SCIENTIFIC AMERICAN

March · 1936

Vol. 154
No. 3

35c a Copy

"THE ACTIVE REFERENCE USER"

MOST magazines are casually read and thrown away, but Scientific American is different: Copies of Scientific American are treasured and kept, referred to over and over again. In fact, every copy has an average readership of at least 10 individuals, for Scientific American is not only read but actually used by executives, research men, educators, and others. In one large organization, we were told by a junior executive that he does not see the current copy of any issue, until two months after publication—it passes through so many hands before it reaches his desk. In fact, that organization should be subscribing to at least 20 copies, but a policy of drastic economy makes one subscription suffice—with a loss to our Subscription Department, but a gain to our advertisers. They have the benefit of an advertising rate based on an A. B. C. circulation of 31,602, and get the value of a circulation of 300,000 at the 30,000 rate. Both reader and advertiser are assured of still greater value by our "Research Leaders Help Us Edit" program.

VARIOUS BIOGRAPHIES portray Dr. Matthew Luckiesh as a scientist and scholar, but close acquaintance reveals an astonishing versatility and interest. Combined with scientific attitude and achievement are other personalities—dreamer, philosopher, realist, humanitarian, nature-lover. In his fluent speech and writing, one or more of these personalities often enhances the cold facts and logic of the scientist.

This comparatively young man has written 20 books and hundreds of scientific and technical papers dealing with the vast complexity of light, color, lighting, vision, and seeing. The researches which he directs at Nela Park have developed a science of seeing which is revolutionizing viewpoint and attitude throughout many activities of a civilization built largely upon seeing, but with inadequate concepts and knowledge of seeing.

Purdue University graduated him in 1909. Then came an M.S. from State University of Iowa; a D.Sc. from Iowa State College; a D.E. from Purdue University; and his share of recognition in many other ways.

In one of his books he states, "Living is a product of time multiplied by intensity." Certainly this is the theme of his work as well as life. He believes that the method, attitude and spirit of modern science can and will eventually escape its narrow confines and pervade the thought and action of people.

31,602 A. B. C. = 300,000 A. R. U.

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EVERY significant scientific discovery or laboratory development is immediately recorded and evaluated. This editorial service is not for the specialist in a particular field, but for all research men in industry, for research students in school, college, or university, and for that select group of science-minded individuals who cherish accurate scientific knowledge for its own sake.

Measured in numbers, the readership of Scientific American is not large, and never will be large. Its editorial standard is too high either to appeal to or to be appreciated and understood by the mass mind, yet the Scientific American readership, in its influence and purchasing power, is an unexploited and unused market for many advertisers desiring to reach those who pioneer in Commerce, Industry, School, and Government.

Constantly used as a reference, every issue has a circulation at least ten times greater than the numerical count of 31,602, credited it by the Audit Bureau of Circulations, of which it is a member.

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SCIENTIFIC AMERICAN

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NINETY-SECOND YEAR • ORSON D. MUNN, Editor

The SCIENTIFIC AMERICAN DIGEST

CONTENTS · MARCH · 1936

COVER

IT may seem strange to see a white coated doctor using a hypodermic syringe on a sugar cane stalk. This, however, is exactly what J. P. Martin is doing in the photograph reproduced on our front cover. As told in the article on page 144 of this issue, scientists in Hawaii are striving to improve the resistance of sugar cane to certain diseases, and thus build up desirable qualities in the cane, which qualities may be perpetuated in future crops.

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50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of March, 1886)

STEEL SHIPS—"As wood, in the construction of ships, was gradually replaced by iron, so iron, in its turn, is giving way to steel. The latter phase of the evolution has been very rapid. It is only seven years ago that steel began to attract attention as a substitute for iron in ship building. Its free use had just then been made possible—on the score of economy—by the perfection of the Bessemer process."

PATENTS—"According to the recently submitted report of the Commissioner, covering the business of the Patent Office for the last calendar year, it appears that there were 24,233 patents and reissues granted in 1885, as against 20,413 in 1884, and 22,383 in 1883. . . . The total expenditures on account of the office were $1,024,378.85, and the receipts were $1,188,089.15, or a surplus for the year of $163,710.30."

LIGHTING—"Numerous attempts have been made to obtain a successful incandescent electric light by means of secondary storage batteries, charged from dynamos, but, owing to the small amount of electricity obtained in comparison with the power required, these batteries have so far, we believe, not been proved to be a commercial success."

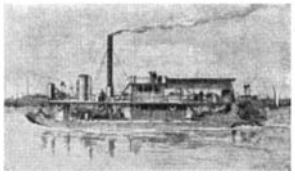
TYPEWRITERS—"Ten years ago, writing machines were little used, practically unknown to the great majority of writers, and were held by the few who knew something of them to be mechanical toys rather than the great time and labor savers they have since proved to be. Up to 1881, when the American Writing Machine Company, of Hartford, Conn., introduced the caligraph, double case writing machines were incomplete, being so constructed as to compel the operator to shift the carriage by a gratuitous stroke for capital letters and figures. The caligraph—of which we herewith present an engraving—prints each character in both (*sic*) capitals and small letters at a single finger stroke."

CARRIAGES—"Mr. Phelps, the new Minister to England, declared in a recent speech before one of the London guilds that 'America makes better carriages than England, and makes them cheaper.' The London correspondent of the Liverpool *Mercury* disputes this statement, and says that 'while America makes lighter and stronger conveyances than England, the landaus and broughams of New York are most of them built in England; and that, in spite of a heavy duty, carriages are bought in London and shipped to New York.' "

DATA—"Professor Huxley, in his presidential address before the Royal Society, said that 'of late years it has struck me with constantly increasing force, that those who have toiled for the advancement of science are in a fair way of being overwhelmed by the realization of their wishes. It has become impossible for any man to keep pace with the progress of the whole of any important branch of science.' "

ITALIAN RAILROADS—"The first line was built in that country in 1838, between Naples and Portici. In 1859 railways were opened in Parma and the Papal States. There are today approximately 15,000 kilometers of road built, under construction, or authorized, about two thirds of which are in operation. The engines are usually of English construction. Some of the more recent locomotives are from French, German, and Austrian establishments. Many of the gradients are very heavy, necessitating heavy engines."

STERN WHEELERS—"Stern wheelers have of late come very prominently before the public in consequence of the success which attended those built by Messrs. Yarrow & Co. for the Nile expedition. These boats were 100 ft. long by 18 ft. beam, drawing 18 in. water. One of them was put together above the second cataract near Wady Halfa, and was ultimately named the *Lotus*. This design of steamer having proved so great a success, Lord Wolseley desired the Government to immediately contract with Messrs. Yarrow & Co. for eight more, which were forthwith proceeded with, and one of these forms the subject of our illustration, which has been engraved from a photograph taken in Egypt."



TELEPHONES—"The growth of the telephone is one of the most remarkable in the history of inventions. In August, 1877, the instruments in use in this country was only 780, while in February 1885, there were 325,574. There are about 18,000 in Canada, and 13,000 in Great Britain. The number of exchanges has grown from 100 in 1880 to 782 in 1885. In January last there were 137,223 miles of telephone wire in this country. There are 5,186 persons furnished with employment by the exchanges. More different patents have been issued on the telephone than in any other single line of invention in this country. The total number for the ten years is 1,521."

FABRY'S COMET—"The students of Johns Hopkins University have been studying the path of the approaching comet, discovered by Fabry, and find that the celestial wanderer will reach its greatest brilliancy on May 2. At that time it will probably be a very conspicuous object in the western sky for some hours after sunset."

MERSEY TUNNEL—"Liverpool and Birkenhead occupy a somewhat similar position in respect to each other as New York and Brooklyn. On the 17th of January, 1884, little more than four years after the tunnel undertaking had been regularly taken in hand, the workmen on the Birkenhead side shook hands with those from Liverpool. So accurate had been the calculations of the engineers that the centers of the borings were less than an inch apart. The tunnel is now in full working order, and trains run freely through it."

TEMPERATURE—"The lowest recorded temperature, 393° below zero F., has been produced by Olszewski, by vaporizing liquid nitrogen under low pressure."

AND NOW FOR THE FUTURE

¶Possibilities of Commercial Transatlantic Air Service, by Reginald M. Cleveland.

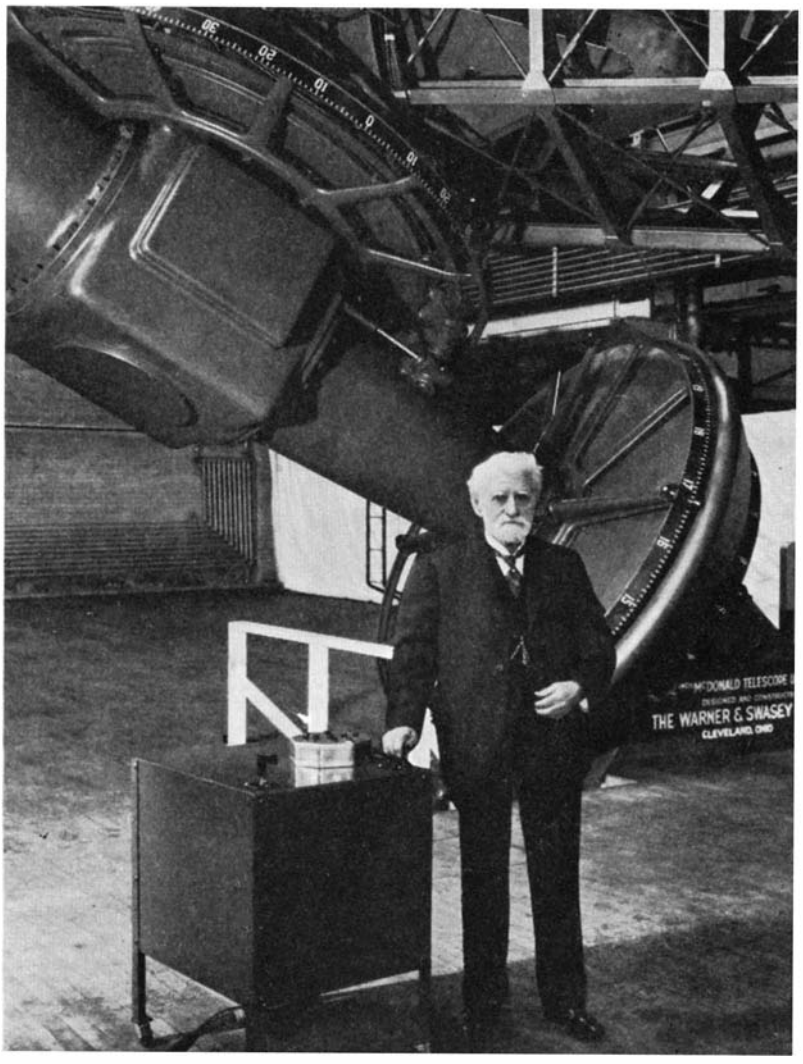
¶Salvaging Scraps—An Important Industry, by Philip H. Smith.

¶The Cabinet Maker's Art Applied to Bone Surgery, by Dr. Fred H. Albee.

¶Testing Uncle Sam's Metal Mules.

¶Trisecting the Angle—Why it is Impossible, by Churchill Eisenhart.

Personalities in Industry



AMBROSE SWASEY

AMBROSE SWASEY, the "Grand Old Man" of the mechanical engineering world, has just passed his eighty-ninth birthday and is still a captain of industry. He is the surviving member of the firm of Warner and Swasey, of Cleveland, manufacturers of two kinds of things that may seem widely different until it is realized that each is a precise, carefully made mechanism—machine tools (notably turret lathes) and astronomical instruments (notably large telescopes).

He has received many outstanding honors both from engineering and pure science: from the former, the famous John Fritz Medal and the presidency of the American Society of Mechanical Engineers; from the latter, prized memberships in the National Academy of Sciences and the American Philosophical Society, also honorary degrees from several universities.

In the photograph at the right, Mr. Swasey is shown standing in front of the massive polar axis member of the 82-inch telescope which has just been completed by his firm for the new McDonald Observatory in western Texas, which is to be run co-operatively by the Universities of Texas and Chicago and Yerkes Observatory. (Further details on pages 136 and 137.)

Ambrose Swasey was born and grew up in New Hampshire. He had little formal schooling and was a product of the "little red schoolhouse." He learned the machinist's trade and as he worked he met another machinist named Worcester Warner, a farmer's son. Warner had studied astronomy at home. These two formed a partnership and soon were foremen in the shops of Pratt and Whitney, at Hartford. Swasey quickly gained a reputation for accurate workmanship. The partners were saving their earnings, studying, and in ten years they were ready to start their own industry. It all reads like a story, or better—from plow boy to millionaire manufacturer.

They established an industry in Cleveland. Their first job was a turret lathe—then came twelve. They soon won a reputation for high-grade work. When James Lick gave 700,000 dollars for a 36-inch telescope the mounting job came to Warner and Swasey, because a telescope is both a big machine and a precise machine, and not every machinist could do that kind of work. Moreover, each was an amateur astronomer and understood at first hand the requirements of telescope users.

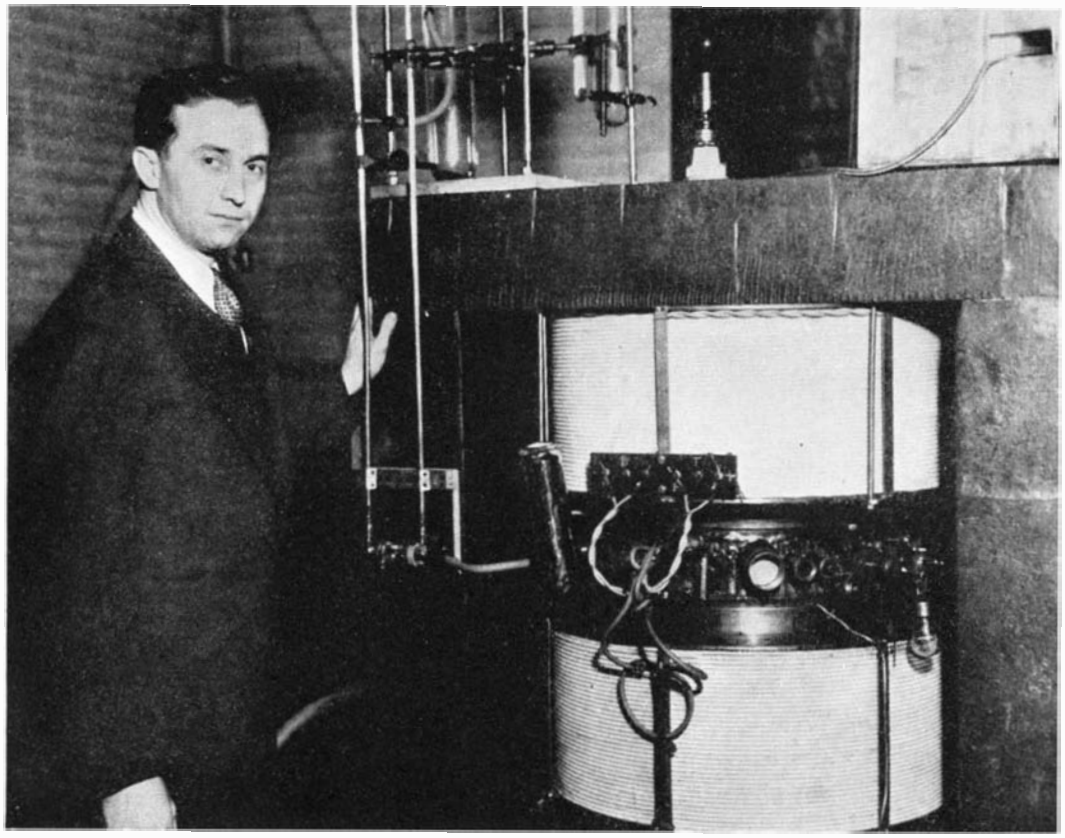
Later Mr. Swasey designed and then built a dividing engine capable of dividing circles for physical apparatus within a tolerance of a single second of arc —less than one millionth part of the circle. He and his old friend and partner built rugged mountings for other big telescopes: the 40-inch refractor at Yerkes, the 60-inch reflector in Argentina, the 72-inch reflector for Canada, and the 60-inch reflector for Ohio Wesleyan.

While they were acting as professional telescope builders they were also amateur astronomers. Making machine tools was their main vocation—making telescopes their avocation.

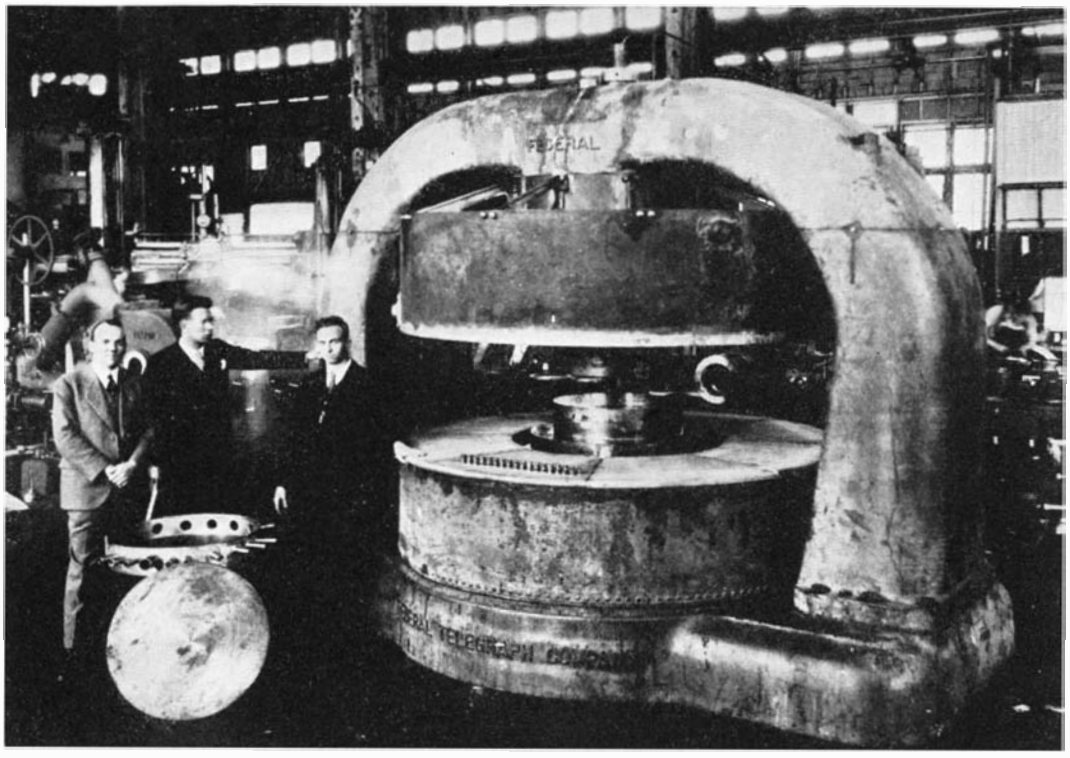
In 1914 Mr. Swasey conceived and founded the Engineering Foundation, for research in engineering, and endowed it permanently.

Mr. Swasey at 89 is strong and keen. When he was 80 he said, "I don't think the world is going to the dogs, as so many reformers would have us think. Young men and women of today are every bit as capable as their brothers and sisters of yesterday."

Calvin W. Rice, one of the founders of the General Electric Company, said of Mr. Swasey: "Whether it was a machine tool, the mounting of an optical instrument, a telescope, a range finder—all instruments of the greatest precision—everything he touched has reflected the perfection of human skill that is so typical of him. We have in him an example of the highest attainments in technical work, combined with an extraordinary capacity for co-operation." These two elements are not frequently combined in one man.



Dr. M. Stanley Livingston, physicist, and the 2,000,000 volt cyclotron (atom smasher) at Cornell University. This is the largest cyclotron now in operation east of the Rockies. It is being used for research both in physics and medicine (cancer); also in genetics, in the hope of producing gene mutations when neutrons are shot through the heredity cells



At Annapolis an old-fashioned electro-magnet of the kind long ago used in quenched arc wireless transmitters, which had been put away in moth balls, was found by physicists. Taken out, dusted off and shipped to Columbia University, it will be converted into a cyclotron like the one built by Prof. E. O. Lawrence (center) at the University of California

NEWEST MECHANISMS FOR SMASHING ATOMS

AFTER the young Prof. Ernest O. Lawrence invented the cyclotron type of atomic particle accelerator described in our January number by Prof. E. U. Condon, other physicists hastened to follow suit. To speed up the particles they are introduced into the strong magnetic field, which curves their path. Timed impulses delivered twice each revolution around the center speed them up by increments—like a dog running around a tree and being dug from behind twice in each revolution by a cat.

Rats taking an interest in a chemical having a vitamin content—"babies cry for it"

VITAMINS TODAY

Thus Far We Have Vitamins A,B,C,D,E,F,G,H,K, and Sometimes We Think There are More... Some May be Imaginary... But Forget Vitamin Worries

By T. SWANN HARDING

A NUMBER of years ago a traveler, just returned from Central Africa, told how he had made a fast friend of an ape there by feeding the animal hard-boiled eggs. It puzzled him, however, to see that the ape not only removed the shell from the egg, an article of food with which he was almost certainly unacquainted, but threw away the white as well and ate only the yolk. The puzzle was solved only when the traveler returned to the civilized world, for then he discovered that vitamins existed. They had been found during his absence. Furthermore the yolk of the egg contained whatever vitamins there were in eggs. Apparently the ape knew intuitively what it took nutrition scientists many years of painful study to find out!

Perhaps this story is somewhat exaggerated. It is certain, however, that laboratory rats will deliberately choose to eat little dry pellets which contain the vitamins necessary to them, if similar tablets containing no vitamins are also accessible. But this is not attributed either to instinct or to intuitive knowledge. It is assumed that when the animals feel poorly they seek to round out their diet by eating those things which make them feel better.

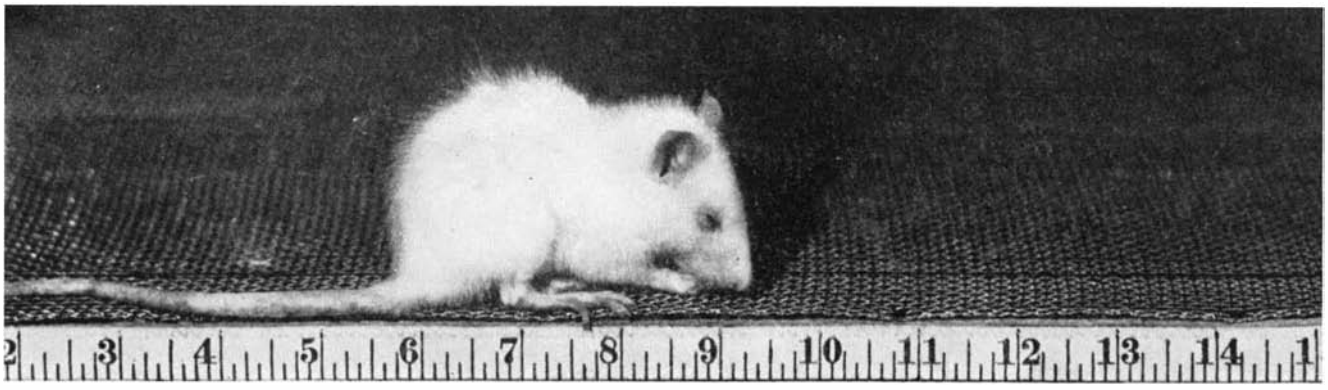
These days, when the necessity for absorbing our vitamins is continually preached at us, many skeptics are naturally inclined to ask: What on earth did our ancestors do when there were no vitamins? Did the world have to wait for modern nutrition scientists to tell it what to eat?

EXPERIENCE seemed to teach both animals and primitive human beings how to get a fairly well-rounded diet in their own natural environment. Not only did the American Indians faithfully eat stews of hackberries and other foods of high calcium content, but they, like other meat-eating savages, were said always to consume the internal organs of animals slain, and there vitamins are concentrated.

Just as the diseases scurvy and rickets early turned attention to vitamins C and D, so beriberi aroused the suspicion that it was caused by dietary deficiency. Between 1897 and 1906 Eijkman was showing that a diet of polished rice produces a disease in fowls that closely resembles human beriberi. This disease he held due to lack of an unknown substance necessary to normal health and growth, a dietary supplement that existed in rice polishings, the outer layers and embryo of rice kernels.

In short, work in many laboratories, especially in Great Britain and the United States, began to show that fats, proteins, carbohydrates, water, and a few mineral salts would not make a complete diet. A mysterious something else was needed. Later it became clear that quite a group of mysterious something elses had to be eaten by animals if they were to grow normally and maintain good health. These mysteries came to be called "vitamins."

Until just a few years ago the vitamins remained elusive. No one knew what they were. Many doubted their existence altogether. Others imagined they were living entities, perhaps crawling about like tiny bugs or worms, or existing as micro-organisms. Today at least



This rat was purposely deprived of vitamin A. His fur is rough, he is underweight, and his eyes have ulcerated

four of the vitamins are available in crystalline form and their chemical composition is known. Only recently crystals of a fifth were displayed.

Since the chemical composition of the vitamins remained unknown long after nutrition scientists were reasonably sure they existed, they began to letter instead of name them. They had different effects and must somehow be classified. Lettering them A, B, C, and so on, offered the best way out, as it committed the relatively ignorant scientists least in those earlier days of vitamin work.

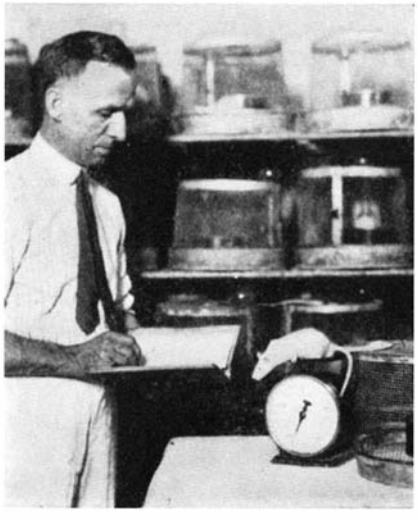
Between 1906 and 1913 it began to be very apparent that rats would neither grow properly nor maintain health if fed what was regarded as a complete, though a purified and synthetic diet. Something else was needed. That something else could be extracted from egg yolk. It also occurred in cod-liver oil. When this so-called "growth-promoting" substance was added to their diet the rats became vigorous and healthy.

HERE was the first vitamin to get a letter. It became A, and today it has enough colleagues to make a football team, and there may even be two or three substitutes—provided they all exist, though maybe some of them do not! For vitamins have strange habits. They tend to appear and then disappear. One vitamin tends to split into several fractions, each setting up on its own, and then some of these fractions may later prove to be more or less chimerical.

The approved functions of the vitamins also change. It is no longer proper to speak of vitamin A as "growth-promoting," for poor growth will occur in the absence of almost any of the vitamins. Nor has the word "growth" been defined clearly. It is quite possible for an animal to grow, by increase in length, even while it loses weight. This is just what a child does when seriously ill.

But vitamin A also helps to keep our mucous membranes in good shape and to aid animals in the reproduction of their kind. However, it would be safer to say that this is true of rats. Human beings do, however, suffer from an inflammation of the eyes, called ophthalmia, when too long on a vitamin-A-deficient diet. Vitamin A also appears to occur in the eyeballs, its absence there producing a type of night blindness.

Rats, deprived of vitamin A, easily become infected because their mucous membranes are injured; also they can not reproduce. But there is not sufficient information to justify any reference to vitamin A as the "anti-infective," in so far as human beings are concerned.



A laboratory rat being weighed in. Each animal's weight is recorded

The best work published to date indicates that feeding up on vitamin A does not reduce the number of colds or respiratory infections the individual has. Not even the addition of both vitamins A and D to a generally deficient diet will improve the growth of children or their resistance to infection. This need not be taken as final. The question is not entirely settled. More work should be done, but what we know so far points in the direction indicated.

What is vitamin A? It appears that whenever the composition of a vitamin is determined it turns out to be some complex organic chemical compound or other. There are at least four such substances capable of producing the effects attributed to vitamin A. These are alpha, beta, and gamma carotene (the yellow substance in carrots), and cryptoxanthin. Weight for weight, beta is the strongest of the carotenes in vitamin A effects—the ones which are cited above.

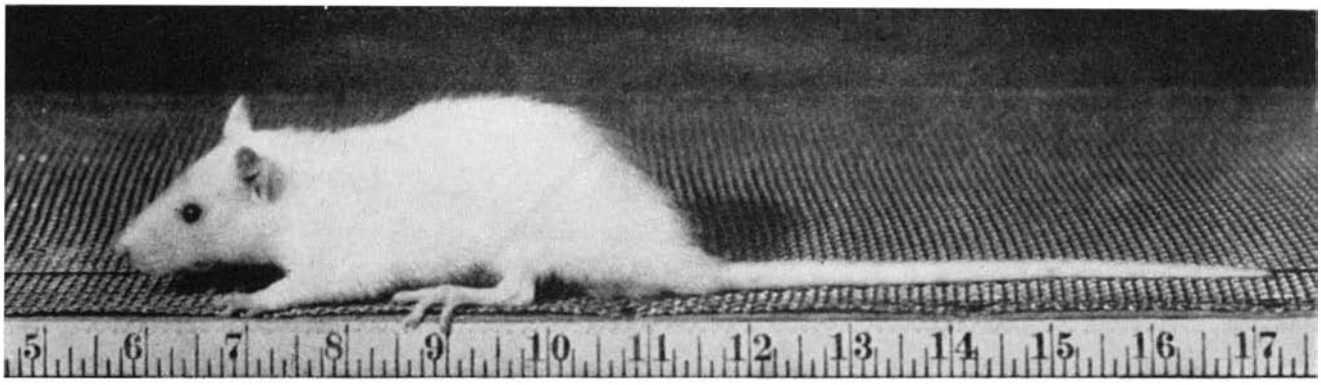
Are these chemicals, any one of them, vitamin A? Strictly speaking, the answer is no. But any of the four will undergo changes in the animal body and become vitamin A, which is said to have the chemical formula $C_{20}H_{30}O$—that is, 20 atoms of carbon, 30 of hydrogen, and just one of oxygen. The true vitamin A itself occurs in cod-liver and halibut-liver oil, as well as in other fish oils. It has been prepared in a state of high purity.

Preparations of vitamin A look like a thick, yellowish oil. The vitamin can be taken directly, although the administration of any of the four chemical compounds mentioned above will produce the same effect. The unit of vitamin A is 0.6 microgram of beta carotene, and a microgram, being a millionth part of a gram, which is itself a thirtieth part of an ounce, is an exceedingly small unit of weight.

WHEN we come to vitamin B we find a welter of confusion. For one thing, Europeans call it B_1. For another, it has been split five or six ways since Eijkman said it prevented beriberi. Soon after that it was found to be a complex and B_2, later P-P, later G, appeared, which prevented the disease of pellagra. Some even claim that there are as many as nine different independent fractions today of the old vitamin B.

The main fraction, still called vitamin B in America, still prevents beriberi, but it is also necessary to maintain an animal's growth. Such formulas as the following have been proposed for it: $C_{12}H_{17}N_3OS$, or $C_{12}H_{17}O_2N_4S$, so it contains nitrogen and sulfur, in addition to carbon, hydrogen, and oxygen. It is made by extracting rice polishings with water and absorbing the vitamin itself on fuller's earth, and is now available in pure form.

All the fractions of the old vitamin B are soluble in water and occur in yeast, hence some lump them as the Y vitamins. Some of the fractions are more easily destroyed by heat than others, which aids in telling them apart. The lack of one fraction causes a peculiar type of paralysis in young chickens.



Unlike the rat shown opposite (his own brother) this rat received a normal diet, hence enough vitamin A

Lack of another fraction injures the health of pigeons, and so on. Until much further investigation has been carried on no accurate exposition of vitamin B complex can be given.

Vitamin C is now available at a fairly low price, in the form of a white crystalline powder that looks like powdered sugar. It turns out to be an acid known to the more esoteric chemists as l-ascorbic and having the formula $C_6H_8O_6$. The acid is altogether new and the name is designed to abbreviate the word "antiscorbutic," or scurvy-preventive.

VITAMIN C, as is perhaps too well known, occurs in the citrus fruits and in tomatoes. The vitamin is quite stable when kept at the normal acidity of lemon juice. It is also known to prevent certain changes in the gums which tend to appear in scurvy, and to help keep the dentine of the teeth in good condition. The unit of vitamin C is 0.05 milligram (not microgram, as before) of l-ascorbic acid—the milligram being a thousandth part, instead of a millionth part, of the thirtieth of an ounce.

Among the symptoms caused by lack of vitamin C are the bleeding gums and membranes characteristic of scurvy, as well as decrease in weight and failure to grow properly—associated, for that matter, with every vitamin lack. The disease diphtheria also causes bleeding from certain membranes, and a curious recent finding indicates that dosages of vitamin C fortify animals against diphtheria toxins.

