and is being, done to determine the minimum amount required by the average infant. It has been demonstrated that milk containing 150 units per quart, when consumed in amounts that the average infant can take per day, healed infants with rickets in an average time of 41 days.

Another recent study has demonstrated that when 50 Steenbock units of vitamin D, prepared from cod-liver oil by the Zucker process, were fed per day in milk from November to May to a group of 48 infants, some of which showed evidence of rickets while others were normal, those that were rachitic recovered rapidly, while the non-rachitic group remained normal during the entire winter season. A control group of same age showed that over 50 percent were rachitic.

THE question is sometimes raised as to whether the addition of vitamin-D concentrate to milk constitutes an adulteration. For very good reasons the laws of the various states are designed to protect such an important food as milk from harmful or fraudulent additions. The addition of vitamin D to milk by any reliable method, such as direct irradiation, special feeding of cows, or the addition of a vitamin-D concentrate, enhances the nutritional value of the milk, as opposed to the addition of an inferior substance which debases it. That this is the view of the Committee on Foods of the American Medical Association is shown by its acceptance of various brands of milk containing the concentrate, and also the following statement made by the secretary of that committee: "The Committee looks upon vitamin-D as a milk with enhanced nutritional values which is in the interest of better nutrition and the health of the public."

Experimental rats used for making tests on vitamin D in the diet

This view is supported by the fact that this type of milk is being marketed in 68 cities of 12 states, with the consent and assistance of food and drug officials.

IN addition to being distributed by means of ordinary milk, the vitamin-D concentrate derived from cod-liver oil by the Zucker process is also being added to evaporated milk. This is a particularly interesting application, since evaporated milk is used by many persons whose means or location are such that they do not ordinarily receive fresh milk regularly. The fact that 1,770,338,000 pounds of evaporated milk were produced in this country in 1930 indicates the part played by this kind of milk in human nutrition, and suggests its value as a carrier of vitamin D to the public.

Bread is also being fortified with the vitamin-D concentrate and is especially useful in reaching children past the infantile age and adults. For bread the standard quantity of vitamin D added is 90 Steenbock units per pound loaf. This amount is regarded as a desirable supplement to the vitamin D supplied in the normal way through sunlight and some articles of food. As in the case of vitamin-D milk, vitamin-D bread is also carefully controlled, the product of each baker producing it being regularly checked by bio-assays.

Thus, the peculiar virtue of cod-liver oil is being made available to an ever-increasing number of persons to fill a gap now existing in the ordinary diet.

This is but one of the several plans now on foot to combat rickets along the broadest possible front. If only a part of these prove practicable and receive the support of the professions interested in public health and of the public, rickets will be eliminated as a major evil in this country.

Vitamin D "line test." Tibiae of rats fed varying amounts of vitamin D. (1) rachitic, (2) healing, (3) normal. The amount of vitamin D needed to produce a continuous line of calcification (2) in 10 days is one Steenbock unit

EARTHQUAKES

What They Are, How the Seismologist Observes Them, and Why They Are Observed

By REV. JOSEPH LYNCH, S. J.
Director of the Seismic Observatory
Fordham University, New York City

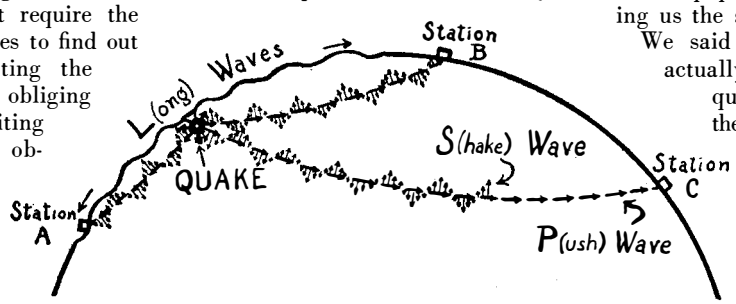
A STORY is told of a night-watchman who was watching an astronomer making some observations through a large telescope. Suddenly, in the region of the sky towards which the telescope was pointing, a star fell —a shooting star. The watchman whistled in amazement and exclaimed to the astronomer, "Gee, Mister, that was some shot!"

Our watchman gave the astronomer credit for far more than he was able to do, and in the study of earthquakes we seismologists too are often given credit for far more than we are able to do. People have often expressed surprise that we are able to record an earthquake here that is occurring thousands of miles away. The fact is, we don't record it—the earthquake is obliging enough to record itself for us. It does not require the talent of a Sherlock Holmes to find the name of a friend who has called to see us during our absence, if the caller has been thoughtful enough to leave his visiting card under our door. So it does not require the talent of a Sherlock Holmes to find out what earthquake is visiting the earth if the quake is obliging enough to leave its visiting card under our seismic observatory door—which is what every earthquake does. True, sometimes it is difficult to make out the writing on the card, but most quakes write their names sufficiently legibly for us to make them out. We have to supply the pen and ink and even the card, but the quake does the rest. On Monday, January 15th, at 3:43 A.M. New York time, a violent earthquake visited northeastern India, and some ten minutes later its visiting card was under our observatory door.

But what is the signature of a quake and how does it write its name?

Before discussing the signature of a quake let us see what an earthquake is. An earthquake may be described as a sudden slipping of a portion of the earth's crust—a readjustment of the crust to a change of forces. A landslide is a readjustment of the crust on a small scale. A snowslide on a sloping roof is an example on a still smaller scale. When the underneath part of the snow melts, the snow begins to slide down the roof and blocks of it fall with a thud to the ground. The force holding the snow to the roof, causing it to stick to the roof, is lessened considerably and the slipping is a readjustment to this change of force—the snow moves until it finds a force which will hold it in place. A slight readjustment of the earth's crust is going on nearly all the time at Niagara. From time to time huge boulders of rock fall into the water. The softer rocks underlying the overhead rock become washed away by the spray of the falls. The supporting force is thus removed from under this overhead rock and boulders of it fall in readjustment. The rock readjusts itself to the forces present.

An earthquake is such a readjustment to changes of pressure but a readjustment on a much larger scale. It is a readjustment taking place deep in the earth's crust, down to the depth of a hundred miles or so. The changes of pressure on such earth blocks may be due to a multiplicity of causes—erosion and deposition; tidal forces; centrifugal force (indicated by the fact that earthquakes are more or less confined to the equatorial belt), and numerous others beyond the scope of this short article. Briefly then, an earthquake is a sudden movement of a portion of the earth's crust.



Author's sketch showing three types of waves from a quake: The P, S, and L, or primary ("push"), secondary ("shake"), and long

This sudden movement causes the whole earth to quiver. This quiver travels through the earth as ripples through a pond, only much faster. It is not very noticeable but it has been noticed on the surface of mercury levels and still ponds. But, while not noticeable as a rule by our unaided senses, it may be made noticeable by a seismograph, the microscope of the geophysicist.

THE seismograph is the fountain pen used by the earthquake to write its signature. Its essential part is a delicately supported pendulum, something like a clock pendulum, the tip of the pendulum being equivalently the penpoint. When the earthquake occurred in India the whole earth quivered and, as the quiver passed through the ground under our delicately suspended pendulum, it made our pendulum quiver and this quivering was traced out by the pen on our paper record underneath it, giving us the signature of the quake.

We said the pendulum quivered—actually, the pendulum did not quiver. The observatory and the paper record and everything in contact with the earth quivered under the pendulum while the latter alone remained still. Hence, relative to the paper, we say the pendulum quivered, just as we say the sun rises when really it is the earth that is in motion and not the sun. Because it stays still while ground and observatory moves underneath it, the pendulum is able to trace out for us the motion of the ground and to give us the signature of the earthquake. The pendulum stays still while all around it quivers, because of its inertia—literally laziness. It will not respond to the earth's quiver for the same reason that none of us care to respond to the alarm clock in the morning. All bodies possess this inertia or laziness of motion. If a careless chauffeur starts a car suddenly, the passengers are thrown backward. Actually, they do not move, but refuse to move—they do not respond to the quick motion of the car because of their inertia, and are left behind, that is, stay still, while the car moves forward, hence they are equivalently

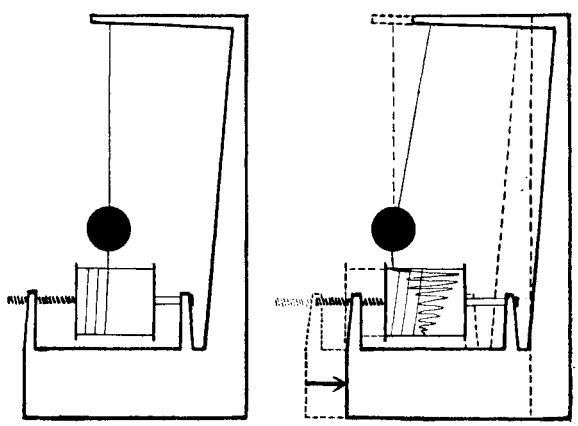
thrown backward in the car. Similarly if the chauffeur jams on the brakes suddenly, the passengers are thrown forward. Because of their inertia they refuse to have their motion stopped, so they continue forward while the car stops—hence they lurch forward in the car. We show this inertia in a personal way—we hate to go to bed, but once there we hate to get up. When the earth moves suddenly, then, under a delicately suspended pendulum, the pendulum lurches backward or forward, depending on the motion of the ground. We say it lurches—actually it stays still while the ground underneath it lurches.

This slight motion of the pendulum can be magnified in many ways: mechanically by a system of levers, electrically by winding a coil round the pendulum and setting the latter up between the poles of a strong magnet—the slight motion of the coil across the magnetic field generates a current which can be magnified in many ways. The most sensitive seismographs we have at Fordham University magnify the motion of the ground about 2000 times. This magnified motion is recorded on paper by attaching a pen to the pendulum or its lever system. To lessen friction and increase magnification, on the more sensitive instruments the motion is recorded on photographic paper by a beam of light reflected from a mirror attached to the pendulum in place of a pen. Such a seismograph set up anywhere on the globe will be set in motion by the quivering of the earth due to an earthquake and will faithfully record the latter's signature.

BUT how can we tell the signature of one quake from that of another? Just as we have the Christian name and the surname or family name in any signature, so we have, as it were, a Christian name and family name in every quake signature. The quiver that is sent out through the earth from every quake is a double quiver. The first pushes or compresses the earth ahead of it and is called a compressional quiver and travels five miles a second. The second quiver is a twist quiver, twisting or shaking the earth from side to side as it travels. It travels more slowly than the first, averaging only three miles a second. The farther an observatory is from the scene of a quake the longer will be the interval between the arrival of these two quivers, and the more drawn out will be the signature of the quake.

We recognize the signature of the quake from this double signature. If it is a long drawn out signature it is a distant quake. If the two names, that is, if the two quivers, are recorded close together it is a close quake, the exact distance being told at once by measuring carefully just how far apart the two quivers are on our record, which is kept moving at a constant rate under our pendulum, the time being marked on it automatically every second by the clock.

These two quivers or waves are due to the elasticity of the earth. The "push wave" is due to the elasticity of volume of the earth, the "shake wave" to its elasticity of shape. We have something similar in the case of a lighting bolt —an earthquake in the sky if you wish.



How quakes are recorded. *Left*: The pendulum point traces a straight line on a slowly rotating drum. *Right*: The drum shifts away from the heavy weight

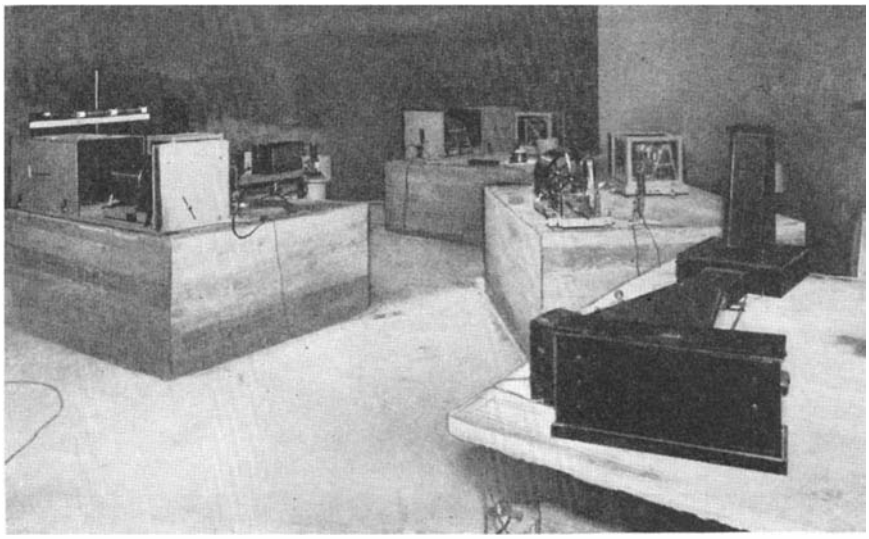
We have two distinct waves sent out—a lightning wave which we see, and a thunder wave which we hear. The lightning wave travels much faster than the thunder wave, hence we always see the lightning before we hear the thunder. In fact we can estimate the distance of the lightning bolt by the number of seconds that elapse between the arrival of the lightning and the arrival of the thunder—each second putting the bolt a fifth of a mile away. In a similar way we can estimate the distance of an earthquake from a seismograph by measuring the number of seconds that elapse between the arrival of the "push wave" or primary wave and the arrival of the "shake wave" or secondary wave. A set of tables has been compiled giving the distance of the quake for each time interval in seconds. In addition to the push and shake waves, a third wave, a combination of the two, travels around the outside of the earth and arrives much later. It is not necessary for the computation of the quake's distance but it acts as a useful check since its speed is likewise known.

I can imagine your saying that this explains how we can tell the distance of a quake from its signature, but it does not tell us just where the quake is. The long drawn out signature of the Indian quake could tell us it was a quake 7600 miles away, but could not tell us whether it were in India or Chile because both are about 7600 miles away. How can we tell the direction from the signature? If we had only one seismograph we could not tell the direction, but we have a whole family of seismographs and the quake obligingly writes its name under each one. Three seismographs of any one type are required if we are to be able to tell not only the distance but also the direction of the quake from its signature. One seismograph is set so as to respond only to motions from the north or south, another seismograph is set so as to respond only to motions from the east or west, and a third seismograph has the weight of its pendulum suspended by a coiled spring so as to respond only to an upward push or a downward pull of the ground. It tells us whether the ground is first pushed up or pulled down under it as a result of the quake. If we piece together all three motions the first two tell us whether the quake is, say, from the north-east or the south-west. The third or vertical instrument tells us whether the ground was being pushed from the north-east or pulled from the south-west.

Hence with three instruments we can tell both distance and direction. Moreover, we have the addresses of nearly all quakes that are likely to call at any time and if we have the distance and probable direction of a quake that has called we can usually say, "That is that South Mexican quake calling again" or "that is that Aleutian Island quake calling again." Both of these were frequent callers during the past year; nine calling from the Aleutian Islands and six from South Mexico.

OFTEN, of course, the signature of the quake is a poor one—very illegible. Legible enough to tell us the distance but not the direction. In that case we consult two other stations and, knowing the distance of the quake from three stations, we draw three circles on our globe with the three stations as centers and the three distances as radii. The three circles can intersect only in one point and that point is the scene of the quake.

We said we had a whole family of seismographs—at Fordham University we have eight in operation. Three of these are very sensitive and magnify about 2000 times. For a very large quake, however, they are sometimes too sensitive and magnify the motion too much. So we have a pair of less sensitive instruments to give us the signatures of the larger quakes. Then again we sometimes have little baby quakes



In a vault, 16 feet below the surface at Fordham University, in New York, eight seismographs take the pulse of the earth when her heart begins palpitating

that are felt only locally. They are not only much feebler than the larger quakes but they quiver more rapidly—the baby takes shorter and quicker steps than its parents, and we have to have a more rapidly quivering pendulum to be able to write down these quick baby steps. We have two so-called short-period seismographs for near and baby quakes.

With regard to the frequency of quakes: During the past ten months nearly 300 quakes called on us—more than one a day. Of these, about 50 left signatures sufficiently legible for us to recognize and locate definitely. Few of these did any serious damage until the last Indian quake, which destroyed about 5000 people.

BUT of what practical use is an earthquake observatory? The new seismology, or the scientific study of earthquakes, since its birth around 1895, has busied itself mainly with four lines of investigation: What can seismology tell us about the nature of the earth's interior; how can seismology be used in prospecting for oil, coal, and such materials; how can we construct buildings that will withstand earthquake shocks; and, lastly, how can we foretell when an earthquake is due in any given locality?

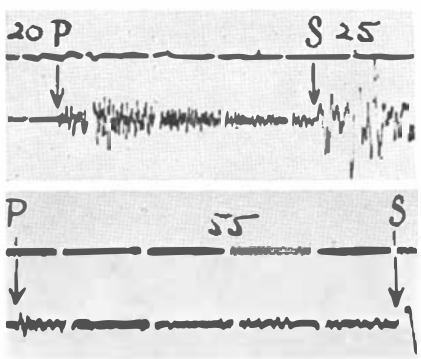
Much progress has been made along all four lines. We have now a fairly accurate picture of the internal structure of the earth. Seismology has, as it were, let down its camera into the interior of the earth and photographed it for us, and we find it to be a solid sphere with a dense core probably of nickel or iron, starting about half way down like the core of a baseball. For many years the interior of the earth was thought to be liquid, but a liquid core does not fit in with the findings of seismology. The existence of the core is deduced from the fact that earthquake waves are refracted or bent as they pass through the earth, much as light waves are refracted as they pass through glass or water. From the amount of refraction we can argue to the depth of the refracting surface. The twist or shake or secondary wave is due to the elasticity of shape and can exist only in a medium which has a shape of its own; namely, a solid. Since the twist wave passes through the core, we conclude that the core is solid, since only a solid can transmit a twist wave.

With regard to the prediction of earthquakes, seismology has not yet reached the stage where we can foretell quakes ahead of time, but investigations in this direction which are being carried out in Japan give hope that the time is not far distant when such prediction will be possible. It has been noticed that in earthquake regions the earth shows evidence of tilt or gradual rising for some years before the quake occurs, much as the inner tube of a tire or the bladder of a football rises gradually through a tear in the cover before finally bursting. The tilt of the ground is being carefully observed and measured, and it is hoped that it will finally give the clue to the forecasting of earthquakes.

Seismology has been used successfully in prospecting for oil and coal. An artificial earthquake is set up in the ground to be prospected by setting off an explosive in the ground, portable seismographs being set up at known distances from the center of this artificial quake. The time of the arrival of the earthquake waves from the artificial quake is carefully observed on these instruments and this time gives a clue to the structure of the ground through which the waves have passed.

In the matter of building, much has been accomplished. The data on seismology given to the engineers have enabled the latter to revise the building codes in California and Japan considerably, and these codes offer a basis for safer construction in other earthquake regions. According to the late Professor Suyehiro, even in the violent Japanese earthquake, buildings which had been designed to resist a horizontal force of one tenth of their weight successfully withstood the shock. The increased building cost necessary to provide this resistance to earthquake shock has been carefully figured and is ridiculously small—about 15 percent. Quakes can, with a little forethought and a little extra trouble in building construction, be effectively provided against.

Seismology has also shed light on earthquake insurance. The late Doctor Freeman has shown that earthquake risk has in the past been enormously exaggerated. Even in the most disastrous quakes, the actual damage has always been confined to a comparatively small area and careful analysis reveals the assuring fact that the actual loss seldom exceeds five percent of the

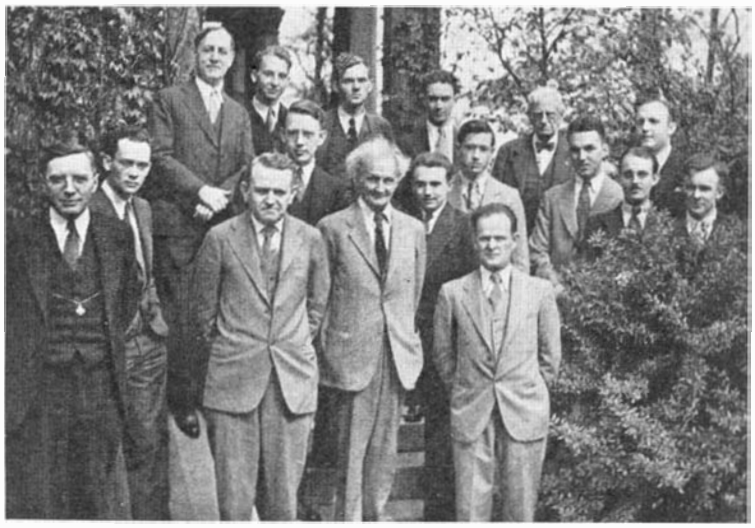


Two typical examples of earthquake records, showing, in either case, the P and S waves. The numerals refer to seconds of time (note breaks in line). Upper lines show no quakes, being from previous turn of drum

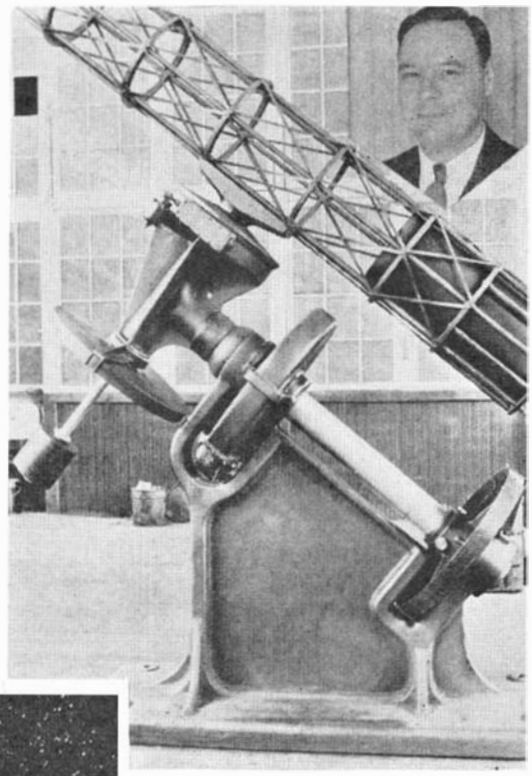
structural value. Were the full facts made clear, both to the public and to the insurance companies, each would be better served; premiums would be reduced, helping the insured, and insurance would be more generally taken out, helping the companies.

IN conclusion we might say that earthquakes are nature's safety-valve, wisely arranged by Divine Providence for our greater protection. They come for the most part in uninhabited regions, but if at times they cause sorrow and hardship, perhaps those beautiful lines of Father Tabb will come to our aid in viewing them in the light of blessings in disguise:

"My life is but a weaving between my God and me,
I offer Him the threads, He weaveth steadily.
Full oft He weaveth sorrow and I in foolish pride
Forget He sees the upper and I the under side."

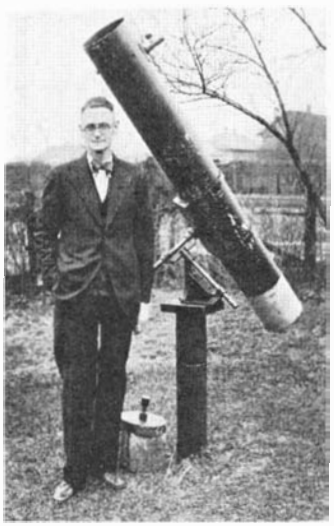


Some members of the Indianapolis Amateur Astronomers' Association



Above: A 15-inch reflecting telescope made by Carl Turner, with a mounting designed to take, ultimately, a 30-inch mirror. Total weight is 5500 pounds. It is driven by an electric motor, through a worm gear of bronze which weighs 700 pounds. Polar axis shaft 5½". Turner (insert in corner) is an automotive engineer

Right: A photograph of a part of the constellation of Cygnus, made by V. E. Maier, Secretary of the Association (1306 Parker Ave.) with a 4-inch portrait lens. A dark nebula, Herschel's famous "hole in the sky," shows in part in the upper right hand corner



R. E. Parker and his six-inch reflecting telescope, made in 1926 from instructions by R. W. Porter, published in the *Scientific American* and in the book "Amateur Telescope Making"

Samuel S. Waters, President of the Association, with his ball bearing mounted telescope. Mahogany tube

Left: Wm. H. Jordan and his 9-inch reflector

Amateur Astronomers' Activities in Indianapolis

SINCE this magazine revived and expanded the slumbering old hobby of amateur telescope making, in 1926, more than 5000 of its readers have found themselves so intrigued by its fascination that they have made their own telescopes, while in several cities—Los Angeles, Chicago, Pittsburgh, Tacoma, Dayton, Buffalo, Cincinnati and others —local clubs of amateur telescope makers and astronomers have been formed. One of these is the Indianapolis Amateur Astronomers' Association, and some of its activities are shown pictorially above. An interesting side light on this hobby is the fact that the comparable clubs from Chicago and Cincinnati often journey and meet with the Indianapolis club.

SUNDIALS AND THEIR CONSTRUCTION—IV

Declining and Reclining Dials

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

PREVIOUS articles have described the construction of the horizontal, direct vertical, equatorial, and polar dials. All of these dials are simply constructed and their computation is not difficult. Each also faces one of the cardinal points of the compass and therefore these dials are not applicable to surfaces which do not face the cardinal points. Recourse must therefore be had to the declining dial, the computation for which is more complicated than for the preceding dials. The construction of the declining dial, by the geometric method, is easily accomplished and should not present any problem to the reader.

There are four types of vertical declining dials: Those facing the south and declining respectively toward the east or west (1 and 2); and those facing the north and declining respectively toward the east or west (3 and 4). The construction of each dial is similar, and only one need be described here. This will be the south vertical dial declining west.

THE plane of this dial is perpendicular to the plane of the horizon, and it does not face any of the cardinal points. Unlike the preceding dials, two things must be known before the hour lines can be constructed: first, the latitude of the place and, second, the declination of the dial or the declination of the plane upon which the dial is to be placed. (The declination of the plane may be found by one of the methods described in the March article.) Figure 3 shows the construction of the hour lines for a dial in latitude 40°30′, declining west 28°.

The gnomon is perpendicular to the face of the dial.

The style points to the celestial pole.

The substyle is to be determined. (The substyle is not the 12 o'clock line, in this type of dial.)

The height of the style is to be determined.

TO find the substyle line, draw the horizontal line *ABC* (Figure 1). From *B* let fall a perpendicular line *BD*, which will be the meridian or 12 o'clock line.

Draw the line *BE* so that the angle *DBE* is equal to the complement of the latitude, which in this case is 49°30′ (90°—40°30′=49°30′).

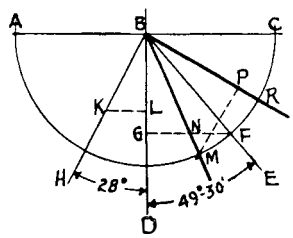


FIGURE 1

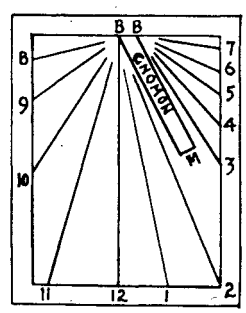


FIGURE 2

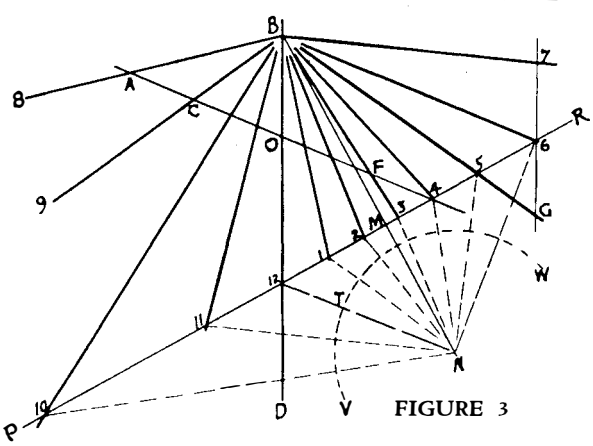


FIGURE 3

With *B* as a center and any convenient radius draw the arc *AC*, which cuts the line *BE* at *F*. From *F* draw a line perpendicular to *BD* at *G*.

From *B* draw *BH*, making the angle *HBD* equal to the declination of the plane, which in this case is 28°.

Make *BK* equal to *GF*, and from *K* draw *KL* perpendicular to *BD*. Then on *GF* make *GN* equal to *KL*.

Draw a line from *B* through *N*, cutting the arc *AC* at *M*. This line is the substyle line upon which the gnomon must be placed, perpendicular to the face of the dial.

The substyle line must fall among the afternoon hours, if the dial declines west; among the morning hours if the dial declines east.

To find the height of the style (Figure 1):

With *N* as a center and the radius *BL*, describe an arc cutting the arc *AC* at *R*.

Draw a line from *B* through the point *R*.

The line *BR* is the style, and the angle *RBM* is the height of the style. (The style must make an angle with the face of the dial equal to the angle *RBM*.)

TO find the hour lines (Figure 3):

In this figure the lines *BD* and *BM* have been reproduced from Figure 1.

In Figure 1 the line *MP* is perpendicular to *BR*.

In Figure 3 the line *MB* has been produced, so that *MN* is equal to *MP* (Figure 1).

With *N* as a center and any convenient radius, describe the arc *VW*; and at *M* draw the line *PR* perpendicular to *BM*, cutting *BD* at 12.

Now draw *N*12, cutting *VW* at *T*.

Beginning at *T* divide the arc *VW* into equal spaces of 15 degrees each. Draw lines through these divisions until they cut the line *PR* at 10, 11, 12, and so on.

From *B* draw lines through the points 10, 11, 12, and so on. These lines will be the required hour lines.

To obtain the hours after 6 P.M., draw a line through 6 (*B*6 is the 6 o'clock line) parallel to *BD*, and cutting *B*5 at *G*. For the 7 P.M. line make the distance 67 equal to *G*6. The 8 P.M. line may be obtained in the same manner.

To obtain the hours before 10 A.M., draw a line through any point on *BD*, such as *O*, parallel to *B*6 (the 6 o'clock line). This line cuts *B*3 at *F*, and *B*4

at 4. From *O* lay off the distance *OC* equal to *OF*, and *OA* equal to *O*4. Lines drawn from *B* through the points *C* and *A* will give the 9 A.M. and 8 A.M. lines.

Figure 2 shows the lines constructed in Figure 3 applied to the dial plate, in their proper position, and the way in which they should be numbered.

The number of hour lines and the length of time the sun shines upon this dial depends upon its declination from the meridian. The 12 o'clock line is always a vertical line.

IN setting the dial it is essential that the plane upon which it is to be placed be vertical. The declination of the plane having previously been carefully determined, attach the dial securely in place.

The hour lines constructed for a south vertical dial declining west will also serve for a south dial declining east, a north dial declining west and a north dial declining east, if each dial has the same declination and latitude. This will easily be seen if the hour lines have been drawn on transparent paper. Thus, Figure 2 represents the hour lines for a south vertical dial declining west 28°. If the figure is looked at from the rear, the hour lines for a south dial declining east 28° will be seen; if the figure is turned upside down, the hour lines will be those for a north dial declining west 28°; and the reverse side of the figure, when turned upside down, will show the hour lines for a north dial declining east 28°. It must be remembered that the morning hours of a dial declining west will become the afternoon hours of a dial declining east; and that the substile of a dial declining west will fall among the afternoon hours. But the substile of a dial declining east will fall among the morning hours. Therefore, while making one dial, the hour lines for all four declining dials have been constructed.

DIRECT reclining dials are so called because their planes face the cardinal points of the compass, and as you stand before them they lean from you (or recline from the zenith). A plumb line is perpendicular to the plane of the horizon and if extended, it would cut the zenith at any given place. The reclination of a dial or plane is that angle, measured in degrees, formed by the intersection of the dial or plane with a plumb line. Two dials of this type—the polar dial and the equatorial dial—have previously been described.

There are four types of direct reclining dials: the direct south, north, east, and west dials. These may be divided into two groups—the north-south and east-west. Before the hour lines for these dials can be computed the dials must be referred to that position at which they *would* become horizontal or vertical dials. This is called "reducing to a new latitude." The method of reduction is but a simple mathematical operation.

Direct north and south reclining dials must be reduced to new latitudes, where they will become horizontal dials. Determine the reclination of the plane upon which the dial is to be inscribed, and proceed as follows:

In the case of the direct south recliner, if the reclination of the dial is *less* than the *complement* of the *latitude*, the new latitude = complement of the latitude *minus* the reclination. If the reclination is *equal* to the complement of the latitude, the dial will be a *polar* dial. If the reclination of the dial is *greater* than the *complement* of the *latitude*, the new latitude = *reclination minus* the complement of the latitude.

In the direct north recliner, if the reclination is *less* than the *latitude*, the new latitude = complement of the latitude *added* to the reclination. If the reclination is *equal* to the latitude, the dial will be an *equatorial* dial. If the reclination is *greater* than the latitude, the new latitude = 180° *minus* (reclination *added* to complement of the latitude).

From the above formulas, it will be noticed that, in each case, the style points to the celestial pole; the substyle is the 12 o'clock line and lies in the plane of the meridian; the height of the style is equal to the new latitude.

The construction of the hour lines for these two dials is the same as that for a horizontal dial.

DIRECT east and west reclining dials (Figure 4) can be reduced to latitudes at which they will be south vertical declining dials. This is done very simply by the following formula: The complement of the latitude of the place is equal to the new latitude, wherein the dial becomes a south vertical declining dial; and the complement of the reclination is equal to the declination of the south vertical dial, in the new latitude. (An east recliner will have a west declination, in the new latitude, and vice versa.)

Having found the new latitude and the declination of the dial in that latitude, proceed to lay out the hour lines for a south vertical declining dial, according to the construction previously described in this article. For example, let it be required to construct an east dial reclining 35°, in latitude 39° north.

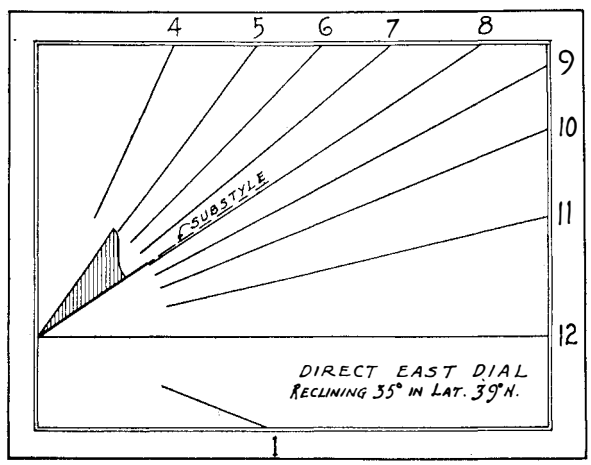


FIGURE 4: Hour lines constructed for an east reclining dial, showing how they should be numbered. The line for 12 o'clock is at the base of the dial and the center is at the left. A west dial having the same reclination will be seen, if looked at from the reverse side, and the center of the dial will then be at the right

From the formula given above, this reclining dial will become a vertical dial in latitude 51° (90°—39° = 51°), and decline in that latitude 55° west (90°—35° = 55°).

Figure 4 shows the hour lines constructed for this dial, and the way in which they should be numbered. The 12 o'clock line is at the base of the dial. The center of the dial, on the east recliner, is at the left; and at the right on the west recliner.

If the hour lines are drawn on transparent paper, the reverse side will show the hour lines for a west dial reclining 35° in latitude 39° north. If Figure 4 is turned so that the 12 o'clock line is perpendicular, the reader will then see a dial which is a south vertical declining 55° west in latitude 51°, the morning hours then becoming the afternoon hours.

Therefore, in each of these dials, the gnomon is perpendicular to the face of the dial; the style points to the celestial pole; the substyle is to be determined (the substyle is not the 12 o'clock line, in this type of dial); and the height of the style is to be determined.

Care must be used to set the dial in the position for which it was computed. The 12 o'clock line will be near the bottom of the dial and must lie in the plane of the meridian and parallel to the horizon.

SELDOM will it be necessary to lay out the hour lines for sundials other than those described in this and the foregoing articles. The following articles will describe various ways of making the sundial more useful, by the addition of numbers and lines on the dial plate.

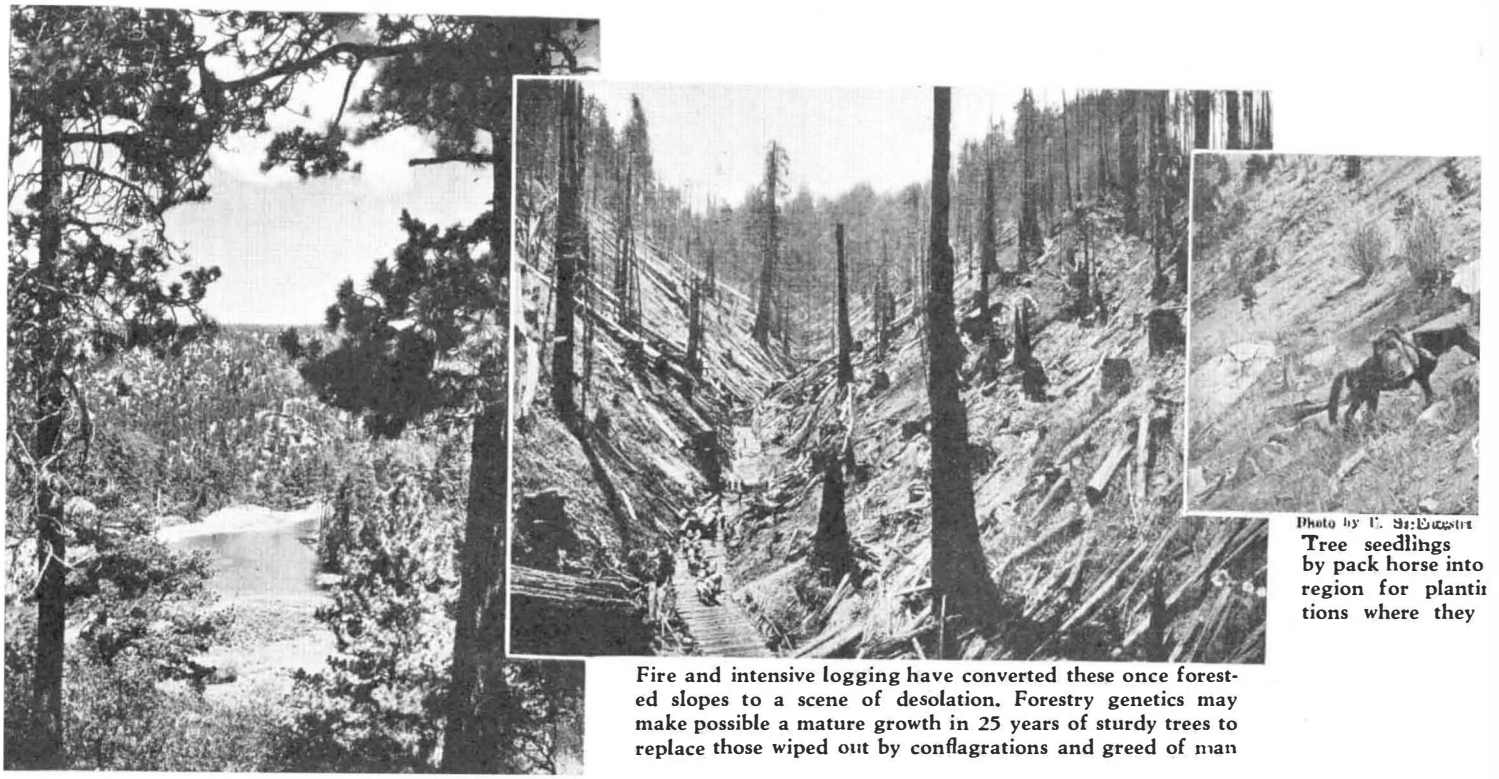


Photo by U. S. Forest

Tree seedlings by pack horse into region for planti tions where they

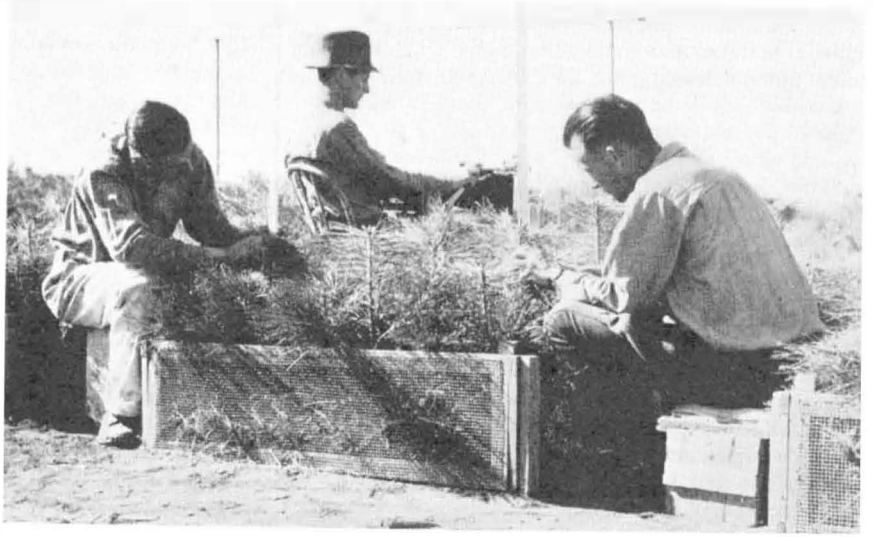
Fire and intensive logging have converted these once forested slopes to a scene of desolation. Forestry genetics may make possible a mature growth in 25 years of sturdy trees to replace those wiped out by conflagrations and greed of man

BREEDING BE

SEEDS and pollen from selected trees of the world have been brought together in the greatest birth-control experiment ever attempted. America is rapidly but somewhat belatedly learning its lesson from the ruthlessness with which our forests have been depleted without thought for the future, and a noteworthy attempt to rectify past errors is being made at the Institute of Forest Genetics, Placerville, California. Here, under the supervision of Lloyd Austin, director of the Institute, experiments are under way which are directly aimed at increasing the rate of growth of various species of trees and, at the same time, improving the breed so that the resulting lumber may be more economically used.