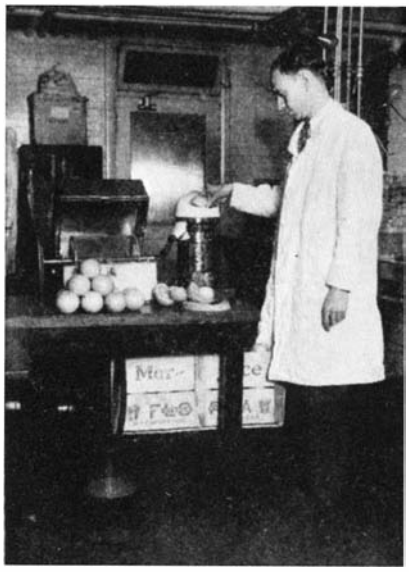
Guinea-pigs deprived of vitamin C readily contract diphtheria. But guinea-pigs which have a minimum supply of this vitamin, even though it is just sufficient to prevent the development of scurvy and no more, are very resistant to the disease. In other words, vitamin C also seems to have an anti-infective function. It aids in building up immunity.

Vitamin D, which occurs in the oils of the cod, halibut, salmon, sardine, and other fish, is definitely known to prevent rickets. This fact was found out and forgotten several times before we decided to admit it permanently. Possibly vitamin D has other functions, but that is in dispute. To date, nothing can be claimed for it scientifically, other than it is an antirachitic agent.

The chemical formula of vitamin D is known and it is produced artificially by exposing the white crystals of ergosterol to ultra-violet rays of a mercury lamp or in sunshine. The artificially produced vitamin is called "calciferol" and the unit is the biological effect of 0.025 microgram of that substance. It is more stable than vitamin A, though not entirely stable.

The lack of vitamin D first produces certain changes in the structure of the teeth, just as vitamin-C lack does, these changes heralding rickets in one case and scurvy in the other. But the addition of vitamin D to an otherwise deficient diet will not by itself produce sound teeth and normal growth. The diet has to be rounded out as a whole. Vitamin D also occurs in egg yolk, so the African ape was right!

There has been some alarm recently about the poisonous nature of cod-liver oil, or the possibility of dangerous overdosage with vitamin D. So far there is comparatively little scientific justification for such alarm. Such massive doses of vitamin D would have to be taken to cause poisoning that there is little danger. Experts estimate that it may take at least 1000 times the normal dose to cause trouble.



H. H. Mottern, food chemist, of the U. S. Department of Agriculture

The formula of vitamin D, or calciferol, is $C_{28}H_{43}OH$. For a time it was held that vitamin D of cod-liver oil had a different effect on infants from that produced artificially from ergosterol, but recent work indicates that this was a mistake. However, while vitamin D prepared from the oils of the halibut, cod, and tuna also acts quite the same when tested on rats, the tuna-oil vitamin D is not so effective as the others in promoting proper bone formation in chickens.

Leaving vitamin D with the hope that it will not break up into too many pieces, we proceed to vitamin E, the so-called sex or antisterility vitamin. Dr. Herbert M. Evans found that when rats were fed a diet complete in all known nutritive and vitamin factors, they failed properly to reproduce. The sex glands of the male rats permanently degenerated. The female rats became pregnant but could not produce their young because the embryos reabsorbed and disappeared. However, it is to be remembered that lack of vitamins A or B can also cause difficulty in reproduction.

SO many and such diverse claims have been made for this vitamin that many scientists wonder whether it even exists. Some declare that it cures sterility, others that it promotes reproduction, rejuvenates the sex organs, determines the sex of offspring, remedies anemia, or even that it prevents cancer. The only scientific claims that can be made for it are very limited. It is said to occur abundantly in wheat-germ oil. In the fall of 1935 its discoverer, Dr. Evans, displayed it in the form of a white, crystalline powder looking like sugar or salt, yet there are other nutrition workers who dispute its very existence. Not even Dr. Evans, however—or least of all he—claims that vitamin E is the sex-potency factor for human beings.

The subject of vitamin E needs complete re-investigation. It is probable that this may be undertaken in the near future. Meanwhile there is little or no

IN the accompanying article Mr. Harding urges that "the ordinary well-balanced diet supplies all the vitamins that human beings usually need," a statement which is concurred in by the Editor. In a way, it is regretful that the findings of science are so readily available to those who may have applied them too enthusiastically in one direction—to bolster "scientific" food fads. Few if any of the scientists who have done the most important research on foods—research which is highly valuable to *medicine*—are in sympathy with the tendency to overemphasize consciousness of their vitamin content. The verses quoted below—their authorship regretfully unknown—reflect the feeling of the staff of this magazine with regard to food fads.
—*The Editor.*

Methusaleh ate what he found on his plate,
And never, as people do now,
Did he note the amount of the calorie count—
He ate it because it was chow.

He wasn't disturbed, as at dinner he sat,
Destroying a roast or a pie,
To think it was lacking in granular fat
Or a couple of vitamins shy.

He cheerfully chewed every species of food,
Untroubled by worries or fears
Lest his health might be hurt by some fancy dessert—
And he lived over nine hundred years!

danger that human beings ever lack this vitamin sufficiently to cause what has merrily been called "alimentary castration."

Turning to vitamin F we approach a now-you-see-it, now-you-don't phenomenon. The letter was once used to designate an unknown that seemed necessary to make animals grow when all the other vitamins were present and it alone was missing. Later investigation appeared to prove that this unknown was a fatty acid called linoleic, but the use of the letter F to designate the substance was discontinued.

VITAMIN G, as we found above, is that part of the old vitamin B that prevents pellagra. Europeans tend to call it B_2. It occurs in yeast and in 1932 was reported to have been split into an X and a Y factor. These were said to differ slightly in their effects upon rat growth. Sometimes the vitamin is called more simply P-P or pellagra-preventive. Today it is claimed that other substances besides vitamin G are needed to prevent pellagra, but we need not go into that.

The letter H is still claimed by the discoverer of vitamin H which, it is said, must be fed to trout to make them grow properly. Human beings need not be concerned about it. Neither need they worry about the letters I and J, which have not yet been used to designate vitamins. For some reason the latest vitamin discoverers to report jumped to the letter K.

This vitamin K is said by certain Danish workers to prevent a variety of internal bleeding from which chickens suffer if deprived of it. Vitamin K occurs, it is said, in hemp seed, kale, tomatoes, and hog liver. In some of its properties it also resembles vitamin E. No claims can yet be made as to its effect, if there is any, on human beings.

Finally, there is the vitamin-like substance which is said to play such an important rôle in liver functioning that its absence can cause a form of diabetes. It is called choline and has not been given a letter. It occurs in yeast, egg yolk, and meat, and its lack causes a fatty degeneration of the liver. It also needs further study.

The very common question—"Well, so what?"—inevitably arises at just this point. As usual, it is somewhat difficult to answer. First of all, vitamins were scientific concepts. They were so elusive that many thought them imaginary. One by one, unknown somethings were discovered which appeared to promote growth, to prevent beriberi, scurvy, rickets, or pellagra, or to make reproduction possible. Simplicity gave way to complexity.

In time the original vitamin A had split into five fractions; there were perhaps as many as nine fractions of the old B, at least four of the old D, and possibly two of vitamin G. Sometimes several entirely different chemical substances would produce the effects attributed to a single vitamin; as, for example, the four chemicals that produce vitamin-A effects. Then the vitamins began to be purified; they appeared in crystalline form, and their chemical composition was in some cases determined.

Here true science begins, for we can take these definitely known chemical compounds and test their physiological effects on animals and on men. Until such carefully controlled research has been carried much further than it has today we should go slowly in dosing ourselves with vitamins, which are really more nearly drugs than foods. They compare rather with hormone substances than with ordinary foods, very minute quantities producing powerful results.

It is true that the development of ophthalmia, a certain eye disease, means lack of vitamin A; the development of beriberi indicates that vitamin B is lacking, of scurvy that C is lacking, of rickets that D is lacking, and of pellagra perhaps that G is lacking. In these cases a specific vitamin need is indicated and the appropriate vitamin should be given as a remedy or medicine.

In general, however, a well-rounded diet and exposure to sunshine are more important than vitamin concentrates in promoting health. This means that there must be sufficient meat, eggs, milk, fruits, and green vegetables on the menu. If the ordinary food elements, including minerals, are not abundant in the diet, no amount of dosing with specific vitamin concentrates can be expected alone to atone for this deficiency.

THERE is a great tendency today to add vitamins to foods. The impregnation of many foods with vitamin D is an example. Such addition at once makes the food over into a drug. But the wisdom of this is doubtful, for the ordinary well-balanced diet supplies all the vitamins that human beings usually need. Vitamin D may be prescribed, of course, if rickets appears, but other than that we should go slowly.

Most of the vitamin work has been done on animals; carefully controlled work on human beings remains to be carried out. We as yet know too little of the vitamin D requirements of older children and adults, of the extent to which the body stores the vitamin, or the amount ordinarily provided by sunshine. Scientists know much less than the average layman evidently imagines about vitamin D. Pregnant and lactating women and young children need it in abundance, but it is plentiful in many fish and relatively so in eggs—foods which most of us eat in an ordinary everyday diet.

The American Medical Association not long ago denounced the crude and unscientific character of vitamin therapy. It said there was no more reason for people to take varied dosages of several vitamin concentrates incorporated in food or drug products than for them to dose up on any other individual, unrelated dietetic components. There is no more reason for a vitamin debauch than for a phosphorus or a sugar debauch. Nor is there any evidence to show that the vitamins increase one another's beneficial effects, while there is some to indicate the reverse.

In brief the best answer that can be given to the question, "Well, so what?", is probably: "So try to eat a varied and well-rounded diet and expose yourself to sunshine now and then, and forget your vitamin worries."

OUR POINT OF VIEW

The Living Wilderness

THANKS to the unremitting efforts of a determined band of conservationists and nature lovers who fought tooth and nail for many years, we have today the great National Forests, preserved for all time against serious encroachment by selfish interests. There remain about four-fifths of the nation's wilderness areas in state and private hands, and here protection is more difficult; probably it is only a matter of time before much of the latter area will have disappeared under the manifold pressures of civilization and its various interests.

A new movement is now afoot and likely to gain velocity, whose aim is to save in wholly pristine form, before it is too late, some real samples of America's primeval wilderness—to save these samples not merely uncontaminated by hot dog stands, dance halls, and similar spoor of humanity in the large, but free even from motor highways, truck trails, rest houses and, in short, everything except what man found on this continent when he first came to it. Such areas would be wilderness in fact, and the "Wilderness Society," with its headquarters at Washington, is the new organization which is attempting to arouse public interest in the preservation of samples of Nature in our land.

No motor roads. No graded trails. No "official" rest houses or camps. No forester's trails and no foresters. No caretakers. Nothing but the wilderness.

Hard to get at? Yes, purposely hard to get at; forcing a man who wishes to enjoy a quiet fortnight or two in the wilderness to put a pack basket on his back and make his way into the preserve under his own power.

Self-defeating because unavailable to everybody who owns a car? Exactly. There are now plenty of places where car owners may enjoy nature without the effort of going on Shanks' mare to see them. Just the consciousness that, over the hill, a motor trail penetrates the wilderness spoils such a place for the true wilderness lover; it no longer remains a wilderness.

No doubt this conception, fostered largely by Robert Sterling Yard, secretary of the "Wilderness Society," will cause many a dyed-in-the-wool "developer" to knit his brows. Not to change or "improve" anything in the wild, wild woods? Not to add a network of motor roads; or anyway, if denied that, at least to whitewash a few rows of stones? Your developer will hardly grasp it.

Others, who sense the feeling of freedom afforded by the full breathing space of half a hundred miles of nothing but the unspoiled wild in every direction—room in which to breathe and let the soul expand—will understand it without further explanation.

Here and there, disorganized but hoping, there are probably millions who would like to know that there remained a few unspoiled pieces of the wilderness in the midst of our civilization, which no civilized instrument could penetrate or despoil or contaminate, even if they never hoped to set foot in it themselves. Now comes a chance for these people to get together and make their influence felt in favor of "the living wilderness."

"Water, Water, Everywhere . . ."

GOLD from sea water; a thought to conjure with, an aim of scientists and pseudo-scientists for decades, a bubble for wily stock promoters, and a snare for investors! There is gold in sea water to the value of untold billions of dollars, and the problem of capturing some of it in commercial quantities—possible, doubtless, at some future date—has so intrigued the imagination of the world that the recovery of a more vital substance from sea water has had but scant attention except in special quarters. This is water—plain, life-giving, fresh water!

To the average person, the salt of the oceans is the familiar salt of the dinner table. To the chemist, however, it is a combination of a vast number of salts of many elements. To remove these and leave potable, or at least industrially usable, water, is the great problem. Arid regions near coasts might be made to bloom were this problem solved so that fresh water could be obtained cheaply from sea water. Steamships, using vast quantities of fresh water for their boilers, and now depending on an extremely expensive distillation process, would benefit; steam plants ashore near the sea, also using billions of gallons of water for boilers, might be divorced from city water supplies, thus solving the problem of adequate water for human consumption; there might even be a possibility of solving for all time the drinking water problems of such cities as New York which, already, is taking water from hundreds of miles away.

A dream? Not at all. Some progress has already been made, according to *Science Service* which reports success of a new process developed in the British government's experimental laboratories at Teddington. So far, little actual information on this achievement is available, though it is said that the processed water is fit to drink but not particularly palatable. It is said to be, however, suitable for use in steam boilers and for other industrial purposes.

In this, the aim of science should be to get fresh water comparable with that of a city's present mountain stream supply. In our opinion, the successful achievement of that end would benefit many millions of people. The problem, therefore, ought to be a major one for science.

Television's Status

THE progress of television in the past few years has been most unsatisfactory, from the standpoint of the general public. Developments are announced in the press, predictions are made, and then a great wall of silence grows up. Probably the most encouraging news of the past year was the announcement by RCA that they would spend a million dollars in developing transmitting and receiving equipment and making field tests that presumably should point the way to commercial operation. But again the wall of silence. True enough, the RCA announcement stated that the work would take from 12 to 15 months before any results could be hoped for, and the only thing to do is to wait.

Now comes another ray of hope. Television has been under the sympathetic eye of the Federal Communications Commission, and in a recent report to Congress the Commission stated that television is practically ready for public use. But—and this is a big "but"—the Commission went on to state that the various experimenting companies have been working on so many different types of transmission systems that to receive even the experimental transmissions requires a different receiver for each.

What is the answer? The Commission states: "In order to give television service, it is necessary for the different manufacturing companies to standardize their transmissions and produce receivers that can receive all programs transmitted."

Perhaps there is a link between RCA's announcement and the statement by the Commission. Perhaps the work of the RCA may point the way to that desired standardization. Certainly, it is a step in the right direction.

DEATH ON FOUR WHEELS

Element of Chance Must be Minimized . . State Accident Survey Shows the Way . . . Cultivate the Proper Attitude Toward Other Drivers

By JOHN HENSHAW CRIDER

A RED light flickered on the panel of the troopers' switchboard; a buzzing sound impatiently demanded attention.

"There's a car turned over and rammed against a tree. You'd better hurry!" cried the voice on the wire.

"We'll be there in a minute." The desk sergeant called the trooper on reserve.

"Another bad one down on the West Hill curve. Get going!"

The trooper found what was left of a roadster jammed like an accordion against the stalwart trunk of an oak tree. The car had turned over in mid-air, landing with full weight, plus momentum, against the immovable impediment.

"We can't get 'er out. Wedged in too tight," said a bystander.

IT took an hour to get her out—what remained of her. She was an 18-year-old girl on her way to college. Her car was an expensive make—advertised as capable of 100 miles per hour, with flawless brakes, and strong steel body. But there was no guarantee against taking chances on the road!

As far as the trooper could learn from witnesses, the girl had tried to pass a car approaching a curve. As she got out on the left of the two-lane highway another car appeared in her path, speeding around the bend. She did the one thing that minimized the consequences of that accident. She turned off the road to the left, killing herself. If she had kept straight ahead there would have been a certain head-on collision, possibly involving the car which she had passed. If she had tried to cut over to the right she would surely have involved the passed car and probably the oncoming one too. Her's was a generous gesture, but it cost her life.

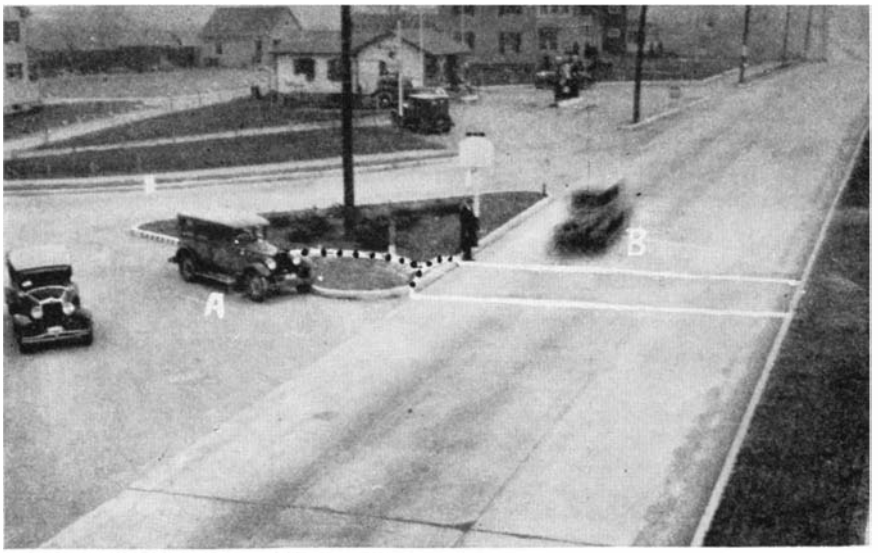
There were about 36,000 deaths in the United States last year attributed to the motor car. More than 50 of these came to the personal attention of the author, and it was his experience in talking with relatives of the deceased that *chance* was the factor usually blamed. They could hold nothing against the members of their families who had been killed. They really seemed to believe "it was just *chance*."

THE editors make no apologies for the expressions of personal opinion by the writer of the accompanying article. These statements coincide with the opinions of the editorial staff on the subject of motor-car safety, and should be read and taken to heart by everyone. In a letter to the editor, Mr. Crider wrote: "I am intensely interested in this great problem of making the highways safer. I have seen too many bloody bodies dragged from crushed cars." If only more car drivers could say the same. . . .

As long as chance is permitted to have a leading place in the list of accident causes, this country is not going to be relieved of its present appalling auto death toll. If we are to minimize the element of chance, we must study automobiles and the habits of those who drive them. Whenever humanity has been faced with a serious hazard, studies have been made to conquer or reduce the danger. It was so with yellow fever, diabetes, diphtheria, and railroad accidents. Eventually, when the public has been sufficiently impressed with some prevalent danger, the big guns of science have been trained on it. So it must be with the auto death plague.

An excellent first step in the right direction has been made by the Commonwealth of Massachusetts with the cooperation of the Federal Government and the Massachusetts Institute of Technology. For months the modern facilities of the Massachusetts Institute of Technology were directed to the problem of explaining why there were so many accidents, why so many killed. How did these drivers operate who did so much damage? What did they think of suggested methods for lessening the toll? How much of the blame could be placed on motor-car construction, and of what importance was the factor of driver-ability to avoid accidents?

THE Federal Government contributed more than 400,000 dollars to the project. The best brains of Massachusetts turned their abilities toward the solution of the problem. Director Robert C. Eddy sent cruising cars throughout the Commonwealth to study the tactics of drivers. Scouts were posted at the scenes of most frequent accidents. Observance of traffic laws was studied in various communities. Some 200 re-



Courtesy Massachusetts Highway Accident Survey

The instruments for measuring speed and driver reaction time are in the car parked at A. The car B is about to pass over the trip cables in the road

When a motor vehicle tries to beat a train to a crossing . . .

ports giving the results of local accident surveys were sent to as many municipalities, thus assisting them in reducing their accident toll. In all, more than 2,500,000 cars were studied on the road.

Now this is the kind of thing that is going to reduce drastically the chance element in motoring, if only drivers, public safety authorities, and manufacturers will make the most of the information made available. The same thing should be done in every state in the Union. The results should be dramatically publicized. There are ways to cut the fatalities, if people will only find and use them.

THE Massachusetts Highway Accident Survey showed that the percentage of drivers who flagrantly violate the law varied extremely depending upon the law involved. The percentage of violations of traffic laws varied from 0.2 percent of drivers who failed to keep to the right when a car was passing, to 14.9 percent who failed to keep to the right through underpasses with no traffic near, and 98.5 percent who made turns from the correct lane (affecting traffic to the right) without using the proper hand signal. The total of right turns observed in which drivers failed to give hand signals (and which affected other traffic) was 99 percent. Only 8.4 percent of the cars failed to operate properly at intersections controlled by traffic lights. It was estimated, however, that on the basis of these figures the total number of traffic-light violations per year would be 23,500,425.

The average speed on straightaways was found to be 36.6 miles per hour. On short-radius curves traffic slowed down to an average of 27 miles per hour. Considering the fact that these speed studies were made during the winter months when snow was on the ground, it does not appear that the Massachusetts driver is by any means a slow-poke. Strangely enough, the average speed of drivers was faster at night than in the day. Maximum speeds varied from 75 miles per hour in the daytime to 81 in the evening.

As to vehicle lighting, the Survey found that out of 101,391 cars inspected, a total of 8.31 percent had defective lights. Among these were 2.24 percent with one head light out, and 5.36 with no tail lights.

By far the majority of accidents occurred at dusk, from 4 to 8:30 P.M., depending upon the season. Few drivers seem to appreciate that visibility is extremely poor in the twilight period after the sun sinks low on the horizon. Most drivers never show their lights until complete darkness descends. How many of them realize that their chances of accident are much greater in those last daylight minutes than after night has fallen?

To determine the attitude of motorists on questions important to law-enforcement agencies, the Survey sent out questionnaires to a large cross-section of the driving public, and received 12,127 replies. Here are some of the questions and answers, from which you can draw your own conclusions:

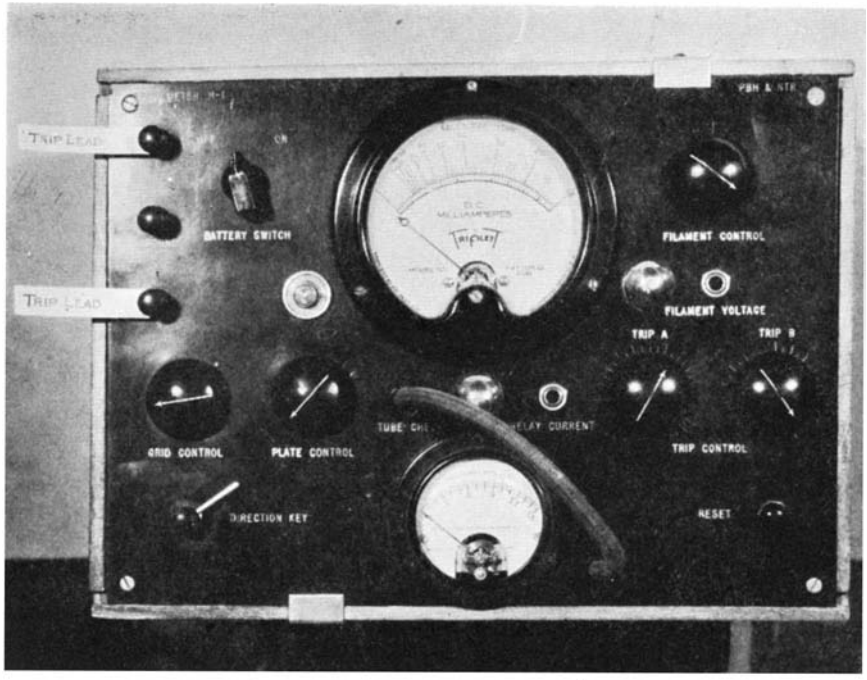
	Percent Yes	No
Do you believe it advisable to re-examine operators at stated intervals?	51	49
Do you believe that a reduction in insurance premiums for good drivers and an increase in premiums for careless drivers would help to prevent accidents?	86	14
Should schools be required to teach accident prevention?	97	3
In general are automatic lights and flashing beacons properly located?	89	11
Do signs similar to those used in Rhode Island showing permissible speeds on the highway help to prevent accidents?	74	26

SCIENCE has not only charted and interpreted phenomena, but through its knowledge and ingenuity it has contrived instruments with which to record some of the more delicate measurements such as reaction time of drivers, and the proper headway of cars traveling in lines. In connection with the Massachusetts Highway Accident Survey, Dr. V. Bush of M. I. T. developed a timing apparatus which was used for the aforementioned purposes.

The device consisted of a condenser charged by a dry battery. For time measurement purposes the condenser was discharged through a fixed resistance, and the voltage remaining across the condenser at the end of the time interval was determined by connecting it to the grid circuit of a three-electrode vacuum tube and measuring the plate current. The ratio between the initial and final condenser voltages bore a known relationship to the interval of time.

By means of this apparatus the Survey measured the braking-reaction time of drivers under actual road conditions. Many previous studies of this kind had been made elsewhere, but, so far as was known to the Survey, only under laboratory conditions. The Massachusetts test was made on 180 individuals, representing characteristic types of drivers. The time taken most frequently for drivers to react to the necessity for applying brakes was found to be 0.52 seconds, and the average time elapsed was 0.64 seconds. Five percent of those observed were found to require more than one second to react.

The importance of the consideration of braking-reaction time is realized when one considers that a car traveling



Close-up of the time interval measuring device used for a motor car survey in Massachusetts. The upper meter dial is calibrated directly in miles per hour

40 miles per hour is going nearly 60 feet a second. Thus, a driver whose reaction time is one second cannot safely drive at this speed closer than 60 feet from the car ahead.

The Survey determined that poor highway lighting is worse than no lighting at all, and that a driver with a braking-reaction time of one second might drive 40 to 45 miles per hour at night without much danger of striking pedestrians, providing his brakes are good, his lights correct, and if he slows down in the presence of glaring headlights. It found also that while there is a small percentage of drivers who seem to be chronically prone to accidents, it is difficult to determine a driver's tendencies from his accident record alone: A poor driver may be fortunate enough not to run into accident situations, and the good driver may be cursed with more than his share of them. In any event, it was found that the most important element in taking chance out of driving is "skill in avoiding accidents when in dangerous situations."

ALTHOUGH statistics show that in about 90 percent of accidents it is the driver rather than the car which is at fault, the Survey included in its report an analysis of automobile construction in relation to safety. This should prove of special helpfulness to persons looking at the new motor cars with intentions of buying. Professor Dean A. Fales, who made the automotive study, included the following among his observations:

"In some of the newer cars with very high and small windows, the effort needed to give proper hand signals is so great that the operator will tend to neglect them. Some of the electric signaling devices and semaphores that are used to a small extent here have been developed and are used largely on European passenger cars.

"Windshields should be kept clean at all times, especially so during the twilight hours. It is suggested that drivers should clean their windshields as evening approaches.

"It is believed that one of the outstanding developments needed is a satisfactory windshield defroster.

"The sloping windshields give better upward vision, but before we can consider that our traffic vision is satisfactory, we shall have to consider sloping the engine hoods downward toward the front of the car.

"For the average operator it would seem that the instruments (on the dashboard) could be replaced by telltale lights, as has been done on some cars. These dashboard signals warn the driver only when something is wrong, and the only instrument he need watch is the speedometer.

"The foot throttle must be placed in a convenient position where no fatigue is suffered from its operation. Too many foot throttle controls are made too cheaply.

"The roadability and directional stability of a car has much to do with its safety. Some cars are unsafe to drive over 40 miles per hour because of poor road-holding qualities, poor steering, and poor riding characteristics.

"Building a car to be stable in cross winds is of more importance from the safety standpoint than true streamlining, as a motor vehicle has to have its wheels on the ground and does not always head directly into the wind. A cross wind of over 40 miles per hour can make some of our lighter cars unsafe at speeds of over 50 miles per hour.

"The power plants in the past two or three years have been developed to a point where the accelerations and top speeds are far greater than the brakes, steering, and road-holding abilities can safely handle.

"Tire chains are of definite value in gaining traction in snow, mud, etcetera, but they also are a hazard. On glare ice, or on wet hard ice, tire chains can cause more skidding and sliding than without their use.

"Such inspection figures as are available indicate that lights and brakes are the parts most frequently in faulty condition."

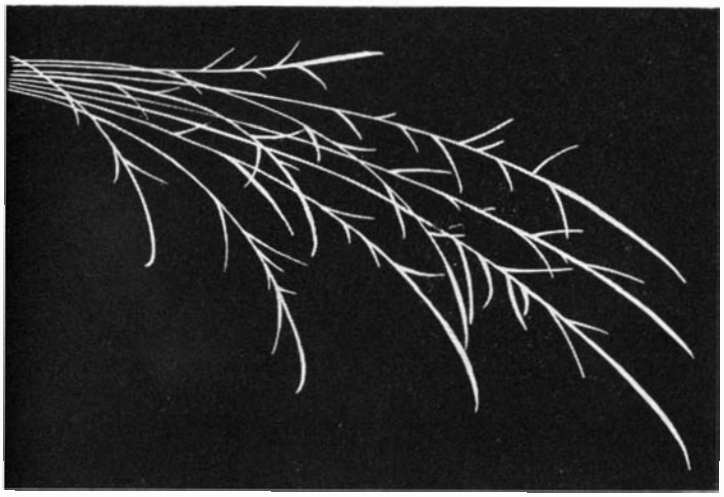
FROM our brief glimpse of some of the highlights of the Massachusetts Highway Accident Survey, it can be seen that such information as the New England surveyors have gleaned from the vast field of their operations can be of great help in assisting motorists everywhere to make their driving less dangerous. But there is another factor in the accident situation which needs serious consideration. That is the attitude of motor-car operators towards others on the road.

The kindly, considerate driver, equipped with proper machinery and a knowledge of the rules of the road, is the least likely to be the cause of an accident. Take the proper attitude away—leave him with only his fine machinery and driving experience, and he may become a real menace. If you are selfish, unthoughtful of others, fail to co-operate, and act as though the road is your exclusive property, you might as well be dead for all the use you are on the highway. And the chances are you will be dead before your time.

Boiled to its essence, this matter of attitude comes down to the old Golden Rule. If you always drive as you would have others drive, you'll be contributing 100 percent towards a reduction in the accident toll. Of course, you must first have a safe car and know how to operate it, but of greatest importance is that you treat other motorists as you would have them treat you. Just think of that on the road some day. Notice how few *do* think of others, and how gratified you are when some occasional driver does show you the courtesies you deserve. If you can only thwart that temptation to be avenged on the road hog, and be a courteous driver whatever the sacrifice, you will have gone a long way toward building that future army of careful drivers which alone can make the highways safe. The value of your good example is often greater than the apparent worth of your good turn at the moment of its performance. Courtesy will continue to pay!

TESTING STEELS BY SPARKING

By DE BARY KERSTON



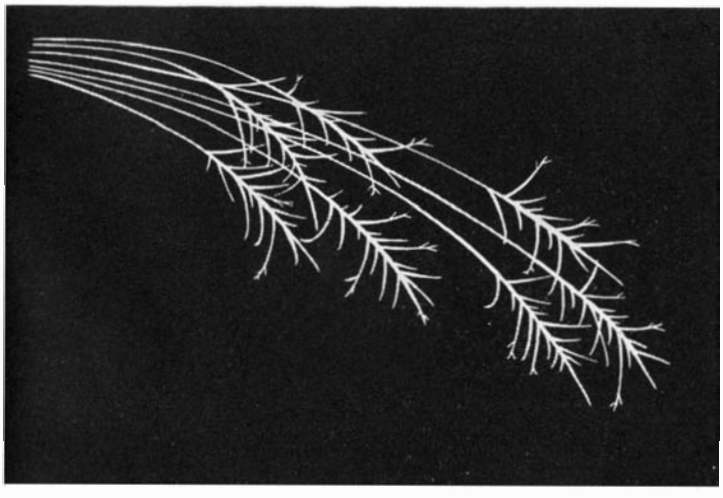
Carrier lines for ingot iron sparks are smooth, but from a 0.15 percent carbon-steel some of the lines are forked with smooth branches

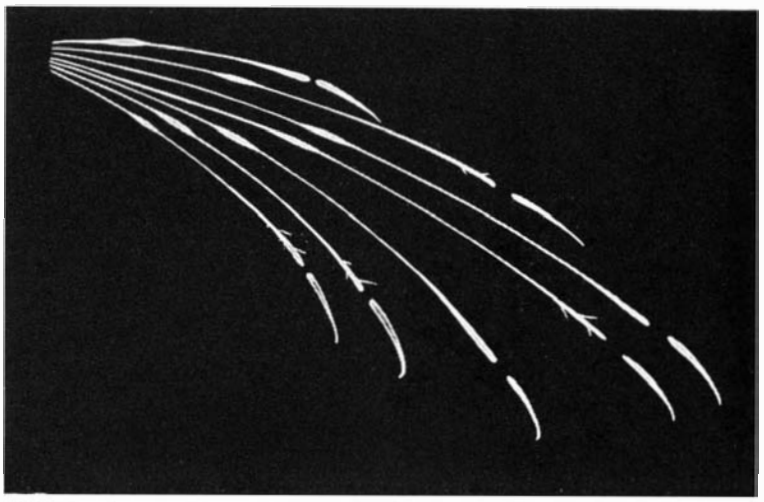
AS everyone knows, a piece of iron or steel becomes coated with rust after a while, which means that it forms a union with the oxygen from the air. This, in reality, constitutes a long drawn-out oxidizing, or burning, process. The same thing happens instantaneously, and much more effectively, when minute particles of steel or iron burn in the air.

Far more spectacular, however, are such sparks made by holding a piece of steel against a grinding wheel. Close observers of this phenomenon have found that the form and the coloring of the sparks, as they fly through the air, vary with the composition of the steel or iron.