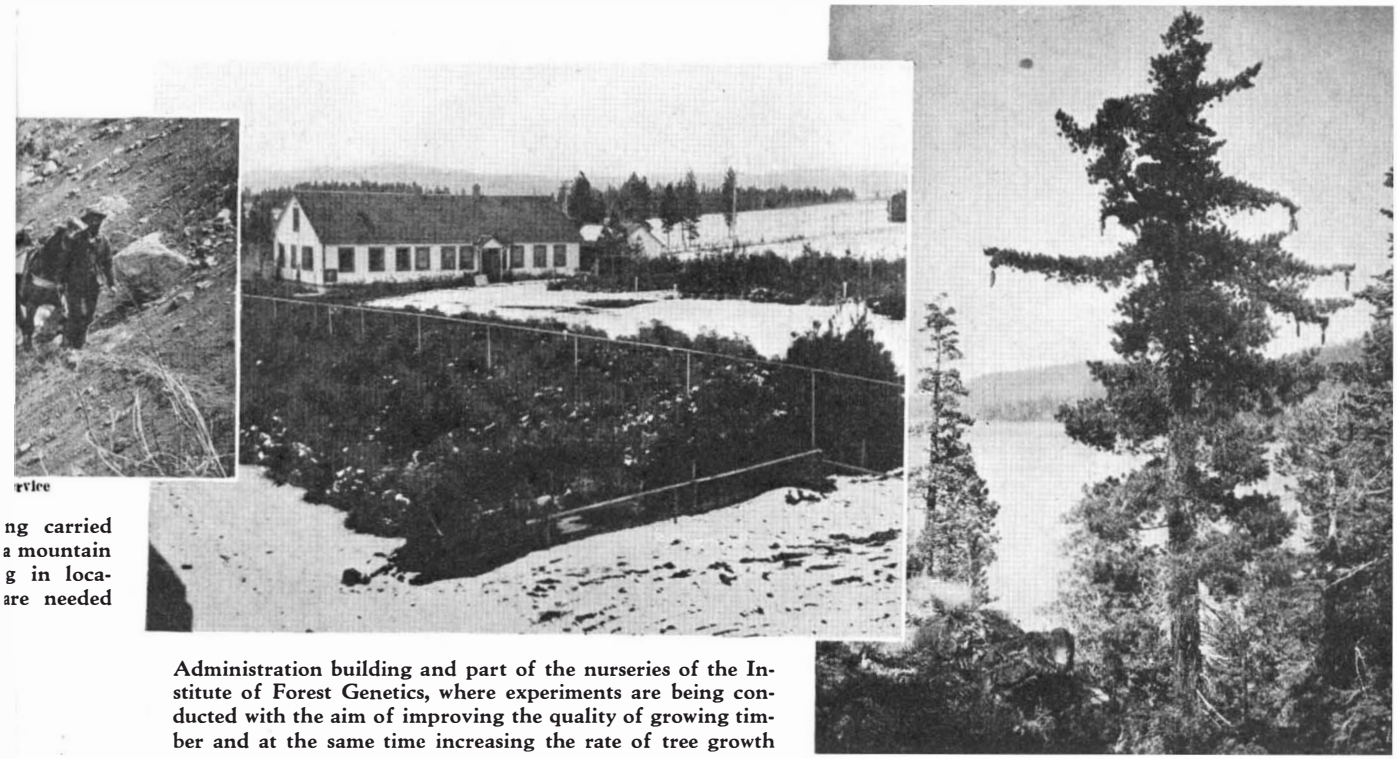
As pointed out in the article on page 234 of this issue, paper production is one of the uses to which vast quantities of lumber are diverted. The experiments at the Institute may have a definite bearing not only upon the new source of pulp-wood mentioned in the article referred to, but also upon other types of trees which are potentially valuable for pulp.

Pinus montezumae, rough branched pine (Mexico) thrives in snow



Measuring tree growth in the nursery. Height, diameter, and branching are all recorded. In one progeny test, 110,000 measurements were taken and recorded

At the present time 60 years are required to grow the average forest tree to saw-log size. If this growing time can be cut in two—if usable timber can be produced in about 25 years—we can save our forests from becoming completely denuded. Therefore, the workers at the Institute of Forest Genetics have



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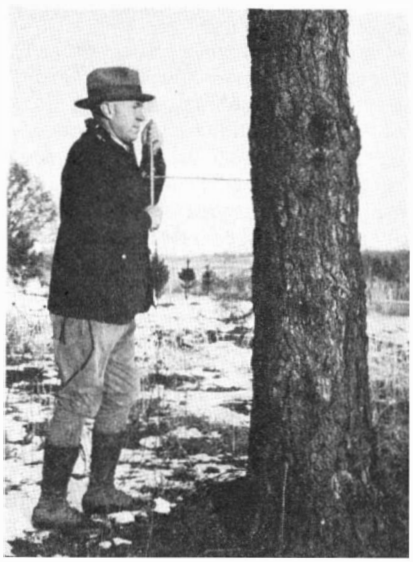
Administration building and part of the nurseries of the Institute of Forest Genetics, where experiments are being conducted with the aim of improving the quality of growing timber and at the same time increasing the rate of tree growth

TTER TREES



Age of a tree is found by counting rings on a core taken with a borer

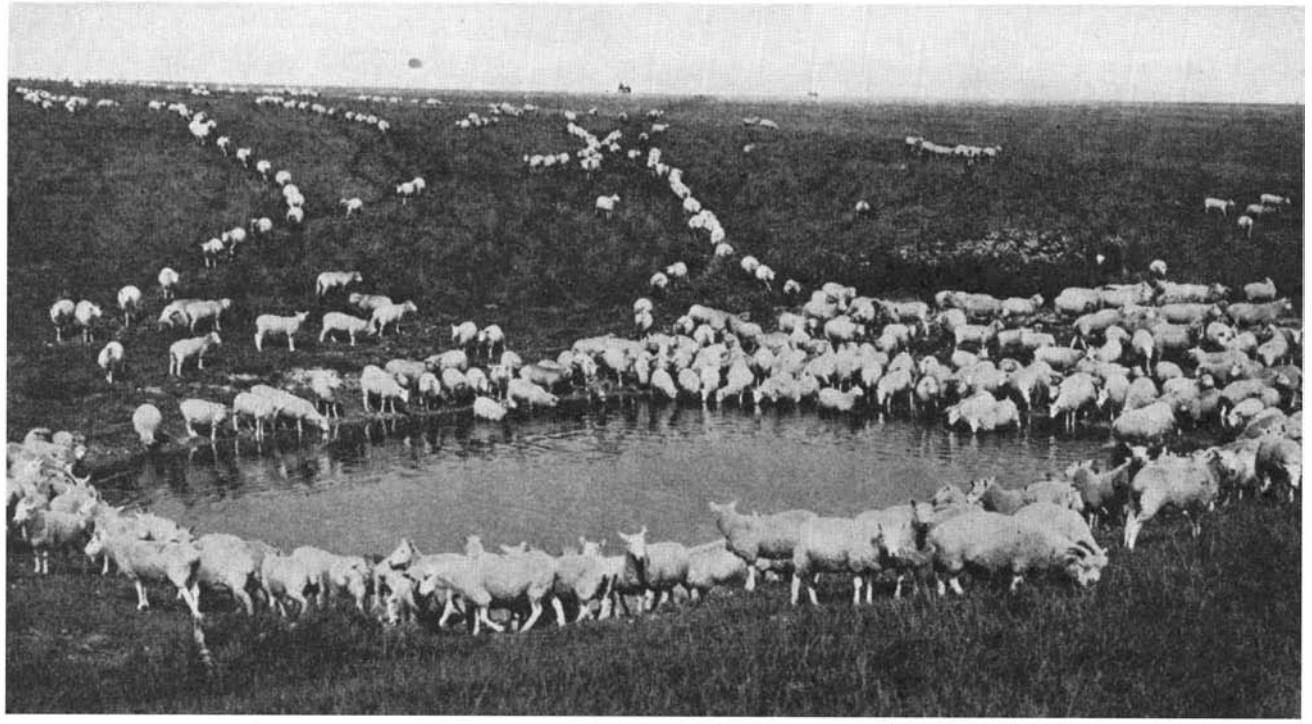
searched the world for worthy parents from which to breed hybrid trees and thus select and promote desirable characteristics of rapid growth as well as efficient foliage with few branches and a sturdy root system to withstand storms. Speed of growth is the first consideration, but the workers have not lost sight of other features that will make the wood applicable to many uses.

Taking a leaf from other plant breeders, the men at the Institute leave nothing to chance in their work. Pollination is carefully controlled, the female flowers of an experimental tree being protected by bags during the pollination time, so that chance pollination cannot take place. At the proper time selected pollen is injected into the flower, possibly from a tree that grew on the other side of the world, and the resulting seed is planted and carefully nurtured.

Throughout the early period of growth, accurate measurements are taken and a complete record kept of all observations. Thus the tree breeders keep a check on results and know at all times how an experiment is progressing.

What will be the super-tree of America, that can withstand the rigors of winter, the ravages of insect pests, the blighting diseases, and the heat and dryness of torrid summers? It is still too early to say, but the work of this Institute is a step toward the solution of a pressing problem, and one which holds promise of brilliant results.

Young trees are tested for hardiness in this field plantation of the Institute, where the temperature in winter frequently ranges down to zero and often below



Sheep at a dew pond, the building of which is still shrouded in mystery. Many such ponds are to be found on the downs of England. This photograph was taken during a severe heat wave, when the pond level remained constant

Dew Ponds

How Water is Obtained on the Bleak Downs of England Where There are No Springs or Streams

IN England, where inscrutable relics of pre-historic man remain to intrigue the imagination of present-day civilization, the dew pond remains as one usable invention, the origin of which is shrouded in the mists of antiquity. What are dew ponds, and what is the source of the water with which they are filled even in the driest of weather? Photographs recently published in *The Illustrated London News*, and reprinted here by courtesy of that periodical, have revived interest in an often disputed question. The following paragraphs accompanied the photographs:

"The mystery of the dew-ponds still remains; and men are wondering today, as they wondered centuries ago, how and whence the water comes that fills those lonely hollows on the highest hills. On the bleakest ridges of the Sussex Downs, far from shade of tree or protecting copse, where no streams have ever flowed, where no marsh has ever been, there, on those arid uplands, are found the dew ponds with the waters that never fail. Condensation of the moisture of the atmosphere it may be, cooling into drops that merge into the pond in the chill night air, and so counteracting the evaporation under the summer sun. Go when we will, at all seasons of the year, there is water for the cattle or the sheep that roam the green downlands.

"The secret of the making of these ponds is known to but a few. The lime and flint to form the saucer-shaped bed, the layer of straw beneath the covering of clay, the final concrete surface, are all wrought with experience and craft that are a heritage from the past, and then left to dry. Once the pond has filled, though the clouds withdraw their shelter and no rains fall, though the torrid sun pour down its relentless heat by day, there will be the water for the cattle to drink.

"IT would be wrong to say that there are no dry dew-ponds, for they are often to be seen about the Downs. But the reason is not far to seek. Once the bed of the pond is damaged, so that the water can trickle through, the pond naturally fails. That is why many of these dew ponds are fenced, so that the heavier beasts cannot tread the surface, and only sheep are allowed access.

"On the heights of Cissbury, not far from Worthing, may be seen the dry, shallow bed of a pond that has been broken up; and the sheep, in their wandering about the Downs, visit this spot repeatedly, as though an instinct led them where water once had been. A mile northward across the same downlands at Chanctonbury, and not far from the well-known Chanctonbury Ring, there is a pond which cattle are allowed to use at will; and through the heat of summer they may be seen standing knee-deep in the water; but already the concrete surface is so damaged that it can be but a little while before those much-needed waters fail.

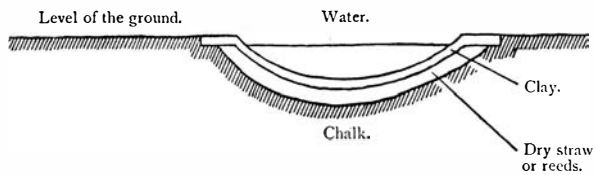
"Only a few new ponds have been constructed of recent years along the Sussex Downs; but westward, on the Marlborough and Wiltshire Hills, some have been added to the already existing number. There is no record of the making of the first dew pond, and the name of the discoverer of the secret has passed from human knowledge; but early dwellers in our land had their cave dwellings on the hills. On the highest portion of the Downs may still be seen the hollows where their pit-homes were excavated, and it may be that these prehistoric folk learned the secret of securing the water they needed for themselves and their cattle on these exposed heights; and that from them, down a long succession of shepherds and hill-dwellers, there has come to us today the secret of the making of the 'mist-pools' of the hills."

Arthur John Hubbard, M.D., and George Hubbard, F.S.A., F.R.I.B.A., in their book "Neolithic Dew-Ponds and Cattleways" (1907), give the following complete description of a dew pond:

"We are not aware that the thermodynamics of a dew pond have ever been elucidated, and it is evident that this cannot be done until the construction of such a pond is understood. There is in this country [England] at least one wandering gang of men (analogous to the medieval bands of bell-founders, masons, and so forth) who will construct for the modern farmer a pond which, in any suitable situation in a sufficiently dry soil, will always contain water. This water is not derived from springs or rainfall, and is speedily lost if even the smallest rivulet is allowed to flow into the pond.

"THE gang of dew-pond makers commence operations by hollowing out the earth for a space far in excess of the apparent requirements of the proposed pond. They then thickly cover the whole of the hollow with a coating of dry straw. The straw in its turn is covered by a layer of well-chosen, finely puddled clay, and the upper surface of the clay is then closely strewn with stones. Care has to be taken that the margin of the straw is effectively protected by clay. The pond will gradually become filled with water, the more rapidly the larger it is, even though no rain may fall. If such a structure is situated on the summit of a down, during the warmth of a summer day the earth will have stored a considerable amount of heat, while the pond, protected from this heat by the non-conductivity of the straw, is at the same time chilled by the process of evaporation from the puddled clay. The consequence is that during the night the moisture of the comparatively warm air is condensed on the surface of the cold clay. As the condensation during the night is in excess of the evaporation during the day, the pond becomes, night by night, gradually filled. Theoretically, we may observe that during the day, the air being comparatively charged with moisture, evaporation is necessarily less than the precipitation during the night. In practice it is found that the pond will constantly yield a supply of the purest water.

"The dew pond will cease to attract the dew if the layer of straw should get wet, as it then becomes of the same temperature as the surrounding earth, and ceases to act as a non-conductor of heat. This practically always occurs if a spring is allowed to flow into the pond, or if the layer of clay (technically called the 'crust') is pierced."



Section of a dew pond, reproduced from "Neolithic Dew-Ponds and Cattleways," mentioned in the accompanying text

In *Scientific American Supplement* Number 1692, June 6, 1908, Edward A. Martin, F.G.S., took quite apparent exception to the conclusions of Messrs. Hubbard, basing the majority of his statements on the theory put forth (and at that time apparently widely accepted) that "dew is really formed from the moisture which rises out of the soil with the radiation of heat, and that it is this which is precipitated when the air into which it passes has been so reduced in temperature as to be unable to hold it as aqueous vapor. If this theory be the correct one," continued Mr. Martin, "it would at once dispose of the suggestion that dew ponds are fed and filled by true dew. . . ."

Reference to the pages of "Physics of the Air," by W. J. Humphreys, C.E., Ph.D., tends, however, to uphold the theory of Messrs. Hubbard in the following statement: "*Dew*, water that has condensed on objects that by any process have attained a temperature below the current dew point of the air immediately in contact with the bedewed objects. The cooling necessary to the formation of dew usually results from loss of heat by radiation."

Whatever the source of the constantly replenished water in the dew ponds of England, certain facts appear to be irrefutable: The ponds do exist, and are constantly refilled, even though no rain falls. If the surface that holds the water is broken, the water drains off and the pond becomes dry.

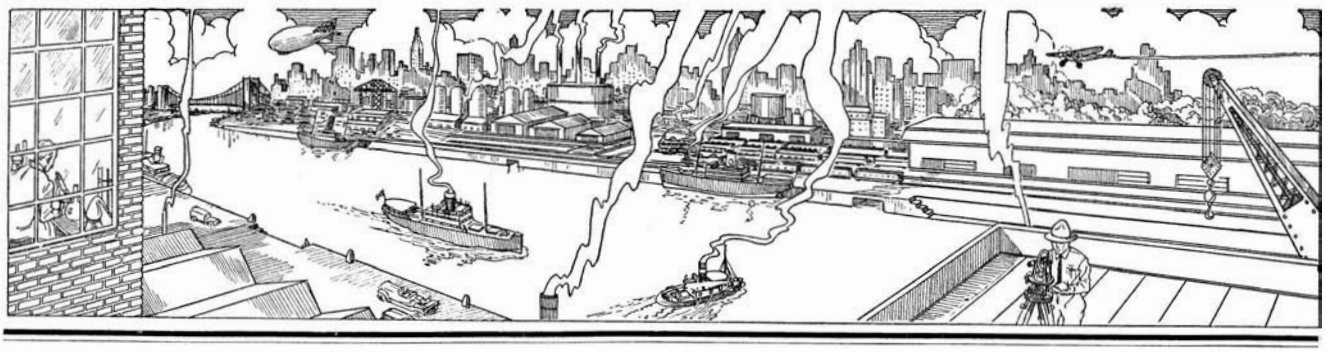
WHAT the true explanation of dew ponds really is must await an open-minded and scientific series of experiments on a large scale. Whether or not these ponds could be successfully constructed in this country is problematical; we should be glad to hear from anyone who may make the attempt, and to receive data on the exact procedure followed and the results obtained.

Photographs courtesy *The Illustrated London News*

The dried-up bed of a dew pond; the bed was broken by the hoofs of heavy cattle, allowing the water to escape, and rendering the pond unfit for further use

●

Owing to unforseen circumstances the eleventh article of our series on microscopy could not be included in this issue, but we are promised, for June, one of the best articles of the series—on photomicrography. This article will give definite instructions for making photomicrographs with simple apparatus—a common electric lamp, your camera, any microscope.—Editor



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
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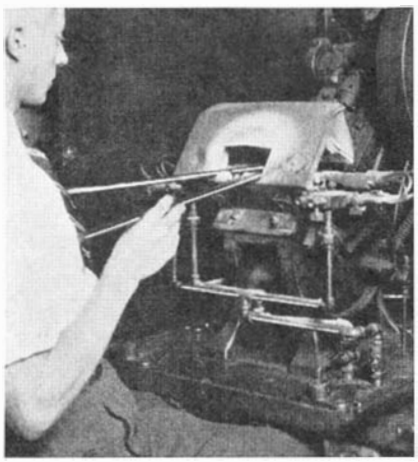
Punching Glass Lenses

YOU have heard of shatter-proof and bullet-proof glass, but have you ever seen glass parts being punched out or "blanked" on a mechanical press? This unusual operation is an actual routine job at the Western Electric Hawthorne Works where a battery of bench type presses are blanking tiny lamp cap lenses out of glass rod.

These bits of glass are produced in several colors and are used extensively in telephone switchboards where every hue has a special significance to the telephone operator.



With a glass rod in each hand, an operator punches out small lenses

Glass of ordinary temperatures is, of course, too brittle to stand the rough treatment of a blanking tool, so gas jets have been installed on specially adapted punch presses to heat the end of the glass rod stock until it is plastic enough to be fed into the press. When the softened glass is used up, the rod is returned to the gas jets for further heating. The operators become ambi-dextrous, turning one rod around in the flame of the gas jet while they are punching lamp cap lenses out of another.

The tool that produces these parts is an interesting study in proper timing. The punch is equipped with a device which cuts off the excess material which drops into a waste receptacle under the press. The finished part adheres to the punch on the upward stroke until it clears the die enough to allow room for a horizontal arm to swing under the punch, catch the finished part and tip it down a chute to an asbestos-covered cooling table having a simple circular maze on its surface. The hot part enters this maze at one end and by the time it has been pushed through to the opposite end it is cool enough to be packed for stock.

Metal Surface Is Liquid

AIRLESS electroplating accomplished in vacuum to prevent tarnish of the metal is promised as a result of a report in the British journal *Nature*, by Prof. G. I. Finch, Dr. A. G. Quarrel, and J. S. Roebuck, of the Imperial College of Science, London, that *the surface of polished metal is liquid.*

The liquid surface of metal was found to dissolve any supplied crystals until the saturation point is reached. This suggested to the scientists that metals should be highly polished before they are electroplated.

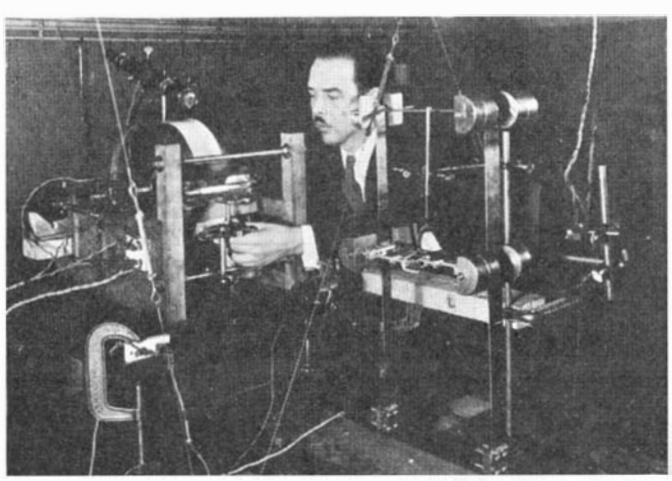
Testing "Earthquake-Proof" Structures

THE effects of earthquakes on buildings are now being studied at the Massachusetts Institute of Technology by means of a new instrument which measures the stresses in the model of a building frame caused by artificial earthquakes. This instrument, known as a stress recorder, was designed by A. C. Ruge, research associate in seismology in the department of civil engineering, and promises important advances in knowledge of earthquake-resistant methods of construction for buildings, bridges, and other structures. (See also article entitled "Earthquakes" on page 246 of this issue. *Editor.*)

In the solution of construction problems the engineer must translate his fundamental knowledge of earthquake movements into terms of their effect upon the structure he is designing in order to test its strength. For simple buildings he can utilize mathematics, but for structures of more than three or four stories the task becomes so involved as to be practically impossible by such means.