If the metal is iron, the result appears to be a small sheaf of single lines. If a piece of carbon steel of about 0.15 percent carbon is held in contact with the wheel, the color of the line is lighter and the presence of a number of short single forks, or primary bursts may be noted. These forks or bursts are undoubtedly caused by carbon embedded in the steel.

Spark identification of 0.30 percent carbon steel. The relation of the carbon content to the frequency of bursts may be plainly noticed



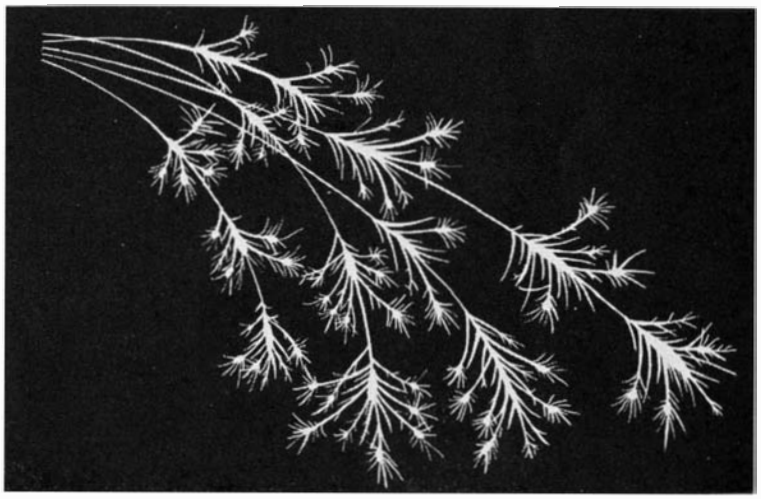


The characteristic spark of molybdenum steel is an orange-colored spear point—always present but broken away from each carrier line

The relation of carbon content to the frequency of the bursts also marks carbon as the element responsible for the forking of the trajectory or carrier line. A 0.15 percent carbon steel exhibits a slight forking effect; a 0.45 percent carbon steel, a pronounced burst; and steel in the neighborhood of 1.00 percent carbon, a minute explosion. Moreover, there is greater intensity of bursting with an increase in carbon.

Steels, alloyed differently, but with the same carbon content, are not always so easily identified. The burst is the characteristic spark of carbon. Other elements have distinctive characters. One of the most easily recognized of all is that of molybdenum, which appears as an orange-colored spear point on the end of every carrier line. Other features of the molybdenum spark are that the spear points are detached from the carrier lines and are always present regardless of the length of the lines.

Nickel gives a characteristic spark, identified as tiny blocks of brilliant white light. When present with molybdenum in a steel alloy, nickel partly suppresses the carbon spark.



Minute explosions in sparks from steel with 1 percent carbon. Steel with 0.45 percent carbon gives off sparks with a pronounced burst

Silicon, likewise, suppresses the carbon spark to a marked degree. The carrier line from silicon steels is much shorter than from a plain carbon steel of the same carbon content, and generally ends abruptly in a white flash of light.

The dull red spark of high tungsten steels is well known to all who have dressed high speed steel tools.

Admittedly, spark testing is not a substitute for chemical analysis, and is not intended for the identification of unknown samples. One of the advantages of the test is that it can be applied to steels in practically all stages of production. Since it is done directly on the pieces themselves, expensive sampling is avoided.

HYPNOTISM

Is Not a "Mystic Force" . . . Is Akin to Sleep-Walking and Insanity . . . Mainly of Use to the Psychologist . . . Other Uses are Very Limited

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

ONCE I won a bet. It happens so seldom that this particular occasion has always stuck in my mind. The bet dealt with hypnotism and its relation to crime. So one day, having duly warned my opponent, Mr. X, that he would lose his five dollar bill within the month, a friend and myself stopped in for tea. A pleasant time was had by all. That evening I called and collected the five dollars, for the chap who accompanied me to tea had been deeply hypnotized all the time, and Mr. X never detected it. Moreover, my friend swore up and down that he had not been to tea at all but had been playing bridge with a Mr. Y, 40 miles away. Furthermore, Mr. Y swore this was a fact—he also was a good hypnotic subject—and they both believed it. A nice little tangle for a jury to unravel if a crime had been committed in Mr. X's apartment that afternoon.

WHAT is hypnotism? It is not a mystic force flashed over hundreds of miles by the power of some dark hypnotic eye. A hypnotist may be a pure nordic and he doesn't even need long hair. In fact, so commonplace has hypnotism become that we now do a great deal of our work by means of a phonograph record. The best analogy we have with the hypnotized person is that of the individual who walks in his sleep. We call the sleep walker a somnambulist and refer to his condition as one of natural somnambulism. The deepest stage of hypnotism we term artificial somnambulism. In fact, if you can find a person who is walking in his sleep, and can start a conversation without waking him—it can be done at times—then that person is hypnotized just as effectively as if the work were done by the best psychologist in the country. You are in touch with the unconscious mind of the subject, which is just as capable of handling the body and is just as acute as is the individual's conscious mind.

How is hypnotism induced? Obviously we can't wait until we find someone walking in his sleep. As a matter of fact we use a very simple technique, described in any good book on hypnotism such as "Hypnotism" by Moll or "Suggestive Therapeutics" by Bernheim. The subject reclines on a couch and the operator "talks sleep" for five or ten minutes. If this is repeated several times we find that about one out of every five or six adults will literally go to sleep and keep on talking in their sleep. We should add that women are no more susceptible than men, despite certain notions as to their love of talking.

This simple technique puts you in touch with the unconscious mind of the subject, which explains the spectacular results which are obtained. First of all, this unconscious mind is extremely suggestible. By that we mean it literally tends to believe anything it is told. The critical faculties are largely wiped out, so that if you tell the individual that he is Alexander the Great, that you are King George, or that Mussolini is a pacifist, it is quite satisfactory to him. He accepts the statement and behaves accordingly.

But suggestion is only the key by which we unlock the real mysteries of hypnotism—for they are mysteries, not in the sense of being supernatural but because we just cannot see how the unconscious mind can do such strange things with the body. For example, we can always get "hallucinations" in any good hypnotic subject. These we define as false sense impressions and they can be obtained in any of the senses. I tell the subject that there is a pink elephant standing in the corner of the room. He sees and describes it. Similarly he can be made to hear the Metropolitan Opera, taste the most glorious wine, or smell a skunk next door. He will shiver with cold or protest that it is suffocatingly hot, all within a minute's time and in the same temperature. Moreover, and closely akin to these phenomena, he will mix things up. Soap will pass for chocolate, if you tell him so, ammonia for eau de Cologne, and the whine of a motor engine for a college band.

THEN we can produce anesthesias in a good subject. Tell him there is no feeling in his hand and you have a stick of wood. You can prick it with a pin, burn it, even amputate a finger without pain. In the old days they used to perform major operations under hypnotism. This was before the time of ether and chloroform, which rapidly replaced hypnotism, owing to their greater convenience and greater certainty.

Not only can we remove the sense of pain by suggestion but we can treat any other sense in a similar manner. Blindness can be so produced, as can also deafness. The sense of taste can be completely obliterated and the strongest ammonia pass unnoticed if held before the nose. We shall see later that these conditions are closely related to certain mental disorders such as hysteria and shell-shock.

PARALYSES of any muscles in the body are easily produced. Suggestion can render an arm or a leg useless, while the whole talking apparatus can be similarly paralyzed.

One of the interesting and instructive phenomena in hypnotism, as it ties in with our study of mental disorder, is the delusion. This type of mental reaction can be obtained in the most interesting and absurd form. Tell an individual he is Napoleon and he behaves as such, imitating the character far better than he could do in his normal state. He will take the part of inventor, gangster, college president, or garage mechanic, on demand. What is far more important, he is not only acting a part—he believes it. He *is* the individual in question and defends his identity with the same heat that you would display if anyone questioned your right to your own home. Two of us spent one hour cross-questioning a man of 25 who claimed he was a captain with the American forces in the last war. He was seven years old at the time. Then we gave up. He still stuck to his story, so the delusion was removed with no ill effects.

It is a very curious fact that the working of body organs can be controlled in hypnotism. A very good subject is required for these experiments, but the heart beat can be hastened or retarded, body temperature can be raised or lowered in some cases and digestion inter-

fered with. Indeed, some go so far as to claim that bleeding can be produced in any part of the body by means of suggestion, and that blisters can be raised simply by applying a postage stamp and assuring the individual it is a mustard plaster! Such claims are as yet not proved to the satisfaction of psychology, although there seems to be a reasonable chance that they may be true in the case of a few very excellent subjects.

Bergson quotes an unusual case. He had a very good hypnotic subject, a boy of 12 who could do the following stunt: The subject would stand facing Bergson, who would hold an open book *behind* the subject's head. The boy, according to Bergson, would then read from the book. Bergson at first thought this was an example of mind reading, since he also read the book at the same time. It turned out that the subject was *reading the reflection of the book in Bergson's eye.* This would require a keenness of vision which would be microscopic. Such reports are rare and cannot be accepted without further proof.

There does seem to be little doubt but that we do get a definite increase in muscular strength during hypnotism, especially in terms of resistance to fatigue. An individual can really show amazing physical endurance but this has not the obvious application you may think. It would be very foolish, for example, to have an athlete break his mile record—and die of heart failure. Your body is a machine and fatigue is simply the warning whistle which tells that the gas is running low. Disregard it and the machine may suddenly stop.

FINALLY, the individual, when hypnotized, has a remarkable memory for events which he has long since forgotten. This is a very curious thing and of great importance to psychology, since many cases of mental trouble are based on experiences of childhood. It is a very strange thing that an individual in the hypnotic trance can recall the events of his early years which have long since slipped from his conscious memory. This method of delving into the unconscious we call "hypno-analysis." Linked with the technic of psycho-analysis, it sometimes yields excellent results in curing some mental ailments.

Hypnotism, in and of itself, has a certain interest to psychology but its great importance is due to the light which it sheds on the so-called functional nervous disorders. So great is its use here that we sometimes refer to hypnotism as the laboratory of abnormal psychology. Perhaps our best way of showing this linkage is to proceed as follows:

Every phenomenon that we can obtain in hypnotism we can get by means of the so-called post-hypnotic suggestion. For example, I suggest to my subject that he sees his brother standing in a corner of the room. He does so. But I can also suggest to him that, tomorrow afternoon at three, or two months from today, or next Christmas eve, he will see his brother in that same corner. Strange to say, he will do so. At the time specified his brother will appear before his eyes and he will act in every way as if this person were actually in the room.

JUDGING from letters received at various times by the Editor, there is still some confusion regarding hypnotism. Is hypnotism scientific or pseudo-scientific? Unfortunately, many persons have not seen and do not know of its use elsewhere than on the stage, where it is often surrounded with added "frills" in order to make of it a more entertaining show. That it is used in the psychological laboratory, and has been used by physicians, are less widely known. A good account of these uses will be found in the accompanying article, also in the Encyclopædia Britannica, under "Hypnotism." Even stage hypnotism is not essentially pseudo-scientific. It is not, as many have suspected, a fake or a trick, for it has no need to be, because the genuine is easier to put on than a good imitation.—*The Editor.*

Similarly, we can reproduce any of the curious hypnotic phenomena after the trance, and apparently time is of little consequence. We have examples of these post-hypnotic suggestions being carried out after a whole year's lapse of time—they would probably work just as well after five years. Paralysis can be made to hang over in this manner and the same applies to anesthesias. Delusions will do the same. One subject startled a group by announcing that he was Lenin restored to life and called to head a Bolshevik revolution in America. A psychiatrist present—it was all for his benefit—was ready to swear as to his insanity when the post-hypnotic suggestion was removed and the doctor realized he had been "framed."

These suggestions have two very curious characteristics which are worth noting because of their bearing on mental disorder. First, the subject will always rationalize. He never knows why he acts as he does, but will always give a plausible excuse for his actions—and he believes it. If he finds himself singing the Star Spangled Banner, it is because he heard it played that morning. If he deliberately breaks his cigarette holder it is because he cut his lip on it yesterday, and if he has a sudden impulse to leave for New York City it is because he promised a friend three months ago that he would meet him in the Grand Central Station tomorrow morning—and believes it. Very rarely will he realize that his actions are the result of a suggestion given in hypnotism.

Secondly, the post-hypnotic suggestion acts with a peculiarly compulsive force. It *must* be carried out. If the subject is told to occupy a certain chair on a given signal he will do so. If someone else is in the chair he will insist on his getting up, even going to the extent of physical violence if necessary. One of the most curious of these developments is to give the subject such an order, then tell him that it is a post-hypnotic suggestion and dare him to resist. I have collected several bets from subjects who thought they could do so. This compulsive power of the post-hypnotic suggestion, as well as the subject's tendency to rationalize, bear a striking resemblance to the symptoms in some nervous disorders.

WE must now note a further development. Anything which you can get in hypnotism or in the post-hypnotic suggestion you can also get by means of auto-suggestion. This is simply the technic of relaxing into a drowsy state and talking to yourself. Do you recall Coué's famous formula: "Every day and in every way I'm getting better and better"? That contains the general idea. (By the way, when Coué returned to Europe he said this formula was of little use in America. It took too long to say. Americans just cut it down to "Hell, I'm well.")

But if you develop the technic as described by Coué or by Baudoin in his "Suggestion and Auto-suggestion," you can actually get not only suggestions but post-hypnotic suggestions by means of auto-suggestion. It is very curious, for example, to awaken at 2 A.M. and listen to an orchestra, all the time fully conscious that it is the result of your suggestion to yourself before going to sleep. When in hospital after the war I had a pet polar bear who would parade around the ward in a most convincing fashion. He also illustrated the dangers of playing with these forces, because he developed the habit of coming uninvited and would not always go home when told, so he was banished forever.

It is here that hypnotism ties in with mental disorder. Anything you get in hypnotism, the post-hypnotic suggestion, or auto-suggestion you can also get in everyday life. You then say the individual has some type of mental disorder, all the way from "peculiarity" to "insanity." Under the influence of strong emotion, especially fear, you are literally

hypnotized. Any impression which strikes your sense organs at that time will give results exactly resembling the post-hypnotic suggestion, for emotion sensitizes the camera plate of the brain.

For example, a soldier in a moment of intense fear had his eyes glued on a German helmet. Result: A case of "shell-shock" wherein the soldier had constant terrifying visions of this helmet and the face beneath. A corporal was turning the elevating screw on a field gun when a shell hit it, killing everyone but himself. Another case of shell-shock in which the soldier could not stop his arm from rotating, for this activity was uppermost in his mind at that moment of intense fear. A child finds himself locked in a narrow alley with a dog which attacks him. The result in later life was claustrophobia or a fear of closed spaces, since the idea of escape was uppermost at the time. Another child is badly frightened by a man with red hair. As an adult he developed a "compulsion neurosis," in this case an irresistible desire to strike every red headed man he saw.

You will note that results here are a little different and the technic is not the same, but if you will just bear in mind the fact that under strong emotion the individual is, to all intents and purposes, hypnotized—witness the bird and the snake—then you can see that all these symptoms of "insanity" are really "suggested" and are first cousins to the post-hypnotic suggestion. For that reason the study of hypnotism is of tremendous importance to the medical profession.

THESE facts being as they are, what does it all mean to the reader? Exactly the same as an article on medicine, engineering, aeronautics. In other words, don't start "experimenting." Hypnotism in the hands of an expert can do no harm. Used by an amateur it may do a great deal. It is a nerve-racking process to have a subject just refuse to wake up, or develop hysterical symptoms after awakening, or insist on going asleep again whenever you glance in his or her direction. Any suggestions of immoral or anti-social nature, even if given merely as an experiment and rejected by the subject, involve strong mental conflict. Then the subject may easily become so susceptible to hypnotism that he will go into the trance for anyone. These problems and others are easily met by the trained operator but may get the amateur into serious difficulty.

Remember also that we have no sure method of telling whether or not a person is hypnotized or is just bluffing. I have seen some ludicrous performances in college, where a good student actor proceeded to "take across" the student hypnotist. One such séance ended in the "subject" pursuing the operator all over the campus with a carving knife, to the huge delight of everyone. On another occasion the subject was made to pose on a chair, as the Statue of Liberty, while the hypnotist pulled the hairs out of his leg one by one, to prove he was hypnotized. This was too much for even the best of good natures and the Statue's arm suddenly dropped on the operator's head with painful results.

AS the author states, hypnotizing is not a safe kind of experiment for the average layman to perform, and the damage, if done, is done to a difficult thing to repair—a human being. In presenting the accompanying article this magazine dissociates itself from all responsibility for injuries which may result from misuse of its content.—*The Editor.*

There is not much danger from criminal or immoral suggestions. Authorities in general agree that the subject will do nothing against his moral code. You must bear in mind that the unconscious mind is very keen. It can do mathematics, write poetry, or memorize history quite as well as the normal mind. The hypnotic subject is also a born actor and will do a great deal to give satisfaction. Give him a rubber knife, a suggestion of murder and he is most convincing. Ask him to forge a check and he will do so. He knows it is a joke and plays the part. Give him a really immoral suggestion and, provided he is a moral individual, one of two things happens. He gives you a point-blank refusal or he wakes up. The hypnotic subject very definitely has a will of his own. He may allow you certain liberties but the dead-line is always very distinct.

Hypnotism is then a condition closely akin to sleep walking. The unconscious mind is in control of the body. In the hypnotic trance, however, this unconscious is also in touch with an operator. This accounts for the curious results, for the unconscious is very open to suggestion and has a remarkable power over the entire body. It can produce visions, anesthetise an arm, paralyse a leg, eliminate fatigue, or regulate the heart beat. In addition it is quite as keen as the conscious mind when it comes to mathematical problems or writing—very easily its superior as a play actor. And the hypnotic subject likes nothing better than to perform fake murders or write "phoney" checks —for the psychologist will tell you that the unconscious mind is a childish mind, with all the child's love of "show off."

The practical uses of hypnotism? Really very limited. Several students have made the bright suggestion that I hypnotize them and make them do their studying while in this state, with the suggestion that they remember everything on awakening. If laziness is the mother of invention, America is going far, fast. Equally brilliant is the suggestion that the student write his examinations while hypnotized. Now that I come to think of it, some of my own pupils may have tried this. They certainly were not noticeably conscious.

Seriously, hypnotism has no great practical use. As an anesthetic it can never compete with the various drugs. I have seen some very excellent work done on alcoholism and drug addiction in general. Also some very good, as well as some very discouraging, results with stammering. It certainly is no cure-all, and the wild claims of some enthusiasts are based on inexperience.

THE great use of hypnotism lies in the field of research, for with its aid we can reproduce most symptoms of insanity and study them in the laboratory. Our need here is much the same as in medicine. The problems of research are greatly simplified if the germs of tuberculosis or typhoid fever can be grown in the laboratory *outside* the human body. We can then work at our leisure, without worry as to the individual sufferer. Hypnosis brings the symptoms of insanity into the laboratory. We can study these also, in our own way, without fear of producing or aggravating any mental trouble.

But bear in mind that hypnotism, like many things, is only safe in the hands of the expert. The story is told of an old darky who was sent out to Paris-green potato bugs. It was the first time he had ever seen the poison, and half an hour later he was found rolling over on the ground in great pain. It seems that one of the bugs had flown down Sam's throat and he promptly drank a cup full of Paris green to kill the offender. Your own treatment of symptoms by hypnotism might be just as crude and ludicrous, for the human mind, like McGinty's mule "ain't near as simple as he looks."

Leave hypnosis to the psychiatrist in the hospital. He has both the knowledge and the facilities. Many colleges and universities have a rule against its use within the walls. It is so at my institution. While there is no danger attached to the use of hypnotism by an expert, there is, nevertheless, a very natural prejudice against its use in certain spheres. Where the prejudice exists, it should be respected. Hypnotism has been unfortunate in that it has been too often associated with stage performances. While these are not of necessity fraudulent, many of them can hardly be called elevating or scientifically valuable.

POWER IN THE WILDERNESS

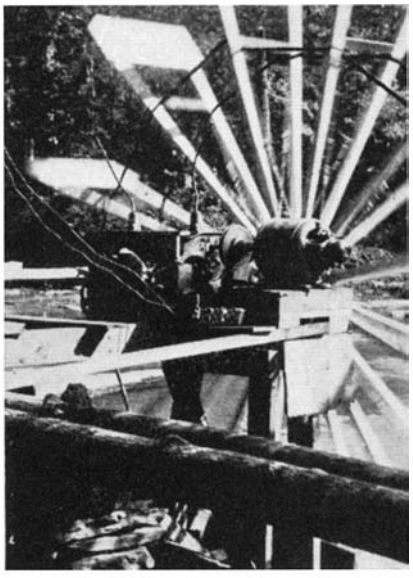
Ingenious, Inexpensive Power Plant is Example for Remote Camps, Lodges, Resorts

By WILLIAM BENJAMIN WEST

A COMBINATION of old automobile parts; a few timbers; a homemade, undershot water wheel; and a small, used, D.C. generator in conjunction with a flume and dam of timbers and stone has been set up to provide electricity at a small vacation resort on the Cahaba River, near Birmingham, Alabama. The resort is five miles from a power line and the owner wanted to "harness" the nearby rapids at minimum cost.

The site selected embraces about 100 feet of river bed in which there is a fall of about three feet, the bottom being ledge rock with strata protruding at irregular intervals and slanting upstream at an angle of about 30 degrees, and running all the way across the channel.

During a part of the year, a sufficient volume of water flows in the stream to operate an undershot wheel even if no diversion works had been provided. However, in order that most of the water might be concentrated at the wheel during low river flow, a low diversion dam was constructed across the river at the head of the rapids and a flume line run along the shore to the wheel pit. This dam is of rock-crib construction, the cribs being built of oak slabs with field fence or "hog wire" securely fastened over the bottom of each pen before it was carried to its location and filled with rocks. The spaces between these pens are closed with removable horizontal boards. The canal is also of timber construction and is securely anchored.



Close-up of generator and motor-car parts of homemade power plant

The water wheel is the feature of this undertaking. Two poplar logs, each about 10 inches in diameter, were secured to two trees near the water at the foot of the rapids. These logs run nearly parallel with the river. Across them two four-inch by six-inch timbers, each 18 feet long, were placed 18 inches apart, center to center. Across the outer ends of these timbers, which hang over the wheel-pit cut in solid rock, two short lengths of railroad rails were securely bolted at such spacing as to fit exactly into the spring saddles of an old Hudson automobile rear axle. The rails were machined on top to meet the curvature of the saddles, and dowel pins were sunk in place to prevent slippage between rails and the rear axle housing.

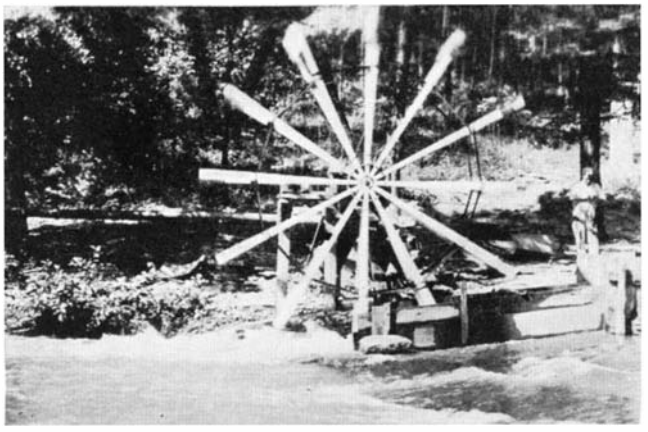
The axle was placed with the right rear wheel over the wheel pit. The left wheel was securely fastened by clamping on the brake. White oak pieces, each three inches by two and one quarter inches by six feet eight inches, were securely bolted to the right wheel to form the water wheel. The "buckets" used were ordinary boards.

WITH this arrangement, the water wheel turns the drive shaft of the old Hudson rear end. The ratio of the differential happens to be 3.5 to 1. On the power shaft pinion, the large gear of a Mack truck chain and sprocket set was secured. The small sprocket is attached to the rear end of a Chevrolet transmission, the front of which, in turn, is connected to the rear of a second transmission box, both transmissions being securely anchored across and above the old rear axle housing. The chain and sprockets have a speed ratio of 3:1. The two transmissions in series, driven from the back, have a combined speed ratio of 18:1, thus bringing the generator up to speed.

The size of the wheel permits operation during most floods, but the wheel-supporting timbers are hinged to permit raising the wheel when desirable.

The cost of the water wheel, used automobile parts, timbers, hardware, a used 110-volt D.C. generator, machine work, and labor was approximately 75 dollars. This did not include the owner's time in building the wheel itself, nor the cost of the dam and canal. The whole job cost an estimated 150 dollars.

The low dam and part of the flume that leads down stream to the site of the undershot water wheel and power plant



A view of the water wheel as seen from the opposite side of the river, showing also the lower end of the wooden flume

A timber bulkhead at Deal Beach that failed because the structure was not supported by a suitable back-filling

By contrast—a fine new sheet piling bulkhead at Deal Beach supported by timber bracing and wide back-fill

Engineers Combat The Sea

New Jersey Studies Coast Erosion...Great Economic Loss...Varied Problems...How Approached...How Solved . . . Findings Helpful to Others

By R. G. SKERRETT

NEW JERSEY is waging war along a battlefront of 125 miles. Her conflict is with Nature; that is, with the Atlantic Ocean which is continually attacking her seashore from Cape May northward to the tip of Sandy Hook. This ceaseless battle is for the defense of menaced properties that have today a combined taxable valuation of more than half a billion dollars.

What New Jersey has done and is doing to protect her exposed seashore should be of interest both to other states and to that great number of our people that annually go to those surf-swept beaches for recreation, rest, and recuperation. Those beaches are patronized by millions of our citizenry living within a radius of fully 500 miles inland. Railroads and fine motor highways make that playground readily accessible. The visitors linger anywhere from a day to a matter of months; and to supply any and all with the conveniences, comforts, and diversions they expect, there has evolved on a truly splendid scale, from Sea Bright south to Cape May, what has been aptly termed "the resort industry."

Along this extensive ocean front there are cottage colonies, townships, and cities; most of the larger communities are thoroughly organized and boast fine hotels, diversified shops, restaurants, and places of varied amusement. The vast majority of these are located on what was a veritable sandy waste, of very little likely value 50 years ago.

The first-comers naturally sought locations that would afford an unobstructed view of the ocean and assure at the same time a suitable beach for bathing. Most of those people believed that they had chosen their sites wisely. Later arrivals, in their turn, also bought as near to the water front as possible. It is fairly certain that a large percentage of those people would have hesitated to spend money on shore properties for their own use if they had studied some of the old maps of that same seaboard.

MAPS made at different times over the last 100 years reveal that within that period certain shore fronts have been built up to the extent of 3025 acres, while the same forces have removed either at those points or elsewhere along the seashore a total of 5220 acres—the net result being a loss of about 2200 acres. The economic significance of these changes would be trifling if the resort industry had not made of the New Jersey shore front what it has. The problem now is to arrest erosion wherever practicable or to minimize it as far as possible. Bitter experience has proved that this cannot be done in most situations by rearing barriers that are counted upon to oppose by sheer structural strength the battering attack of storm-driven waves. Enlightened engineers now know that success is to be won only by resort to strategy—strategy that either diverts the ocean's attack or robs that attack of much of its power to do damage. Indeed, these experts have found ways to lure the ocean to upbuild the beach just where it had previously cut into the shore line. The general public may not be aware of it, but the coast of New Jersey has become a great laboratory for the study of coast-erosion problems that are world-wide in their significance and certainly recurrent at many places along our seaboards and the shores of some of our great inland lakes.

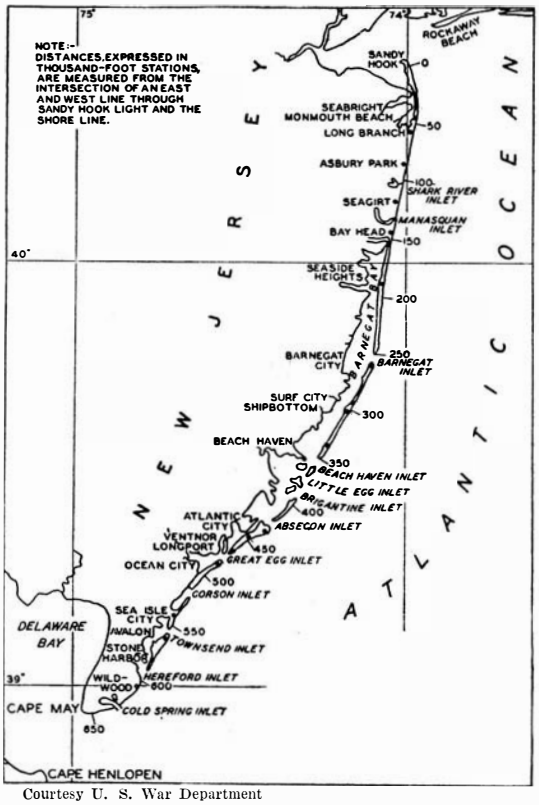
In the past, property owners and seashore communities have spent millions of dollars in erecting barriers of one sort or another at various points. Not infrequently, those defenses have been conceived and built without a sufficient understanding of the basic physical actions they were designed either to arrest or to modify. This unconsidered procedure, with the losses entailed, is responsible for a fairly widespread belief that beach erosion is inevitable and that it is futile for man to try to combat it. Happily, this gloomy attitude is unjustified; the experts of the government and of New Jersey are proving that the fight for protection can either be won convincingly or the advance of the sea upon the land can be slowed down to a marked degree. Success, however, is contingent upon careful study of the controlling conditions at each situation, day in and day out, in all kinds of weather. These circumstances must be taken into account anywhere, and are not peculiar to the New Jersey coast.

Broadly stated, sandy beaches are of two sorts—they either slope abruptly seaward, or they extend farther out from the shore because of their comparative flatness. Each type offers a different

problem in protection. The northern beaches of the New Jersey coast slope abruptly while the southern beaches of that state dip gradually. The northern beaches, because the water is fairly deep close to the shore, are directly exposed to the pounding attack of full-bodied waves urged on by storm winds. The southern beaches, on the other hand, have a broad belt of shallow water lying between them and the ocean, which serves to trip the oncoming waves and to cause them to break, thus robbing them of much of their power to damage before they reach the shore. Manifestly, the strength of the inshore defense against storm waves must be greater at the northern beaches than at the southern ones; and the same is true where the primary purpose of a defensive structure is to obstruct the free sweep of currents that are mainly responsible for the denuding of a beach at one place and the upbuilding of another beach at some point beyond. Due regard must be given not only to the range of velocity of such currents but to their prevailing direction. The attacking forces that both make and destroy beaches are waves and currents produced by winds, and this is especially true of local winds as distinguished from occasional storm winds.

THE seashore of New Jersey is composed of beaches of two types—namely, the headland beach and the barrier beach. The headland beach is the eroded water front of the mainland; the barrier beach is a narrow strip of sand lying more or less offshore and parallel with the mainland, with a sheltered body of water between it and the mainland. The barrier beach constitutes a battlefront that lacks the immediate support that the headland beach possesses. The barrier beach is more susceptible to the action of waves and currents; the continual fluctuation of the ocean front of such a beach is a ceaseless reminder of the forces that brought it into being and which may still add to it or withdraw from it at any time some of its sandy mass. It just happens that the New Jersey seashore is mostly of the barrier beach type.

Generally speaking, the seashore defense structures now used may be grouped in two classes. These are sea walls, or bulkheads; and jetties, or groins. To prevent confusion, we shall use only the terms "bulkhead" and "jetty." Bulkheads are reared at the inshore limits of a beach and parallel with a beach. and their purpose is to halt the frontal attack of storm waves. Jetties commonly extend outward across a beach from a bulkhead or a bluff shore, and usually to a point that is not uncovered at low tide. The jetties are intended to arrest erosive currents that sweep parallel with a beach or meet it diagonally. Waves or currents that strike a beach diagonally do more damage than waves advancing upon the beach perpendicularly or currents moving parallel with a beach.



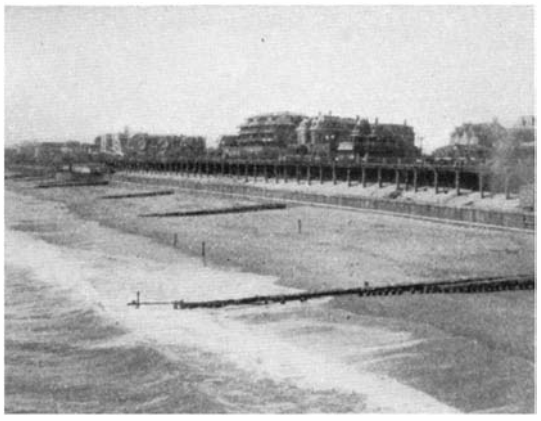
Courtesy U. S. War Department

Many resorts are located on the narrow offshore barrier beaches of New Jersey

The engineer must adapt his defenses to combat those conditions that prevail most of the time, and this is especially true in the case of jetties that are designed to arrest erosion, which takes place in fair weather and foul. Wet sand flows readily, and seas and currents can pick up that sand and transport the suspended particles considerable distances. Sand so moved, depending upon the size and weight of its particles, is precipitated later as the water currents lose their speed. In this manner, a beach is progressively reduced and the sand carried off is dropped elsewhere to upbuild. This process may bring about momentous alterations, varying with the strength of the eroding forces and the time they are active. If the sweep of sand-laden waters can be slowed down, then the sand will be caused to settle and a beach will begin to form or be extended. The function of a jetty is, accordingly, twofold—to arrest erosion and to increase the expanse of a beach. The seashore of New Jersey exemplifies how this can be done provided the jetties are sufficiently durable and dimensioned to meet the circumstances at their respective locations. Similarly, bulkheads will withstand the frontal assaults of storm waves if they are built to meet those blows and are not exposed to the undermining actions of water that may weaken their foundations or impair their immediate and necessary backing.