The stress recorder, which weighs only an ounce or so, by an ingenious system of mirrors, lenses, and prisms writes a record of the stresses in models on photographic paper by means of a pencil-point of light moving back and forth across the paper, which is fastened to a revolving drum. Simultaneously, time marks are "flashed" on the record by an electric spark operated by a magnetically controlled tuning fork. This arrangement enables the observer to compute time intervals on the record to an accuracy of 1/1000 of a second or better. The models used in Technology's laboratory of engineering seismology are made up of flat steel bars welded together at the joints. At the "floors" of the frame are iron weights proportioned to represent in miniature the weight of the prototype structure.

A model, if built according to the correct model laws, will react to an artificial



The complete set-up for recording stresses in the study of the effects of earthquakes on buildings. A record is made on the drum in the background

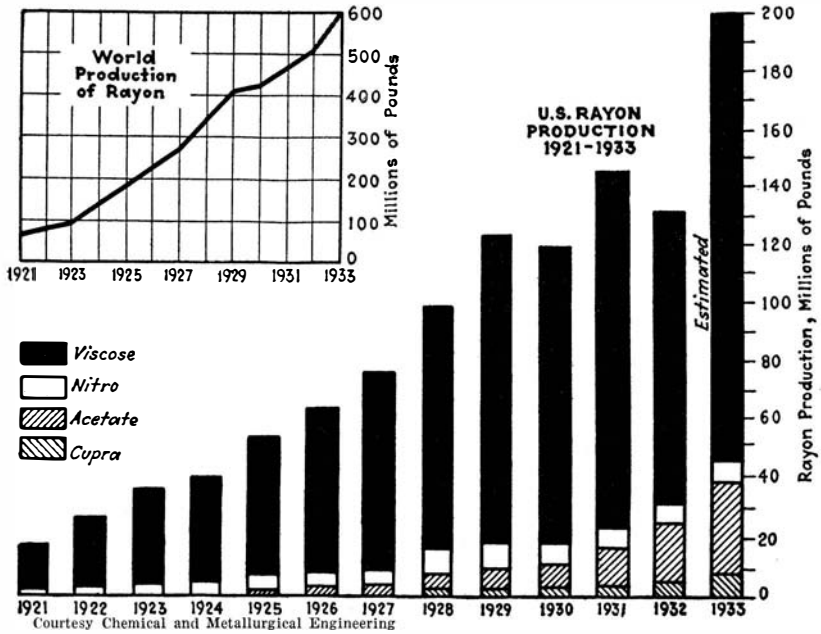
earthquake in exactly the way the large structure would react to a natural earthquake, only on a smaller scale. If the scale is chosen properly it is quite possible to build a model of a ten-story structure having a total height of only four or five feet and a total weight of perhaps a hundred pounds. Such a model can be put on a "shaking table," which produces an artificial earthquake, and the results will immediately reveal more than months of careful figuring could.

Rayon Production in 1933

TWO hundred million pounds of rayon were produced in the United States in 1933—an all-time record, according to *Chemical and Metallurgical Engineering*. World production also rose to unprecedented heights. Somewhere in the neighborhood of 600,000,000 pounds was produced, the United States leading the list, with 2½ times the production of its nearest competitor, Japan; and with Italy, Great Britain, and Germany following closely in that order. In the cases of both the United States and world production, 1932 was badly eclipsed, the former by 52.2 and the latter by 17.8 percent.

Further emphasis is being placed on low-luster yarns and on fine denier filaments. The latter have contributed materially to the truly remarkable improvement in wet and dry strength that has been made in recent years. In the last ten years, according to *Textile World*, dry strength has been increased by 30 to 50 percent and wet strength by 80 to 90 percent.

The anti-creasing process developed by Tootal, Broadhurst and Lee, Ltd., is now being used in at least three plants in the United States. By the formation of a synthetic resin of the urea-formaldehyde or phenol-formaldehyde type within the fiber of the fabric, the resistance to creasing of both cotton and rayon has been greatly increased. Another resin-treated fabric, Revolite, developed by Johnson and Johnson in co-operation with the Bakelite Corporation, was announced within the year. The product resists oil, water, and most cleaning preparations and is used for drapes, theatrical scenery, and similar purposes.—*A. E. B.*



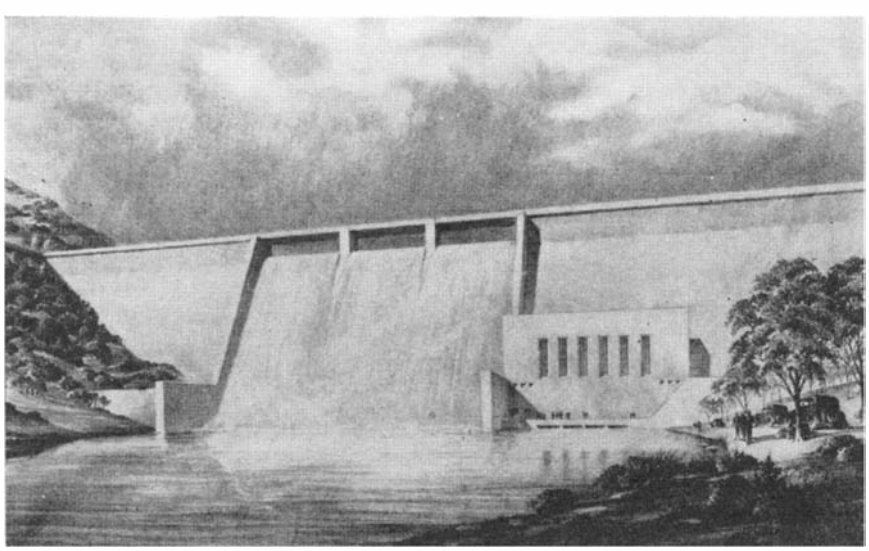
Courtesy Chemical and Metallurgical Engineering

Diet and Teeth

SINCE 1917, May Mellanby, wife of the physiologist Edward Mellanby, has been continuously engaged in researches for the Medical Research Council on the effects of diet on the structure of the teeth and on dental disease.

Mrs. Mellanby has shown that the liability of a tooth to decay depends largely on the perfection of its structure, which in turn depends on nutritional influences during growth, both ante-natal and post-natal. Ill formed teeth are much more common than has been supposed and are particularly liable to bacterial invasion. The teeth require for their formation adequate supplies of calcium and phosphorus and an ample supply of vitamin D to insure that these are put to use. The same factors are necessary for the health of the teeth during the rest of their lives, and especially for the healing of caries (cavities). Thus two main factors control the onset of caries: The better formed the teeth, the more resistant they are; and, independent of structure, resistance is directly influenced by diet.

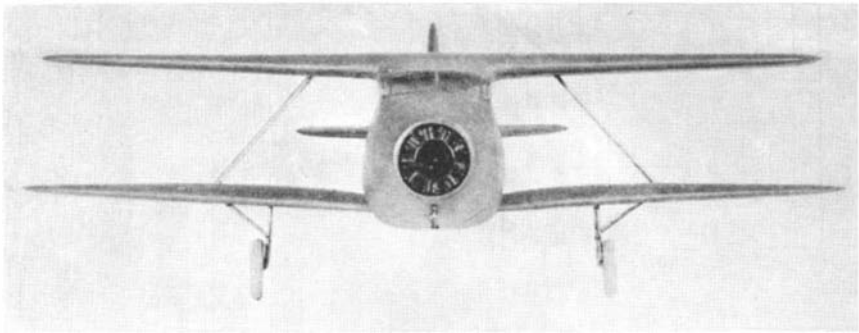
Prolonged studies of children's teeth have confirmed the views formed by Mrs. Mellanby—that the health of the teeth can be largely controlled by certain dietary constituents, some of which are protective and others harmful. Prominent among protective substances is vitamin D (found in egg yolk, animal fat, milk and cod-liver oil). Cereals, such as oatmeal and bread, are given as the best example of harmful foods. Mrs. Mellanby has shown that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation, and in the diet of the offspring during dental development, substances containing much fat-soluble vitamin, calcium and phosphorus, such as milk, egg yolk, fish, and animal fats. The vitamin D can be obtained also by exposure of the skin to sunlight or other sources of ultraviolet radiation. Cereals, especially those rich in embryo, such as oatmeal, tend to produce badly developed teeth and call for a corresponding larger supply of calcifying foods for good development.—*Journal of the American Medical Association.*



This artist's drawing shows the design adopted by the Tennessee Valley Authority for the Norris Dam on the Clinch River near Knoxville, Tennessee. The spillway section and the power house are shown. The dam itself is approximately as high as a 20-story building and the power house is as tall as a 12-story building. The dam will create a lake of 83 square miles with a shore line of between 800 and 900 miles. A roadway topping the dam will form the connecting link in the "freeway" which the TVA is building from Knoxville to Coal Creek. Work on the dam is progressing rapidly and probably will be completed within two and a half years. John L. Savage, chief designing engineer of the United States Reclamation Service, directed the design of this, and of Boulder and Madden Dams

Is Washington Monument Disintegrating?

IS that beautiful marble shaft, the Washington Monument, beginning to crumble and decay? Of late years a slow flaking of the marble has become more and more noticeable until Bureau of Standards experts have been called upon to investigate the cause and cure of this "spalling." It occurs mainly in the lower 150 feet of the structure and affects the marble mainly along the horizontal mortar joints. A possible explanation is that the marble is supporting more than its share of the super-



The convertible plane in landing or take-off condition

imposed weight, and that this results in the spalling. With uniform distribution of the load over a horizontal section of the masonry at the ground level and the maximum wind pressure, no part would be stressed as much as 700 pounds per square inch. Tests recently made on blocks of the same material which had been exposed to the weather for about 70 years indicated a bearing power of more than 5000 pounds per square inch. Hence the spalling and cracking of the marble indicate that it is actually stressed much more than the theoretical 700 pounds per square inch.

Details of the early construction of the Monument are not available, but it is believed that a rubble masonry filling exists between the outside marble ashlar and inside walls of granite ashlar. Thin mortar joints in the ashlar masonry and thicker mortar joints in the rubble fill would account for uneven distribution of the loading.

The experiments now in progress are for the purpose of determining if a proposed plan of widening the horizontal marble joints for an inch or more from the surface and refilling with a more elastic mortar will overcome the spalling. For this purpose it was considered desirable to use marble of the same kind as that in the monument and which had been exposed to the weather for a similar period of time. Some blocks were taken from the top of the old Patent Office Building for the experiments, since the marble in it came nearest to satisfying these conditions.—*A. E. B.*

Memorizing Log π

THE logarithm of *pi* to the base ten is often used in scientific problems. To memorize this value to 20 decimal places, memorize the following rhyme. Each word represents a digit of the number, which is determined by the number of letters in the word. "No" represents zero. $\text{Log}_{10}\ \pi = 0.49714987269413385435$.

No task, therefore, becomes a bore
Following pleasant Science.
It simply increases what I use, and
Supplies might, like the lion's.

—*Earl C. Rex, M. S.*

Silver for Oil-less Bearings

SILVER may be used as bearing metal in bearings operating without any lubricants, according to *Chemical and Metallurgical Engineering*, especially for revolving machinery used in high-vacuum equipment. The silver bearings are said to possess very smooth running properties and make it possible to dispense with the undesirable evaporation of lubricants which takes place in high vacuum. Furthermore, silver offers the advantage of such a high melting point, compared with normal bearing alloys, that it is possible to heat the evacuated apparatus to red heat or higher, which is often necessary in the production of a high vacuum.—*A. E. B.*

A Convertible Biplane

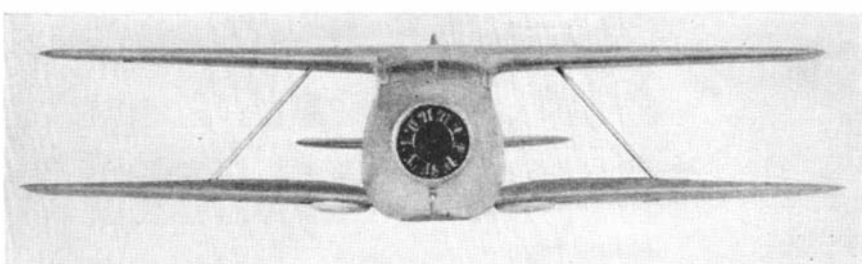
THE retractable landing gear has become almost a commonplace. Now we have the possibility of retractable wings. The Aircraft Improvement Corporation has developed a retracting system whereby a biplane can be converted into a monoplane or vice-versa.

One of the photographs shows a model of a biplane with air-cooled engine, a closed cabin body, and a landing gear. If the landing gear is swung about a horizontal axis it can be retracted so that only the wheels project slightly under the lower wing. Then by means of a carefully designed mechanism the supporting struts can be swung backwards and inwards; thus the lower wing on either side retracts and fits snugly into the side of the fuselage.

What is the advantage of such an operation? For landing, take-off, or climb, the lower wing will be extended, the loading in pounds per square foot will be light and hence performance will be good.

For high speed, the lower wing will be retracted, leaving exposed the smallest amount of frontal area.

Exhaustive wind-tunnel tests at New York University have indicated that the idea is thoroughly sound from an aerodynamic point of view. The mechanism has been simply and carefully worked out. Full flight embodiment of the idea is thoroughly justified.—*A. K.*



The landing gear of the convertible plane has been retracted

Flight by Man Power?

WRITING in *Flugsport*, Herr Haeszler advocates the establishment of a prize for a new sport—flight by man power.

He suggests the construction of a large glider of very light weight and clean lines. Within the body of this glider there would be place for a man in a reclining position, with his feet on bicycle pedals. The pedals would drive an airplane propeller through a chain and sprocket. The man-powered machine would be launched into space just like an ordinary glider by rubber shock cord methods. Then the legs of the man would set the propeller in motion and he would be able to stay aloft for a flight of say 1000 yards. The aircraft would be so designed as to be stable, and the only control necessary therefore would be the rudder control, effected through a hand-operated steering handle inside the body of the glider.

There is no doubt that if such a conception could be realized, there would be plenty of amusement in the new sport—certainly more than in the glider alone.

The question arises: Is the conception at all possible of realization?

To fly at minimum power the weight of the man and the glider must be low, the area of the wings so large that the flight is very slow, and the man himself must be a superlative athlete.

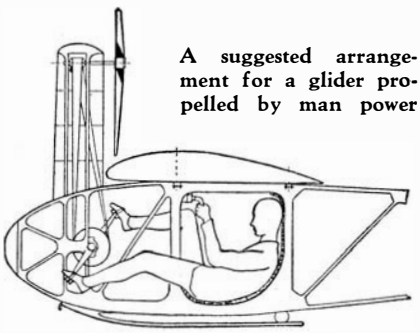
Scientific investigations have shown that a trained runner can achieve 1.4 horsepower for an instant, and average 1.2 horsepower for five minutes. If a glider could be built weighing only 300 pounds (man included) and with a wing area of 400 square feet, then the minimum power delivered to the propeller would have to be 1.04 horsepower. The speed of flight would be 24 feet per second. This would be postulating a very efficient wing, and practically no resistance for the rest of the aircraft.

It is difficult to build so light a glider with so large a wing area, and difficult to keep it practically as efficient as the wing

Lower wings and landing gear retracted: Ready for full flight

alone. And it would be a problem to find a very small man with the enormous strength and stamina required.

While the outlook is not promising, it is not hopeless. The practical thing to do would be rebuild a glider, installing the man-power propeller drive, and try it out.



A suggested arrangement for a glider propelled by man power

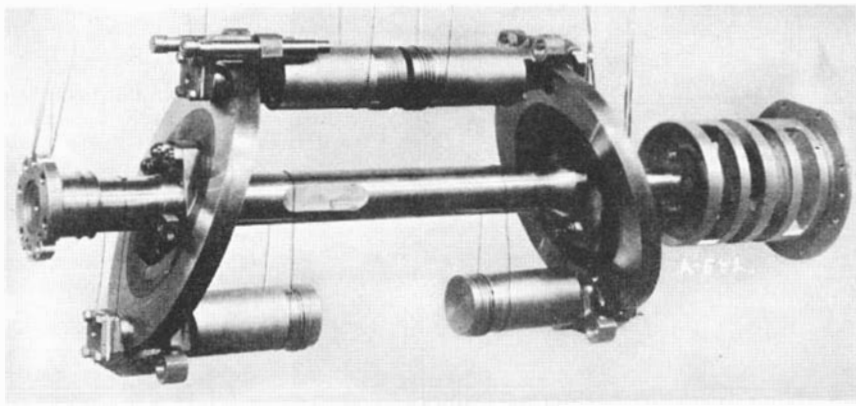
Even if a long hop could not be achieved, the glider once launched would stay aloft longer, and even without completeness of human flight, some exciting sport would be achieved.—*A. K.*

Cows and Aviation

THE cow does not fly, but John Wilson, Chief Inspector of the Boeing Airplane Company, lists many parts of its anatomy which do. The casein in milk makes a strong glue, and casein glue is used extensively in the construction of wing ribs, panels of plywood in the airplane cabin, and so on. Hot glue is made of cow's hoofs. Its hair is used for chair padding and sound deadening. Hides are made into seat covers and straps, and into the fine hide glues which are used in wooden propeller manufacture. Finally, the gold-beaters' skin for dirigibles is made of its entrails. Certainly the cow makes praiseworthy contributions to aerial navigation.—*A. K.*

Pre-Stressing Concrete

A NOVEL type of concrete construction was exemplified in the pre-stressed concrete tank recently exhibited by the Stebbins Engineering Company. This tank was built by pouring concrete within forms in which asphalt-coated stressing rods are suspended. After the concrete has set, compression is applied to the wall by tightening nuts on the ends of these rods. The next operation is to tighten continuous hoops around the tank to the desired stress. The tank is then finished by applying a coat of unstressed concrete outside the hoops. Bottoms are made with radial reinforcing and linings and generally of acid-proof stoneware. Dome covers are built on a beam principle and attached to the body by the stressing rods.



The pistons and oscillating disks of the crankless engine described

Tanks of this have been used for boiling tanks in the pulp and paper industry. At lower temperatures they are suitable for pressures as high as five pounds per square inch in a 30-foot diameter tank. Water tanks as large as 120 feet in diameter have been built.—*A. E. B.*

A Crankless Engine

THE Sterling Engine Company has produced a novel engine, which while primarily designed for motor-boat work has real possibilities in the aircraft field. It is a crankless, two cycle, compression-ignition engine burning heavy fuel oil. Camshafts, cylinder heads, valves, and other parts are eliminated.

In our diagram and photograph two combustion chambers are indicated. Two opposed reciprocating pistons work in each combustion chamber. The cycle of operations is as follows: The bottom cylinder has its pistons at its maximum displacement from one another. The ports at either end of the chamber are uncovered. Through the left-hand port scavenging air under pressure is being admitted; through the right-hand port the exhaust gases are being evacuated. Next the pistons approach one another, shutting off the ports until a very narrow space is left between them. This is the condition for the upper chamber of the diagram. The air at this instant is raised to an enormous pressure, and simultaneously fuel is injected. Owing to the pressure and high temperatures developed, the fuel and air mixture ignites spontaneously without the aid of electrical ignition. The pistons then move apart on the power stroke which ends with the ports again being uncovered for exhaust and scavenging. To make the scavenging air most effective it is compressed in the two cylinders at the extreme left, in which pistons move in unison with the main pistons.

Now we come to the elimination of the crank, from which elimination the name of the motor derives. This is accomplished by the two inclined disks, which are virtually flywheels, driven at either end through Mitchell or Kingsbury thrust bearings (such as are universally used on ships the world over). As the inclined disks oscillate and rotate, they turn the central shaft.

Why are we so sure that such an engine has decided possibilities for aircraft?

Because, first of all, this arrangement allows the prime mover to have minimum frontal area for a given power. A powerful water-cooled unit could disappear completely within an airplane wing. Another advantage from an aircraft point of view is the burning of non-inflammable fuel.