Where lack of proper and united efforts has led to the virtual disappearance of the beach that prompted a costly development of these seashore properties

Bulkheads are variously built of timber throughout, of a combination of steel sheet piling and timber, or of concrete and timber. In any case, these wall-like structures are invariably braced on their rear sides and further stiffened against the shock of impacting waves by a backfilling of rock or earth or both. The backfilling must be done to prevent infiltrating water from weakening it. Lacking a satisfactory foundation and proper backfilling, no bulkhead can survive long against the insidious effects of permeating water and the direct onslaught of full-bodied waves. In recent years, interlocking steel sheet piling has been used more and more



Shore front at Long Branch showing well-backed bulkheads with jetties into the ocean

in building bulkheads for shore protection. Besides its inherent strength, the interlocking piling can be sealed to make it acceptably tight against the intrusion of undermining water. The relatively simple timber bulkheads of former years are rapidly disappearing along the New Jersey coast because of their inherent short-comings and because of the attacks of marine borers that bring about their destruction.

There is no fixed type of jetty that will answer under all conditions, for the engineering experts have found that each jetty must be designed with regard to the special circumstances of its situation. At Sea Bright, for example, where the beaches dip sharply, one section of the shore is defended by a massive jetty composed of large chunks of hard rock. That jetty extends out beyond the low-water line and it crosses the beach somewhat obliquely the better to intercept and turn aside the prevailing erosive currents, and also withstand the pounding of heavy waves. This veritable breakwater has caused the upbuilding of a beach that was being progressively carried away and it also checks storm seas that threatened to cut a breach right across the peninsula. Again, at Sea Bright, there are sections of the much exposed shore that are now shielded from the direct attack of storm waves by frontal barriers formed of massive slopes of rock. The same sections were unsuccessfully defended previously by timber bulkheads.

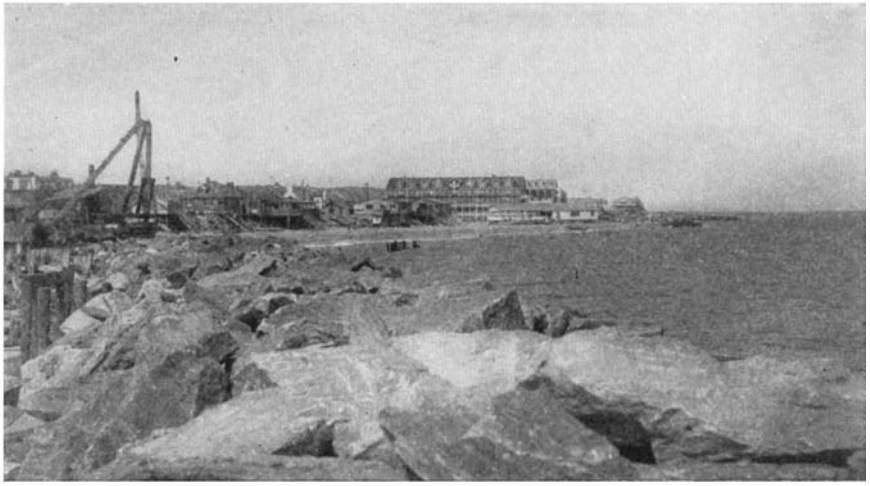
EXPERIENCE has seemed to warrant the belief on the part of the state engineers that even these manreared promontories of rock should be built with an impervious backbone or core to arrest the passage of forceful currents or jets of water, which are likely to do damage to the adjacent beach and possibly lead to the undermining and settling of the jetty. Core walls can be formed of small pieces of rock that will pack snugly, of steel sheet piling, or of timber piling and sheeting; but if timber is used, that material should preferably be treated to discourage the attack of the teredo or other marine borers. There are some rock jetties, built without core walls, that are now supplemented by paralleling jetties of steel sheet piling.

Between the main defenses of two rock jetties, comparatively low timber or steel sheet piling jetties can be used to stabilize a re-formed beach or to protect an existing beach from impairment; but the advice of a qualified engineer must be sought to decide where this can be done. Gently sloping beaches can be shielded by jetties of relatively light construction. It should be apparent that jetties, like bulkheads, may be of several kinds to suit different situations; and where the jetties meet the conditions properly, beaches can be restored or created anew, astonishing results often being achieved in even a few months.

The seashore of New Jersey bears evidence of what can be done by recourse to suitable measures; there, too, can be seen what may happen when the forces of the sea are either imperfectly controlled or left free to follow their natural courses. The state of New Jersey initiated a policy of state aid 15 years ago; and since that date the state, municipalities, and other interests have spent substantially 3,000,000 dollars in battling beach erosion. This work has been under the direction of the New Jersey Board of Commerce and Navigation; and that organization has developed basic designs for jetties and bulkheads, susceptible of modification to suit local requirements. Mr. Victor Gelineau is director and chief engineer of that board, and he reports that the structures so developed have proved generally capable of withstanding the attacks of the sea and at the same time have induced waves and currents to upbuild valuable water-front areas. Where a private owner has not the means to provide protection for his particular stretch of beach, he not only jeopardizes his own holdings but he may imperil the property of others, many others. The same agencies that have made the barrier beaches have also made the inlets that link the sea with the lagoons and bays behind those beaches, and the existing inlets have shifted up and down the coast considerably during modern times. It is for this reason that some of the inlets are today flanked on both sides by rock-formed jetties that reach seaward for hundreds of feet.

THE Corps of Engineers of the United States Army and appropriate agencies of the various states on the Atlantic, Pacific, and Gulf coasts, and also on the Great Lakes, are jointly engaged in studying the problems of beach erosion; these technicists, using the New Jersey sea coast as a laboratory, are seeking to unravel some of the mysteries of coastal currents, wave action, and the ways in which the sands of the waterbed are picked up and distributed in alternately denuding and adding to the shore areas. The ultimate aim is to place protection against coastal erosion on a still firmer foundation of knowledge that will give to all engineers engaged in such work data that will guide them in meeting any set of conditions at any given location. In short, an age-old problem is thus being dealt with in a typically up-to-date manner. This research, plus the experience already gained, should prove invaluable in combating storms and forces that annually do a great deal of costly damage.

The mighty Atlantic is ever ready to break through weak points in man-made defenses. Only by eternal vigilance and by the employment of structures of proved efficiency, such as those described above, can the sea's attack be arrested or diverted.



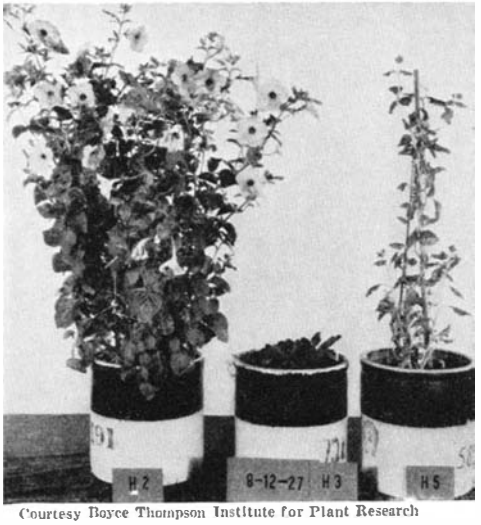
This section of the shore front at Sea Bright is adequately guarded by a bulkhead of rock (in foreground), and a massive rock jetty (in background)

Electrical Floriculture

Artificial Light Supplements Daylight . . . Of Use in Greenhouse or Home . . . High Lighting Intensities Not Necessary . . . The Results

By LAWRENCE C. PORTER*

FOR a great many years man has been studying ways and means of growing better plants, getting blossoms out of season when they will command a higher market price, and finding ways and means of decreasing production costs. Early research was directed toward the possibility of raising plants entirely under artificial illumination indoors where it would be possible to control accurately the conditions of humidity, temperature, amount of light, and so on. It was found to be possible to grow plants by artificial light only, but this required such high intensities of light, more or less comparable to sunlight which may run as high as 10,000 foot-candles, as to be commercially impractical from a cost standpoint.



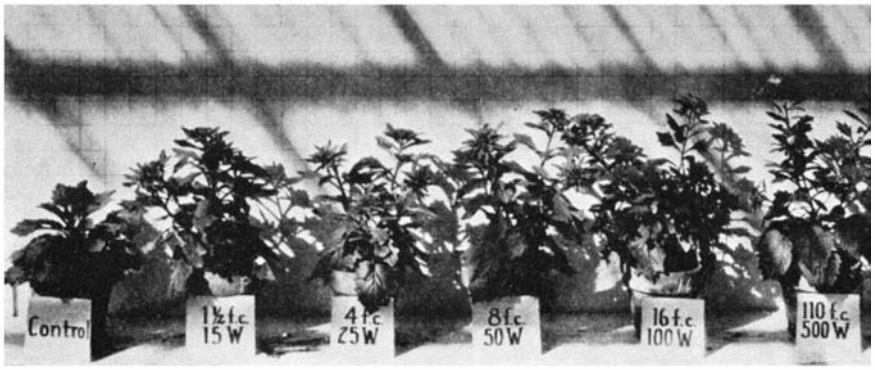
Courtesy Boyce Thompson Institute for Plant Research

Plants grown under (left) daylight; (right) red; and (center) ultra-violet

Later research developed the fact that the blooming time of plants is controlled largely by the total number of hours of light rather than by the intensity of the light. For example, plants which bloom in the spring and fall do so because in their natural environment they receive about eight hours of sunlight. Those which flower in the middle of summer do so because they have a total of 14 to 16 hours of light. If it is desired to have plants which normally bloom in the middle of the summer come into bloom in the spring, or even in the winter months, this can be done by supplementing the normal daylight which they receive with five or six hours of artificial light.

It is not necessary for the artificial light to be of high intensity. Intensities in the neighborhood of 10 foot-candles are satisfactory for plants which are grown in greenhouses where they receive the maximum intensity of daylight. In homes where plants do not receive nearly so high intensities during daylight as they do in a greenhouse, the supplemental lighting should be of intensities somewhere between 100 and 300 foot-candles.

*Illuminating Engineer, Incandescent Lamp Department, General Electric Company.



The results of supplying supplementary lighting to greenhouse plants. The plant at the left received only daylight; the others daylight-plus, as indicated by labels

High-wattage lamps permanently located near roof of the greenhouse

Not all plants respond equally well to the same intensities or the same hours of artificial light. An average of results obtained with some 25 varieties of flowers commonly grown for the market showed that supplemental lighting of about 10 foot-candles for four to six hours a day resulted in bringing the flowers into bloom 30 days earlier than those having no supplemental light. There were on an average 12 more blossoms per plant, and the flowers were larger and the stems longer. This supplemental light cost approximately one half cent per flower, which was less than the increased price obtained for these blossoms due to getting them on an early market. The supplemental lighting used was that from ordinary incandescent lamps of the type used for lighting offices and homes.

MANY experiments have been made on the effect of colored lights on plants. Red light tends to make the plants tall and spindly; blue light tends to make them short and stocky. Ultraviolet, contrary to general belief, has been found to be not only unessential to plant growth, but actually detrimental, and the shorter the wavelength of the ultraviolet the more it inhibits the growth of plants. Experiments have been made with neon lamps, mercury

A new type of greenhouse with the walls built of insulating material

tubes, and sodium lamps. Of these the sodium seems to offer interesting possibilities because of its much higher efficiency. Until further researches and tests have been made with sodium lamps, the regular incandescent lamps are the most practical light sources to use.

Artificial light in plant growth has found its widest application in commercial greenhouses. Until recently small lamps on drop cords were used over the greenhouse benches, these cords being so arranged that the lamps could be raised as the plants grew. The latest greenhouse practice is to use higher wattage lamps permanently located near the roof of the greenhouse. While this practice wastes some light in the aisles between the benches, nevertheless the increased efficiency with which light is generated by the higher wattage lamps more than offsets the loss in the aisles. For example, a 40-watt lamp generates approximately 10 lumens of light for each watt of current consumed, whereas a 1000-watt lamp generates approximately 20 lumens of light for each watt. In other words, a 1000-watt lamp is twice as efficient as a 40-watt lamp. It has been determined also that the higher the efficiency of the lamp the closer the color of the emitted light approaches daylight and the better its effect on plant growth.

SOME experiments have been made in connection with flashing lamps. Apparently if the lamps are on for periods of five seconds or less and then off for a corresponding period the effect on the plants is quite comparable to that of continuous light. The flashing cuts the total current consumption and lamp renewals nearly in half, offering an interesting possibility for economy in the use of lights in greenhouses. No matter what type of lamps are used they should be equipped with efficient reflectors to collect as much of the light as possible and concentrate it onto the plants.

An example of interest to demonstrate the value of supplemental lighting is that of the Santa Clara Ranch in California where botanists are developing new varieties of plants. Before supplemental lighting was used, this process took from three and a half to five years, as the plants had to be grown from seed, cross pollinated, and another crop—sometimes several crops—raised. Since artificial light and soil heating cable were installed to speed up the growth of the plants, this time has been cut approximately in half.

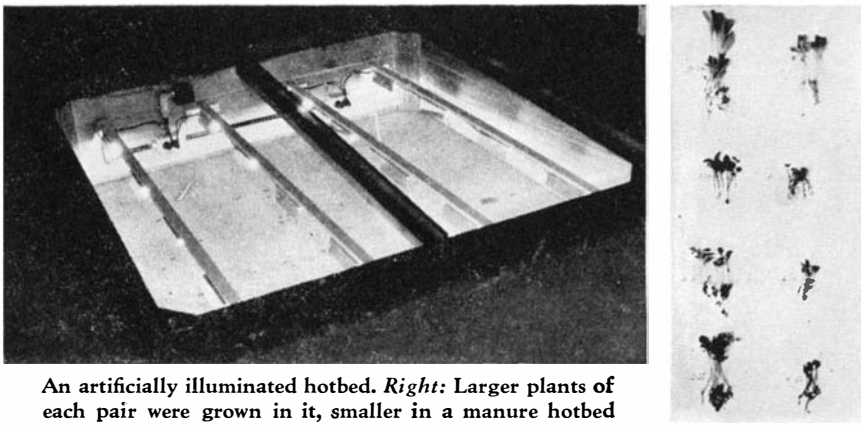
In Sioux City, Iowa, artificial light has been used in growing seed corn. By the use of 100-watt lamps over the plants, corn which was sowed on the 10th of January matured on the 1st of May.

Another interesting development is being carried on at the University of California where plants are being grown without soil. The bulbs or tubers are placed in a layer of straw held on wire netting at the surface of a tank of water which contains chemical nutrients, the roots going down into the water. By this means a much heavier crop of potatoes has been raised than has been possible when the potatoes are grown by the usual method in soil.

Several of the universities have been studying the possibility of growing plants in sand, furnishing the nourishment by means of liquid nutrients.

Perhaps the most interesting development in connection with greenhouses was an experiment conducted at the Boyce Thompson Institute for Plant Research last year. There a greenhouse was constructed in which the walls, floor and half of the roof were made of heat insulating material. There was a single row of glass sash in one side of the roof. This sash was set at such an angle as to admit the maximum amount of sunlight. The interior of the house was painted white to reflect such light as fell onto the walls back onto the plants. The only heat used in this house was that generated by the 500-watt Mazda lamps which were used for supplemental lighting on the plants. These lamps were thermostatically controlled to maintain a temperature of about 68 degrees, Fahrenheit. It was found that even during the coldest winter weather there was sufficient radiant energy in the sunlight coming through the single row of sash to maintain the temperature when the sun was shining. In fact, it was found necessary to open the sash and ventilate on many of the cold winter days. On cloudy days the lamps burned occasionally and during

Left, above, and upper right: **Comparisons of plants grown in an ordinary greenhouse (at left in each photograph) with those grown in the heat-insulated greenhouse illustrated at the top of the page**



An artificially illuminated hotbed. *Right:* Larger plants of each pair were grown in it, smaller in a manure hotbed

the night they were off and on for periods totalling approximately six hours per night.

The results obtained in this greenhouse were remarkable. Larger and better plants were grown than was possible in the conventional type of all-glass greenhouse. The plants in the heat-insulated house came into bloom in some cases eight weeks ahead of the controls in an ordinary type of greenhouse. It is believed that these experiments may revolutionize greenhouse construction and operation. It may be entirely practical to build greenhouses several stories high. Such houses would be more economical to construct, easier to operate, and would result in large savings where land values are high. Furthermore, this makes possible the construction of small private greenhouses fabricated at the factory and erected quickly and easily by the purchaser at a relatively low cost, since there is no heating equipment to purchase and maintain. The heat-insulated greenhouse enables the maintenance of higher humidity with less watering of the plants. In fact, with thermostatic control of the ventilation, a house of this sort would be almost entirely automatic in its operation, thus requiring a minimum amount of time and labor for its maintenance. There are already two concerns prepared to furnish greenhouses of this type.

ARTIFICIAL light has been successfully applied to hotbeds. Lamps have been used to heat the bed as well as to light it, and they also have been used in combination with soil-heating cable. (See also page 243, May 1935 Scientific American.—*Ed.*) Probably the best effect is obtained where soil heating cable is used to germinate the seeds and allow the plants to secure good root growth. After the seedlings are up, the lights are turned on to stimulate their growth. In one hotbed of this type 16 30-watt lamps were used in a six by six-foot hotbed. These lamps were equipped with aluminum reflectors made by bending up pieces of polished aluminum into troughs eight inches long by two inches wide by two inches deep. The advantage of this type of reflector over the conventional round commercial type reflector is that it does not cut off so much sunlight during the day. The lamps and reflectors are mounted on a simple wooden strip resting on cleats. Each strip is attached to an outlet box by a separable plug so that it may be easily removed when it is desired to work in the bed. The lamps are controlled by an automatic thermostat to maintain the desired temperature in the hotbed. The advantage of a bed of this type over the old fashioned manure heated bed is shown in one of the photographs in which the seedlings in the left hand row were planted at the same time that similar seedlings were planted in the manure type bed. The picture shows clearly the increased growth of the seedlings in the bed equipped with lamps.

***Above and right:* Two types of combination lamps and flower stands**

This same type of lighting equipment is particularly well suited for use in cold frames to protect the plants on occasional nights when the temperature goes below freezing. For this purpose two strips of two lamps each would be adequate for a six by six-foot bed.

There are few people who have the opportunity to use greenhouses, whereas almost every home has plants of one type or another. In the past it has been necessary to keep plants in the home close to the windows in order that they may have sufficient light to grow. The success of supplemental lighting in greenhouses led to the development of plant light fixtures for use in the home. These consist essentially of more or less conventional types of floor and table lamps, except that higher wattage bulbs are used and holders for flower pots have been attached to the fixtures. The latest plant light fixture consists of a semi-indirect floorstand type of lamp using the three-light lamp in which either 100, 200, or 300 watts may be obtained in the same bulb which contains a 100- and a 200-watt filament, either of which may be used separately or both together. This fixture is so designed as to put an intensity of about 300 footcandles on the plants, while the light outside of the area occupied by the plants meets the Illuminating Engineering Society's specifications for good reading intensities, absence of glare, and low intrinsic brilliancy from any part of the fixture in the direct line of vision. Units of this type are not only excellent reading lamps, but they also direct a sufficient amount of illumination up to the ceiling to provide excellent general lighting throughout an average room. The illustration directly below shows one of these combination flower stands and lamps in use.

PLANT light fixtures make it possible to grow plants in the home in locations far removed from the windows. It is necessary to burn the lamps in such fixtures only during the hours they would ordinarily be needed for general lighting purposes, namely from dusk until bedtime. For example, a plant light fixture may be located 15 feet from the nearest window and direct sunlight may never fall on the plant.

MINOR PLANETS — I

Thirty Thousand of Them Are Observable . . . Mass Production in Asteroid Discovery . . . Names For all of These Objects Are Becoming Hard to Find

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

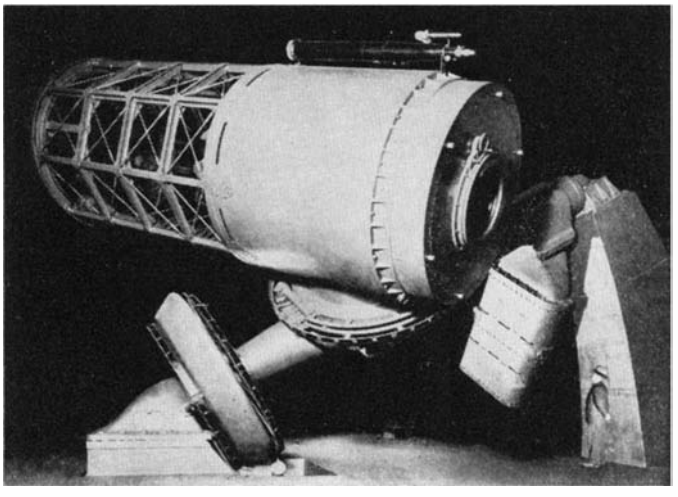
ONE of the difficulties of present-day scholarly work—whether in science or in other fields—is to find out what other people have done already. No one desires to spend his time in working out what has already been proved, or in laboriously collecting data which have already been published and thus put at the disposal of all investigators. But the earlier worker may have published his results—or a more or less adequate summary of them—in one of a dozen languages, and in any of hundreds of periodicals—or perhaps in a separate book, or a pamphlet of which few copies were circulated.

It is a real service to science to collect the scattered data and prepare a summary from which the would-be student may find what has been done and where to find the full account of it.

An excellent example of this has just appeared from the University of California—a volume of "Research Surveys of the Minor Planets," prepared by Professor Leuschner and his associates. Its preparation was no small task. All astronomers, and the majority of well-informed people, generally know that there are thousands of little planets in our system; but few, even among professionals, would have realized that a mere condensed summary of the work that has been done upon them would fill an octavo volume of more than 500 pages.

Even so, this list is confined to the 1091 planets discovered up to February, 1928. A manuscript continuation includes the rest of the 1301 asteroids for which reliable orbits had been computed by the end of the year 1934.

A complete discussion of the minor planets of our system—when and if the advance of observation and calculation might make its preparation possible—would fill not a volume, but a bookcase, for the rate of discovery is still rapid.



The new reflector for the McDonald Observatory in Texas, just completed by Warner and Swasey, as mentioned on page 115. The mirror, according to the makers, is either 80 or 82 inches in diameter (both dimensions are given), and the blank is Pyrex brand glass, ribbed in the manner of the big 200-inch disk. This reduces its weight to only 5600 pounds, while the moving parts of the telescope weigh 45 tons. The mounting is unusual, the counterweight being offset and placed near the northern pier, in order, it is said, to avoid interference with the hydraulic hoists which operate the two platforms for the Cassegrainian arrangement. Note the ruggedness of this huge mounting, comparing its parts with the man standing in front of the northern pier. The declination bearing is especially large. The focal length is 312 inches, and the makers of the mounting figured the mirror. The design is said to be that of E. P. Burrell of Warner and Swasey

Baade, from the number of faint and previously unknown planets found on Mt. Wilson plates, estimates that the whole number observable with great telescopes is of the order of 30,000.

The total amount of labor which has already been expended upon the known asteroids is staggering to contemplate. Probably the heaviest part of this is concealed behind the single statement that 322 planets had been discovered by visual observation before 1893.

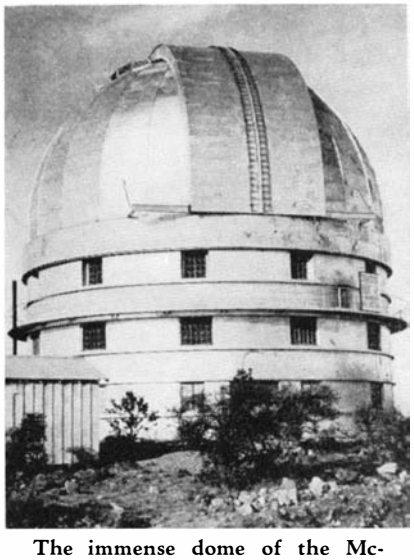
The first discovery of all—that of Ceres by Piazzi on the first night of the 19th Century, was one of those happy accidents to which the world owes so much. Piazzi, in preparing an extensive catalogue of telescopic stars, was searching for a star listed in an earlier publication as "Mayer 87"—that is, No. 87 in Mayer's Catalogue. There was no star in this catalogue in the position given; and while searching the sky to find out what was wrong, Piazzi found a moving, star-like object which, upon further observation, turned out to be a new planet in the gap between Mars and Jupiter. The original puzzle was later solved by finding that the star was No. 87 in Lacaille's Catalogue—not Mayer's—so that a slip of the compiler's pen led to the first discovery of a minor planet!

Inspired by this discovery, astronomers for a decade searched the heavens near the ecliptic, making charts of the telescopic stars, with enormous pains, and comparing them again and again with the sky, to see if anything new appeared. Three more planets were found in this way, by 1807, and nothing more for nearly 40 years. Finally, in 1845, an amateur astronomer, Hencke, who had worked for 15 years, charting fainter stars than his predecessors, found a fifth planet, and another in 1847. Since that time, every year has brought its new discoveries. Considering the very laborious method which was alone available, the discovery of 317 planets in less than half a century shows how keen were the star-gazers of a time when the astronomers' attention was less diverted than it is now into the fascinating realms of physics.

MASS-PRODUCTION in asteroid discovery came in shortly after 1890, when Max Wolf of Heidelberg applied photography. A camera, with a wide angle lens of several inches aperture, is mounted so that any desired star-field may be followed for an exposure of some hours. With careful guiding, the stars appear as small black dots on the negative. Any asteroids in the field, having moved during the exposure, appear as trails—recognizable at once.

A still more effective method was introduced later by J. H. Metcalf—an American clergyman, who designed and constructed large lenses of the highest quality as a recreation. By moving the plate slowly during the exposure, in the direction and at the rate at which an asteroid might be expected to move, the star images are drawn out into trails, while those of the planets are reduced almost to dots (not quite, because the individual planet will not move at the average rate). This concentrates the light of the asteroids, which we want, and weakens that of the stars, which we needn't bother about, and so permits the discovery of much fainter objects.

WITH these powerful methods, the rate of discovery increased so fast that it was no longer possible to keep track of all that were found. Before a fairly reliable orbit can be calculated for a planet, three good observations of its position in the heavens, at intervals of a fortnight or so, must be available. There are two serious obstacles to securing such observations—the weather and the moon. A series of successive cloudy nights may interfere with observations of a newly discovered planet until it has moved so far that the rough prediction which is possible from the direction and length of the original trail no longer suffices to find it; and too often, when the weather clears, the moon is bright and its light fogs the plate if long exposures are attempted. Even when the asteroids are the primary objects of observation, something like half of them are liable to be lost again before enough observations for a good orbit have been secured. Moreover, numerous trails of asteroids (for the most part previously unknown) are found on plates taken for other purposes, such as the search at the Lowell Observatory which resulted in the discovery of Pluto. These trails are marked on the plates for future measurement, but as they are wholly incidental to the main program, it may be years before the measures are completed and the results published.



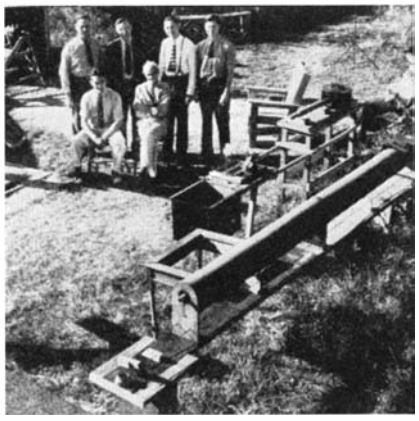
The immense dome of the McDonald Observatory, which has been built on top of Mt. Locke, in the Davis Mountains, 42 miles from Marfa, Texas, at an elevation of 7000 feet. The observatory was built by the University of Texas, and personnel for its operation will be furnished by Yerkes Observatory under the directorship of Dr. Otto Struve. The big dome is 62 feet in diameter and the cylindrical part on which it is placed is 71 feet in height. It has two separate stories beneath the rising floor of the dome, in which are the offices, library, living and sleeping quarters of the staff, also developing rooms. Every moving part of the dome and telescope may be operated from one small flexible cable in the hands of the observer, merely by pushing different buttons on a small panel

Astronomical literature, therefore, contains a steadily increasing storehouse of observations of minor planets for which orbits cannot yet be computed, but which may be utilized in future. They are, indeed, continually proving of value. When a minor planet has been well enough observed to get a trustworthy orbit, the practiced computer (like those of the Recheninstitut at Berlin) may calculate its position in the sky previous to the discovery, choosing, of course, dates when it was nearly in opposition to the sun, since this region of the sky is preferred by the asteroid-hunters. It is fairly common to find that some one of the hundreds of insufficiently observed planets was so close to the calculated position as to make identity probable. More detailed calculation will then settle this question.

The new survey lists 15 cases in which a planet turned out to have been discovered and lost again in two different years before its orbit was at last determined, and two cases in which this happened three times! Single instances are very numerous.

When at last a good enough orbit has been determined to convince the experts of the Recheninstitut (which acts as a sort of international clearing-house) that its position may be predicted for some years to come, it receives a permanent number, a place in the list, and its discoverer may give it a name.

For the first hundred planets or so, these names were taken from classical mythology or geography, but, with the present horde of aspirants, the legends of antiquity are pretty well exhausted, and a fairly wide tolerance rules, except for the convention that the names must be feminine—with the exception of certain interesting bodies which lie at the very inner edge of the great swarm, such as Eros, or at its outer fringe like the "Trojan group," which have substantially the same period as Jupiter, and have been called after Homeric heroes.



A Hale spectroheliograph and solar spectroscope, made by Samuel S. Waters of the Amateur Telescope Makers of Indianapolis, Indiana

Even the femininity of the names persists only as a matter of form—at least, such names as Chicago, Ohio, and Berkeley have been accepted for American discoveries.

A tendency to give honorary names recalling past worthies has recently been manifest: For example, asteroid number 1000 is named Piazzia, in honor of the discovery of the first; and 1001 Gaussia, in memory of the great mathematician who, faced with the unprecedented problem of calculating the orbit of a planet from observations covering only a few months, solved it so successfully that the planet (Ceres) was observed near the calculated position the following year—while the same method of calculation, with minor changes, is still in use. Not all the individuals thus honored are of a past century, nor of the Old World. Pickeringia and Frostia, for example, recall memories of friendship, as well as of scientific eminence, to many of the guild of American astronomers, while the originals of Rockefellia (904) and Hooveria (932) are not far to seek.

A NEW departure, promising an extensive addition to the list of available names, has recently appeared. Planets bear the accepted official names of Petunia, Primula, Azalea, Magnolia, Aquilegia, Lobelia, Campanula, and others of the same sort. All the members of the celestial garden have been discovered by Reinmuth of Heidelberg—whose hobby may perhaps be suspected.

When a planet has thus been provided with an orbit (that is, with one whose size, shape, and position we know), a number, and a name, one might suppose that the astronomers' work was well toward completion. In fact, all the hardest part is still to do: but the rest of the tale must wait till next month.—*Princeton University Observatory, January 5, 1936.*

In Case of War

Civilian Activities Demand Certain Essential Imports . . . War or Sanctions Would Stop Them . . . What They Are . . . Scientific Substitutes

By PHILIP H. SMITH

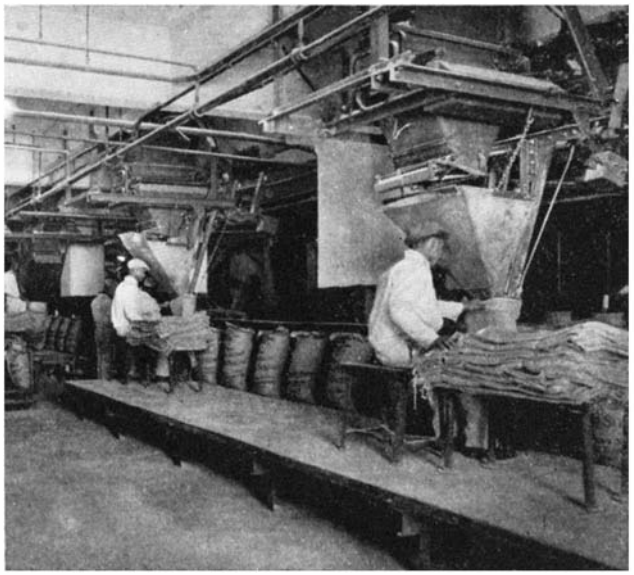
SUPPOSE the United States were cut off from the rest of the world by rigid sanctions imposed on a group of warring nations, by an isolationist neutrality act, or by a war of our own. Imagine the worst possible situation, with Canada and the countries south of us included among those to whom we could not have access. How long could we carry on civilian life? How long, if conducting a war, could we carry it on?