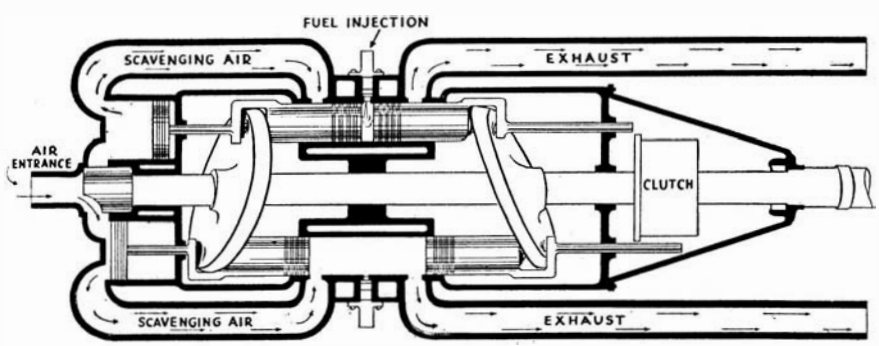
There is one other point to which attention must be drawn. In the ordinary two-cycle engine in which fuel and air are admitted together while exhaust is still going on, there is always some loss of the incoming charge. With fuel injection at the instant of maximum compression such loss disappears, since fuel is only admitted when both the air inlet and the exhaust ports are closed.—*A. K.*

Pushing 'Round a Corner

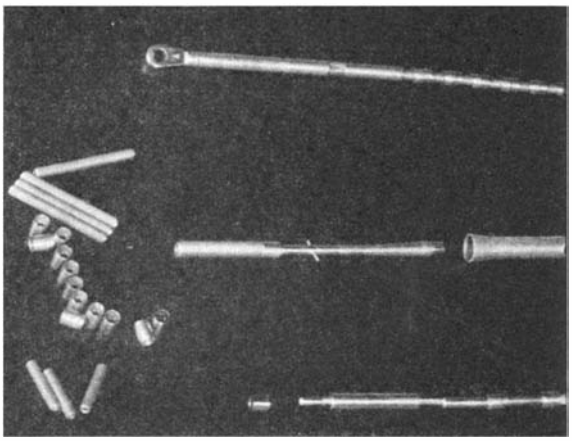
ONE of the problems of airplane construction is control at a distance. It is easy enough to exercise a pull at a distance, but it is not so easy to push at a distance, particularly if the push has to be "'round the corner"; that is to say, not in the same straight line as the original push. For example: The pilot may have to open a throttle for an engine which is mounted outboard on a wing. Here the effort has to be carried back in the fuselage, outward along the wing and then perhaps upward and forward to the engine nacelle. The throttle may have to be opened or closed. Therefore if a pure cable system is employed, it has to be in duplicate; one cable pulls the throttle one way, the other cable reverses the action. Moreover, cables are not always positive enough. Therefore, where distance controls 'round corners have to be employed, designers may employ push rods, and a number of bell cranks. Push rods and bell cranks are apt to be heavy and awkward.

These problems arise with auxiliary balancing surfaces on the rudder, elevator, or aileron; throttle and spark controls; carbureter adjustment; controllable pitch propellers, and so on.

The Simmonds-Brewster control system



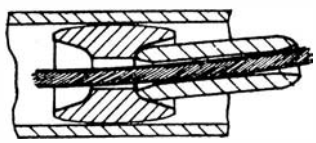
Cross-section diagram of crankless engine: See text



Left: **Near the lower left-hand corner is a group of parts for the new airplane control cable designed for pushing around corners. Sections of the cable and housing are shown to the right in the photograph.** *Below:* **A cross-section drawing of one of the "olives" of the cable system**

seems to accomplish this pushing "'round the corner" in a simple and ingenious manner.

In this control, there is first of all an inner cable. This gives a pull at a distance, no matter whether action is in a straight line or not. The cable passes loosely through an "olive," as shown in the drawing. The "olive" has a socket-like recess at either end. Into these sockets fit "spacers" which are tubes with rounded ends. The spacer can evidently move around in the socket of the olive. Now let us imagine the cable, the olives, and spacers mounted in an outer casing. Quite evidently a pull at one end will be transformed into a pull at the other end through the cable. A push at one end will tighten up olives and spacers and so compression can be transmitted through the tube but owing to the ball and socket arrangement, flexibility is not lost. The ends of the cable can be adjustable, provided with eye-ends, lock nuts, and so on.—*A. K.*



A Dangerous Sport

IT is considered exciting sport to hunt birds or foxes. Sportsmen travel to Africa to kill lions and be thrilled. But here is a more exciting sport in reverse: to be hunted by bombing airplanes while seated in a motor boat. Of course, the bombing pilots do not attempt to hit the target; their aim is to come as close to it as possible without actually scoring a direct hit. But even then sitting in the target boat must be far from soothing to the nerves. This form of target practice is considered highly effective training by the British Royal Air Force. The boats are 37 feet 6 inches long, are constructed of mahogany, powered by three 100 horsepower engines, and develop a speed of more than 30 miles per hour. They also have great maneuverability and can lay effective smoke screens as added protection against the bombers.

In the construction of the boat every precaution has been taken against accidents. Thus the crew, sitting amidships, is protected by an armored cowling. This cowling is continued over the machinery and gasoline tanks. The sides of the vessel are also protected in like manner. Forward of the steering compartment is a small cockpit with duplicate controls, so that when the boat is not in use as an actual target the crew can drive the boat from the forward position.

There are still other precautions: Forward of the open cockpit, the hull is filled with a form of expanded rubber which weighs about 1/10th as much as cork. This material is extremely buoyant and should bombs be dropped on this section of the hull (even if they passed right through) the rubber filling would prevent the boat from sinking. The hull is also divided into water-tight compartments so that if a bomb passes through one section of the hull only that one section becomes water-logged and it is possible for a member of the crew to proceed forward, plug the hole when not being bombed, pump the water out quickly, and proceed with the regular day's work.

The boat is of course quite inexpensive compared to the armored battle cruisers previously used in such target practice.

Having read of these various precautions, are our readers anxious to act as targets for a few fast bombing planes?—*A. K.*

Fake or Fact?

CAN a South Sea Islander walk barefooted over red hot stones? A reader of this magazine, Mr. A. W. Peters, of Kirkwood, Missouri, submits this question in the following form:

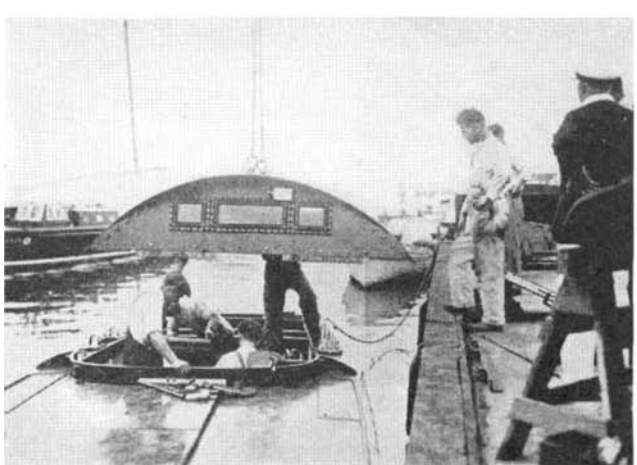
"In Frederick O'Brien's book 'Mystic Isles of the South Seas' he describes a ritual performed by certain tribes in Tahiti which consists of walking barefooted over red hot stones heated in an excavation 25 feet long by 15 feet wide by five feet deep. Mr. O'Brien states there was no trickery used, nothing put on the soles of the feet, and that while a paper he threw on the stones was immediately consumed, the persons who walked over these same stones were apparently not injured although the leader stood in one spot while being photographed.

"Was Mr. O'Brien in a sort of hypnotic state, or is such a procedure a fact?"

Mr. Peters' question was referred to the anthropologist, Dr. Alfred L. Kroeber, who passed it to Mr. Peter H. Buck of the Department of Social Sciences at Yale University. Mr. Buck replied to it as follows:

"I saw a party of Fijians perform the ceremony some years ago in New Zealand. It looked very simple and natural. In the Society Island Group it used to enter into certain religious rituals in the island of Raiatea, which was the religious center of the Group. I met an old Raiatean who had taken part in such exhibitions and he said it was a good 'stunt.' The religious side of the business had disappeared and he looked upon it merely as a spectacular exhibition.

"The question why people can walk over hot stones is a job for the physicists who are concerned with heat. I do not know of any scientific investigation having been made by men who are qualified. The general opinion appears to be that the stones used are bad or rather poor conductors of heat. The heat of the upper surface of the stones is not sufficient to burn the thick soles of the fire-walkers unless the feet re-



Courtesy The British Power Boat Company

Placing the armored cowling over the pilot's position in the speed-boat used in aerial bombing practice maneuvers

One of the speed-boats, described above in the item "A Dangerous Sport," being driven from the open cockpit

main in contact with the same stone for some time. The natives walk deliberately over the stones, but they don't stand on the same stones for any length of time.

"In preparing the oven, the natives were careful to level out the hot stones so that they would not slip, and to remove burning pieces of wood and hot embers from the surface of the stones. They were careful not to tread on live embers that stuck in the interstices between the stones. Thus live embers burned, but the upper surface of the stones did not affect them.

"I regret that I cannot give you exact details to meet your requirements but as I said before it is job for a physicist and not a humble ethnologist."

Steel Roads

STEEL as a road-building material is being widely experimented with abroad, according to the *Industrial Bulletin* of Arthur D. Little, Inc. "For new road construction, iron grilles, weighing about 50 pounds per square yard, are anchored to the gravel bed, welded or bolted together, and then covered with about two inches of asphalt and fine gravel. The grilles are made at the factory, making the labor of using them very slight, on the job. The idea of metal roads has been tried to a certain extent in this country, and American companies are watching these new European tests with interest, for 500 to 1000 tons of steel per mile of road is no small matter."—*A. E. B.*

A Magnificent Airport

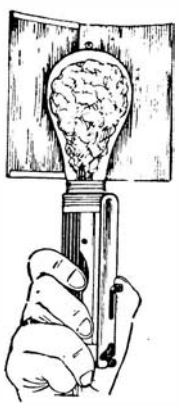
EARLY in March Pan American Airways opened a magnificent airport on Biscayne Bay, Miami, Florida. The airport area covers about 44 acres of land. At its central point is located the passenger terminal, in the form of a three-story building. This houses waiting rooms, international mail office, emigration offices, customs rooms, and so on. The spacious central hall is two stories high, and its ceiling is decorated with the signs of the Zodiac, historic airplanes, and so on. A huge globe is placed in one wall, and moving pictures may be shown on the other side. Around the hall are baggage rooms and offices for the airway personnel and radio and weather services.

The lower floor of the building gives access to covered steel gangways which lead to the docking floats. There will be no confusion for outgoing or incoming passengers, since there will be but one way for them to go when embarking or disembarking and visiting the various offices for necessary formalities.

Extensive parking facilities, docking facilities for planes of over 200 feet in span, and a fine architectural and landscape layout complete the airport.—*A. K.*

Camera Shutter Synchronized With Illumination

THE amateur photographer who makes use of Photoflash bulbs for photographic illumination will find a valuable accessory to his work in a little device called the Photoflash synchronizer. This consists of an ingeniously designed folding reflector, a holder for flashlight cells, and a combination switch and cable release mechanism. In use, the cable release of the camera is clipped into position on the synchronizer, the Photoflash bulb is inserted in the socket, the camera is focused, and the trigger on the side of the Photoflash bulb holder is released. This trigger, at one and the same time, closes the circuit of the Photoflash bulb and presses the cable release. Thus the instantaneous illumination and the operation of the camera are perfectly synchronized.



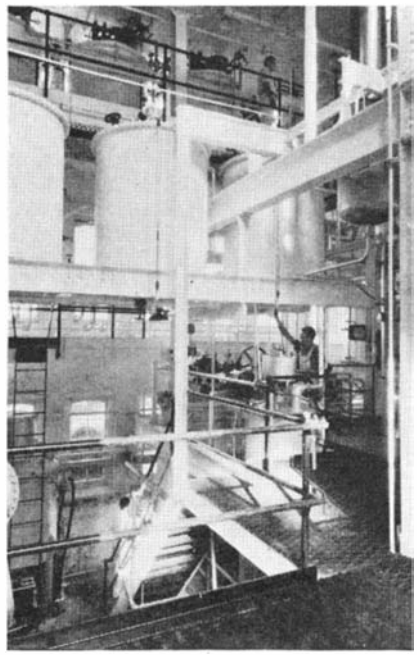
The handy device for synchronizing the camera shutter with the light from a Photoflash bulb. The cable release of the camera is placed in the slot near hand

New Yellow Fever Serum

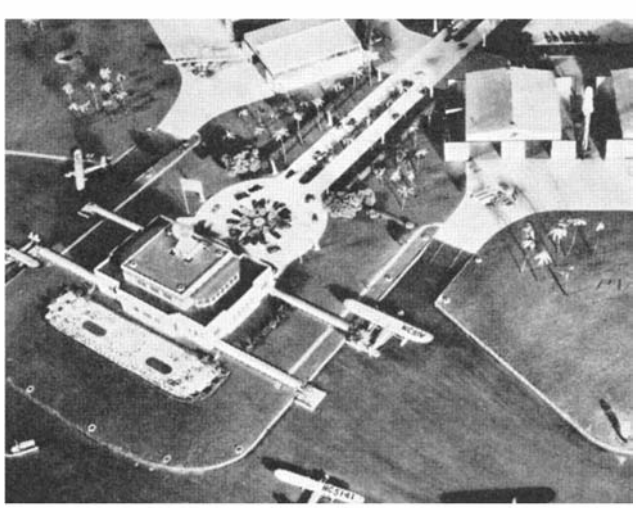
MISSIONARIES, government officials, and scientists whose work takes them into regions where mosquitoes carrying yellow fever may bite them are now being adequately protected against this toll-taking disease.

For two years medical research scientists of the Rockefeller Foundation, working in New York at the Rockefeller Institute for Medical Research under the leadership of Dr. W. A. Sawyer, have applied practically their vaccination technique. Yellow fever virus made safer by at least a hundred passages through white mice is used. Along with the weakened virus human blood from those who have had the disease or have been vaccinated is injected without bad effects. There results an active immunity similar to that which is caused by an actual attack of the disease.

When in 1931 vaccination against yellow fever was announced to the medical world at a meeting in Philadelphia, it was not known how long the immunity caused by inoculations with immune blood serum would last. Experience has shown it to be exceedingly efficient. Protection lasts at least two years.



In a "Vitamin Plant." Here, in a modern factory, under ideal conditions, the vitamin of cod-liver oil is extracted and concentrated. See also the article on the same subject on page 244 of this number



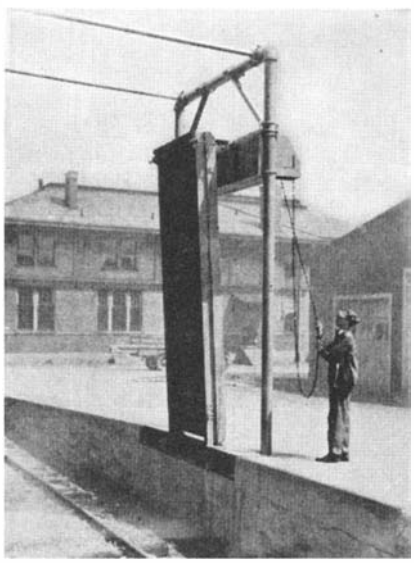
Two views of the beautiful new airport recently dedicated at Miami, Florida

Now efforts are being centered upon making the injections less difficult and less costly in human blood. It is not yet practical to protect a whole population against yellow fever, but those most in danger can with safety do their work in dangerous areas.

The Pasteur Institute in Paris has used in its yellow fever vaccinations the blood of immunized horses.—*Science Service.*

Draw Bridge for Industrial Plants

IN industrial plants, where it is desirable to cross over depressions or to bridge railroad tracks and other rough going, a small easily operated draw bridge can be



used to solve the problem. This draw bridge, shown in the illustrations, can be supplied with either hand or power operation; in the latter case the control can be placed at some distance from the draw. The counter-balancing method permits extremely easy and fast operation. The entire bridge and its supporting structure is strongly braced to carry any ordinary loads.

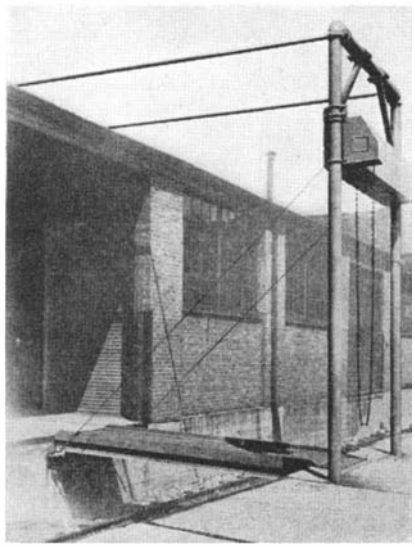
Big Telescope Mirror Cooling

A HUGE pancake of Pyrex glass, more than a foot in thickness, nearly seven feet in diameter and weighing 5600 pounds, is being cooled slowly at the rate of two to four degrees a day. This cooling process will continue for more than three months. At the end of that time the glass pancake will be the raw material for the 80-inch mirror in the reflecting telescope being built by the Warner and Swasey Company, Cleveland, for the McDonald Observatory of the University of Texas.

The mirror was poured by the Corning Glass Works, Corning, New York, in the presence of company officials, Dr. Otto Struve, director of Yerkes Observatory and the new McDonald Observatory, and E. P. Burrell, director of engineering for the Warner and Swasey Company.

The grinding of such an enormous mirror, exceeded only in the entire world by the 100-inch reflector at Mt. Wilson, is a long and tedious process. With good luck, it may take only a year. If all conditions are not perfect, it will take as much as two years.

When the mirror is completed, it will



Above and left: **The draw bridge for industrial plants, showing operation, and how it bridges depressed roads, canals, or railway tracks**

measure 80 inches in diameter, 12 inches in thickness and will have a concave upper surface one and a quarter inches deep. Through the center will be a hole 13½ inches in diameter for the passage of light rays.

Engineers Play Ping Pong to Test Lighting

FROM a delightful indoor sport, Ping Pong recently was elevated or degraded —purely a matter of viewpoint, of course— to a practical engineering demonstration of the latest kind of electrical illumination. O. H. Biggs and W. P. Lowell, Jr., both of the lamp engineering department of the Hygrade Sylvania Corporation, arranged for several Ping-Pong matches under a huge canopy containing the usual tungsten filament lamps and the latest sodium vapor lamps, either set being switched on at will.

These enterprising engineers wanted to determine whether the flicker of sodium vapor lamps—and there are 120 flickers per second with the ordinary alternating current circuit—would have an appreciable effect on the action. And they further tried to determine whether the absence of all colors, except yellow, would make any difference to the players, for under these lamps everything appears yellow, gray or black.

The Ping-Pong games did indicate some stroboscopic effect; that is, the ball and paddles did intermittently flash before the eyes. To some it seemed more noticeable than to others, and opinion was very much divided as to whether it is an asset, drawback, or immaterial.

But the color of the light, at least to those who tried playing the game, made no apparent difference. For while, as one expressed it, "you see better but not so much" under the deep yellow, almost amber light of sodium vapor, the contrast was not marked enough to reveal any departure from normal in the eye activity or see-ability of the players.

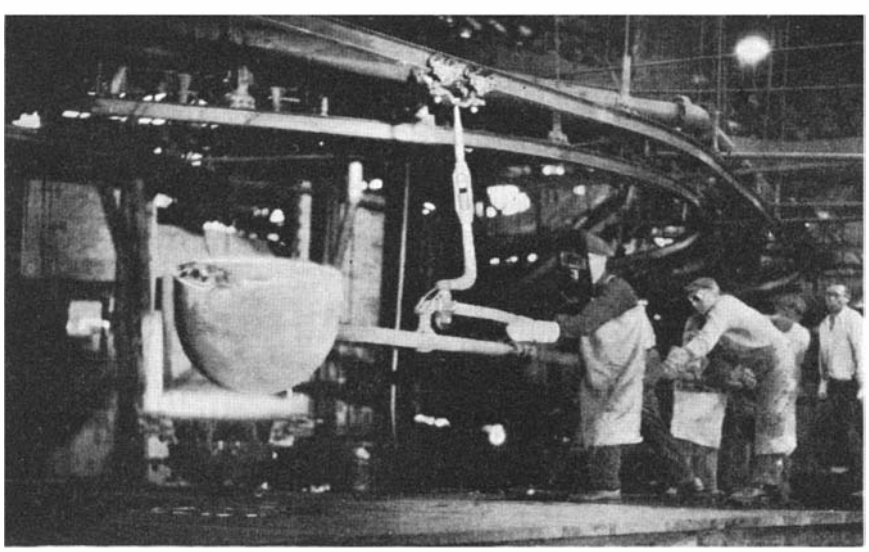
The present interest in the sodium vapor lamp is due to the enormous gain in luminosity with a given current consumption or wattage rating. The new lamp produces two and a half times as much light as the usual tungsten filament lamp of corresponding wattage. This enormous saving in current consumption is attracting the attention of illuminating engineers particularly with highway lighting in mind.

Protective Coating for Stone

A PROTECTIVE coating for stone surfaces, particularly adapted for use where stone walls are subjected to the corroding effects of chemicals or to mechanical abrasion, have been developed from certain silicic acid esters. Tetraethyl silicate ester, dissolved in alcohol, to which has been added the desired pigment, may serve for this purpose. As the coating is applied, the silicic acid is set free, and a rapidly drying insoluble film results which is easy to clean and which possesses great resistance to chemical attack and to mechanical wear. By use of proper pigments it may be made to resist temperatures up to 1200 degrees, Centigrade.—*A. E. B.*

Sex Predetermination Hopes Raised

HOPE that it will be possible for parents to determine in advance the sex of their children was renewed recently by a report of medical research that appeared in



Ladle containing 400 pounds of molten telescope mirror glass ready for pouring

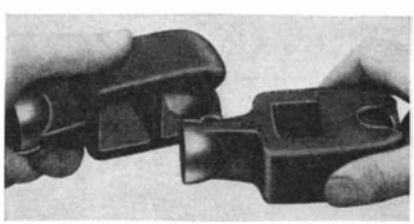
the British journal, *Lancet*. Drs. Harold Taylor and Gordon Kirwan-Taylor, London gynecologists, tell how they successfully applied a modification of a German method of predetermining sex of human beings.