This supposition, improbable but not impossible, raises the question: "What materials would be war essentials for us?" We have been hearing a great deal of discussion as to what materials are and are not essentials to other nations, and the issue is not without its boomerang. It is obvious that a line drawn between materials used for war and civilian purposes is wholly imaginary. The bone and sinews of a military machine are the bone and sinews of a modern civilization. An act of war merely deflects the course a few degrees off center. At the risk of uttering a generality that glitters, it can be said that a war material, by and large, is a material essential to national life and often one which a nation does not possess as a domestic resource. The United States has its vulnerable spots—lack of domestic supplies of essential materials—and we need to know what they are and what can be done about the whole situation.

Military men ponder over this problem. It is part of their job as strategists. Based upon the above supposition, which rules out all "ifs" and "buts," our War Department states that we have just 26 tender spots—26 raw materials for which we depend upon outside sources either because we cannot produce them ourselves or, at best, cannot produce them in sufficient volume. The number is by no means large and it tends to diminish, but strategic importance is concerned much more with the question of *what* is lacking than with mere number. The "what" in this case includes eight metals, two minerals, two food products, and a miscellany of 14 vegetable and fibrous materials. Their importance ranges all the way from the vitally-needed manganese, with which most experts would top the list, to coffee, which could be replaced quite simply with cereals.

Manganese we must have for civilian as well as military use. Ferro grade manganese ore—ore having 50 percent or more manganese content—is the source of ferro-manganese which is essential to the manufacture of steel. It serves as a scavenging agent because of its affinity for oxygen and sulfur, and it imparts toughness and hardness to the finished product.

Domestic deposits of this ore are far from adequate, even for a depression-time use; commercial tonnage comes principally from Russia and, to a lesser extent, from Brazil, British India, Gold Coast, and Cuba. Our low grade ores, the ferruginous and manganiferous ores, while bountiful enough to provide for certain types of alloy steel manufacture and the production of pig iron, could not be made to serve all our needs and no substitute has been discovered.



The sugar industry would be seriously hampered by any interference with imports, and the nation would suffer

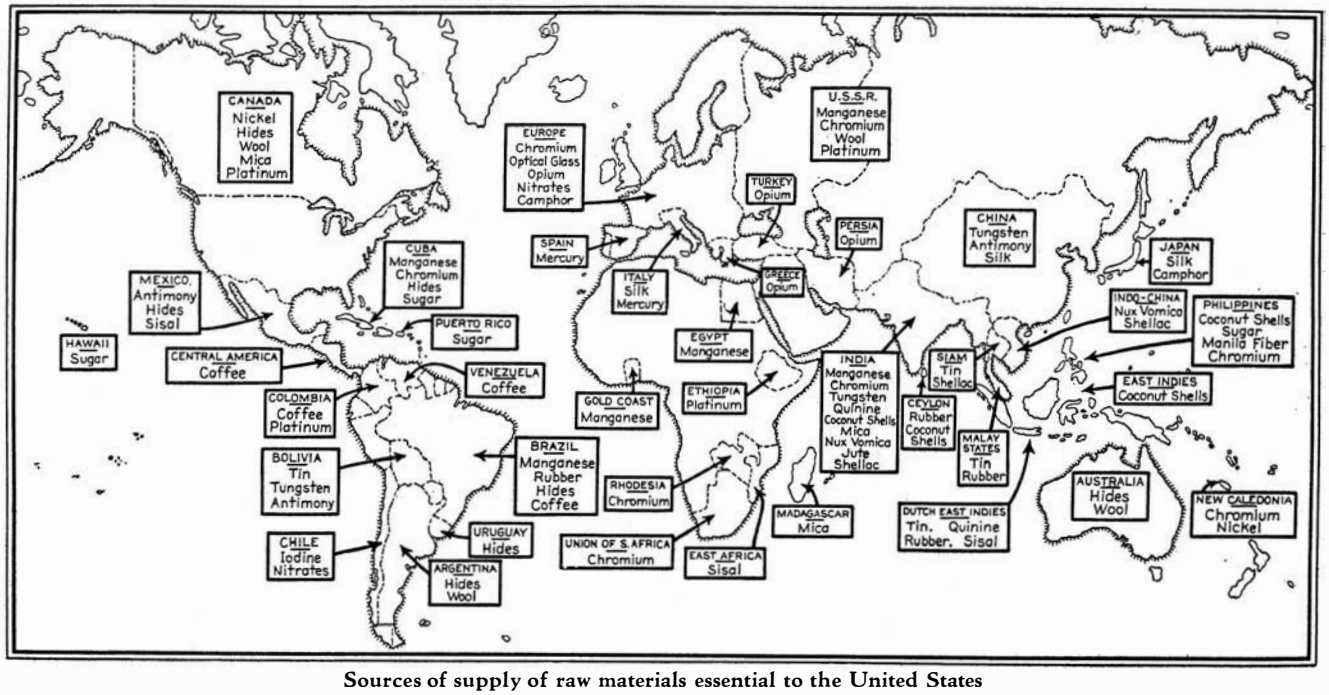
STRATEGIC RAW MATERIALS

Antimony	Nitrates
Camphor	Nux Vomica
Chromium	Opium
Cocoanut Shells	Platinum
Coffee	Quinine
Hides	Rubber
Iodine	Shellac
Jute	Silk
Manganese	Sisal
Manila Fiber	Sugar
Mercury	Tin
Mica	Tungsten
Nickel	Wool

CHROMITE ore is a close second to manganese in military and civilian importance, since chromium has come to play a large rôle in metallurgy. It is an almost indispensable alloying element in high grade steels; it has wide use in electroplating; and it is used for refractories, for pigments and for tanning certain types of leather. The United States once led the world in chromium production, but for the last 50 years imports have predominated and principal sources are now Rhodesia, Cuba, New Caledonia, Greece, and the practically unexploited Philippine ores.

The chromium situation can hardly be called as critical as that of manganese. We possess small deposits of high grade ore and considerable holdings of low grade. And, thanks to comparatively recent research, substitution has already gone forward. In certain high grade steels, molybdenum is being used instead of chromium, either straight or in conjunction with nickel; and since supplies of molybdenum are probably inexhaustible we can expect further substitution along this line.

Under conditions of extreme emergency, present consumption of chromium could be curtailed as much as 30 percent, according to some authorities. The motoring public could forego chromium plating on its motor cars; magnesite could be used for refractories, though not as efficiently; the employ-



Sources of supply of raw materials essential to the United States

ment of chromium for dyes and tanning could be dispensed with altogether. The needed balance could be very largely met by development of domestic production from both high and low grade ores, at a price.

Much has been written about the indispensable nature of tin, which is now classed as a strategic war material, but recent developments hint that the time may come when even this unique metal can be dropped from the list. The principal uses of tin are for the plating of metal containers; as a constituent of bearing metal, solder, and bronze; for tin plate, tin foil, collapsible tubes, and tin foil condensers. We have no domestic tin and must get it from the Malay States, Bolivia, Dutch East Indies, Siam, or China.

Today there are few, if any, uses for tin which cannot be handled by substitutes, and perhaps the artificial control of tin output with its resultant high price has been responsible for the search for substitutes. While tinned containers could be replaced with glass for the preservation of food, it would be at great inconvenience, and substitution is likely to be of another type. Two substitutes are on the way and give promise of success. Recently a method has been perfected for plating steel or iron with aluminum which would provide an aluminum can. Synthetic resins of the vinyl type are now being used as a coating over tin for the lining of cans and it is possible, by using this lacquer directly over the can base, to do away with tin altogether. That this has not yet been done on a commercial scale is due more to existing manufacturing set-ups and technical problems than to ultimate feasibility.

Aluminum can replace tin plate and is already being widely used for foils and collapsible tubes, and could be used for condensers. Your tooth-paste tube and the foil around the bar of chocolate you purchase are most likely made of aluminum, even now. During the past two years, research on bearing metals has brought into use cadmium-silver-copper bearings, while for solder we have lead-cadmium-zinc, and silicon in place of tin for bronze. It would be unwise, however, to bank too heavily on cadmium as a substitute for tin, because demand has already outstripped supply. Domestic cadmium is a by-product in the recovery of zinc from zinc ores and is available as yet only in relatively small amounts.

In the last analysis, tin is a convenience rather than a vital necessity and the recovery of this metal by the detinning of scrap could go far to supply needs for which there are no completely satisfactory substitutes.

TUNGSTEN, another of the strategic metals, has been of greater importance in the past than it is today, thanks to research leading to substitutes. Domestic reserves of tungsten are wholly inadequate for our needs, hence reliance upon these substitutes has become imperative. The two uses for which no replacement is at present possible are as electric contacts and as a component of tungsten carbide, that phenomenally hard substance used for dies and cutting tools. Molybdenum is now partially replacing tungsten in high speed tool steels: in the formula 18 tungsten, 4 chromium, 1 vanadium, the addition of 8 percent molybdenum reduces the tungsten to 2 percent. It is also replacing tungsten in high creep strength steels. Tungsten in armor-piercing bullet cores can be replaced with carbon steel, while its place in civilian life as filaments in electric lights can be taken over by carbon filaments, though there are many installations where vapor lamps would serve infinitely better.

Indicative of the improved strategic position is the fact that tungsten consumption has not risen proportionately with industrial expansion. This is attributable to more economical use and to efficiency in sec-

Agriculture still depends to some extent on imported nitrates. Agricultural machinery needs imported metals

ondary recovery of the valuable metal.

Nickel occupies a unique position among the metals. It is the most widely used of alloying metals and is almost indispensable in war materials manufacture, but available stocks and the opportunities for curtailing use, coupled with the fact that the source of nickel is almost wholly concentrated just over the border in Canada, minimizes concern over supply. Nickel is still an important element in the nickel-chromium-molybdenum steels, but in certain steels molybdenum can completely replace nickel. There is no substitute for nickel as the dominant element in Monel metal, but the use of Monel metal itself could be curtailed.

ELECTROPLATING could be virtually eliminated as a consumer of nickel, if necessary. If corrosion resistance is sought, cadmium can be used, but since supplies of this substitute are not large, it is likely that there would be a return to the use of zinc. Even now the scant supply of cadmium is forcing a move in that direction. One source of nickel to be counted upon is our coinage. Although our nickel piece contains only 25 percent pure nickel, its recall would yield more than 1500 tons of the metal. Were we, in times of peace, to follow the practice of some European nations and issue coinage of pure nickel, reserves might be increased by many thousand tons.

Of the three remaining metals, antimony, mercury, and platinum, antimony may be said to figure most critically. The situation is, however, greatly relieved by a peculiarity which is regarded as unfortunate in peace time by those who like to see consumption mount. It is that a major proportion of antimony which goes into commercial channels is recovered.

The principal uses for antimony are the strictly military ones of hardening the lead in shrapnel bullets, of making a dense smoke in explosives and in making the priming mixtures for cartridges. In the first mentioned use, there can be substituted Frary metal—a composition of lead, calcium, and barium. The recoverable uses are the civilian ones where antimony is used in type metal and bearing metals and to harden the lead in battery plates. Military authorities now claim that all emergencies can be met by curtailing consumption in non-essential fields, by using substitutes, and by speeding up secondary recovery.

Transportation needs quantities of rubber

Some mercury is produced in the United States, though supplies are obtained chiefly from Spain and Italy. If we were to have such high prices as would stimulate "uneconomic" production, and if we employed all possible substitution, there is every possibility that we would survive the scarcity of this metal. Mercury is used in the fulminates of explosives, but non-mercurial substitutes are available. It is also widely used in drugs, and, while substitutes are few, a sharp curtailment could be withstood.

Platinum, which is obtained principally from Russia, is listed as a strategic material although there are broad possibilities of substitution. For example: platinized silica-gel will cut the use of platinum as a catalyzer in the manufacture of sulfuric acid; tungsten, palladium, and silver are being used for electrical contacts; stainless steel, chromium, quartz, and many other things will serve for practically all laboratory ware; that leaves precision instruments as the only item requiring platinum. Considering the vast amount of platinum jewelry adorning civilians of the nation, all vital needs could be met by a call to patriotism.

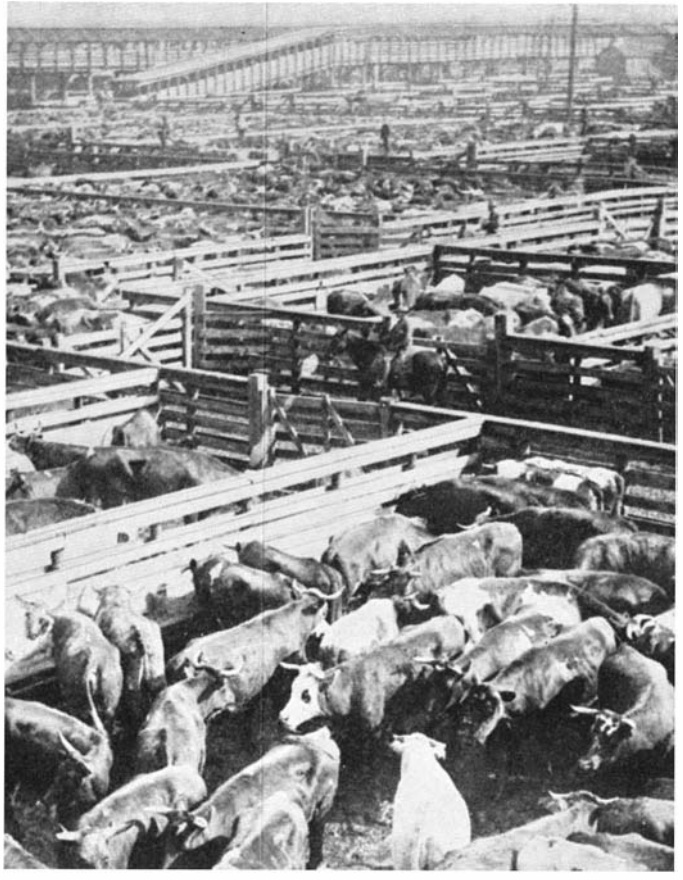
Military conflict would make scrap metal a more widely appreciated natural resource. We have all read reports of heavy purchasing of scrap by foreign powers, of the melting down of metal ships, and of the struggle to collect old machinery. However, our interest here is in scrap as a means to conserve and bring into use again strategic metal alloys, rather than as a source of iron and steel, though that, too, is important because it conserves power. Manganese cannot be recovered nor our requirements reduced by remelting scrap metal, but nickel can be salvaged and so can a certain amount of the chromium content of some alloys. Tin, tungsten, nickel, and antimony already figure importantly in secondary recovery. Presumably an already well-organized scrap metal industry could co-operate to supply even more highly selected alloyed scrap for military needs if there were occasion for it. But the steel industry would have to make further progress in the use of scrap before this source would suffice.

What other materials are vital to our war needs? The two minerals are mica and nitrates. Of small flake mica we have plenty, and our concern is with the sheet form. Given time to develop domestic resources and, meanwhile, substituting porcelain and glass wherever possible, all needs for mica as an insulating material could be met.

THERE is no question about the essential character of nitrates from which nitric acid, explosives, and fertilizer are made. There are no substitutes, but there is every indication that we now have the power and equipment to produce all the nitrates necessary. If we lacked the facilities for production, this particular item would have to be put at the head of the list, but the production impetus given by the World War has carried us beyond any critical period.

The miscellany which comprises the remainder of the War Department's classification of raw materials can be dismissed briefly, with few exceptions. We should have silk for parachutes; but powder bags, cable coverings, and clothing could be taken care of with cotton or rayon, Manila fiber could be replaced by hemp and cotton for cordage, and by wire and cotton for rope. Jute, which

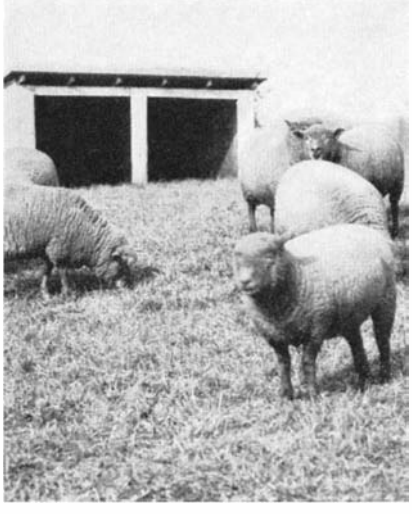
s play a very important rôle in normal American life, and t quantities of them are imported. See map on preceding page



goes into burlap and floor covering bases, would yield to cotton; while hemp, cotton, flax, and paper could replace sisal in cordage. Wool and hides we produce in huge volume, but civilians might have to scrimp in time of war. For both these products there is a vast array of substitutes, cotton and artificial leather being the most obvious.

The situation with rubber is quite another matter. The British Empire controls 87 percent of the world's supply and we normally consume about 80 percent. Here is a raw material of vital importance both to armies and civilians, for both are now motorized to a degree where sharp curtailment in supplies would cause a serious dislocation of all activities. The bulk of rubber imports comes from the Malay States, Dutch East Indies, and Ceylon, the countries of the western hemisphere accounting for less than 2 percent. This permits easy stoppage of imports.

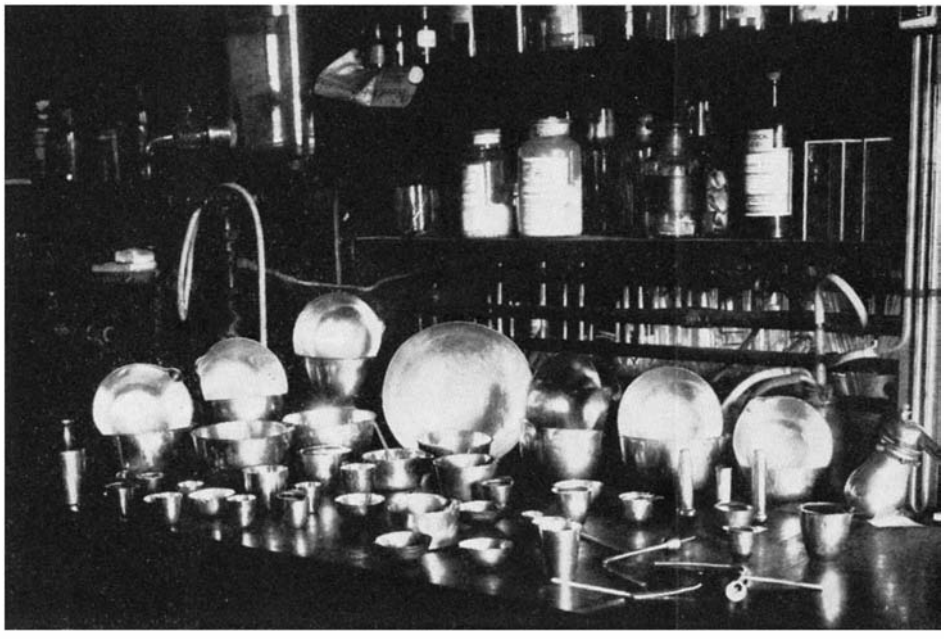
HOWEVER, the worst has been said. The possibilities are that rubber will become less of a problem as time goes on. Chemists have been extremely successful in developing synthetic rubbers so that, in time, military needs might be met with substitutes. Duprene, Thiokol, and Koroseal are laboratory products gradually entering into commerce. High production cost, which stands in the way of their exploitation, is a problem which is slowly being solved, and cost is not the primary factor



Wool is an essential commodity of which this country has but little

in wartime. Hope is expressed that rubber can be obtained from domestic products, Edison's goldenrod-rubber experiments showing the way.

Two more possibilities contribute toward making the rubber war-time picture more optimistic. Reclamation of scrap rubber now accounts for about one third of the total rubber consumed annually in this country, and this could be stepped up considerably in an emergency. Retreading of old tires affords the second important opportunity.



Platinum, which must be imported, finds use not only in the laboratory but in indus

Research has also brought relief for three other products listed as strategic. Iodine, used for drugs, dyes, and photography, comes mainly from Chile, but recovery from oil well brines is being carried out successfully in California and all needs can thus be met. Camphor is being made synthetically from turpentine; and shellac, which normally goes into paints, varnishes, plastics, and binders, can be replaced by nitrocellulose lacquers and synthetic resins.

The two strategic foods can be managed with a fair degree of ease. Sugar supplies can be augmented by corn, grape, and maple sugars and by saccharine; coffee can be replaced by cereals as it was in Germany during the World War. This leaves four raw materials for which no substitutes are available. They are quinine, nux vomica, opium, and cocoanut shells, this last used in the manufacture of activated carbon for gas masks.

We should recall here that the foregoing list of raw materials is compiled on an assumption of complete stoppage of trade. This is, of course, hardly probable. If we assume an alignment of nations, the picture immediately changes and changes with every grouping one can conceive. Should trade routes to our southern neighbors remain open, for example, the war situation would be immensely simplified, as can be seen by reference to the source map.

Successful procurement of raw materials depends upon many things. Immediate sequestration of existing stocks would be the first step, then regulation of use. Control which would cut off unnecessary consumption would solve any problem relating to wool, hides, opium, quinine, sugar, and coffee. Certain of the materials—notably manganese, chromium, nickel, tungsten, tin, and rubber—are held in storage in considerable volume against later commercial use. These stocks could be sequestered. Nickel and platinum stocks could be augmented by calling in currency and jewelry, respectively.

PERSONS at all familiar with the raw materials problem must be struck with the enormous advances made toward self-sufficiency since the World War. Artificial nitrates, synthetic camphor and rubber, iodine extraction, and synthetic resins are all post-war developments. The outcome may shortly be a smaller list of essentials. Chemistry has done much to free this country from dependency upon the rest of the world. The aims of chemistry may not be grounded in war conditions and many of its contributions are quite accidental (commercial supply and demand governs research more than war threats) but the fruit is rich enough to warrant a great deal of faith being placed in the laboratory.

Another possible contribution to the solution of the problem arises from the use of airplanes in mining operations. A difficulty in procuring several domestic metals has been the remoteness of deposits and the lack of transportation facilities. Now comes the airplane to offer a solution. There are today mines in Alaska which have been opened, equipped, and had ores removed from them with no other facilities than aircraft. Does this not suggest practicability in event of war?

Our own peculiar position is most strikingly brought out by this compilation of strategic products. The total absence from this list of such vitally important products as wheat, coal, oil, iron, copper, and cotton is particularly significant. It is the lack of such items which gives the war strategists of almost all other countries of the world an insoluble problem with which to wrestle. That they are no concern of the United States simply means that Nature favored us when distributing the raw materials of the earth and perhaps she did so in the interests of peace rather than war.

WHY AREN'T MORE WOMEN ATHLETES?

Exceptions . . . Muscular Development Interferes with Motherhood . . . Women Tend to Shun Competition

By DONALD A. LAIRD, Ph.D., Sci.D.
Psychological Laboratory, Hamilton, New York

IF the average woman's credit were better, women would be better athletes than they are. And thereby hangs an interesting story, as we shall see as we read on.

There have always been a few outstanding, and exceptional, women athletes—such as Helen Wills Moody, Eleanor Holm, Babe Didrikson; or 19-year-old Virne Beatrice Mitchell who received 1000 dollars a month as pitcher for the House of David baseball team; or 25-year-old Georgia Englehardt who has scaled nearly 100 of the loftiest mountains; or Marjorie Foster who defeated 99 men, all soldiers, and won the King's rifle match in England.

Such energetic women are exceptions to the rule, for women have many characteristics which definitely place them at a disadvantage in such so-called manly pursuits. For one thing, men are more pugnacious and self-assertive than women. As a rule women do not like open competition.

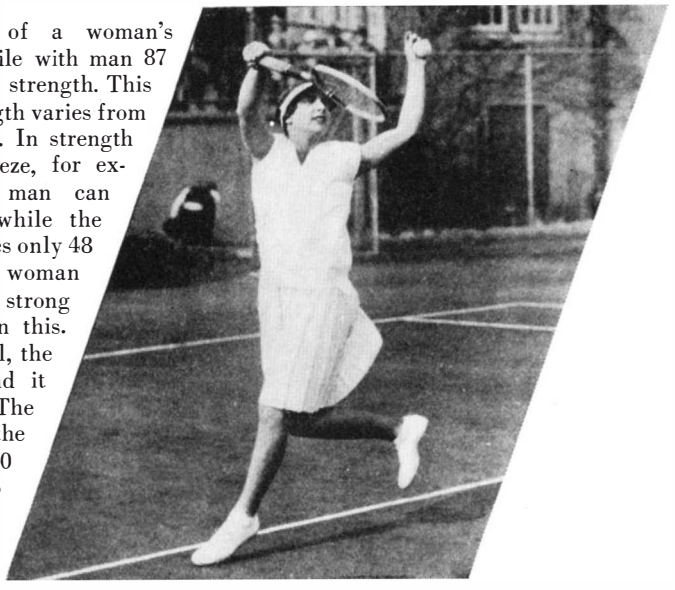
The average woman's strength also keeps her from being much of an athlete. Of course women are not as large as men, being an average of some five inches shorter. But the differences in the relative strength of the two sexes are greater than any differences in mere size. The average woman's body, for example, is slightly less than one third muscle, while the average man's is slightly more than one third muscle. Women's muscles are proportionately longer and thinner, and their muscle fibers are less viscous.

Fifty-four percent of a woman's weight is strength, while with man 87 percent of his weight is strength. This ratio of weight to strength varies from one muscle to another. In strength of grip, or hand-squeeze, for example, the average man can squeeze 81 pounds, while the average woman squeezes only 48 pounds. Scarcely one woman out of a thousand is as strong as the average man in this.

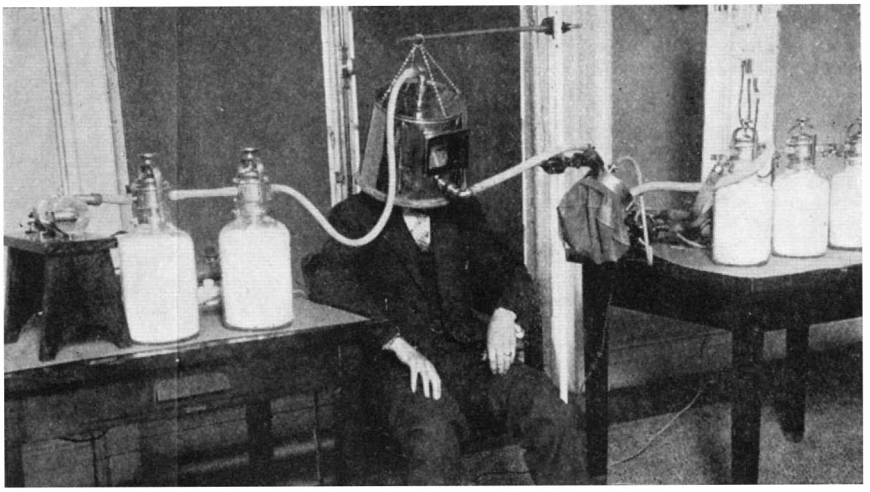
In driving a golf ball, the average man can send it from 120 to 140 yards. The average woman drives the same ball only 70 or 100 yards. When it comes to the high vault, the record for men is twice that of women.

In socking the baseball out into center field, too, the men can bat it about twice as far as women. All in all, men's athletic records are about half as good again as women's. The women who swam the English Channel have shown undenied endurance, but they have not approached the average time of the many men who have swum the same channel.

Differences in muscular strength are one obvious reason for the athletic differences between the sexes. Strength, however, is only one of a number of peculiarities. The joint surfaces of women are smaller, just as their individual muscles are relatively longer and thinner than men's, and this contributes to their lack of athletic excellence.



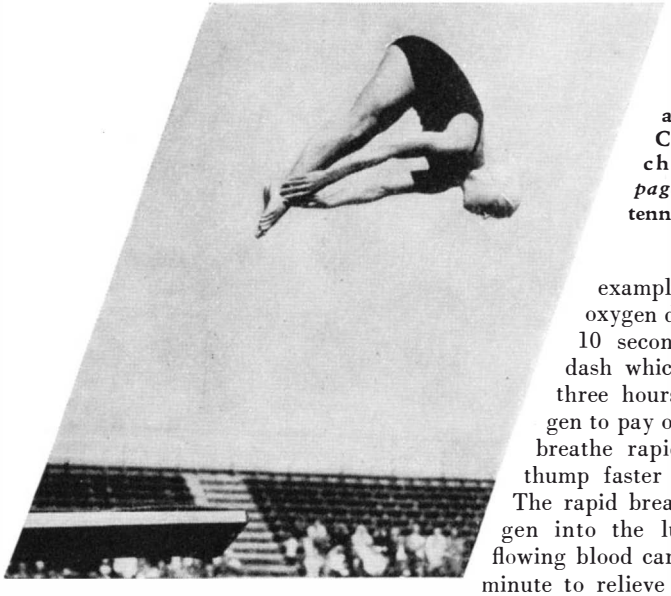
Although women's muscles may be able to move just as rapidly as a man's, yet women do not use them as rapidly. Something happens in woman's nervous system that slows down her reactions. Dr. L. M. Gibson has found that women show a very marked delay in their decision time. That this slowness is not due to changing their minds, but primarily to delay in reacting, is shown by a study reported in 1933 by Dr. Edwin G. Flemming, the brilliant New York City psychologist, who concluded that "women do not change their minds to a greater extent than men; in fact, the situation is, if anything, just the reverse."



A helmet invented by Prof. Frances G. Benedict to be used for studying the chemistry of breathing. Oxygen "credit" is of very great importance to athletes

In line with this is the finding made by Prof. C. E. Tucker of the Massachusetts Institute of Technology that it takes the average man 70/100 of a second to apply the brakes of his automobile after he sees the "stop" signal on the car ahead of him, but that it takes a woman 87/100 of a second to perform the same operation under the same conditions. Almost half of the women, in fact, required a full second or more to get the brake pedal down.

This delayed decision time, of course, is a disadvantage in co-operative games. The base-ball player must make a quick decision whether to throw the ball to first base or third base, whether to steal another base or stick close to the bag. In football the decisions are still more important. This, as much as any intrinsic differences in strength or endurance, is why the rules under which women play basket ball, for example, are so different from the rules for the man's game.



Exceptions to the general rule: ***Above:*** **Mildred ("Babe") Didrikson, all-around athlete.** ***Left:*** **Georgia Coleman, swimming champion.** ***Opposite page:*** **Helen Wills Moody, tennis ace who came back**

Women's bones help to make her superior in dancing, although they may make her deficient in other exercises. Not only are her joint surfaces smaller, and her elbows and knees knocked-in a bit, but the proportions of her bones are different. Her legs are short in comparison with her trunk length. That handicaps her, of course, in jumping or running, since she cannot cover as much territory in a single stride as a smaller and weaker man can.

Her relatively short legs, however, make it easy for her to bend at the waist and touch the floor with the tips of her fingers, without bending her knees. The average man's long legs keep him so high up in the air that it takes long practice for him to do this thing which almost any woman can do the first time she tries.

Men's shoulders are distinctly broader, while it is women's hips which are wider. And it is these bony differences which contain the secret of woman's relatively limited endurance. Broad shoulders indicate ample development of heart and lungs, which provide the "credit" needed for athletic work.

Dr. A. V. Hill, the distinguished English physiologist, has pointed out how muscular work is done on credit, by running up an oxygen debt. When a muscle contracts, chemical changes take place. The by-products of this change can be eliminated only by oxygen carried to the muscles by the blood. When a person engages in some strenuous activity, the by-products accumulate much faster than the regular blood oxygen supply can convert them into less-poisonous substances. The hard-working athlete actually poisons himself.

The skilled man runner, for example, will accumulate an oxygen debt of this sort in the 10 seconds of the 100 yard dash which it requires two or three hours for the blood oxygen to pay off. That is why people breathe rapidly and their hearts thump faster after some exertion. The rapid breathing gets more oxygen into the lungs and the faster flowing blood carries more of it every minute to relieve the condition of the semi-poisoned muscles—poisoned with the products of their own exertion until with time these are removed.

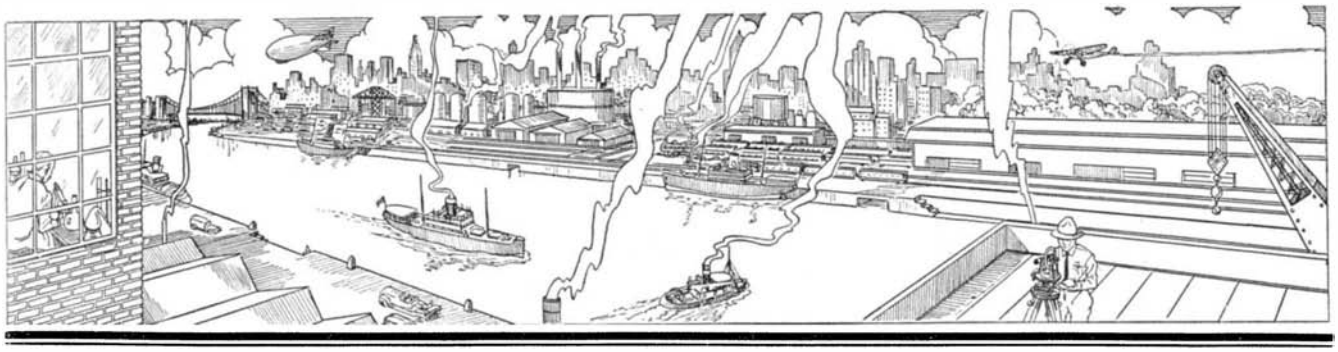
But the average woman has her greater development in stomach and other organs of her abdomen. Her lungs are not sized as generously as man's, and it is difficult for her lungs to take in enough oxygen to pay off the oxygen debt. Her blood itself would not absorb as much oxygen, even if her lungs took it in, for she has about one fourth fewer red cells, and those are the ones which carry oxygen to relieve the half-narcotized muscles.