It is a matter of the acidity of the fluids involved and the time relations of the monthly physiological cycle.

Three cases in which births have occurred resulted as the doctors planned and the parents desired. Other cases are pending.

There is a diversity of opinion in scientific circles about the validity of the methods used. Critics of the findings emphasize that the evidence must be much more voluminous before any conclusions can be drawn with general assurance.

The sex predetermination technique depends on the chemical reactions of the vaginal secretions. It was found that the secretion is usually nearly neutral immediately after menstruation, becoming progressively acid until the next period. This is modified by the alkaline cervical flow during coition. Without coition monthly variations in the individual's acidity are normally uniform. Thus a series of examinations during one cycle can guide the physician's advice as to the time of coition and the treatment that should be undertaken during subsequent cycles. The treatment consists of douches, which if too alkaline, too acid, and too shortly before



coition tend to produce sterility. The observations of the London physicians confirm the conclusion that uninterfered coition following menstruation tends to produce sons and before menstruation tends to produce daughters.—*Science Service.*

American Grown Rubber in Auto Tires

RUBBER from the only large source within the borders of the United States, the guayule shrub, has been given a commercial test in automobile tires and tubes. What the motorist and the army could expect from tires that would have to be made from this local source in case of a war embargo was told to a gathering of chemists of the American Chemical Society recently by J. Harvey Doering of the Firestone Tire and Rubber Company.

The test tires built by this company from rubber that was exclusively guayule failed between 8500 and 10,200 miles because of tread wear. The inner tubes proved satisfactory throughout the test.

The chief difficulty with the extensive use of guayule rubber is its high resin content, Mr. Doering said. This can be overcome by an expensive process that will remove the resin. The tires tested were not made from treated rubber, but contained from 18 to 20 percent of resins. These rubbers are extremely soft and sticky so that it was found necessary to add several "drying" pigments before the tires could be built.

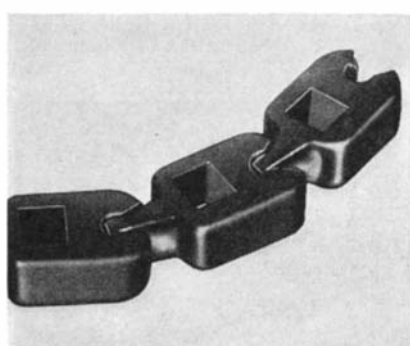
Small quantities of dirt and bark in the rubber made it very difficult to build good tubes. Mr. Doering expressed the opinion that these foreign substances could be removed by some straining method such as is used in cleaning reclaimed rubber.

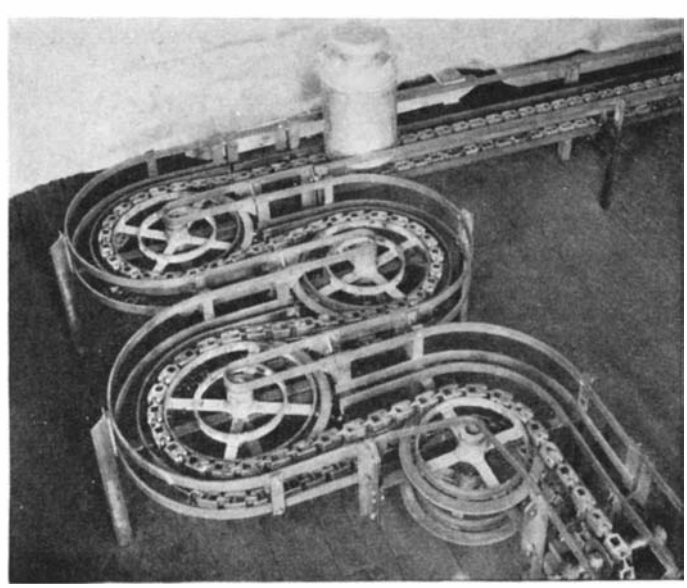
It seems very improbable that the guayule product will take the place of hevea rubber imported from the East Indies except as an emergency measure, such as war. Uncle Sam probably has enough stored away, in the form of new and reclaimed rubber, to last the nation for perhaps two years in case of war, while rubber experts are developing this emergency supply. Under these conditions Mr. Doering promised guayule tires as good as the fabric tires of 1918.—*Science Service.*

A Ball and Socket Power Conveyor

WHEREVER boxes, cans, cartons, bottles, and other uniform packages are to be carried regularly between certain equipment or locations in a factory or other industrial plant, a new power conveyor can often find an economical and desirable application. This type of conveyor, shown in the photographs in these columns, is small and compact, may be reversed when required, is easy to maintain, and above all, is strong and sturdy in construction. The links of the chain are of such length that it can follow very short curves in the conveyor line. The ball and socket connection between each link of the chain is so simply constructed that it can be separated or put together by hand. The wear and tear on the chain itself is distributed over large surfaces in the ball and socket, and efficient lubrication is maintained automatically.

These chains can be used either singly or in multiple installations, and are adaptable to shunting materials from the main conveyor line to a siding.





Right: **The ball and socket power conveyor in operation, showing the sharp turns that can be made.** ***Above:*** **Three of the links, indicating the angle at which the chain may be bent.** ***Upper left:*** **The links may be connected or separated by hand without the use of tools**

Arabic Numerals Not Arabic

CREDIT where credit is due, even at the cost of racial prestige, is accorded by the Arabs in their mathematics books, says Dr. George Sarton, historian of science and research associate of the Carnegie Institution of Washington.

It has been known for a long time, Dr. Sarton notes, that the system of numerals commonly called Arabian really originated in India. However, he adds, they have never been called Arabian by the Arabs themselves. In their books they always call them "Hindu numerals."—*Science Service.*

Desert Marsh Yields Chemical

SODIUM sulfate, once a plentiful by-product of nitric and hydrochloric acid manufacture, has become relatively scarce in this country because of recent changes in the manufacturing processes of those acids. Just when it began to appear that the United States would have to depend on imports for its sodium sulfate, an isolated desert marsh began to yield this chemical, in practically pure form. This strange deposit, where sodium sulfate, or "glaubers salt" can be scooped up by steam shovel is known as Rhodes Marsh, and is located in Mineral County, Nevada. P. C. Rich relates the story of this unique development in *Chemical and Metallurgical Engineering.*

A few years ago, P. S. Williams, a chemical engineer at one time associated with a concern producing sodium sulfate from Carrizo Lake, California, came across an old report of Prof. Joseph LeConte, geology professor at the University of California, in which mention was made of an enormous deposit of glaubers salt at Rhodes. In 1928 he was able to interest a group of San Francisco men who spent considerable time prospecting the deposit, surveying the markets, and investigating processes for recovery of the sulfate. The first plant was erected in 1930. With the experience thus gained as a basis, a program of improvement was initiated late in 1932, under the

superintendence of D. E. Root. At the present writing the out-put is about 50 tons of finished salt cake per day.

Rhodes Marsh is roughly circular in shape. The mineralized section is about 200 acres in area and covered with six inches to 2 feet of silt. On the south half of the deposit, a 15-foot layer of glaubers salt is found immediately under the overburden; in places it has been found to be present at a depth of 80 feet. The north half of the deposit is slightly different in character, large areas having been marked in which the glaubers salt is overlain with thenardite (anhydrous sodium sulfate) in a layer from three to five feet thick. In this portion the overburden consists of salt (NaCl) as well as fine silt.—*A. E. B.*

Cod-Liver Candy Bars from Canada

IF Junior refuses to take his cod-liver oil "straight," he probably will not object to eating it in a candy bar or ice cream, which he may soon be able to do as a result of recent investigations.

A method whereby the fresh cod livers can be mixed with cocoa in such a way that all the health-giving properties of the livers are retained without oiliness or objectionable taste or odor remaining, has been devised by H. A. Wentworth of Fairhaven, New Brunswick, the Canadian Department of Fisheries has announced. The new mixture can be successfully used in the manufacture of a chocolate-coated confection.

Manufacture of the candy has already been started and persons who have eaten it declare it is impossible to notice any taste of the oil. The liver-cocoa mixture has also been used in making ice cream and milk and egg shakes.

While the mixture carries no taste or smell of oil, it is produced by a "cold process" and it is stated that there is no impairment of the livers by chemical or physical changes and that they therefore retain unchanged in quality their natural maximum quantity of vitamin A, the growth vitamin, and vitamin D, the rickets-preventive, "as well as substances for pernicious anemia and goiter therapy."

It is not only the livers of codfish which can be treated by this method. Other species of fish which store up their oil in the liver instead of having it distributed through the body would be a source of supply, such as the halibut, and an important effect of the work may be the enlargement of the demand for this type of fish.—*Science Service.*

Many New Dairy Methods Perfected

THE Grove City Creamery at Grove City, Pennsylvania, together with the surrounding farming community, has become widely known as a "proving ground" for new ideas in dairying as a result of cooperative activities with the Federal Bureau of Dairy Industry.

Swiss cheese is now widely made by the "culture" method perfected at Grove City, and more and more factories are making cheese equal in quality to the imported kind.

Roquefort cheese can now be made from cow's milk in this country, instead of from sheep's milk as it is in France. Recent developments indicate that sealing this cheese in cans and storing it at low temperatures preserves the color and general condition and makes a convenient package for shipping.

The new method of making a low-acid rennet-type cottage cheese has served to increase the popularity of this product, and its manufacture provides a desirable outlet for surplus skim milk in many Pennsylvania factories and elsewhere.

An improved method of making concentrated sour skim milk for animal feed was perfected a number of years ago, making it possible to convert skim milk into a form in which it can be preserved and transported for feeding to hogs and poultry in sections where milk products are scarce. Last year 25 factories converted 34 million pounds of skim milk into the concentrated product.

Sticky Statistics

IT has been said that animal glue serves man from the day he is born and placed in a cradle until he is laid to rest in a casket. The extent of the animal glue business in this country can be appreciated from the fact that the domestic production of glue from hide and bones totaled nearly 60,000,000 pounds in 1931.

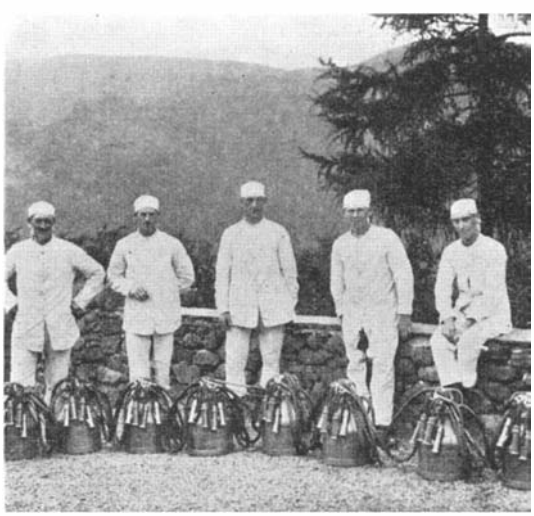
George I. Cooper, writing in *Chemical Industries*, discloses the somewhat surprising fact that the strength of animal glue is nearly always underestimated. Whenever it is used properly, it provides a factor of safety which is so large as to be a virtual guarantee that if failure occurs it will not take place in the glue itself. The tensile strength of the best grades of woodworking glue is 20,000 pounds to the square inch.

Wood joints, made under proper conditions with ordinary paper box glues show, when ruptured, wood failure while the glue has held perfectly. This proves that the tensile strength of the lowest grades of animal glue is greater than wood, although their use is not recommended for woodworking because to give such results they must be used under more exacting conditions than prevail in commercial shops. —*A. E. B.*

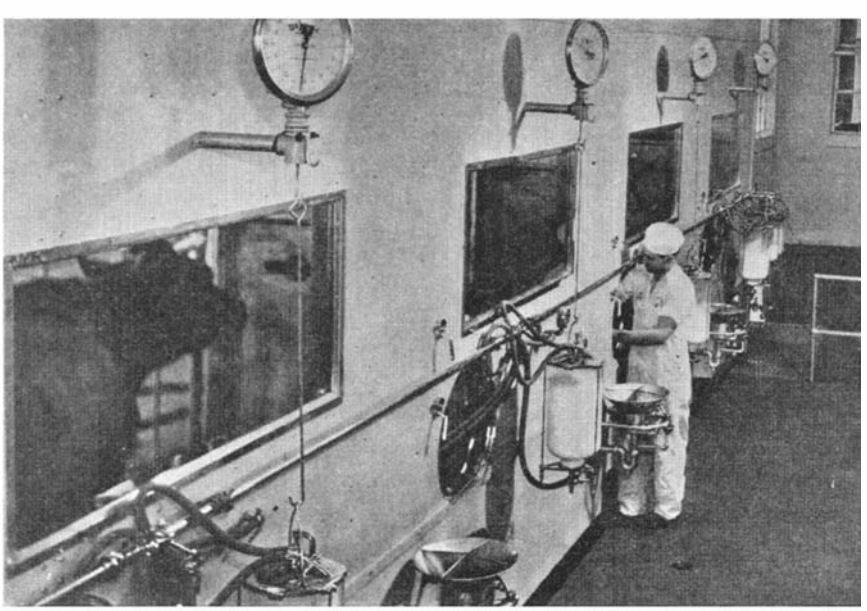
Crystal Speaker—Crystal Tones

THE advent of a new crystal speaker with a sensitivity said to be much greater than that of the magnetic speaker and somewhat greater than that of the ordinary dynamic is causing an increase in the use of centralized radio in schools, hospitals, and hotels.

After many years of experimenting, it was found that crystalline plates of Rochelle salt cut perpendicular to the "A" axis and with the edges at 45 degrees to the "C"

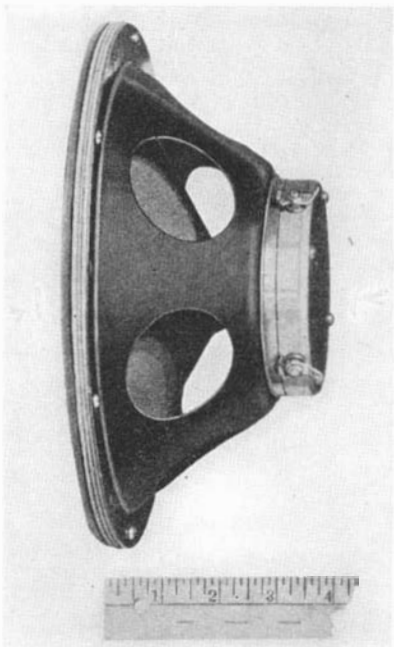


New methods for producing various dairy products are mentioned in the item above. While these processes have been developed, mechanization of the dairy has kept pace. In an American dairy farm (shown below), high-speed automatic milking machines deliver the milk to sterile glass containers. In England, also, mechanical milkers are gaining popularity. At the *left* is shown a group of milkers at a Keswick (England) farm with up-to-date milking equipment



axis tend to expand and contract longitudinally in response to applied electric potentials. Consequently, a bimorph element consisting of two such plates cemented together and provided with proper electrodes will, when held at one end and charged with an electrical potential, bend and move in a direction perpendicular to its major surfaces and parallel to the "A" axis.

Through such discoveries, a double curvature bimorph element was developed as



The new crystal loudspeaker. Note comparison with a ruler (below)

the standard speaker driver, which was two and a half inches square by one quarter inch thick. This element is clamped between rubber at three corners. The fourth corner engages a 2½ to 1 step-up lever arm, the free end of which drives a small cone. When so arranged and operated from a conventional radio amplifier, the speaker gives a very good response throughout the broadcasting range.

Some of the advantages of this new speaker are clear tone, compactness, permanence, and low cost; it requires less power for operation, and only a two wire lead is necessary as there is no field current to be supplied.

New American Made Telescopes

ENCOURAGED by the tremendous success of their 6-power achromatic telescope the Wollensak Optical Company, Rochester, New York, has introduced a complete line of American-made achromatic telescopes. Because of their optical systems and construction these new telescopes are considered the finest in the world in their price classes. They are excellent for all-around sports use and especially suited for use as spotting 'scopes by marksmen.

You Get Sweeter When You Smoke

THE gratification you get from smoking, particularly when you are tired and hungry, is due to an increased amount of sugar in your blood brought about by the

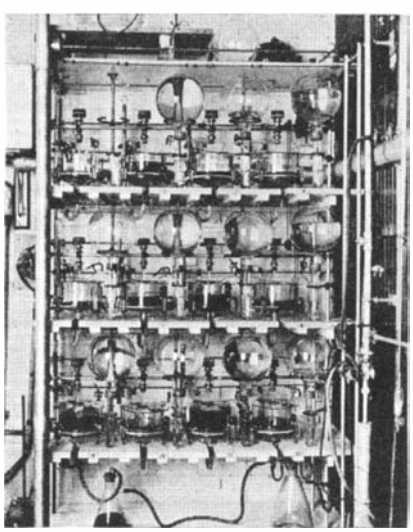
nicotine from your cigarette—or pipe or cigar. This explanation of what has long been a mystery has just been reported by two Yale University scientists, Drs. Howard W. Haggard and Leon A. Greenberg, to the scientific journal, *Science*.

The nicotine in the tobacco acts upon the adrenal glands, causing them to discharge more adrenalin into the system. As a result, the glycogen stored in liver and muscles is converted to sugar, and the sugar concentration of the blood is increased.

The same thing happens after a meal. It is this increased sugar concentration that definitely relieves the fatigue and irritability which develop when the amount of sugar in the blood is at the fasting level; in other words, when you are hungry. This also explains why many tobacco users smoke when they feel tired or hungry. The nicotine relieves the hunger and fatigue temporarily by increasing the amount of sugar in the blood.—*Science Service.*

Improving Honey

TRAIN your bees to sip their honey only from orange blossoms and sweet clover if you would have them produce the clearest grade of honey. This, at least, is one



Battery of ultra-filtration units used to remove turbidity of honey

of the conclusions that the layman would draw from the elaborate and interesting experiments of H. S. Paine, S. I. Gertler, and R. E. Lothrop of the Bureau of Chemistry and Soils, who report their exhaustive investigations of honey in *Industrial and Engineering Chemistry*.

It has been known that the color, the turbidity, and the caramelization temperature of honey are influenced by its colloid content. Some of the difficulties encountered in the commercial handling, processing, and packing of honey are traceable, in part at least, to the presence of relatively small quantities of colloidal substances. Extracted honey for the retail trade comes into competition with sirups, and, especially when packed in glass containers, suffers by comparison with the clarity and brilliance of appearance to which the public has become accustomed. So the investigators determined to find out whether the amount of colloidal matter in the honey could be controlled by regulating the "diet" of the bees. They collected 37 samples representing the most common American floral types and filtered out the colloidal matter.

Now, it is easy to say "filter out the colloids" but actually to do it is another matter. Colloidal matter is so finely divided that it will run right through an ordinary filter. Therefore, an ultra-filter must be used. The accompanying illustration shows the battery of Dawson filters used in these studies. The filter proper is made of a nitrocellulose film, prepared by spreading a thin layer of collodion on the surface of mercury in a glass dish and allowing it to "harden" to a film, which constitutes what is technically known as a semi-permeable membrane. This membrane will filter out colloids—but it is a long, slow process, and must be carried out under a vacuum. From three to five days of continuous operation were required for the ultra-filtration and subsequent washing of the colloidal material.

It was found that dark-colored honeys, such as a "diet" of buckwheat produces, ran as high as 1 percent of colloidal matter. Light honeys, such as those from clover and orange, ran less than 0.1 percent of colloids. These colloids, which are the primary cause of turbidity in honey, were found to consist largely of proteins, emulsified wax particles, pentosans, and inorganic constituents. The frothing and caramelization of honey upon heating were found to be materially decreased when the colloidal matter had been removed.—*A. E. B.*

Dry-Ice for Spotting Tanks and Machinery

AN interesting method for placing heavy machinery or equipment has been used with success by the engineer of a large ice cream plant in New York City.

The problem involved was the spotting of a rectangular welded steel brine tank weighing 6500 pounds on a flat foundation. The tank was fabricated on wooden cribbing placed so that all parts of the tank were accessible for welding.

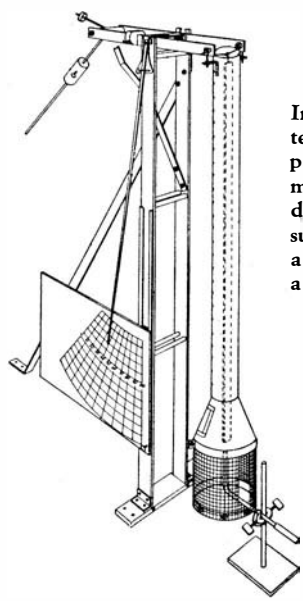
Six blocks of dry-ice (solid carbon dioxide), each a 10-inch cube, were next evenly spaced on the foundation. The tank was moved approximately into place and lowered by jacks until it rested directly on the dry-ice. At this stage the friction between the tank bottom and the dry-ice was so slight that the entire tank could be moved into exact position by one man pushing against it. It was then blocked to prevent any lateral shifting, and allowed to settle to position as the dry-ice melted.

The method is believed to be applicable to lowering all kinds of heavy equipment where space is cramped and where overhead crane facilities cannot be had.

A similar procedure has been used before with ordinary ice but the great advantage in using dry-ice is that the dry-ice evaporates without leaving the mess that follows use of water ice.

Fire Test Adopted As Standard

A FIRE-TEST tube apparatus developed by the United States Forest Products Laboratory, Madison, Wisconsin, and accepted as a test instrument by institutions

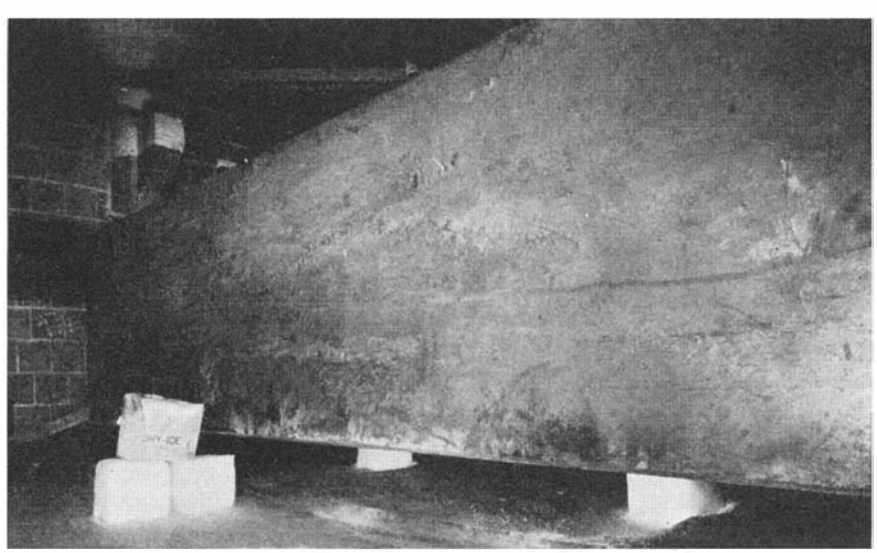


In the fire-test tube apparatus, the material under test is suspended in a tube over a "standard" gas flame

conducting research on fire retardants for wood in this country, also meets the requirements of German engineers.

The fire-test tube was developed at the Forest Products Laboratory as a necessary preliminary to the Laboratory's studies of fire-retardant chemicals. It has met a need of American testing laboratories for a convenient and reliable standard apparatus for testing the effects of fire on chemically treated wood. The tube, pictured on this page, shows temperature, loss of weight,

(*Please turn to page* 272)



How dry-ice was used in spotting a heavy tank

CURRENT BULLETIN BRIEFS

RELATIONS BETWEEN CUBA AND THE UNITED STATES, by Juan Andres Lliteras, and RELATIONS BETWEEN CENTRAL AMERICA AND THE UNITED STATES, by Dana G. Munro (International Conciliation, January, 1934, No. 296), gives information about such hard-to-locate subjects as the Platt Amendment. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—5 cents.*

WILD FLOWERS IN KANSAS (Volume LI No. 204—B) is a pamphlet of 293 pages, by Frank C. Gates, with 448 drawings by Mrs. Albert Dickens. The Department of Botany of the Kansas State College answers more letters and questions pertaining to the flora of Kansas than it does on any other subject. No satisfactory book has heretofore been available to the layman who wishes to learn about the wild flowers of Kansas. For copies apply to *J. C. Mohler, Secretary, Kansas State Board of Agriculture, Topeka, Kansas.—Gratis.*

RENSSELAER POLYTECHNIC INSTITUTE (Engineering and Science Series No. 45). This pamphlet deals with Amos Eaton, author, teacher, investigator: the first laboratories in any country for the systematic individual work of students in chemistry, physics, and botany: B. Franklin Greene and the reorganization in 1849-50. *Rensselaer Polytechnic Institute, Troy, N. Y.—Gratis.*

DARDELET THREAD HANDBOOK. This book of 220 pages contains much theoretical and practical information relative to the Dardelet thread, other thread forms, and thread-locking devices. There are also a number of tables which are not usually found in a single handbook. The Dardelet thread is designed to provide an efficient locked connection between a bolt and nut. This connection is produced without undue torque effort. *Dardelet Threadlock Corporation, 120 Broadway, New York, N. Y.—$2.00.*

HEALTH THROUGH THE AGES, by C.-E. A. Winslow and Grace T. Hallock, is intended to give boys and girls of high-school age a sense of the agelessness of man's search for health. It traces through various historical periods the story of how man has learned not only to protect his own body but that of his neighbors. One copy for each classroom. *Metropolitan Life Insurance Company, New York City.—Gratis.*

THE ANGLO-FRENCH MICRO-RAY LINK (Electrical Communication, Volume 12, No. 3, January, 1934). This communication system between England and France represents the shortest wavelength radio telephony link in regular commercial operation today and may be considered as heralding an era in which the privacy, efficiency, and reliability of micro-ray waves will be exploited to the full. *International Telephone and Telegraph Corporation, 67 Broad Street, New York, N. Y.—75 cents.*

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

WE have been accused of publishing in this column too many descriptions of telescopes made by amateur telescope makers, rather than other more advanced, specialized matter pertaining to the hobby of telescope making. We admit the justice of the accusation and have gone easy on such matter for the past half year or so. But we have so many of these descriptions on hand and unpublished that we shall

Callum's reflector

run off a few in order to make a hole in the pile. First, however, some odds and ends:

THE new aluminized mirrors have been acclaimed as most satisfactory by several who have had the job done. A dozen have asked us for "complete instructions" for doing this job themselves. The February number of *Publications of the Astronomical Society of the Pacific* contains the data, by Professor John Strong of the California Institute of Technology—the man who made the process what it is today. "The data," we say, but the published data *do not* include the six months of grief involved in teaching the temperamental apparatus to perform—the "period of adjustment," a term usually applied to the first year of marriage and as aptly applied here.

The Bureau of Standards has recently prepared data on another cantankerous job —casting speculum metal. 'Tis said by some that here, too, the correct procedure is to read all about it and then not try it.

Now that winter is approaching—in the antipodes—we suppose somebody in Admiral Byrd's expedition will be making a telescope in the long Antarctic night. We have never learned who. Just before sailing, Admiral Byrd requested a copy of A.T.M., and got it. Who the TN in his party is, we can't say. Has any reader a notion?

OUR mention of photo-electric guiding in the February number brought out the fact that the idea had already been worked on by not a few. Noël Deisch, 908 G St., N. W., Washington, D. C., states that an article on the same subject appeared in *Zeitschriften für Instrumentenkunde*, November, 1929, and in *Revue d'Optique* for December, 1931; while Samuel Wein, 2065 Croston Avenue, New York, cites a paper in *Physikalische Zeitung* 1905 (p. 838), and states that he wishes to co-operate in this problem with interested workers. We have known for almost a year about the research of one worker on this apparatus but he wishes us to keep his results under our hat until his equipment is entirely freed from bugs—which it is said to be now, or relatively so.

WE have been flirting with the idea of starting a new magazine—a small one of course, at least at first—for the amateur telescope maker, and sent out 480 feelers to that many purchasers of A.T.M. selected at random, enclosing in each case a self-addressed stamped reply card. Of the 480 cards, 185 have come back, and of these 167 are favorable to the idea of organizing a society for amateur astronomers and telescope makers and publishing an organ. On the basis of this we either shall or shall not undertake it! (Tell you later.) The names suggested for the society and for the magazine range from the sublime to something else. The most pleasing return came from that staunch old telescope and spectrohelioscope maker, Henry B. Prescott of Wells River, Vermont, who enclosed two one dollar bills, making him potential subscriber No. 1, and said "Let's go." We have already spent his two dollars (embezzled it) so it looks as if we were morally obligated to start the magazine. (By the way please don't emulate Prescott —just yet—for we lack a technically correct way to dispose pro tem of such two dollar bills.) Our tentative idea is a format like that of the *Readers Digest*, but a thinner magazine, of course, for it takes years to build up a magazine to an armful, and this just happens to have exactly the dimensions of A.T.M. Accordingly—why not make the magazine uniform typographically with A.T.M. and, as it would contain all the advances, regard its bound volumes in the light of new editions of A.T.M.?

A DECIDEDLY neat and inventorish rig for a telescope is that of George E. Meyers, 106 Ann St., Hartford, Conn. The pictures almost explain themselves. The eyepiece may be turned to any position and locked there by means of the large knurled ring. This is the best solution of a bothersome problem we have ever seen. Meyers' mirror cell is equally ideal, permitting micro-adjustment without loss of alinement. It is like the one shown in A.T.M. page 449, which also screws in.

The three remaining telescopes shown are similar in appearance—two of them in principle. The first is by William Callum, secretary of the Amateur Telescope Makers of Chicago, and he states that it is a copy of Eliason's, shown on page 386 of A.T.M. It has an 8-inch aluminized mirror of f/8.25. The base is of steel, the tube of aluminum. The declination slow motion, on the side, is a new idea and is within reach. It consists of an arm which clamps to the trunnion supports, and which is controlled by a wheel running on a bent threaded rod. It can be set to 10 minutes of arc. Callum says the Chicago group has 53 members and that they are "as enthusiastic a bunch of nuts as you will meet anywhere outside of certain institutions which we will not mention." However, a good recipe for

Meyers' head rig and cell

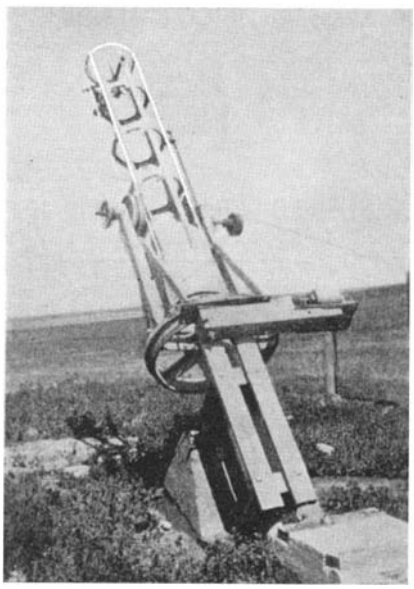
longevity is to get nutty over some hobby and remain so.

Gerald E. McCord of Oak Park, Illinois, a member of the A.T.M.s of Chicago, uses the Porter roller mounting, as Callum and others have. He, wisely we think, likes a wooden tube. Note picture. Such tubes give less trouble from differences of temperature than metal ones.

McCord's rolling telescope cover and 'scope

THE Rev. Cyril E. Martin of the United Church Manse at Preeceville, Saskatchewan, writes:

"I was making my usual round of pastoral calls," he writes, "when I happened upon a copy of the SCIENTIFIC AMERICAN, and there learned that it was possible for even a 'sky pilot' to build his own astronomical telescope. I resolved to try my hand at telescope making. An order for material was sent, a copy of 'Amateur Telescope Making' was obtained and work was begun.



The Rev. Martin's telescope

"I had almost completed the polishing process of the mirror when I cracked it while warming it in making a lap. Work was held up for another month while another disk was sent for. This time I had better luck, the mirror was parabolized, set in its cell, and ready for my first view of the moon. I shall never forget that night. While the neighbors were sleeping I was aiming my six-inch at the moon. With trembling hands I adjusted the eyepiece, and that which was first a globe of light started to define itself until the craters and the mountains stood out clearly. Next day the mirror was silvered and next night the neighbors gathered from far and near to look at the moon for the first time through a telescope.

"The polar axis is a piece of 3½-inch shafting which revolves in two six-inch ball bearings. To this shaft is attached a wheel 24 inches in diameter. A worm gear is cut in the edge—this was done in a lathe with only a 9-inch swing, by placing a tap in the chuck and bringing the edge of the wheel against the tap, so that threads were cut. The hour circle markings were made on an aluminum strip and bolted around the edge of the wheel. To the wheel is bolted and braced the fork in which the telescope is swung. You will also note the two Ford brake drums through which the trunnion passes. Between these two drums is a disk of leather which serves as a clamp to hold the tube in declination, when the wheel, which can also be seen, is turned. The whole thing gives excellent results.

"The clock was made from an old Edison cylinder phonograph motor, the spring being replaced by a weight. This will keep an object in the field of the eyepiece for about half an hour."

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 268)

and extent of flaming or glowing on a 40-inch strip of wood subjected to a standard flame for a standard test period. The tube or chimney with specimen inside is swung from a beam and counterbalanced. Percentage loss of weight of the specimen is self-indicated by the pointer and scale.

New Method of Dehydration

VEGETABLES may be dehydrated in one third the time ordinarily required with a method developed by Berthold G. Freund and tested by Prof. Charles W. Thomas, chairman of the subcommittee on drying of the process committee of the American Society of Mechanical Engineers, according to *Food Industries*. The process is said to retain the vitamins, so that the dried product is equal to the fresh in food value.

With the Freund-Thomas method, the vegetables are revolved rapidly in a draft of warm air, the temperature of which does not rise above 90 to 95 degrees, Fahrenheit. The rotary movement throws moisture off the surface through centrifugal action, simultaneously extracting the moisture from the inner cells.

Fruits, meats, fish, and cheese can be dried in this way.—*A. E. B.*

The Mystery of the "Cyclops"

WHEN the naval collier *Cyclops* disappeared without a trace on her homeward voyage from South America to the United States during the World War, theories as to the cause of her disappearance were many and varied. These have been discussed time and again in the newspapers so we shall not repeat them here. The latest theory, which seems more plausible than most, is quoted below from an article by Will Talsey in the magazine *Our Navy*.

"It will be remembered," relates the naval informant, "that during the war the sweepings of the rackets joined the navy to escape the army draft. There were in the personnel of some of the American ships specimens of the toughest hombres it has been my privilege to know; former convicts, thugs, burglars, and crooks of all kinds. Don't let me mislead you into thinking they were more plentiful in the navy than they are in any city in the land. They weren't. But in some mysterious manner a group of these tough guys got into the crew of the old *Pittsburgh*, an armored cruiser. These racketeers preyed on their fellow enlisted men until they created a reign of terror amongst them. They became so bold that they followed their fellow seamen to the paymaster's office and forced them to turn over their pay envelopes as soon as they drew them. They exercised terrorism through beatings, threats and worse, to such an extent that no one dared to tell the officers what was taking place. A report meant death—thrown overboard. This condition of affairs persisted until this motley gang of criminals became so bold as to lay plans to murder the officers and take over the ship. But here is where they reckoned wrong for the of-

ficers uncovered the plot, discovered the reign of terror amongst the enlisted personnel, and had them all arrested.

"The *Pittsburgh* in those days was the flagship of the squadron sent to Central and South America to establish friendly relations for our side in the war. When it came into the harbor of Rio it found the *Cyclops* about to weigh anchor and start home to the States. Since the *Pittsburgh* was bound on its mission and that meant carrying the mutineers half way around the world before placing them in a naval prison, it transferred the prisoners to the *Cyclops* for shipment home, prison and death.

"Perhaps as the *Cyclops* neared the United States the officers eased down on their vigilance. Remember these prisoners were wily, cunning and desperate men, determined not to have their lives and/or liberty taken away from them without a violent try at resistance. A guard enters the room in which the prisoners are confined. He is overpowered. The thugs are at liberty. They get possession of his weapon, kill other sentries and get their weapons. They had already perfected plans to sink the ship and escape in boats in the confusion. So they make their way to the seacocks. They open them and water pours into the low laden ship. The engine room is flooded before the officers and crew know what it is all about. The dynamos are disabled and the radio operator hasn't the electric power to send an SOS. With such suddenness has it all happened, that the heavily laden old ship sinks too rapidly for the mutineers to swing the boats over side and escape; the tremendous suction caused by the *Cyclops*' fast sinking pulled all down with it. Maybe some of the mutineers did get away in a boat. Maybe they landed on the beach of one of the innumerable sponge fishing villages that dot the Caribbean. Yes, maybe some are even there today for there are many out-at-the-heels disreputables strewn from Havana to Tela of whose past nothing is known."

Although the last explanation appears to be the most plausible of all, yet it is a guess. What happened to the *Cyclops?* That was the question asked by the United States Navy and the public back in 1918 and 16 years later it still remains an unanswered question. It remains the greatest mystery of the World War.

Radioactive Textiles

"MY dear, you are simply radiant in that gown!" This remark (guaranteed to "go over big" with any woman) may come to be literally true, according to reports from abroad where experimenters have produced a rayon material which is radioactive. This result is achieved by dissolving a minute quantity of radium sulfate in the rayon spinning solution, before the thread is manufactured. Fabrics giving off mild radiations are said to result from the addition of 0.02 percent of the radioactive substance to the solution. Higher proportions of radium salt naturally render the fabrics more intensely radioactive. Apparently repeated wearing and washing has no appreciable effect on the radioactivity of the fabric.

Just why anyone should want a radioactive silk dress is not clear to this writer. Moreover, with radium at present prices,

it is an open question whether anyone could afford such a luxury. But no doubt a good advertising campaign could convince the ladies that they can never capitalize their full charm until their silken garments broadcast gamma rays.—*A. E. B.*

Alcohol Banned in Candies

THE repeal of the 18th Amendment did not abolish that stringent clause in the Food and Drugs Act which defines as adulterated any confection or candy which contains intoxicating liquors, according to J. W. Sale, Federal Food and Drug Administration. This clause of the law was designed largely for the protection of children who relish candy and eat quantities of it. The provision has been stringently enforced and, declares Sale, will continue to be stringently enforced. The Federal Food and Drugs Act states that confectionery is adulterated "if it contain***any vinous, malt or spirituous liquor or compound."

How Lightning Produces Thunder

IT is now thought that the sound of thunder is caused largely, if not entirely, by a sudden increase of pressure due to heating, dissociation, and ionization along the path of a lightning stroke, says M. G. Lloyd, Chief, Safety Standards Section, United States Bureau of Standards, writing in *The United States Daily.*

The energy of a stroke may amount to 10.8 or 10.9 watt-seconds, of which the greater portion is expended in heating the air. If the path is assumed to be a foot in diameter and a mile long, 10.8 watt-seconds would heat it to about 650 degrees, Centigrade, with an increase of pressure of about two atmospheres. The dissociation would add to this by increasing the number of gas molecules.

This increase of pressure, which may in reality be much greater than two atmospheres, takes place very abruptly and is sufficient to account for the ear-splitting crash which accompanies a near-by flash of lightning.

Chemistry Aids "Talkies"

FALSE teeth and phonograph records, two articles of widely different utility, are produced today in a much improved form as a result of the chemists development of the synthetic substance known as vinylite. This ubiquitous material, one of the large and growing family of synthetic resins, is made by the combination of two organic chemicals, vinyl chloride and vinyl acetate. According to Carleton Ellis, who describes it in *Industrial and Engineering Chemistry,* it is available as a molding powder in various colors and has been used for wall panels and doors, which are probably the largest single-piece press moldings ever made from a synthetic resin. The compositions have been tried experimentally for many articles, including molded jars, automobile steering wheels, and translucent panels for lamp shades and indirect lighting fixtures.

In the sound record industry, a 4-ounce Vinylite record for motion picture theaters now does the same job that formerly required a shellac record weighing 20 ounces. The reduction in size from 16 to 12 inches in

diameter was made possible by the greatly increased strength and flexibility of the new material as well as by its finer texture. Other types of records have been made from this resin. The versatility of vinyl resins in this field is illustrated by the successful substitution of non-inflammable Vinylite for celluloid in disks for home-recording. Vinylite can be handled on the same equipment used for shellac compositions, with only minor changes in technique. The total production to date, including home recording, motion picture, and all special Vinylite records, is probably about a million records.

Artificial dentures have been made from a number of materials: hard rubber, celluloid, Bakelite, and so on. Denture compositions of vinyl resin containing only a small amount of pigment and having a very natural appearance have been prepared which are adapted for this application. They are tasteless, odorless, and unaffected by continuous exposure to moisture, dilute acids, and alkalies.

Polystyrene, a resin related to vinyl polymers, shows great possibilities, but at present its cost of production is too high to warrant any extensive use. The resin is water-white in color and has the highest insulating power of any available synthetic resin, higher even than shellac. Some samples of polystyrene which have been examined are so tough as to require a hammer and anvil to break them.—*A. E. B.*

A Bee-Sized Bird

HUMMING birds are commonly considered to be about the smallest of the feathered family—at least in this country. In Haiti, however, Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, has discovered a tiny bird, no bigger than a good-sized bee. This insect-like bird is quite pugnacious and does not hesitate to attack birds as large as a mocking bird.

A Flower That Eats Insects

A BOTANICAL curiosity which can be grown in the home has recently appeared in a metropolitan store. This plant is called the Darlingtonia (*Chrysamphora darlington*) and in shape resembles the hooded cobra of India. The blossoms are brilliant purple and crimson; a fluid exudated from the flower attracts ants, flies, and other insects, which the plant promptly consumes. In an advertisement of this flower an inspired copy writer added the following note: "If kept in a room free from insects it enjoys an occasional particle of meat!"

INDUSTRY—RESEARCH

(*Continued from page* 243)

the huge stores of these materials as assets, when they cannot possibly be unless they are moved from the warehouses and into the channels of trade. Lately, we are changing some of our old ideas and setting up new conditions to fit our times for production and distribution. As soon as these ideas are more firmly established we will go ahead again at full speed.

If you would sit down and analyze the situation, you would find out that the old maxim, that there is nothing so constant

as change, forbids and prevents ever crystallizing anything. When you are discussing science and business you are discussing the process of change, and nothing else.