Women athletes, soldiers, and bull-fighters need not only the lung development of the average man, but also the oxygen carrying power of man's blood. Channel swimmers, such as Gertrude Ederle and the other half-dozen women who have negotiated the English Channel, have most need for these two vital things, for the long continued exertion of swimming such a distance would otherwise run up such a terrific oxygen debt that it could hardly ever be paid off.

Anthropmetric measurements indicate that women have been gradually increasing in muscular strength in recent years. Dr. Knight Dunlap, psychologist at Johns Hopkins University, reports that "it is interesting to note that year by year, as girls and young women go in more and more for athletics, sports, and outdoor life, the track, field, and strength test records for women approach nearer and nearer to those for men. Laboratory records will probably show that the resistance to fatigue of these hardier women approaches male standards."

It may be a good thing, however, that women are not as a general rule interested in athletic things and the development of more powerful muscles, for it has been noted by many scientific observers that feminine muscular development interferes with motherhood. What woman needs—and has—is a good system of involuntary muscles, not bulging biceps or the hand-squeeze of a sailor. She has plenty of muscle and oxygen carrying power for simple household tasks which take plenty of oxygen. She has ample development for a multitude of light office and factory work. But men should keep her away from the heavier tasks, both out of chivalry and good sense. She can stand loss of food and deprivation of sleep better than can men, and has greater resistance to many diseases. But measured by strength or any athletic endeavors, she justly belongs to the weaker sex. Hardier perhaps, but at the same time undeniably weaker.

"Women have more strength in their looks than we have in our laws," wrote Saville, "more power by their tears than we have by our arguments." Which consideration makes the odds about even again.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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Laboratory Earthquakes

A NEW type of shaking table has been built at the Massachusetts Institute of Technology for studying the destructive effects of earthquakes on buildings and other engineering structures. This machine makes it possible for the first time to duplicate in the laboratory the motions of destructive earthquakes directly from seismograph records.

The laboratory earthquake equipment set up to test a model tank

In the foreground of our illustration, Arthur C. Ruge, research associate in the Department of Civil Engineering, who designed the machine, is adjusting the optical system and electrical "thinking" device, which has an electric eye that follows the wavy outline of the shadowgraph of an earthquake record. The white shadowgraph in front of him is a seismograph record of the Long Beach, California, earthquake of 1933. A pencil of light is the only connection between this device and the shaking table on which the scale model of an elevated water tank is being tested.

Beyond the model is the driving mechanism, including an oil-actuated piston which moves the table under the control of a very sensitive, quick-acting valve which transmits to the piston every detail of the earthquake waves as they are seen on the shadowgraph by the electric eye. The model of the water tank under test is five feet high and holds 40 pounds of water. The new machine makes it possible to see just what might have happened to a full-size structure of like design in the Long Beach earthquake.

PETROLEUM RESERVES

ACCORDING to the American Petroleum Institute, proved underground reserves of petroleum in known fields of the United States are 12,177,000,000 barrels. This does not include an indeterminate quantity left in the ground by present producing methods, but possibly recoverable by advanced methods of production.

The Sugar Cane Doctor

"HERE in Hawaii," says J. P. Martin, Pathologist, Experiment Station, Hawaiian Sugar Planters' Association, Honolulu, "the two major problems facing the American sugar industry are diseases and insects. However, these are problems of major importance in all sugar producing regions, and must be considered by the scientists in order to obtain the maximum yield per acre.

"The sugar cane plant, like other economic agricultural plants, is frequently affected by diseases which cause large financial losses to the grower. The duty of the phytopathologist, or 'cane doctor,' is to determine ways and means for controlling these diseases.

"In general, diseases affecting the sugar cane plant may be classified into three groups, namely: (1) non-parasitic diseases wherein the depressed growth of the plant is directly associated with poor chemical or physical soil conditions or adverse climatic conditions; (2) parasitic diseases—wherein the subnormal growth of the plant is caused by specific organisms known as fungi or bacteria which live at the expense of the cane plant once they have become established within the plant; (3) virus diseases—wherein the failure of normal plant growth is caused by ultra-microscopic entities or bodies of an unknown nature found within the plant that are capable of producing disease. Insects play an important rôle in this group since they act as carriers of the virus and incidentally inoculate healthy plants during their search for food.

"It is not always a simple matter to bring about a satisfactory control of a disease once it has become established in a cane field. The outstanding control of any sugar cane disease has been accomplished by the use of resistant varieties. A variety may be highly resistant to a specific disease but be of little commercial value because of its poor sugar-producing qualities. The ideal variety, namely, the one possessing both disease-resistance and high sucrose qualities, is obtained only after many trials which must extend over several crop periods, each crop period being approximately 18 months in length.

"The degree of resistance or susceptibility of a variety to certain diseases may be determined by inoculating the plant with a pure culture of the causal organism of that particular disease. It is often possible to isolate from diseased cane tissues the fungus or bacterium which is responsible for causing the disease. It is also possible to grow the organism on an artificial medium and maintain it in a pure culture without the aid of the cane plant. When cane plants are

The sugar cane doctor inoculating cane with an organism of disease

to be tested against a disease, the organism is then taken from a pure culture and injected into the cane plant, frequently by the hypodermic needle method or, as in the case of eye spot disease, by spraying spores of the eye spot fungus on the leaves of the plants to be tested.

"The inoculation tests are conducted under field conditions most suitable for the development of the disease and, after a stated interval, the degree of resistance of each variety is determined. In such a test, anywhere from 100 to 200 of the more promising agricultural varieties are included."

Methyl Bromide Fire Extinguisher

METHYL bromide is recommended as a fire extinguisher for certain types of fires instead of carbon tetrachloride, according to *Chemical Age*, which reports that methyl bromide produces 1.6 times as much gas as carbon "tet" and is six times as effective. Boiling at 4.5 degrees, Centigrade, methyl bromide volatilizes very rapidly when thrown on a fire. Neither this fact, nor the large volume of gas liberated is sufficient to explain the effectiveness of methyl bromide as a fire extinguisher, however. It is believed that the presence of bromine in the gas has a definite inhibiting effect on combustion.—*A. E. B.*

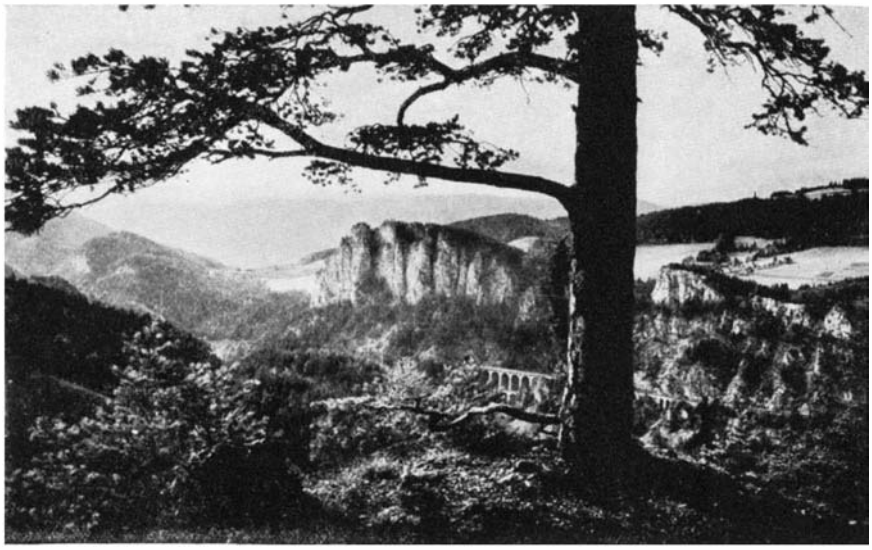
American Influence on Early European Railroad Building

THE accompanying photographs show sections of the famous Austrian railroad from Vienna south over the Semmering Mountains which is credited with being the first large mountain railroad. An interesting story lies behind the construction of this road, according to an old volume which has just come to light.

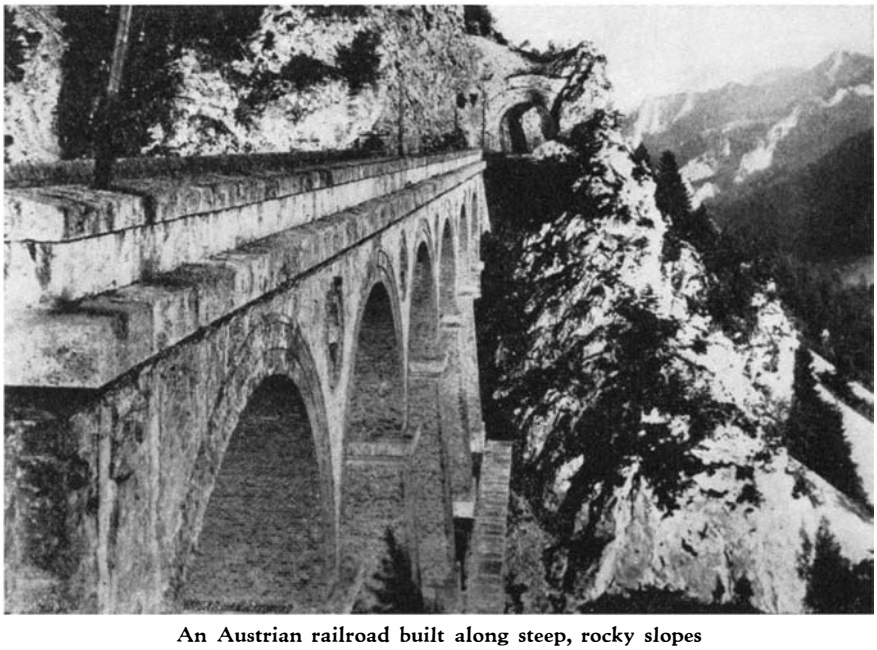
Back in 1829, consideration was given to the possibility of connecting Vienna with the Adriatic Sea at Trieste, and with the coal fields of the north, in Silesia. At that time no European engineers had had experience in mountain railroading and their opinion was that the British scheme of road building would have to be followed. Its ideal was to have a track of no sharper curves than three and one half degrees, and grades of not more than 0.5 percent. Due to the steepness of the grades on the proposed route, the pulling of cars over inclines by means of rope operated by stationary steam engines was the solution generally accepted.

There was a wide difference of opinion in Austria and the Austrian engineer von Schoenerer finally came to America and carried back with him the confirmation that America had emancipated itself from British tradition; he asserted that a locomotive road over the Semmering would be the correct solution. In spite of his complete report of the manner in which American engineers had conquered difficulties of terrain and his statement that the road could be built without the use of rope-operated sections, the fight went on until the government stepped in and ordered the road built, and sent the engineer von Ghega to America to report fully. He inspected the Baltimore & Ohio road which had then progressed to Harper's Ferry. The road was accordingly built.

So well did Ghega's observations serve his purpose that, coördinating them with his own genius, his solution for the Semmering Railroad, for which he chose two and one half percent grades and nine and one half degree curves, became the model mountain railroad of Europe, in addition to being the first enterprise of its size and difficulty in the world, and one of the most beautiful and successful.



Entering the Semmering Mountains on the Austrian Southern Railroad



An Austrian railroad built along steep, rocky slopes

TROJAN WAR

PRIAM fought on layer seven. This may sound somewhat cryptic but it means simply that recent excavations have indicated that the Homeric city was the seventh layer in the mound which constitutes the ruins of the nine cities built upon the site of Troy.

Codling Moth Control

PHENOTHIAZINE, a compound prepared by fusing sulfur with diphenylamine, has been mentioned in these columns for its remarkable toxicity to mosquito larvae. Lately it has shown promise for killing young codling moth larvae, when sprayed on apple trees. Some laboratory and field tests have given promising results but further tests are needed. These studies are being made in order to find a substitute for lead arsenate, which still remains the most generally used material.—*A. E. B.*

Pimples

ACNE is associated with abnormality of the sex hormone, according to Dr. Theodore Rosenthal of the dermatology department of the Columbia University School of Medicine.

"The evidence is strong," he said, "that acne is caused by disturbance in the sex endocrines. Just what the disturbance is, or how it acts, is not clear. Endocrine therapy for acne is not yet reliable because we do not know the best preparations to use, or how best to administer them. Chocolate, white bread, and iodized salt are three foods which have been found to create digestive disturbances aggravating this common skin disease of adolescence," he declares.

"It is a clinical observation that choco-

late in any form may produce new outbreaks, or aggravate existing acne lesions in some individuals," Dr. Rosenthal said. "White bread, particularly in large cities, contains potassium bromate introduced as a riser, which in baking is reduced to the bromide. This of course must be eliminated.

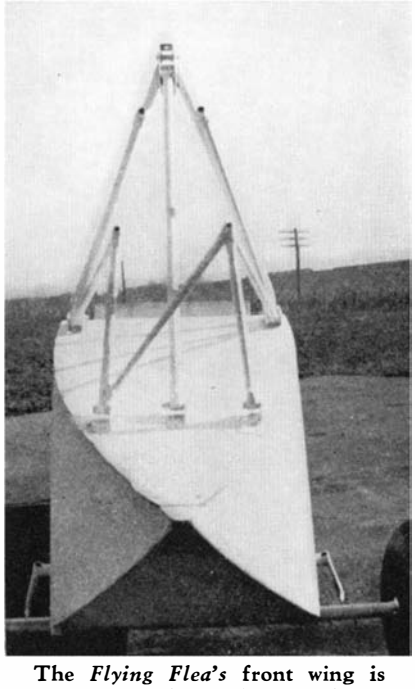
"At the same time a careful search for iodides and bromides in food or incidental medication must be made. The most frequent offender is iodized salt."

Correction of personal food fads, bringing the weight up or down to normal, rest, exercise, fresh air, and sunlight are also imperative in the treatment of the disease, he adds.

Because few children are entirely free from facial eruptions, Dr. Rosenthal points out that a few acne lesions at the age of puberty are physiologically normal. "It is only when the lesions are unusually numerous, severe, or persistent that we can consider it as a disease."

The "Flying Flea"

THE *Pou de Ciel*, built by a French furniture manufacturer, M. Henri Mignet, and illustrated here, has created quite a sensation in France and England. More than 150 of these tiny machines are flying

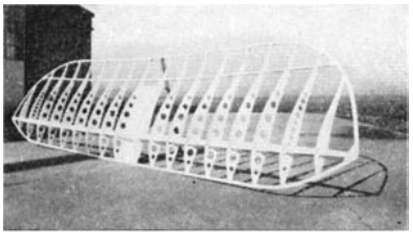


The *Flying Flea's* front wing is mounted on the top bearing shown

in these two countries. Many of them have been built by amateurs following the instructions in M. Mignet's book, and without special shop or tool facilities. Building the *Flying Flea* at home is both simple and inexpensive, and even when factory built the sales price in England is only about 800 dollars. The *Flying Flea* has now been brought to this country by Major Sidney Arram, and has been flying at Roosevelt Field, Long Island.

The question that now arises is: Is this the long expected "flivver" airplane that is going to make private flying possible to everyone?

The *Pou de Ciel* has one large wing above, and a smaller lower wing immediately behind the upper one. The total wing area is



Simple yet strong construction of the main wing of the *Flying Flea*

132 square feet. The gross weight is about 650 pounds. Total span is 19.9 feet and the over-all length is 11.1 feet. With a 20 horsepower, two-cylinder, two-cycle engine, a "fast" cruising speed of 62 miles per hour is claimed; take-off and landing can be accomplished in short distances.

A personal inspection of the small aircraft at Roosevelt Field gave us the following impressions: When seen in a hangar, by the side of the conventional three-seater cabin plane, the *Pou de Ciel* certainly looks tiny. It is pleasing to be able to raise the tail and move the machine about, unaided. Certainly this makes for very easy handling by the owner. The construction and appearance of the machine are apt to suffer by comparison with conventional modern aircraft, but they will pass muster. The construction is indeed very simple, and, while the cockpit is a little cramped for a large man, it probably is ample for the average youngster. The vision ahead is perfect. It would be rather amusing to fly in the somewhat drafty cockpit and again experience the thrill of open cockpit flying of the early days. The installation of the power plant is simplicity itself so that keeping engine and plane going would be just as easy a task as building the plane in the first place.

Now we must consider the heart of the question, which lies in the aerodynamics and flying characteristics of the craft.

There is no elevator. The front wing is hinged at a point forward of its quarter-chord point, and its center of pressure is constant and ahead of the center of gravity. From the upper wing two wires run down to the control stick. Since the center of pressure of the wing is behind the hinge, it is always tending to rise and push the stick forward. When the pilot pulls back on the stick, the wires tighten and the front wing is pulled down to a higher angle of attack. It then lifts more than before and the nose of the machine rises. To secure change in speed it is not necessary to change the whole attitude of the machine as much as in the conventional airplane. The longitudinal control is very good. Again, the front wing is in the upwash of the rear wing and stalls first. Hence there is little danger of the "stalling" of the craft as a whole; this is a decided advantage.

With a large rudder and powerful dihedral, ailerons are dispensed with. In making a turn to the right, the plane skids to the left under the action of centrifugal force, and then the dihedral banks the plane automatically for the turn. It should be noted that the stick controls both the change of incidence of the front wing and the rudder, so that the conventional rudder bar is eliminated and the novice does not have to

Prof. Klemin finds rather cramped quarters in the cockpit of the *Flea*

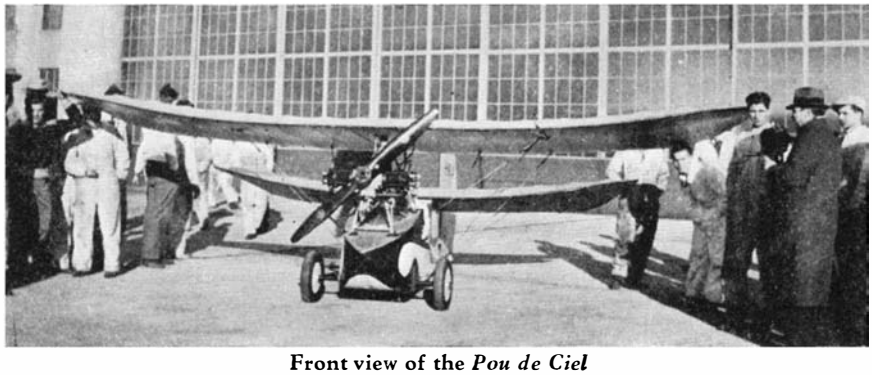
learn the difficult art of coördinating the action of hands and feet.

Here is the balance sheet: On the good side—something very inexpensive to build and maintain; very handy; fairly easy to learn to fly, with one control eliminated; moderate speed but good landing and take-off characteristics. Probably a quite satisfactory craft for fair weather flying just around the aerodrome.

On the bad side—not enough speed for

FORTY PLANE CAPACITY

FORTY "Cubs"—a popular two-place sport plane, made by Taylor in Bradford, Pennsylvania—could be carried in the *China Clipper* if they could be packed in the space available.



Front view of the *Pou de Ciel*

cross-country work; a simple but not a positive control system—neither turns nor corrections against a roll will be clean or assured: anyone who learns to fly on this ship will have to start afresh on a conventional machine; anyone who learns to fly in a conventional airplane will have to learn over again when handling the *Flea.*

On the whole, it would seem as if the contribution of the *Pou de Ciel* to the advancement of real private flying will be very small. But it should provide a fascinating, inexpensive hobby for young men or even boys, who just want to fly around at minimum expense, and from this point of view we wish it all success.—*A. K.*

Douglas Sleepers

A NUMBER of new Douglas sleeper airplanes, models DST, are being placed in service by American Airlines. The DST is essentially a development of the famous Douglas DC-2, of the same general type and construction but of larger size and increased horsepower and weight. The wing span has been increased to 95 feet. To accommodate the sleeper berths the fuselage has been increased slightly in depth and is approximately two feet wider. The over-all length is now 65 feet and the over-all height is 17½ feet.

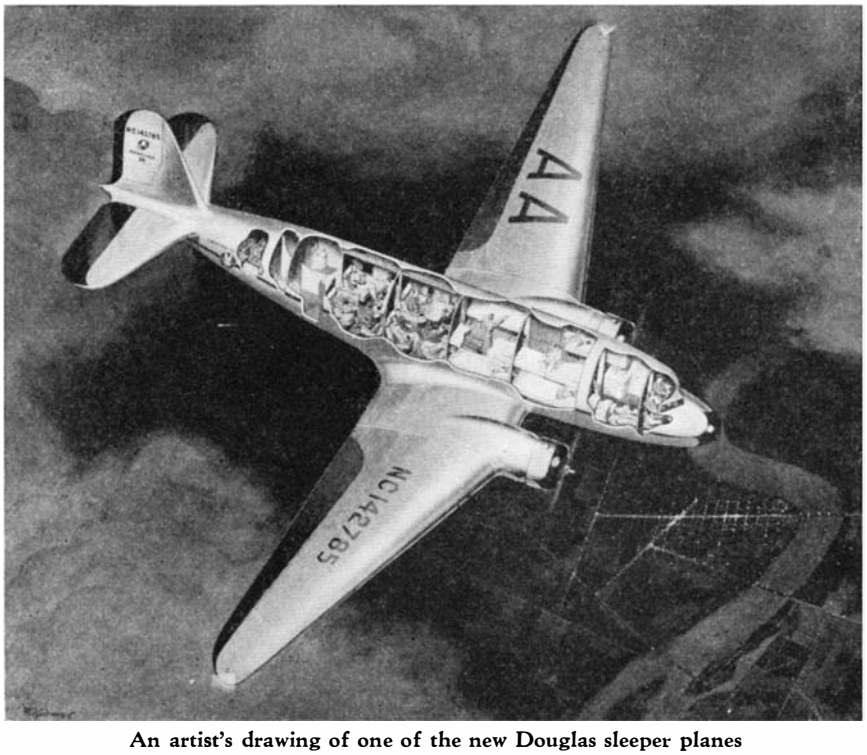
The weight empty is 16,000 pounds; the weight fully loaded is 24,000 pounds, leaving a useful load of about 8000 pounds.

The fuel capacity is 825 gallons, and the oil capacity 66 gallons. Fuel is carried in four tanks of approximately 200 gallons each. The Wright Cyclone G-5 engines use Hamilton Standard, constant-speed, controllable-pitch propellers. Sperry Automatic Pilot, heating equipment for carbureter de-icing, and emergency alcohol de-icing equipment for windshield and propellers will be among the modern equipment carried. Complete two-way radio, ultra-violet instrument lighting, and improved steam heating will also be provided.

The cabin accommodations are arranged for 16 sleeper-passengers with a possible maximum of 32 day-passengers for short hauls. The berth arrangement is essentially Pullman type, the seats and berths being 36 inches wide. Double dressing rooms and lavatory facilities are provided at the rear of the cabin. Mail will be carried forward of the passenger accommodations and baggage and express aft. Facilities for handling meals are provided in the form of individual tables for each compartment and a completely equipped buffet forward of the main cabin. The airplane crew will consist of pilot, co-pilot, and stewardess.

The high speed at rated power and altitude of 11,000 feet is computed to be 219 miles per hour.

It is hardly necessary to emphasize how complete and adequate such an airplane really is for passenger transport.—*A. K.*



An artist's drawing of one of the new Douglas sleeper planes

Radio Meteorography

AVIATION weather service has made notable advances in the development of radio meteorography. The aeronautical meteorologist needs daily and even hourly cross-sections of the atmosphere with regard to its pressure, temperature, humidity, wind direction, and velocity up to great heights. With information of this kind available for all levels, up to and including the stratosphere, the method of forecasting by studying "air mass" movements becomes truly effective.

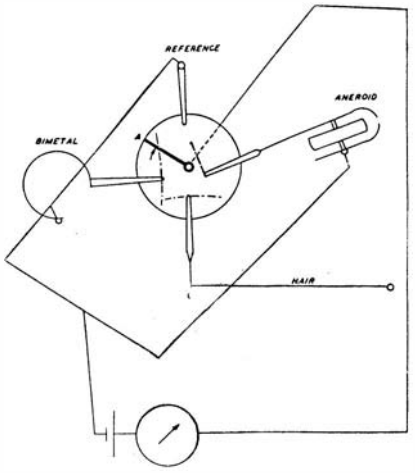
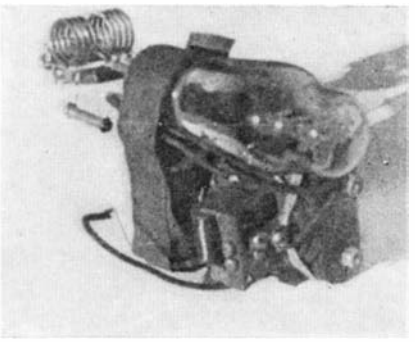
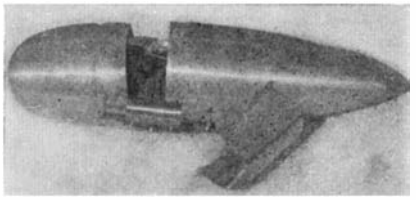


Diagram of the radio meteorograph





***Above:* Compact short-wave transmitter for the radio meteorograph. *Below:* In its streamlined housing**

Upper-air data have hitherto been obtained by pilot balloons, airplanes, sounding balloons, mountain stations, and the observation of clouds. Serious objections can be raised to all of these.

The ideal method of observation is the sounding balloon equipped for radio transmission, so that there is no limitation as to height and so that information is instantly transmitted to the weather station; in other words, a sounding balloon provided with a "radio meteorograph."

Such instruments have already been used in airplanes, but the final development for use in sounding balloons has only recently been completed at the Blue Hill Observatory in Massachusetts, under the direction of Dr. Charles F. Brooks.

The principle of the meteorograph is quite simple and is illustrated diagrammatically in our drawing.

A rotor A turns around a center at constant speed—say once every 30 seconds—and at each revolution makes contact through the point marked "Reference" in the diagram. Three instruments are carried aloft: an aneroid barometer or pressure indicator of conventional principle; a hygrometer, consisting of a hair which expands and contracts as the humidity changes; and a thin bimetal thermometer. Each of these instruments moves a small extension-arm which has a very fine point at its end. The rotor is insulated everywhere except for three metal spirals embedded smoothly in its sides. The extension arms make contact with these spirals, the duration of contact depending on the positions of the extension arms; these positions depend on the readings of the aneroid, the thermometer, and the hygrometer.

Once an electrical contact of varying duration is made, it is obvious that a radio transmitter can be put into operation and a complete record transmitted directly to the ground.

The great problem is to keep the weight

of the instruments and transmitter on the sounding balloon down to a minimum, so as to permit a rapid rate of ascent. Such a rate is indispensable so that the ground distance between transmitter and receiver does not become too great and also to provide a more useful meteorological record.

The weight of the radio equipment and the meteorograph has been kept down to a little over two pounds by very refined design of the meteorograph and by the use of short waves.

Up to 20,000 feet a wavelength of 5 meters has proved satisfactory. A tiny 4½ volt battery allows three or four hours of operation, and weighs only 150 grams. A conventional two tube oscillator circuit is employed.

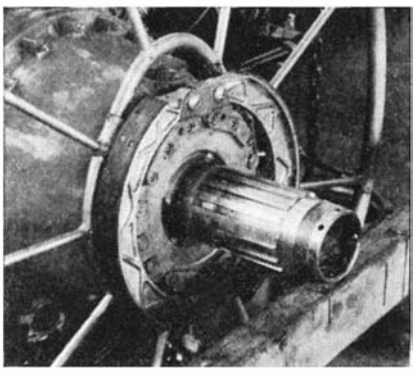
The meteorograph and the radio transmitter are all mounted within a bullet-like shell (so designed to reduce air resistance in the climb), which is suspended below the sounding balloon.

Reception of the ultra-short waves may be aural or on a recording chronograph which is synchronized with the turning of the rotor on the meteorograph. Great credit is due to the meteorologists, radio, and instrument experts who have collaborated in producing this useful device.—*A. K.*

Brakes for Airplanes

WHEN making a normal landing, the airplane pilot closes the throttle but the propeller continues to turn like a windmill, retarding and disturbing the air flow behind it. If the propeller is disposed ahead of the wing, it spoils the lift over that portion of the wing which its disk area embraces. The landing speed goes up accordingly, which is undesirable.

In a multi-engined airplane with several propellers ahead of the wing, there are other unpleasant effects. If an outboard engine quits, the loss of lift means that, in addition to the rudder, ailerons have to be used to counteract the rolling moment due

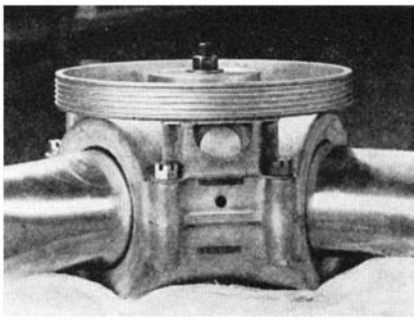


Brake bands on engine nose

to unequal lift over the two sides of the wing. Thus a double task is imposed on the pilot. Also, the drag of the idling propeller is considerable and that means more rudder than with a stationary airscrew. An idling propeller also introduces unpleasant vibrations.

From every point of view, therefore, it would seem desirable that as soon as an engine stops either voluntarily or involuntarily, the propeller should be prevented from windmilling.

Many attempts have been made to provide brakes for stopping the airscrew simultaneously with the engine, but none of these brakes have been sufficiently simple,



Brake drum on propeller hub

inexpensive and light enough to warrant their general use.

Now we learn that Raymond B. Quick has given the problem intensive study and in collaboration with the engineers of Sikorsky Aircraft Corporation has produced an entirely practical device which has been used with much success on the Sikorsky Clipper, the *S-42*. The entire brake installation weighs only 52 pounds, and is extremely simple, being operated by an oil pressure system similar to that used in "hydraulic" brakes on automobiles.

The brake shoes which act on a drum are hinged on the nose section. The shoes are made of duralumin castings. The brake drum is machined from a steel forging and has cooling fins. It is connected to six hub bolts on the three bladed propeller by means of welded fittings.—*A. K.*

New Swedish Radio Beacon

A SWEDISH radio beacon of a new type has been delivered to the Turkish government and erected at Rumeli, a small fishing village on the coast of the Black Sea. It stands on a rock, and sends directed radio beams, so that approaching ships need use only ordinary radio receivers. The position of the vessel in relation to the beacon is determined by counting the number of signals received, after the call signal, until the sound completely disappears. The number of signals heard corresponds to the number of degrees from the west over the beacon to the vessel. To facilitate the counting, every tenth-degree signal is of a lower tone than the rest. Therefore, it is only necessary to count the signals in groups of 10, and when the sound becomes fainter to begin to count the degree signals.

Like the radio-sounding receiving sets, the beacon is equipped with a loop antenna. To correspond with the antennas on the ships, the beacon antenna should revolve according to the signals dispatched, but it would entail great technical difficulties to rotate the large frame in time with the signals. Therefore, a goniometer is built in the beacon, permitting the entire field to revolve. The goniometer transmits the direction of the radio waves exactly as if the huge frame were turned.

The radio beacon, which was delivered by the Aga-Baltic Company, in Stockholm, consists of two Atlas-Diesel motor-generators, one Jungner battery, an antenna mast, and sending and receiving apparatus. It operates automatically, being started and stopped by means of contact chronometers. All the personnel has to do is to keep the battery charged and now and then adjust the chronometers according to time signals.

What makes this radio beacon unique is that the signals can be picked up by ships equipped with nothing more expensive than an ordinary crystal set. The intricate radio-sounding apparatus is all located within the beacon. Therefore the smallest fishing boat can find its way in fog and darkness.

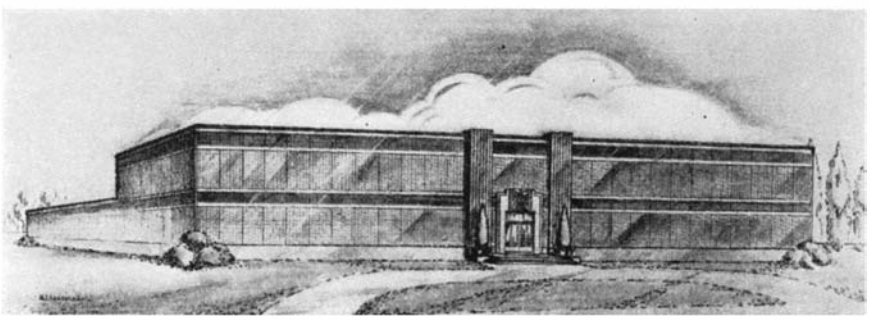
The construction of the beacon was made under the supervision of Frans Franson, staff engineer of the Aga-Baltic. The entire machinery was shipped overseas to the open and unprotected coast at Rumeli, and thence on mule-back to the tall rock on which the tower stands.—*Holger Lundbergh.*

SEASICK FISH

FISH can get seasick! At least cod-fish which were being transported in a tank on shipboard, after some time ashore in a tank, manifested the usual symptom of seasickness—loss of their dinner. This was reported by R. A. McKenzie, marine biologist.