Modern business has had its department of finance, its departments of production, sales, advertising and so forth, but until very recently it has not had a systematic department of change making; and that is the new factor which is being introduced more and more into business, from the board of directors down. Business will change whether you want it to or not and so it is necessary to study these changes and be ready for them with a new or improved product.

Most people think of a research department as a test tube or microscope or some scientific instrument of that sort. It is nothing of the kind. It is more a point of view from the management standpoint. Even in the laboratory, research is not done in a test tube or under a microscope. It is done in the mind of some individual long before it gets to the test tube stage.

The research department should keep in close touch with the trends of its own business and, what is just as important, the trends in other industries. It is only in this way that the outstanding things that are likely to influence your own industry can be followed. You are always too late with a development if you are so slow that people demand it before you yourself recognize it. The research department should have foreseen what was necessary and had it ready to a point where people never knew they wanted it until it was made available to them. If this is not done, the business slumps until it takes a heroic method to get it back to where it should be.

THERE has been a great deal of failure in research in industry for the reason we have gone out and hired some technician from some reliable organization and set him off in a corner and said, "That is our research department." That is not enough. You have to analyze your business to find out what it needs and then give the technical man a specific problem. He cannot be a superman and work you out of your difficulties in a day or week.

But industries are fast beginning to realize that some department must look ahead and plan for the future. So research sits in the executive conferences and is considered just as fully as manufacturing, marketing or any other problem. Instead of being put in some dark, unused corner of a factory building it is housed as well as the other necessary departments of business where contacts with production, sales and financial executives are easily made. With management open-minded to the ideas originating from research the future of an organization is just as assured as if it were covered by an insurance policy against becoming stagnant.

The first thing necessary is for management to recognize that change is inevitable. It is then the job of the research department to find and recognize the factors that are going to make it change, and then have them digested by the entire organization before the public demands the change. The closer contact of research executives and other executives in business is bound to result in a more complete program of advancement.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Inventions and Industry

IF America wants a Five Year Plan that will put her ahead five centuries, . . . let her cease drafting new laws for two or three years, while a few thousand genuine scientists who are not Yes-Men for corporations ascertain which unexploited inventions and discoveries might be quickly turned to account, without too greatly disturbing affairs. There are hundreds of such, many of them pigeon-holed in patent files or else lying around unused for lack of financial backing. Let our political pundits finance the free experimenting with new ideas, no matter how remote and abstract they may appear to laymen; the only proviso being that a committee of scientists and engineers uninfluenced by slick profiteers passes judgment on the ideas as worthy of inquiry.—From "A Short Introduction to the History of Human Stupidity" by W. P. Pitkin.

Pictures on Labels

IT was recently held by First Assistant Commissioner Kinnan that where a registration was sought for a label containing the picture of a woman, either it was error to require a statement that the representation is fanciful or, if the contrary be true, that the consent of the individual be filed, where there was nothing to indicate that the picture was that of a living person.

In his decision, the First Assistant Commissioner said:

"It may, however, be proper to state that the requirement has been made from an analogy to the statutory requirement in connection with the registration of a trade mark including the portrait of an individual.

"Where, as here, the officials of this Office have no basis for considering that the picture in the label is that of any living person, it is believed unnecessary for this Office to investigate the matter. The examiner is authorized to withdraw his requirement."

Inexpensive Protection

A MANUFACTURER was amazed recently when his attention was called to a newly issued patent relating to his industry. "Why, we have been doing this for the last 15 years," he said. "Why did the government issue a patent for it at this time?"

He then drew out from his desk a small printed pamphlet which he issued to the trade many years ago to confirm his statement.

Upon being asked whether he sent a copy to the Patent Office he said, "Why no, why should I? There is no law requiring it, is there?"

This is a typical case which occurs quite often. The manufacturer usually operating on a small capital to begin with devises a new machine, process or article. He does not proceed to protect them by a patent and hastens to invest capital, equipment, and advertising effort in his new development. He may print some interesting trade literature describing his product and send it out to the trade.

The chiseler then comes along, files a patent application for the new development. The Patent Office has no literature in its files which it can cite to anticipate the claims of the application and it does not have any records of all the trade practices in the industry owing to lack of appropriations from Congress for this particular purpose. The patent therefore issues much to the chagrin and annoyance of the true inventor.

The moral is that all new developments should be safeguarded by patent protection but if such protection is not desired for diverse reasons the simple precaution of promptly sending one or two copies of the printed trade literature to the Patent Office would serve the purpose in many instances. The Patent Office could then cite the publication against the chiseler and thus spoil his game. Without having this information the Patent Office could not possibly protect the original inventor.

The function of the Patent Office is not only to issue patents but also to prevent their issuance to unwarranted persons in order to protect the public from harassing monopolies. Manufacturers and all other interested persons should therefore assist the Patent Office by sending all the technical publications, reprints, bulletins, trade catalogs, circulars, etc., which they issue and thus keep the Office informed in regard to their new developments. They should also co-operate by sending in any specially prepared bibliographies, digests, and summaries of the literature on particular subjects which are not ordinarily available.—*Journal of the Patent Office Society.*

Bromo-Quinine Trade Mark

IT was recently held by First Assistant Commissioner Spencer that The Paris Medicine Company, of St. Louis, Missouri and Wilmington, Delaware, is entitled to register, under the ten year clause of the Act of February 20, 1905, the notation "Bromo-Quinine" as a trade mark for medicinal tablets for relief of colds and so on.

The ground of the decision is that the applicant had had the required ten years use and that the mark can function as a trade mark.

In his decision, after noting that "Bromo" and "Quinine" are recognized medical terms indicating that the product, as it does, contains both a bromide and quinine and that descriptive marks are registered under the ten year clause and that the showing had been made that the applicant had the ten year use and the mark has always indicated to purchasers a source of origin or manufacture, the First Assistant Commissioner said:

"It is urged by the Examiner that the terms 'Bromo' and 'Quinine' being recognized medical terms cannot indicate origin or ownership but merely serve to specify or describe a certain product. . . . This mark may come under the prohibition established in such cases . . . but, if so, such fact is not disclosed by the record in this case nor does it fall within the scope of judicial knowledge or inquiry of this tribunal.

"Under the circumstances this tribunal is disposed to adopt the contentions of the applicant and accordingly hold the mark registrable."

Damascus Trade Mark

IN *ex parte* Damascus Steel Products Company, First Assistant Commissioner Spencer held that the company, of Rockford, Illinois, is not entitled to register, under the Trade Mark Act of February 20, 1905, the term "Damascus" as a trade mark for knives and other tools made of steel.

The ground of the decision is that the mark is merely geographical or descriptive.

In his decision, after noting that Damascus is the name of ten villages in this country as well as the name of an ancient city in Syria and that the dictionary defines it as indicating steel of superior quality, the First Assistant Commissioner said:

"The applicant is between the horns of a dilemma. If the term is employed in its primary sense, it is geographical and hence barred. If reliance is placed upon its secondary meaning, it is clearly descriptive of the 'quality of such goods' and similarly barred. . . ."

Deafness "Cure" Curbed

ADVERTISEMENT and sale of an electrical device called "Mears Airosage" as a cure or relief for deafness, is prohibited by the Federal Trade Commission in an order to the Mears Radio Hearing Device Corporation, New York City. "Hearing has been restored by the use of Airosage after 20 years of extreme deafness," the company had said in its advertising describing the device.

Findings of the Commission after taking testimony in the case are that treatment by use of the device is not scientific but is dangerous.

The company was ordered to stop representing that "Airosage" and "Mears Ear Oil" will cure or relieve deafness or head noises, or that use of the former with or without the ear oil is scientific or proper treatment for deafness or head noises, or that the oil has therapeutic value.

Books SELECTED BY THE EDITORS

THE LIMITATIONS OF SCIENCE

By J. W. N. Sullivan

REVIEWS of this book published in various scientific magazines here and abroad show that it is being regarded generally as one of the outstanding books of the year. It is mainly a book of criticism concerning the philosophy of science and the scientific outlook, the connections between religion and science, and so on. It also points out the limitations of science—what science can do and cannot hope to do. The style is lucid but the book is not for lightweight readers, having a large content of material for the provocation of thought.—$2.95 postpaid.—*A. G. I.*

BUMBLEBEES AND THEIR WAYS

By O. E. Plath, Prof. Biology, Boston Univ.

A COMBINED popular and scientific account of the life and ways of the familiar bumblebee, written by a scientist who makes their study his summer hobby. Quite plainly the observation and study of these big good-natured fellows (or rather, ladies) provides as fascinating a scientific hobby as that of the domesticated honey bees. How many of us know, for example, that there are not one but a dozen common species of bumblebees in our fields?—$4.20 postpaid.—*A. G. I.*

HEWITT'S HANDBOOK OF STREAM IMPROVEMENT

By Edward R. Hewitt

FISHERMEN and other nature lovers will find much of interest in this book. It is an accepted conclusion that fish in the streams of the United States, placed there in the large majority of cases by stocking programs, do not have an even chance for obtaining sufficient food to sustain life. The author gives his views of the situation, and how it may be changed by stream improvement. A practical book based on practical experience.—$2.65.—*A. P. P.*

T N T

By T. Swann Harding

"THE argument of this book is not to defend Government or even the NRA as an ideal dictator destined to produce Utopia. It is to show that the social business of the Federal Government, can be conducted more honestly, more intelligently, and more competently than the business carried on by private enterprise under the profit incentive. Furthermore it is the contention of the book that only Government can effectively redistribute income so as to produce the broad base of widely diffused consumer purchasing power upon which mass production depends. If private enterprise is able to elude the guiding hand of the Government, not only will the NRA fail, but the whole structure of our civilization will inevitably collapse."

The author has contributed several articles to SCIENTIFIC AMERICAN and his style is dynamic and lively. He has a lot to say and he says it fearlessly.—$2.90 postpaid.—*A. G. I.*

THE DISCOVERY OF THE ELEMENTS

By Mary Elvira Weeks, Asst. Prof. Chem. Univ. Kas.

A COMPACT 355-page detailed account of the discovery of each of the 92 chemical elements, each discovery being dealt with both in its scientific and its historical (human) aspect. This is the first time all this widely scattered data has been brought together. It is a rich mine of elementary chemical lore, informatively but most readably written and copiously illustrated.—$2.15 postpaid.—*A. G. I.*

THE AMATEUR MACHINIST

By A. Frederick Collins

THE author has produced a whole shelf full of "handy how-to-do-it" books. The present volume deals in a simple manner with hand and bench tools, the common lathe, the screw-cutting engine lathe. There are chapters on mechanical drawings and the finishing of metal work. The cost of most articles is given.—$2.15 postpaid.—*A. A. H.*

PIRATES OF VENUS

By Edgar Rice Burroughs

IF you can take your scientific fiction with at least the proverbial grain of salt, and without getting too serious about it, here is a book for you. It is crammed full of adventure and excitement, all being built on a semi-plausible background. Briefly: The central character starts out in a rocket ship for Mars. A miscalculation carries him past this planet and he lands on Venus where he has many strange adventures—and of course a love affair—amid the Venusans and their weird animals and mile-high trees. Oddly enough, he does not marry the girl! The author supplies a clever background of language and customs of his imaginary inhabitants of Venus.—$2.00 postpaid.—*A. P. P.*

AUTOBIOGRAPHY OF A BIRD LOVER

By Frank M. Chapman

THOSE who are interested either in birds or conservation, and many others, will find fascinating reading in this life account of the world's leading bird lover, Frank M. Chapman of the American Museum of Natural History and editor of *Bird Lore*. It will take them far afield to countries where both birds and adventure abound. Primarily this autobiography is not about birds but about the rather romantic career of a remarkable man. Perhaps this is why the reviewer found himself reading for fun rather than duty, though he has no interest in birds, for the book carries the reader along with its current of ever-varied narrative. 384 pages, illustrated.—$3.90 postpaid.—*A. G. I.*

CAN WE LIMIT WAR?

By Hoffman Nickerson

MR. NICKERSON answers his own question. He believes war is inevitable but that it can be limited. Pacifists may disagree with him on the one point but all of us hope he's right on the second. Having read the impressive evidence on the impossibility of the perpetual peace of idealists as set forth in Stockton's "Inevitable War," we consider Mr. Nickerson's contribution to the study of this vital problem logical almost to a fault and extremely impressive. "Can We Limit War?" is, indeed, a provocative study of the intimate relation between war and our social order, by an author who has been proclaimed our greatest military historian. 300 pages.—$2.95 postpaid.—*F. D. M.*

THE TURNING WHEEL

By Arthur Pound

ALTHOUGH this book is obviously publicity material for General Motors, it is so well prepared and pre-

its own in the history of the automotive industry. Everyone who can remember the cars of three, two, or even one decade ago will find this book to be one that will make absorbing reading, and at the same time will be informative. The author devotes the first chapter to the evolution of the automotive vehicle. He then considers the formative period from 1879 to 1899. From this point on is built up the background of the great General Motors Corporation as it stands today. The influence of a vast organization such as this on the general welfare and progress of the country is not to be dismissed lightly. The author tells the whole story and tells it in smooth, flowing, narrative style that makes for easy reading. 517 pages including valuable appendices, bibliography, and a comprehensive index. Well printed and illustrated. Bound in stiff covers.—$3.70 postpaid.—*A. P. P.*

BEHIND THE DOCTOR

By Logan Clendening, M.D.

REVIEWING some books is a downright bore—or it would be if boresome books were really reviewed in these columns. The reason why the books reviewed here are so uniformly praised is that those which bore the reviewers are not "selected" (see heading at top of page). Dr. Clendening, the author of "Behind the Doctor," is no book bore—just the reverse, he is the most yawn-proof writer of accurate, authentic popularized science in America today. His first book, "The Human Body," published in 1932, brought him instant fame, for he took a dull subject and breathed life into it so that his book became a scientific best seller. Now he has taken another supposedly dull subject, the history of medicine, and performed a greater miracle than he did before. There has been plenty of real drama in the growth of medicine —the discovery of anesthesia, of insulin, of germs, X rays, septic surgery, vitamins—dozens of discoveries. What Dr. Clendening has done is to ransack original sources—he is a practicing physician himself, no hack writer, and knows his background at first hand—and select the most dramatic and revolutionary events, then make his book entirely of these. It is in narrative form and mainly in dialog. It is as much about people as about things. This book lives in every one of its 444 illustrated pages. The volume is nicely produced—nice binding, paper, type.—$3.90 postpaid.—*A. G. I.*

JANE'S FIGHTING SHIPS

Oscar Parkes, Editor

NAVAL history having been made during the past year, this latest edition of a famous book by a noted authority has much to offer in the way of details and descriptions of fighting fleets. Many photographs of newer ships —such as the new U.S.S. *Ranger*— which have not been seen elsewhere, appear in its pages. A fresh feature in this edition is the summary of naval forces of the British, U.S.A., and French navies. Over 450 new illustrations have been added and the text has been thoroughly revised to show the innumerable alterations to tonnage, horsepower, secondary armament and complement, uniforms, and flags.—$18.00 postpaid.—*F. D. M.*

THE SINGLE WOMAN, A Medical Study in Sex Education

By Robert Latou Dickinson, M.D., and Lura Beam

THIS is the second volume of a series of advanced studies which are being published by the National Committee on Maternal Health, the first volume, entitled "A Thousand Marriages, a Medical Study of Sex Adjustment," by the same authors, having been reviewed in these columns in January 1932. Of the latter book the great psychiatrist William A. White said:

"To those who are interested in human beings—real human beings—not fictitious, imaginary human beings that stalk across the pages of most of our books that deal with their peculiarities, this book is a rare contribution. It tells the story of the vital concerns of human lives and their effects upon health in a simple, straight-forward manner, free from prejudice, prudery, and hypocrisy."

"The Single Woman" is also that kind of book. It is a scientific, medical study of the sex life of the single woman, as revealed in 1078 case records. It deals with the single woman's physiology and anatomy, her psychology, environment and social life, her conflicts and refuges. No comparable study of the single woman has appeared hitherto, because the case material gathered by Dr. Dickinson in 50 years of practice as a specialist is unique. The book should be of value to parents with adolescent daughters, to teachers and social workers, sociologists, jurists, ministers, and to all the intelligent, socially minded persons who believe that sound sex education is the necessary basis for a normal adjustment to life. 460 text pages.—$5.20 postpaid. —*A. G. I.*

THE MODEL MAKER FOR THOSE INTERESTED IN MAKING WORKING MODELS

Edited by W. Edmunds Spon

MODEL making is much more in vogue in England than in the United States, so we welcome this bound volume of a monthly publication, in usable form, accompanied by an index. The advertisements are all of American concerns selling material for amateur model makers.—$2.40 postpaid.—*A. A. H.*

THE CHEMICAL FORMULARY, VOLUME I

Editor-in-chief H. Bennett

THIS is a volume of more than 550 pages and contains thousands of practical formulas for making products in all fields of industry. It will serve as a valuable companion volume to our "Scientific American Cyclopedia of Formulas." The new book differs from our own in the inclusion of special substances which are the creation of manufacturers of various special substances and chemicals. The use of these new materials gives an improved or altogether different product. The formulas that have been issued in folder form have given our readers satisfaction, particularly in the line of cosmetics, automobile polishes, et cetera. Among some of the unusual formulas are: antifogging solutions; airplane "dope"; carbon suspensions, chlorine treatment, chromium plating, crease-proofing fabrics, and hundreds of others. Another volume is promised next year.—$6.25 postpaid.—*A. A. H.*

THE FRESH-WATER ALGAE OF THE UNITED STATES

By Gilbert M. Smith, Prof. Botany, Stanford Univ.

A BOOK for the amateur microscopist who is interested in the fascinating study of those multitudinous living forms of sub-visible life known as pond life and who wishes a reference source for identifying the various algae of this country. It is a large book of over 600 pages, with 449 illustrations showing the commonest of these tiny organisms, regarding some of which it is difficult to say whether they are plants or animals (forms probably reminiscent of the early times in evolution when plants and animals had not yet clearly differentiated). Each form is described in detail. There are preliminary chapters on their distribution and occurrence, their collection and preservation, and on their nature, evolution, and classification. This is not an elementary book, but as a reference book it should be in the library of every amateur microscopist. —$6.25 postpaid.—*A. G. I.*

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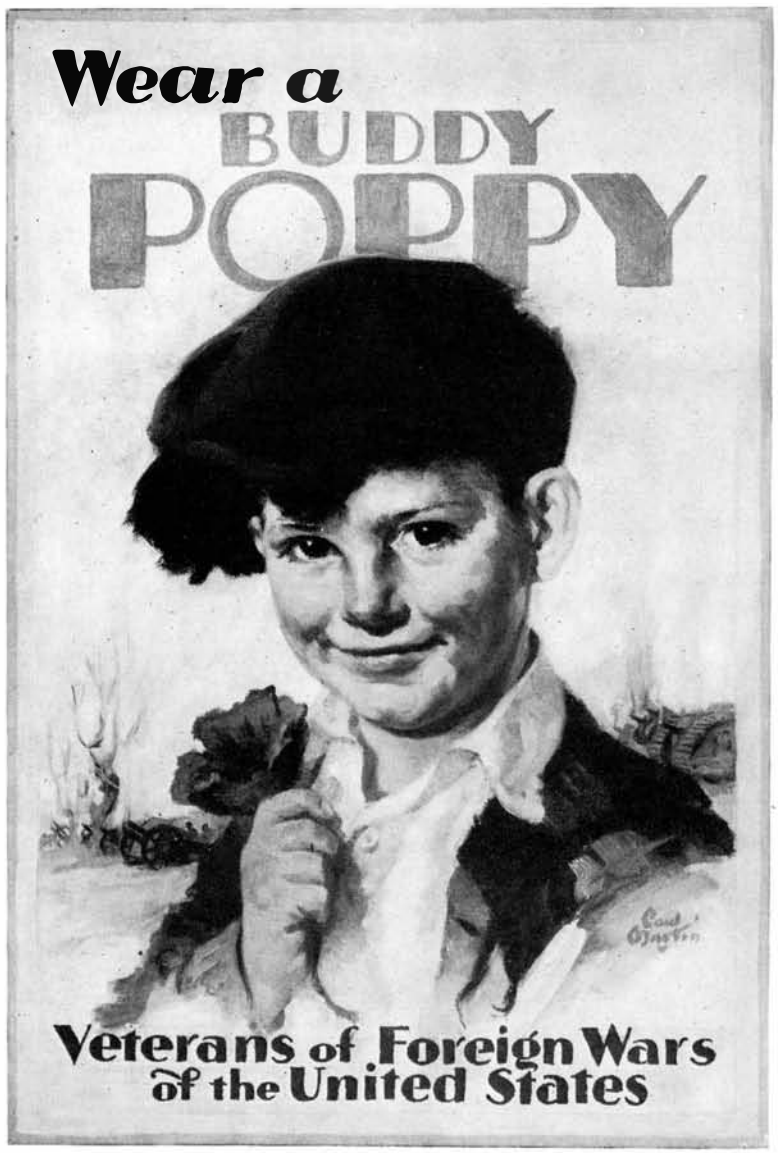
34 EAST 75TH STREET · NEW YORK . . . *Telephone:* RHinelander 4-0435

If a resident outside Greater New York write: AMERICAN SOCIETY FOR THE CONTROL OF CANCER · NEW YORK

Wear a Buddy Poppy

on

Memorial Day



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