Trench Mouth Increase—Poorly-Cleaned Beverage Glasses

AN increase in trench mouth and possibly other serious diseases has been laid at the doors of taverns and eating establishments serving alcoholic beverages, by Dr. Don Chalmers Lyons of Jackson, Michigan. The increase in these diseases has probably occurred because beverage dis-



What could be more fitting than that the research laboratory of a glass company be built of glass, thus exemplifying and testing at the same time the theory of glass buildings? The drawing shows the design of the research laboratory built by the Owens-Illinois Glass Company, entirely of glass blocks. It will be a modern wonder of air conditioned comfort and natural lighting, with no windows, roof insulation of glass wool, and glass wool filters in the air conditioning system

pensing establishments are not using proper methods of cleaning their glasses, Dr. Lyons charged in a report to the Society of American Bacteriologists. He found large percentages of the trench mouth organism and other disease "germs" on the rims of glasses racked on the bar and ready for use, and also on glasses rinsed after their return from the customers.

The findings of this study and of a similar one by Drs. W. L. Mallman and W. L. Chandler of the Michigan State College suggest, said Dr. Lyons, "the necessity for better control of methods of glassware cleansing in such establishments."—*Science Service.*

New Color Analyzer

WHITE is simply white to many people, but to a new instrument white is a mixture of all colors—with the result that the instrument recognizes, and labels, a myriad of whites. Ink, dye, paint, textile, paper, and other manufacturers, as well as research laboratories, have of course long recognized the existence of the multitude of shades and differences in colors, and color specification is an important part of production control.

Black is not always black; there are blue-blacks, brown-blacks, and red-blacks. Similarly, each color has a multitude of variations.

A new instrument, known as the recording photo-electric spectrophotometer, and shown by the General Electric Company, makes it easy to obtain, quickly and accurately, an analysis of the color of a wide variety of materials, either as reflected or transmitted by the sample. The material to be examined is placed in the instrument, operation is started, and in less than three minutes the operator removes a chart which shows exactly how much of each wavelength of light is reflected or transmitted by the sample. Comparisons of charts from different samples show in what respects their colors differ—whether one might have, for example, more yellow than another. With the charts available, it is possible to make the necessary color corrections.

The instrument consists essentially of a monochromator, photo-electric photometer, and means of recording their respective indications.

The monochromator is of the double-dispersion prism type, which insures a high degree of spectral purity. It is equipped with bilateral slits which are adjusted automatically for a 10-millimicron band. The wavelength range is from 400 to 700 millimicrons.

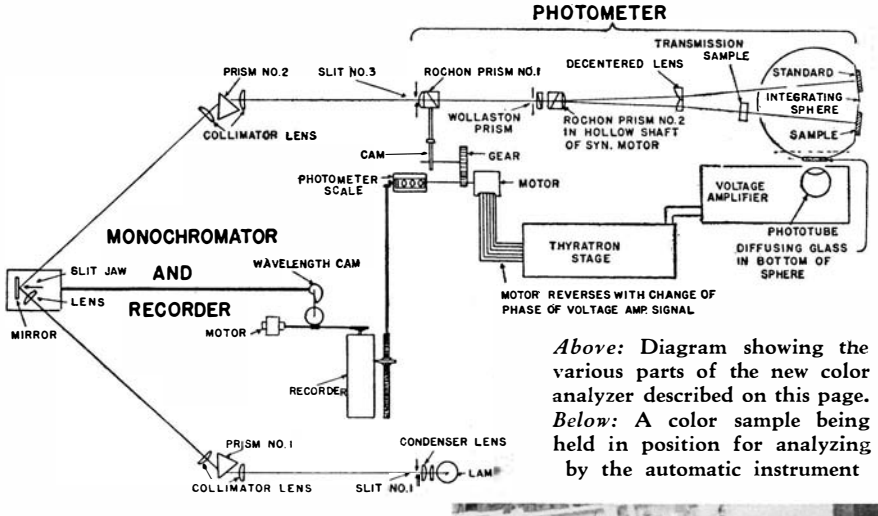
The photometer combines the polarization method of photometry with a photo-electric balancing scheme in such a manner as to eliminate from the measurements the factors of light source, phototube characteristics, and amplifier sensitivity. Reflectance values are expressed in percent of the standard selected by the operator. Transmission values are expressed either directly in percent or in terms of a standard transmission sample.

The recorder is of the drum type, in which the wavelength value is related to the drum position, and the photometric value is indicated by the pen position. Means are also provided for plotting special functions of reflectance, such as density, and logarithmic or multiplying factors.

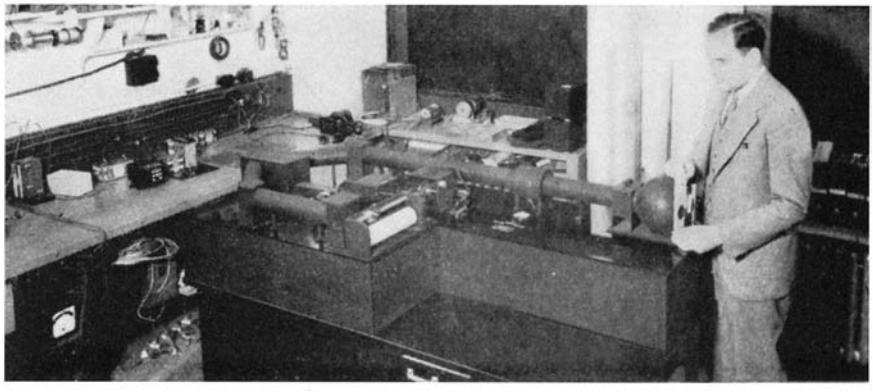
The design is such that the recording and other automatic features may be omitted for special purposes. Thus it is possible to use the instrument as a manual, automatic balance, or recording spectrophotometer.

Courtesy Briggs Mfg. Co.

It had to come—this safety bath tub—for each year thousands of ribs are broken as a result of falls in smooth porcelain tubs; even more serious accidents happen in them. This new one, porcelain on pressed metal base instead of cast iron, has a pressed serpentine bottom and is only a third as heavy as the ordinary cast iron bath tub



Above: **Diagram showing the various parts of the new color analyzer described on this page.** *Below:* **A color sample being held in position for analyzing by the automatic instrument**



INSECT

IT is fortunate for human beings that one ancient insect became extinct. Fossil remains, discovered near Elmo, Kansas, by Dr. Frank M. Carpenter, of the Harvard Museum of Comparative Zoology, show that this particular dragon fly, which lived 150,000,000 years ago, was nearly two and one-half feet long.

Close Control of Temperature

SO sensitive that it maintains a given temperature within a range of 0.04 degrees, Centigrade, is a newly perfected instrument known as the ultra-thermostat. In most observations of physical and chemical processes the accurate maintenance of the observation temperature is of the utmost importance. The ultra-thermostat overcomes, in the simplest possible way, the difficulty of holding temperatures constant over a long period and the large expenditures in supplementary apparatus and time.

A metal vessel of about seven-liter capacity contains the bath liquid (water) which is continuously stirred by a specially constructed, noiseless, vibration-free electric motor. Heat is supplied by two electric heating units, so built as to have minimum heat capacity. The electric controlling thermometer can be set at the desired temperature between 0 and 100 degrees, Centigrade, by means of a magnet and regulates the heating units through a quartz-tungsten relay. The heating units are switched in and out automatically to hold the temperature within ±0.02 degrees, Centigrade. A pump connected with the motor delivers about two liters per minute of the constant-temperature liquid to the measuring instrument and returns it to the thermostat.

In the thermostat there is also a cooling coil through which a separate liquid can be run, if it is desired to work at a temperature below that of the room. By using the ap-

propriate liquids the range can be expended to from —25 to +200 degrees, Centigrade.

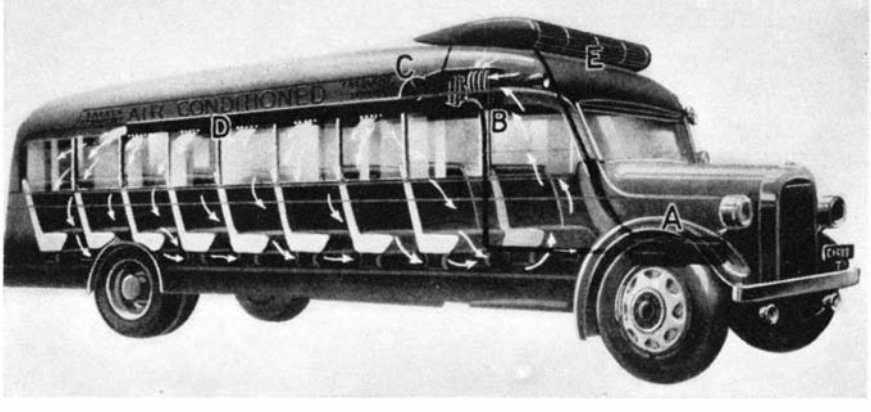
In use, the ultra-thermostat is connected to the lighting circuit and the apparatus. After a few minutes the constant temperature is reached and may be maintained for weeks without attention.—*A. E. B.*

Air Conditioned Motor Vehicles

TRAVELERS by bus or in their own private automobiles will soon be able to enjoy custom-made weather wherever they go. Details of a newly perfected system which provides air cooling or year 'round conditioning similar to that in use on railroads, in theaters and in stores, were outlined recently by Ralph F. Peo, General Manager of the Houde Engineering Corporation, a division of the Houdaille-Hershey Corporation, and E. P. Heckel of Chicago, Vice President of the Carrier Engineering Corporation, air conditioning specialists.

While stressing the fact that commercial production of these systems has not been started, it was indicated that recent engineering development has proved the entire feasibility of the principle. Research on the new system has been in progress for more than a year. A standard five-passenger automobile was used as a proving ground for the development of the system. This vehicle was in almost continuous service throughout last summer.

The system calls for the use of a refrigerating compressor driven directly by the car motor which supplies a special refrigerant to an evaporator or cooling coil located within the vehicle. A small fan draws air over the cooling coils and circulates it throughout the vehicle while at the same time drawing in sufficient outside air to provide ample ventilation for the dilution of smoke and odors. The air is filtered.



Above: **Air conditioning for a standard motor car.** ***Right:*** **Bus equipment. A is the compressor, B the cooling coil provided with a filter, C the fan, D the distribution ducts, and E the condenser cooling coil that dissipates heat extracted from the interior of the vehicle**

This machine projects fingerprints

The refrigerant, which is the same as that used for buildings where large numbers of people congregate, is entirely harmless, non-inflammable and non-explosive. It actually has fire extinguishing properties. The function of the refrigerant is to extract heat from the vehicle by cooling and dehumidifying the air drawn over the cooling coils. After it has done its work, the refrigerant is cooled in a condenser coil which is located on the roof of the vehicle, in the case of a bus. The movement of the car provides a sufficient flow of air over the condenser coil to dissipate the heat which has been removed from the vehicle by the refrigerant. The refrigerant is then used over again.

It is expected that several companies will equip their buses with trial installations and that a number of such vehicles will have standardized air conditioning systems in service by next summer.

The practicability of air conditioning for taxicabs, private automobiles, and ambulance service was also stressed by Messrs. Peo and Heckel, who indicated that these classes of vehicle were well adapted for air conditioning and that they foresee a growing new demand in that field.

New Fingerprint Machine

CATCHING criminals has become so active that mass production methods are being employed by the police department in Pasadena, California. The newest aid is a machine, the dactyloscope, for examining fingerprints more readily.

The old method of squinting through a magnifying glass is too tiring when there is a steady stream of prints all day long. The new fingerprint machine projects the image of a print so that it can be viewed in normal posture and with both eyes at once. Moreover, several observers can see the image at the same time.

The projection screen is not at a distance as in motion pictures but only about two feet from the eye. This arrangement enables the expert to make, in a few seconds, a tracing of the enlarged fingerprint which may then be compared with a latent print taken at the scene of the crime or with suspected prints in the fingerprint files.

The new apparatus has also been found useful for the study and measurement of written and typed material and, in fact, is used as an "eye-of-all-work" at Pasadena Police Headquarters.—*Science Service.*

OYSTERS

A BARREL of water is filtered through the body of an oyster in one day, according to a report of Dr. T. C. Nelson of Rutgers University. As this water is pumped through, the minute plants which are the oyster's food are sifted out and enough oxygen is obtained to keep the oyster's modest vital fires.

Boron Wearing Surfaces for Metal Parts

TWO methods of applying metallic boron crystals to the surface of metals for the production of wear- and corrosion-resistant surfaces have been developed by Colmonoy, Inc. The "sweating-on" method mixes the crystals with sodium silicate to form a stiff paste which is then coated over a surface to be processed. Sufficient heat is applied with a torch or arc to sink the crystals into the parent metal. The second method, the "cast-on" process, employs a mixture of crystals in a matrix of nickel alloy with a lower melting point than steel which is melted and poured on the surface, within a mold. The overlay fuses securely to the parent metal.—*A. E. B.*

Marihuana Menaces Youth

MARIHUANA smoking has spread so rapidly that the drug has become a serious menace, particularly among youthful lawbreakers. The drug, also known as loco weed, muggles, Indian hay, Indian hemp, hasheesh, laughing tobacco, and reefers, is dried and rolled into cigarettes selling from

five to 25 cents apiece. From 300 to 500 cigarettes can be made from a pound, making it highly profitable for its underworld vendors.

Marihuana produces a wide variety of symptoms in the user, including hilarity, swooning, and sexual excitement. Combined with intoxicants, it often makes the smoker vicious, with a desire to fight and kill.

Addiction to the drug is common in Mexico and some authorities have estimated that as many as one out of every four persons in some of the southern states are users. Out of 450 prisoners examined in New Orleans in 1930, 125 were found to be addicts. Despite the vicious effects of marihuana, only 17 states have laws against it and its control is not yet included under the federal Harrison narcotic act.

16th Century Bethwackment

MERRIE England, in the lusty days of Henry VIII, Will Shakespeare, and Good Queen Bess, was probably the thumpingest, flailingest, battering, and bumfeagling nation the world has ever known, judging from word research on the Early Modern English Dictionary being edited at the University of Michigan.

This discovery that the 16th Century beat all as a banging time grew out of a three-letter word, "lam." "Lam," with the meaning of "to strike," first appears on the verbal field of battle in the middle 16th Century. Writing in the Michigan *Alumnus Quarterly*, Dr. Leo L. Rockwell tells how the dictionary staff lashed and mauled their way through a tangle of words to isolate all forms of assault and battery.

Before 1200, they found, one gentleman might only threaten to beat, buffet, fell, hit, knock, smite, or thrash another gentleman. Before 1300, however, bob, bounce, ding, dint, gird, squat, and tap were added to the vocabulary of violence; while, by 1475, such terms as bat, batter, bless, bunch, chop, clap, clod, dab, flap, flash, hammer, lash, lay on, maul, pop, rap, scour, staff, whip, crack, dress, flail, knap, nape, pash, pelt, skelp, spar, and wale had appeared.

Then came the 16th Century when apparently every solid Britisher must have spent a good share of his time in thumping, or at least threatening to thump, his neighbors. Blessed with a good memory, a subject of Queen Elizabeth might drub his enemy verbally with the following 83 types of mayhem: anoint, bang, baste, bebang, bebat, bebaste, bebatter, becudgel, becurry, belam, belay, bepommel, besoop, beswaddle, beswap, bethump, bethwack, box, breech, bum, bumbaste, bumfeagle, bumfeg, bumfiddle, canvass, chock, clapperclaw, claw, club, coil, colpheg, comb, cudgel, cuff, curry, douse, ferule, filch, fillip, firk, fist, flip, flirt, gag, jerk, jut, kemb, knack, lace, lam, lamback, lambskin, lick, lump, nevel, pat, pay, pummel, punch, ribbaste, ribroast, shock, souse, slash, slat, stab, swaddle, swash, swinge, taw, thump, thwack, tick, tickle, tip, trim, trounce, twig, walk, wherret, whisk, whop, yerk.

After that socking 16th, the succeeding centuries seem wan and weak. Only a few really good solid terms of bethwackment arose, such as belt, bebump, flay, lambaste,

(*Please turn to page* 161)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

THE use of wooden tubes instead of metal, for amateur's telescopes, is apparently increasing. They are believed to give less trouble due to temperature effects, for example, atmospheric "boiling," which is often thought to be high aloft, when much of it actually takes place within the telescope itself. On this page are four photographs of wooden tube telescopes. Figures 1 and 2 show a telescope made by Horace E. Dall, 166 Stockingstone Road, Luton, Beds., England, who writes: "I am enclosing a print or two of my latest complete telescope—a 10″ Newtonian equatorial with circles. The tube is of the square plywood type, which I favor on account of freedom from air current trouble. The mounting uses an 18″ face plate on rollers—very rigid and sweet running. I did the optics—all the lathe and instrument work, including the circle engraving, slow motion clamps, and so on. A local friend, Eric Perry, did the woodwork, concrete and cast iron work,

Figure 1: **Wooden tube. Dall**

patterns, and so on. The R.A. circles are 20″ and the decl. 12″ in diameter. The telescope is delightful to use—extremely crisp images—in and out of focus star disks dead alike. The figure was perfect to my measures and no scratches. A parson in Norfolk (Eng.) now uses it."

THE photograph in Figure 3 is that of Max Papkoff, 382 N. 19 St., Salem, Oregon, and his 8″, square, wooden tube telescope. Mr. Papkoff states that he cemented a disk of ⅜″ plate glass to a thick piece of wood and made his mirror thus. By all rules, laws and sacred traditions, such a mirror ought to be badly flexured, especially when the wooden backing warps due to intake of moisture. Yet he says it gives sharp, distinct star images with a half-inch eyepiece. Several amateurs are similarly known to be flirting with thin mirrors, backed and unbacked in type, and we hope later to publish a few statements from some of them (more are solicited).

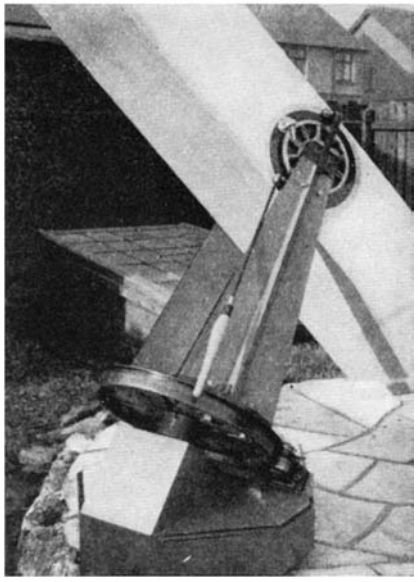


Figure 2: **Mounting. Dall**

This question may not be so simple as it appears. Perhaps it is not one to be settled merely by citing "rules." It is suspected that the thin disks sometimes stand up on their own account, regardless of supposed assistance from the wooden, metal, or glass backing to which they are attached either rigidly or the reverse. The 1:6 or 1:8 ratio usually demanded does, of course, allow for a big factor of safety. When a thin disk performs well, would it have performed equally well without the backing? Unscrambling the several complex considerations involved in this whole question, and making a really scientific analysis, would be a nice job for someone. No general deduction made from one, two or three or less than a dozen or so of mirrors made of different glass would seem to be very safe. Hence, a big job. A writer in the *Journal of the Royal Astronomical Society of Canada,* July-August, 1935, seemed pretty dogmatic about the matter, attacking the 1:8 ratio recommended in "A.T.M.," and another Canadian has requested us to answer his article, "taking the other side." But we do not wish yet to take any side in this argument, for it is possible that there is insufficient data as yet to back either side very positively. This taking sides and arguing business too often obscures matters that ought to be handled with more light than heat. We need more light.

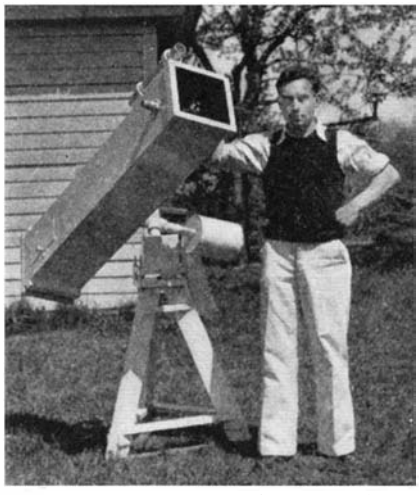


Figure 3: **Wooden tube. Papkoff**

The wooden tube telescope (Figure 4) is hexagonal and was made by Ellsworth Mebold, a commercial artist, Marine, Illinois.

Recruits are wanted for the "Wooden Tube Club."

A FEW numbers back we suggested that someone work out a dingbat by means of which an old hand at mirror testing could coach a rookie, the two (or any other two) being able to watch and discuss the same shadows at one time. William Scott, Glascock Reynolds, and Louis Mobley, 140 Westminister Drive, Atlanta, Georgia, sent in the photograph shown in Figure 5. It shows a typical test rig, plus a diagonal

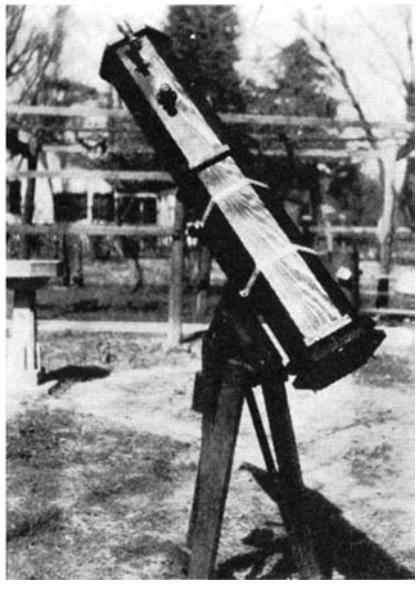


Figure 4: **Wooden tube. Mebold**

sheet of flat glass at a 45° angle, placed between mirror and knife-edge. The glass is very thinly silvered. (This is easy—just set out to get a thick coat.) These three complain that they have to place their cheeks "affectionately close" in order to see well. Their whiskers became tangled. Chester Silvernail, 5151 Bristol Road, San Diego, California, proposed a similar set-up, to be combined with a Ronchi rig like the one in "A.T.M.," page 266, Figure 3.

THE following is from J. J. Ruiz, M.S., D.Eng., 1065 Park Ave., Schenectady, N. Y. "Many an amateur telescope maker, while walking around his barrel, must have speculated, at one time or another, about the size and shape of his Carborundum and of the pits and holes on his glass. Being an

amateur microscopist as well as a telescope maker, I set myself the task of finding out, and here are some photomicrographs showing what I found. Figure 6 shows what the abrasives look like under a magnification of approximately 80 diameters. They are Nos. 80, 280 and 400 Carbo, and the last is No. 800 emery. Note that the emery does not show the sharp splinters and corners of Carbo, which explains why the final fine

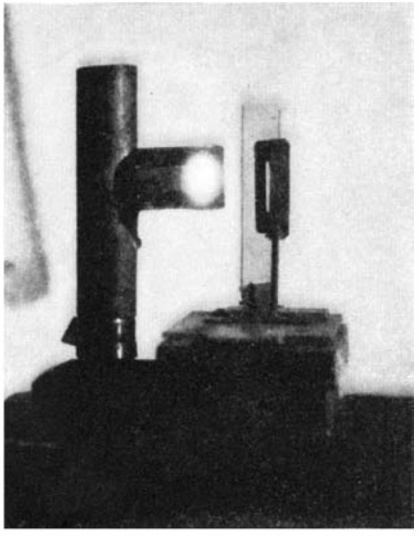


Figure 5: **Two-man test rig**

grinding with emery gives a smoother surface. Figure 7 shows the appearance of glass under vertical illumination when ground with No. 80 emery, No. 280 Carbo and No. 800 emery. The magnification is approximately 100 diameters. [For the time being, the photo in the lower right-hand corner may be ignored.—*Ed.*]

"Using the method suggested in a previous number [First focusing the microscope on the level parts between the pits—after a small amount of polishing—and then on the bottom of the pits, and measuring the distance between these two focal planes by means of a micrometer attachment.—*Ed.*] the depths of the pits left by the different grades of abrasives were measured. The microscope was provided with means for vertical illumination, and a dry 3-mm. objective was employed. The averages of several measurements give the following:

Grade	Material	Depth of pits in microns. (One micron=0.000039 in.)
80	Emery	16.3
220	Carbo	11.2
280	Carbo	6.6
400	Carbo	4.1
600	Carbo	2.5
800	Emery	2.0

"The pits left by No. 80 emery are not proportionally so large as those left by 220 Carbo. This is probably because the large grains break down easily under pressure into finer grades. Note in this connection the appearance of the ground surface shown in Figure 7."

An attempt was made to correlate the figures which Mr. Ruiz gives for pit depths with those for abrasive size, given on page 493 of the new (fourth) edition of "A.T.M." While more data on more sizes of abrasive would perhaps better define a rule, it was apparent that pit depth is at least approximately proportional to grain diameter.

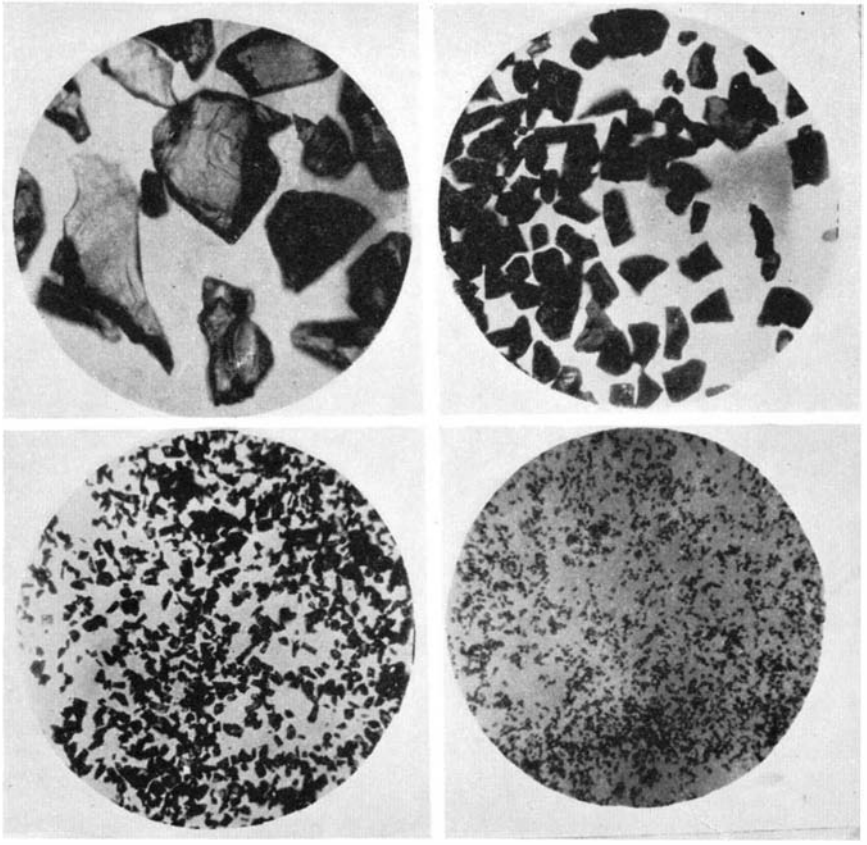


Figure 6: Top: No. 80, 280 Carbo. *Bottom:* No. 400 Carbo, 800 emery

The big professional manufacturers have (secret?) data on this.

Mr. Ruiz continues: "When we come to rouge, we find that it is in a class by itself. The lower right-hand photomicrograph in Figure 7 shows rouge under a magnification of approximately 800 diameters, or ten times that of the previous photomicrographs. The diameter of the rouge grains is about 0.7 micron (0.000026 inch) which is only a thousand times (more or less) the diameter of a water molecule. A suspension of rouge in water can be used to show the Brownian movements caused by the random impacts of the water molecules. Every amateur telescope maker who has access to a microscope with an oil immersion lens ought to perform this experiment."

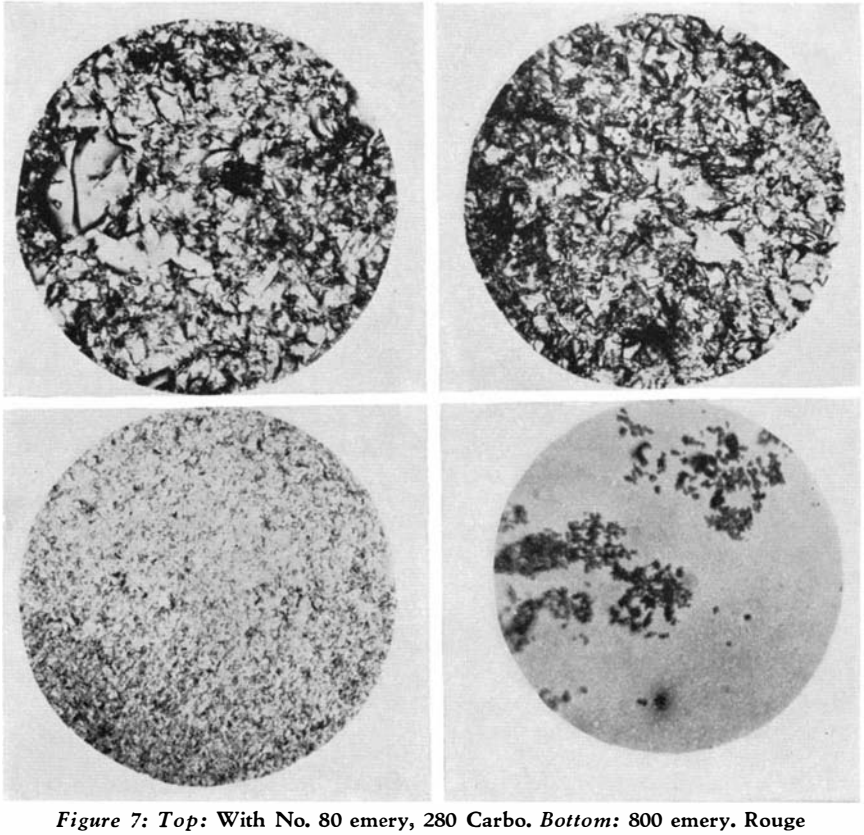


Figure 7: Top: With No. 80 emery, 280 Carbo. *Bottom:* 800 emery. Rouge

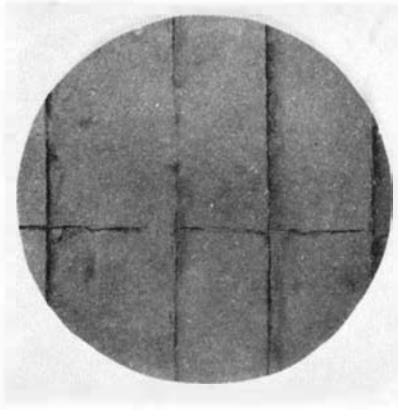


Figure 8: Glass after scoring

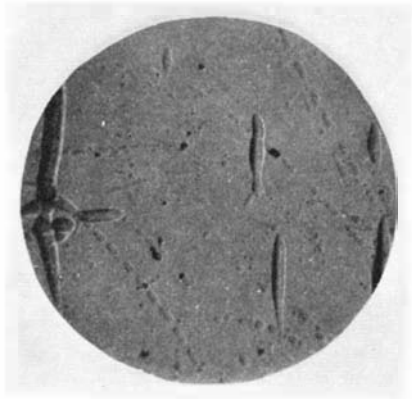
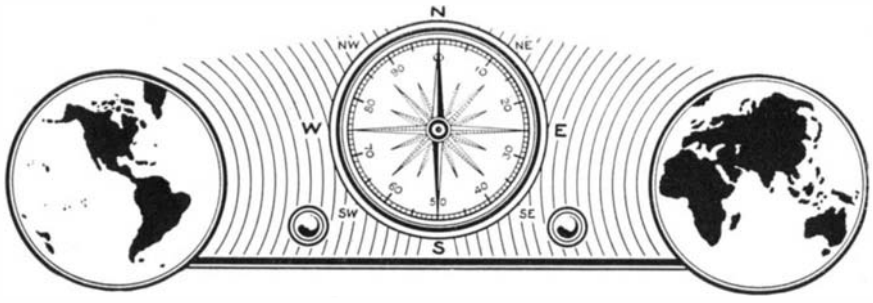


Figure 9: Same after polishing

MR. RUIZ next takes up the question of the actual nature of the polishing operation—sub-microscopic planer work or molecular flow (the "butter" theory—which is discussed in "A.T.M.," pages 326-331, but which has never been settled).

"The process of polishing," he says, "is different from that of grinding. Years ago Lord Rayleigh advanced the theory that polishing is essentially a process of plastic flow of molecules from the hills into the valleys, although undoubtedly there is some removal of material which is not deposited. Figures 8 and 9 show the results of an experiment by the author which bears out this theory. Figure 8 is a photomicrograph of an ordinary piece of plate glass which has been scored with a splinter of Stellite; the magnification is approximately 100 diameters. The glass was then polished with rouge on pitch, using considerable pressure, until all the scoring had completely disappeared when examined under the microscope. Chemists tell us that a substance on which energy has been spent is less stable, so that if we etch the glass with hydrofluoric acid, we may expect that the acid will attack and remove more readily the material deposited in the grooves. Figure 9 was taken after the glass had been etched with the acid, and it will be seen that the original pattern of the scoring is brought out more or less. The scoring was not of uniform depth, which explains why some of the lines have disappeared almost completely. The distortion of the lines shows that there has been plastic flow of the material. The numerous random light scratches were caused by carelessness in polishing."

These results are in favor of the butter theory. Most scientists who have investigated favor that theory—most practical opticians the other.



WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN*

AUTOMATIC VOLUME CONTROL

RECEIVERS having automatic volume control may prove to be excessively noisy when tuning from station to station, due to the fact that the sensitivity of the receiver circuit reaches maximum at such intervals when there is no signal voltage.

The automatic volume control is really not a volume control at all—it is a sensitivity or gain control, but since an increase in sensitivity or gain also produces an increase in signal volume, the term applies.

The operation of an automatic volume-control circuit is not difficult to understand. A portion of the rectified signal voltage is fed back to the control grids of the amplifier tubes. This voltage is effectively negative, and the greater the negative voltage impressed on the grids of the amplifier tubes, the less the amplification. Since the value of this negative voltage is dependent entirely on the strength or voltage of the received signal, it is obvious that the weaker the signal the less negative voltage there will be to impress on the amplifier tubes. Consequently, the amplification or gain is of a high degree. If the signal strength is of a considerable value, the negative voltage impressed on the grids of the amplifier tubes will be greater, and in consequence the amplification will be less. The net result is that irrespective of the strength of the received signal, the output will remain at a fairly constant level.

It is evident from the foregoing that if no signal is being received, there will be no negative voltage on the grids of the amplifier tubes, with the result that they will operate "wide open," so to speak. Under this condition of maximum sensitivity, local noise is greatly amplified, which accounts for the racket when the receiver is being tuned from one station to another.

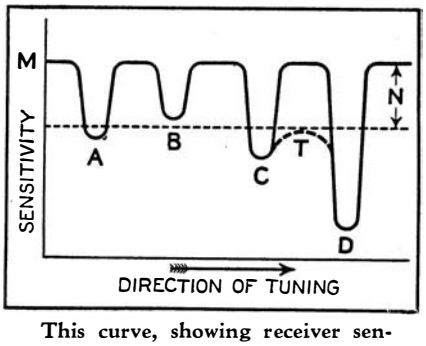
The accompanying sketch serves to illustrate this action. In the sketch, the receiver sensitivity is plotted against the motion of the tuning dial pointer. The point M represents the maximum sensitivity of the receiver.

It will be noted that as the tuning dial pointer is rotated (this corresponding to the direction of tuning in the sketch) the receiver is at maximum sensitivity until broadcast station A is reached, at which point the sensitivity is levelled off to a point which provides the correct amount of signal voltage to maintain equal volume output with respect to other broadcast stations.

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

As the tuning progresses, the receiver again reaches maximum sensitivity as there is no signal voltage to hold down the gain. However, as soon as the receiver comes into tune with broadcast station B, the sensivity again decreases to a value that will provide the same volume output. The same is true for stations C and D, and so on.

It will be noted that the dips in the curve are not uniform; neither are the signal voltages received uniform. Thus A represents a moderate signal, B a weak signal, C a strong signal, and D a very strong signal from a nearby station. When station D is being received the sensitivity of the receiver is at a very low point, and there



This curve, showing receiver sensitivity plotted against motion of the tuning dial pointer, illustrates the operation of automatic volume control. A full explanation of the important action that takes place in a receiver is given in these columns

is little, if any, possibility of hearing anything but the loudest local noise or man-made static. On the other hand, the signal from station B is so very weak that high sensitivity is required to bring it up to an equal volume level. The result is that local noise is also amplified.

Every locality has a definite "noise level" below which satisfactory reception cannot be had. An arbitrary noise level is indicated by N in the accompanying sketch. Any signal so weak that the degree of receiver sensitivity falls within this area will be a signal accompanied by noise—such as with station B.

An automatic volume control is actually an anti-fading device; that is, it will, within limits, keep the volume level of a fading signal at substantially the same value. This means that if the signal from station A should commence to fade, the sensitivity or gain of the receiver would automatically increase. Thus station A might cause only a slight dip in the sensitivity curve one moment (such as at B) and a large dip (such

as at D) the next moment. But, irrespective of the strength of the signal, the output volume level would remain substantially constant. The only discernible difference to the ear would be that, during the period when the signal was very weak (such as at B), the noise level would be audible. You can demonstrate this action very nicely by tuning in a distant station and noting the rise and fall of the noise level in the background.

Not all receivers equipped with automatic volume control are noisy between stations. As a matter of fact, it is common practice in the better receivers to introduce a time lag or a delay action to the avc. This is represented by the dotted line T in the sketch. In this instance, the automatic volume control does not release the tubes instantaneously, with the result that when tuning from station C to D, for example, the receiver does not return to full sensitivity at once. The process is gradual, and since a listener tunes from one station to another quite rapidly, sensitivity, and therefore noise, is held down.

Cuban 'Phones

THE Cuban Government has authorized the use of a portion of the 40-meter amateur band by Cuban amateur radiophone stations—stations having calls with the prefix "CO". The specific channel opened for 'phone use extends from 7000 to 7100 kc. United States amateurs are not permitted to use radiophone transmitters in the 40-meter band. It has been set aside for use by amateur radio-telegraph stations only.

Frequency Modulation

MAJOR Armstrong's system of frequency modulation is unique if for no other reason than the fact that the greater the frequency band width employed for transmission, the less noise received. Until recently, noise has been fought with power; possibly in the near future noise will be fought with frequency bands. In either event, the Federal Communications Commission is the deciding factor.

"The Shadow"

THE mysterious form of interference reported in this department last month has occupied the attention of governmental and commercial radio agencies alike. Because of the unpredictable raids of this interference into marine, trans-oceanic, aircraft, military, naval, amateur, and probably also in the television sections of the radio spectrum, the strange radio signals have become known to engineers as "the shadow." William A. Winterbottom, Vice President and General Manager of R.C.A. Communications, Inc., has made the announcement that scientific methods are being employed to track down the source of these sounds. These radio waves have not the character of telegraphic or telephonic signals, and are definitely unrelated to any "static" or cosmic-ray phenomena within the experience of engineers. Unlike static, they are usually observed on definite frequencies. Their "fingerprints" have been taken in the form of phonographic recordings of the weird sounds they produce, and the engineers are slowly "closing in" on the answer to the mystery. Radio direction finders and cathode-ray oscillographs are other devices of modern radio science that are being employed in the hunt, the one being used to determine the direction from which the signals come, and the other to measure their phase and frequency of modulation.

"The shadow" has been most active in the frequency band between 11,000 and 14,000 kilocycles, although it has been observed as low as 6000 kilocycles and as high as 18,000.

The type of signals emitted by "the shadow" are annoying but rarely disruptive to the communications paths across which they sweep. Their interference is most serious to radio-telephone signals, which of course includes the short-wave broadcasting services that hundreds of thousands of persons in this country tune in on their all-wave receivers.

At stations of RCA and other radio companies in the eastern United States, the mysterious signals are most frequently observed between the hours of 9 A.M. and 6 P.M. But it is already known that "the shadow's" operations are by no means limited to this section of the country, for it has been observed on both coasts, and at various points in between.

As a matter of fact, "the shadow" took a hand in the recent broadcasting which attended the stratosphere flight from Rapid City. On that occasion the RCA station at Riverhead, L.I., tuned in directly on the balloon's transmitter and had perfect reception but for the interference of these mysterious waves. This caused a quick change in the technical facilities employed to bring voices from the balloon to the broadcasting networks, it being necessary to pick up the balloon's radio at an RCA station in Chicago, where the interference was not being experienced at that particular time.

So far the radio communication and broadcasting companies have had no serious difficulty in circumventing the interference caused by the mystery signals. But there is little doubt that the public who listen in on the short-wave bands have already suffered considerable inconvenience, and may expect still more in the event that the mystery is not solved shortly, for "the shadow" has become increasingly active in the United States.

Engineers are confident that, from whatever source the mystery waves may come, they are not being employed in any known form of communication. It is therefore possible, if not probable, that whoever is generating the waves may be entirely unaware of the interference they are setting up. Were they carrying intelligence of any nature, this would supply important clues to their origin. But as it is, the searchers must rely entirely on analysis of waves by scientific devices in their approach to a solution of the mystery. It has already been determined that the power sources of the waves are of two types; on some occasions the signals are produced by half-wave rectified power, and on others by a full-wave rectified source.

It is understood that engineers of the United States Navy Department have attributed at least part of the weird interference to radiations from high-frequency "fever machines" used in hospitals. But whether "the shadow" is, after all, a "multiple personality," arising from a number of sources, is still to be finally determined.

CAMERA ANGLES

Conducted by JACOB DESCHIN

Much in Little

THE epigrammatic form of expression may be employed by the photographer as forcefully as by the orator and author, if the camera worker will concentrate his lens on the particular feature of the human anatomy, inanimate object, or what not, that appears to him to fit his interpretation

"Pipe Dream"

of character, mood, atmosphere, or of some original idea.

He may slice a head, for example (but "gently, brother, gently, pray"; that is, with an eye to composition, for one thing), or he may emphasize in his picture only eyes, or feet or hands, a significant crook of the elbow or the graceful curve of a woman's neck. This dramatization of detail will often tell more within its small scope than would the inclusion of the entire figure or object, without the annoying distractions and superfluous material which the latter too frequently entails.

Composition is all-important. A "much-in-little" photograph will stand or fall on the correct placement of the chief point of interest within the framework of lines and curves, few though they may be. Failure in this regard will, more often than in other types of photographs, mean failure of the idea in the photographer's mind to be realized on paper. Good composition will provide emphasis where it belongs, and correct emphasis for a well-conceived idea will mean a striking picture-story.

Since interpretation and not realistic presentation is the method employed in producing this type of photograph, the usual rule of standing well off from the subject in order to achieve good perspective may be ignored for the time being. So, using ordinary common sense and guided only by the idea, crawl up as close as you need to or as the lens will permit. A short-focus lens will do wonders here, but the regular lens, and, of course, the telephoto will often serve.

Incidentally, if the particular lens you have will not give you just the small portion you want, take whatever else goes with it and compose your picture by enlargement later.

Treatment of an epigrammatic picture may be grotesque, with serious, humorous, or serio-comic implications, or, within its sphere, may be fairly straightforward. Thus, "Pipe Dream" might be included in the former category, and "Tangled Thoughts" in the latter. Because of the abrupt point of view, distortion is unavoidable, and, in fact, desirable, but distortion here means something else again from the meaning of the term as it was discussed in our February issue. Distortion here is a means employed for the projection of a thought; in the other case, a deliberate, manual procedure during enlargement to produce caricature.

While epigrammatic pictures generally are made after much planning, it is surprising how often some of the best suggestions will come in the course of arranging the subject and in varying the position of the camera. Material lies everywhere and may be used for other purposes than to express an idea or emotion. Thus, a broken egg shell, the spokes of a wheel, an interesting design noted in, perhaps, some commonplace household object, may be sufficient justification for a picture if the arrangement and lighting are so executed as to give joy in pure line and the satisfying contrast of light and shade.

"Tangled Thoughts"

The photographer is at liberty in this type of work to shift his material as he sees fit and sometimes in a grossly unorthodox manner. Thus in "Pipe Dream." the subject's

head was originally in a horizontal position; also, the picture is a print made by combining two negatives, one being reversed, although this could just as well have been done by taking the second negative in the reversed position in the first place. But then, the photographer did not think of the final

"Contrast"

print until he started arranging his material in the darkroom, so this offers another chance for working up an idea or completely revising the original one.

Thinking about epigrammatic pictures and playing with ideas while studying the possibilities of the humblest material that greets the eye are good training in composition and in noting in sticks and stones pictorial sermons well worth photography.

Still-Movie Camera

A COMBINATION motion picture and still camera selling at an extraordinary low price is shaped something like a movie camera, loads 10 feet of film at a time, and may be operated continuously for this length for movie work, or 40 pictures may be snapped off in quick (or otherwise) succession. If the exposures are made in quick succession, prints are later made up into book form in the order in which the exposures were made. Flipping these 40 prints quickly gives the illusion of a movie.

Fine Grain Developer

A NEW fine grain developer which has been attracting favorable attention is the Eastman Ultra Fine Grain Developer, which comes handily packaged in pint and quart cartons. The latter is more economical to purchase since the cost is only a third more than that of the pint.

Giving the fine grain results of paraphenylenediamine types of developer but without their slowness, the new developer allows the same maximum enlargement, exposure latitude, and film speed, is stainless, non-toxic, keeps well in solution and has great developing capacity, being as simple to use as the tried-and-true "M-Q." Speeds of development at 65 degrees are 10 to 15 minutes for such films as Panatomic and 15 to 20 minutes for "superpan."

Screw-In Mounts

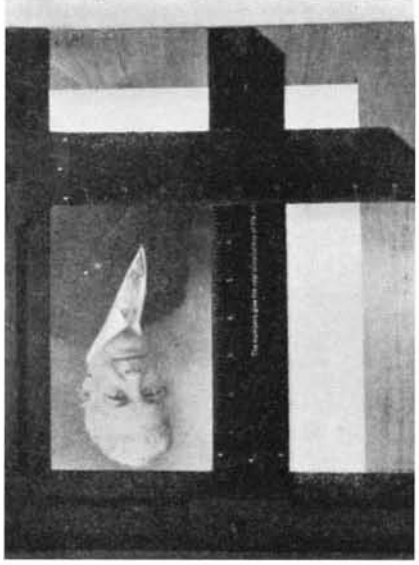
SOME persons find difficulty interchanging lenses on screw-in mounts, preferring for that reason camera bodies equipped with mounts of the bayonet type. We know that reasonable gentleness and caution in starting the lens or filter on its circular course are the whole A, B, C of the problem, and the "knack," if any, lies merely in bringing the lens down level with the mount and carefully sliding the lead end of the threading of the lens into the grooves of the mount. It may be helpful to some not to attempt to interchange lenses while holding the camera in the hand but to first place the camera on its back on a table or other flat surface.

"Bulletin" Board

A PLACE for everything and everything in its place is the rule in the darkroom of the worker who aims for perfection in his pictures. In one darkroom a piece of Beaverboard measuring 12 by 18 inches was nailed to the wall, in the corner where solutions are weighed out and mixed. Manufacturers' formula sheets and formulas copied out of books and magazines or obtained from dealers or fellow workers are thumb-tacked to this board and are there whenever wanted. Another use for such a "bulletin" board is for a list on which needed items are noted as they approach the vanishing point. There is nothing so exasperating and so dampening to enthusiasm as being short of some chemical ingredient when we have gone half-way through the process of mixing a formula, or finding during a heavy evening of printing that we lacked sufficient paper to complete the program we had set for ourselves.

Easel Copying Stand

A VALOY enlarging easel was pressed into service for a copying stand on one occasion and found very serviceable. The easel was placed against a wall with the original upside down in order to get a right-side up view on the ground glass. A vertical picture, of course, can as easily be taken by resting the easel on a table and shooting down. The easel guides furnished ideal margin rules and, being of metal, held the picture rigidly.



How an enlarging easel may be used to hold a photograph for copying

Focusing Aid

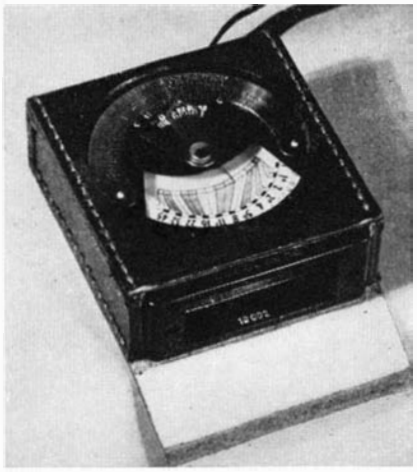
THOSE who have found difficulty looking for a negative that could be scratched so that on projection the sharp lines could be focused—the damaged negative to be replaced by a good negative which could not

properly be focused because it was overdense or for some other reason—will welcome a device known as the Exakt that does the job much better. Coming in sizes ranging from 35-millimeter to 9 by 12 centimeter, the device is a film, in the center of which is a negative the size of the negatives being used. This negative, instead of the haphazard scratches aforementioned, consists of fine dots and geometric figures, which are easily focused. All the lines should focus sharply, thus affording sharp definition; one worker has found that he can focus best with the dots, others may find they can do better with the lines.

NEW PHOTOSCOP ARRIVES

FINAL details on the new Photoscop photoelectric exposure meter have been made available with the appearance of the instrument on the market. Designed for still and motion picture photography, it is of vest-pocket size and comes in an "ever-ready" leather case which may be swung from the neck by a cord.

In describing the original feature of the new meter—the inclined photo-cell and mirror—the distributor says that it "limits the angle of measurement to only about 45



The Photoscop with its leather case open, ready for instant use

degrees of photographic importance; only about 20 degrees above the meter axis, and about 25 degrees below the horizontal plane of the meter. The region directly in front and just below the horizon is favored. The 'top-light' influence, which is so frequently interfering in exposure meter reading, is completely eliminated."

The new Photoscop gives direct readings after pre-setting of the film speed and the generally used shutter-time of the still-camera or the "taking-speed" of the motion picture camera. A red pointer swings into position on the dial when the meter is pointed at the object, giving instant reading.

The meter gives readings from 30 seconds to 1/1000 of a second, with cinematic taking speeds ranging from 8 to 96 frames per second. Film speeds are from 14 degrees Scheiner (Kodachrome speed) to 29 degrees.

The statement is made that "the new Photoscop will cover every fairly adequate illumination, daylight or artificial light, in which the vast majority of pictures is taken, and which is necessary for attractive results."

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 151)

raddle, slam, sock, and whang. The coming of dictionaries and formal correctness slowed up the flow of homely language.

But the present century gives some hope. "It is too early to make more than a surmise," says Dr. Rockwell, "but no devotee of the funnies can fail to read the signs of the times." In the vigorous style of modern fiction he also sees words which will force themselves into standard usage. "He that has ears for hearing, let him sharpen them and he will surely hear the grass growing in the field of verbal lambastics."

Sad State of Nation's Timberland

THE completed report on timberlands in Minnesota—the first state to be surveyed in a nation-wide inventory by the Forest Service—is called a "picture in miniature" of the forest situation in the United States. It shows that "a century of use and abuse has made a profound change in forests." It shows "conditions typical of many states where destructive clearing and lumbering" have been common. But it also has brought together facts important in forming new programs of conservation and rehabilitation in all states.

Of an original forest area of 31½ million acres in Minnesota, there remain today only 19½ million acres, much of which is classified as "forest" for lack of a better name. Actually, 21 percent of it has no tree growth, and 38 percent is occupied only by aspen and scrub oak. Only 41 percent retains any semblance to the original types.

The changes in size and quality of timber are striking. The original forest contained at least 10,000,000 acres of old growth pine, spruce, and hardwoods. The present area of old growth saw timber of all types is only 343,000 acres or 3 percent of the original. Ninety-seven percent of this kind of timber, which was the mainstay of the lumber industry, is gone.

A few areas in Minnesota—such as the Superior district and the Chippewa National Forest—indicate what may be expected of cut-over lands with reasonable care and protection. The Superior district, burned over almost completely 70 years ago, now has more than 300,000 acres of second growth nearing merchantable saw-timber size and nearly a million acres of cordwood forest, over half of which is in valuable pulpwood types.

Mosquitoes Cause Many Deaths in U. S.

BECAUSE so much publicity has been given to the remarkable eradication of yellow fever throughout the world by control of the particular mosquito which carries the germs of that disease, the erroneous belief has sprung up that mosquitoes no longer are important agents of disease, points out the American Institute of Sanitation.

"Close to 3000 persons in the United States die annually from malaria, which is

caused solely from the bite of anopheline mosquitoes whereby microscopic parasites are introduced in the body to live in the red blood cells," says the institute.

"But the death rate from malaria is no true index of the human misery caused by mosquitoes. For every person who dies from malaria there are dozens who are partially incapacitated by the affliction. A person may suffer from the disease the greater part of his life with a reduction of productive capacity of 50 percent or more, yet he may finally succumb to an entirely different ailment. Although rarely fatal, malaria undermines the constitution and resistance, with the result that the victim easily contracts other ills."

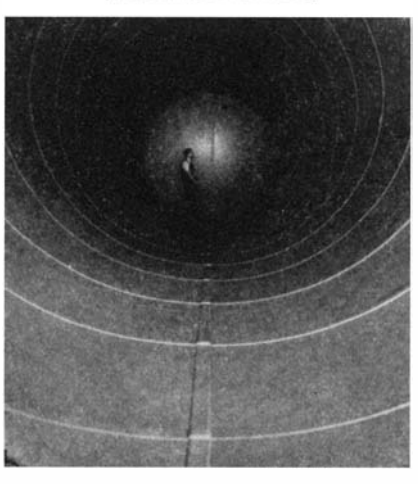
Hydrogenation Ages Whisky

A NEW and promising method of removing "greenness" from freshly distilled whisky is described by Hochwalt, Thomas, and Dybdal in *Industrial and Engineering Chemistry*. Hydrogenation of the fresh spirits, accomplished by passing hydrogen through it in the presence of a nickel catalyst, is said to do the trick. The disappearance of the disagreeable odor and taste is the immediate obvious change that occurs on hydrogenation of freshly distilled spirits. The compounds which cause the unpleasant odors and taste known as "greenness" and which prolong the maturing period are changed by the reducing action to odorless and tasteless bodies. Both physical and chemical methods have been unsuccessful in detecting any change in the hydrogenated product; for example, only the empirical tests such as taste and odor, which are extremely sensitive, show the difference of the hydrogenated product. —*A. E. B.*

Latex Coated Textiles

THE development of a new process for coating textiles with rubber latex promises to call forth a large industry. First products to reach the consumer market are ordinary canvas work gloves. These are made by dipping into or spraying with a vulcanized rubber latex solution and then drying. The advantages of this process are extreme simplicity and low cost, while for the product itself are claimed a double or quadruple wearing life, depending upon the use to which the gloves are put, a resistance to many acids, and added warmth. Non-slip qualities make them admirably suited for driving; non-wetting qualities promise use for children's winter mittens.

This process is also being applied to work clothes such as overalls and for the making of substitute oil-skins. The latter features non-stiffening when subjected to low temperatures.



Antidote

AN antidote for otherwise fatal poisoning from overdoses of commonly used luminal, veronal, and related sleeping powders has been found in picrotoxin, a drug formerly much in vogue but little used in recent years. Two human cases in which the new treatment proved its worth, and animal experiments leading to its use, were reported by Drs. T. Koppanyi, J. M. Dille, and C. R. Linegar, Georgetown University Medical School, Washington, D. C.

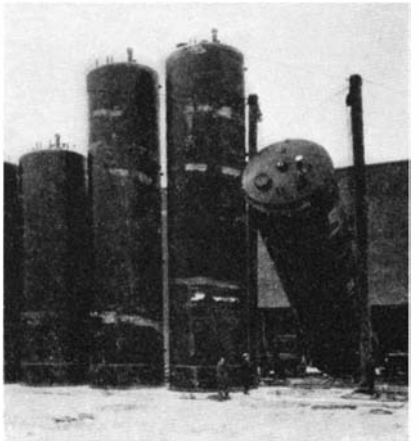
Physicians will soon be able to use this new treatment in rescuing from death those who inadvertently or with suicidal intent take large doses of the barbiturate sleeping powders.—*Science Service.*

Diamond Finger Checks Car Cylinder Repairs

"BETTER than new" is the slogan of many reconditioners of automobile cylinders. Many conscientious garage mechanics almost reach such perfection, but some operators are turning out work which is far rougher than the original finish.

Unimpeachable evidence that this is the case has recently been gathered by the "profilograph," or roughness detector, developed by physicists of the University of Michigan Department of Engineering Research. A delicate diamond-pointed finger, moving over a supposedly smooth surface, traces, magnifies, and records irregularities which hitherto could not be satisfactorily measured.

Even on the mirror-smooth finishes of new cylinders the profilograph is sensitive



These huge tanks, each with a capacity of 32,000 gallons, are part of one of the largest hydrochloric acid storage units in the United States. The tanks are lined throughout with rubber, and their contents are withdrawn through a rubber-lined pipe system. An interior view of one of the tanks, taken before erection, is shown at the left. Note the size of the tank in comparison with the man at the far end.—*A.E.B.*

enough to trace slight hills and valleys, which are unimportant, however, in car operation. Some of the refinished jobs, on the other hand, show a traced profile resembling a side view of mountain peaks. Some reconditioned cylinders may approach new work in smoothness, states E. J. Abbott, research physicist, but many are much worse.

Motorists should require that reconditioned cylinders should not only be bored or ground to correct for wear, but the finish should also be restored by honing by competent mechanics, he states. A surface merely bored is left rough, which affects both initial and long-time wear, fit, oil consumption, and general motor depreciation. Instead of testing the finished surface merely by running the finger nail along it, the usual method, mechanics should have sections of cylinders of known degrees of smoothness for purposes of comparison. Even the finger nail test may be fairly efficient if such sections are always at hand, instead of depending on memories of previous finishes.

Chromium Plating Improved By New Method

ELECTRICITY can be "fooled" into following unusual lines by the addition of certain complicated organic chemicals to the bath in which metal articles are electroplated, with the result that much of the special apparatus now needed to apply the popular chromium plate may be discarded.

This discovery, saving much time and labor in chromium plating, and described as "the first real improvement in chromium handling since 1920," is reported by Dr. Richard Schneidewind, of the University of Michigan Department of Engineering Research.

Lightning, with its millions of volts, tends always to strike high and pointed objects. In the same way, the relatively low voltages flowing through an electroplating bath also are attracted to the raised and sharp-pointed parts of the object undergoing plating.

This means that the high parts of the object get the most current and, likewise, of the chromium or other metal which the current carries with it. The hollows and creases of the object receive less, often being left bare, in fact, unless special wires are arranged to conduct the current into these areas. This uneven spread is especially marked in the case of chromium.

The organic chemical which Dr. Schneidewind uses in the plating solution has the peculiar ability of "spreading" the electric current, so that instead of making a beeline for high spots, much more reaches into, and plates, the hollows. In engineering language, the chemical increases the metal "throwing" power of the solution. One manufacturer, for instance, found that he could increase his production of chromium plated frying pans from 65 to 100 an hour, largely because it was no longer necessary to take the time to fit the hollow of each pan with a special loop of wire.

Power-Driven Pruning Saw

A RECENT interesting development by the U. S. Forest Products Laboratory, Department of Agriculture, is a power-driven pole saw to be used in pruning operations. The Laboratory reports, however, that it is still in the experimental stage. "The power unit," says the *Log of the Laboratory*, "consists of a one-cylinder gasoline motor weighing about 60 pounds and mounted on a light drag. A 15-foot length of flexible shafting connects the motor to a pole unit. The pole itself is a hollow aluminum casing, inside of which a shaft revolves to drive at high speed the six-inch circular saw mounted at the top. The pole unit weighs about eight pounds and has an effective reach of 14 to 16 feet."

A "long arm" for tree pruning

Food *Versus* Beauty

IN a good year, according to Dr. Edward L. Thorndike of Teachers College, Columbia University, Americans spend 17 billions of dollars on food, but only a little more than half that amount to satisfy hunger. Another 8 billions goes for clothing, but only 41 percent of that for actual protection against cold, heat, and wet.

About 700 millions are spent on cosmetics and beauty parlors. Of this amount, one seventh is for the pleasures of sight and smell, one fourth for the pleasures of sex and courtship, one third to gain general approval from others, one eighth to have inner self-approval, and about one tenth to secure mastery or domination in business or social life.

Searching for Oil Source

MAN is still seeking the origin of oil, industrial life-blood of today's machine age. Under the sponsorship of the American Petroleum Institute, national trade association of the petroleum industry, the search for oil sources begun several years ago is being continued with the cooperation of scientific organizations, domestic and foreign government bureaus, and individuals.

Scientific research is being employed in seeking the source of oil where once the "wildcatter," or oil prospector, gambled by drilling undeveloped territory. It is believed that with further progress it will be possible to ascertain not only the sources of

oil, but also to determine in which regions the chance of discovering hidden subterranean oil pools is greatest.

In the light of present knowledge, structure, sand, and source are requisites to an oil pool. Productive pools have been found on poor structure, and even treacherous sand conditions have yielded substantially, yet many wells have been drilled where both structure and sand conditions were favorable, but oil was lacking. Deficient source now is believed to explain the failure of Tomball Field, on the Gulf Coast, of Wheeler Ridge Field, in California, and of other fields, to produce satisfactorily despite favorable indications.

The research work in oil sources is considered of vital importance not only in the search for new oil areas and fields, but also in connection with other studies, such as the migration of oil underground. While sporadic work has been done in studying migration, particularly as to how far and how rapidly oil can move through porous sands and rocks, definite conclusions cannot be reached until the origin of oil is known.

Under the direction of Dr. Parker D. Trask, of the U. S. Geological Survey, the Institute's research project began with a study of the oil-forming ability of the muds and sands of ocean bottoms. Virtually all known oil fields are in, or are associated with, rocks that once were such muds and sands. In this study Dr. Trask and those co-operating with him analyzed samples of mud and sand taken from the bottom of the Seven Seas.

The second stage of the work, now in progress, involves collecting and studying the formations associated with known oil fields, the knowledge gained in the first stage being applied in the second. While those engaged in the task say that possibly five years remain before thorough understanding is reached and the origin and sources of oil are known exactly, the work of the past three years steadily has narrowed the broad field of theories as to the origin of oil. Each newly-discovered fact has been a direction marker pointing the course of new research.

Results obtained already have proved useful, and the work is seen as entering the stage where each year's findings not only will add to man's knowledge of the origins and sources of oil, but will be of material aid in solving many of the petroleum industry's production problems.

Stainless Steel River Bed

IN the construction of the dam at what is to be known as the Lady Bower Reservoir, situated some 10 or 12 miles from Sheffield, England, on the Sheffield to Manchester "Snake" road, an unusual type of bed has been constructed. The Derwent Valley Water Board has taken advantage of the use of "Staybrite" stainless steel for the laying of a "throat" between the dam and the continuance of the River Derwent, towards Bamford. The throat, as will be appreciated by water engineers, lies on two sides of the embankment, with a sort of hump between the flow in the two streams, and is completely lined with 18-gage sheets from two to four feet wide, rectangular in shape. The sheets are bent like trays about 1¼ inches deep which are set in concrete.

Use of this metal as a lining, or bed, enables the engineers to calibrate the flow of the water and to ensure also that the markings will always be discernible. The metal is polished and does not permit corrosion or accretion of moss and other vegetable growth which would interfere with the markings.

Steady Rise in Locomotive Tractive Power

LOCOMOTIVES in service on Class I railways numbered approximately 48,300 at the end of 1934. There have been steady reductions in the number of locomotives ever since 1924.

These reductions have been made possible, in part, by the installation of new engines of greater power, and by more intensive locomotive utilization; the decline in traffic since 1929 has also been an important factor. The number of locomotives in service on Class I lines, together with the average tractive power per steam engine, is shown below.

Year	*Number of Locomotives*	*Average Tractive Power (Pounds)*
1916	61,332	33,188
1920	64,746	36,365
1921	64,949	36,935
1922	64,512	37,441
1923	65,327	39,177
1924	65,358	39,891
1925	63,974	40,666
1926	62,776	41,886
1927	61,363	42,798
1928	59,470	43,838
1929	57,571	44,801
1930	56,582	45,225
1931	55,149	45,764
1932	53,316	46,299
1933	50,903	46,916
1934	48,304	47,712

As stated, one of the reasons why the railways have been able to reduce the number of locomotives in service is that remarkable progress has been made in increasing the power of the average locomotive. From 1916 to 1934 the tractive power of the average steam locomotive has been raised from 33,188 pounds to 47,712 pounds, an increase of 44 percent. The 1934 figure represents the highest point yet attained.

Painless Dentistry

DENTAL patients received with much pleasure the recent news that Dr. LeRoy L. Hartman, Professor of Dentistry in the Columbia University School of Dental and Oral Surgery, has developed a chemical which would deaden the pain of drilling a decayed tooth. Dr. Hartman has not patented this invention, but instead has offered it as his contribution to the relief of unnecessary suffering. At a recent meeting in New York, Dr. Hartman made public for the first time the formula for his pain deadener, together with directions for its application. This information is quoted below:

Formula by weight:

Thymol	1¼ parts
Ethyl alcohol	1 part
Sulfuric ether	2 parts

Keep tightly corked in brown glass bottle. One-half ounce sufficient for 200 applications. Use cork or tin-lined stoppers only.

This is a topical application, made on a moistened pellet of cotton, not saturated, directly to the dentin or caries. If applied

over the caries, a second application may be necessary after the caries has been removed. Allow pellet to remain in contact one minute for children, 1½ minutes for adults. Remove pellet and apply blast of warm air to area of application. Use rubber dam.

If cotton rolls are used, varnish gums surrounding tooth and change cotton rolls immediately after application.

Rhodium and Rhenium Plating

RHODIUM and rhenium, two precious metals, which belong to different groups in the periodic system, but which have much in common galvano-technically, are now finding commercial application in plating. Both are nearly the same price, and as they are about the most expensive metals used for plating purposes, they are limited to very thin coatings, which, because of their exceptionally high corrosion resistance, serve as an effective protection for other metals or metallic coatings.

Rhodium has become useful for protecting silver from tarnishing; a deposit of 0.0001 mm. thickness has been found sufficient for this purpose. Like platinum and palladium, it may be plated from an ammino nitrite bath. A half minute flash is sufficient to protect silver. Rhodium is also used for plating reflectors and optical mirrors.

Rhenium is characterized by high resistance to hydrochloric acid; it is plated from a bath containing potassium perrhenate, in combination with perrhenic acid and sulfuric acid, or with phosphoric acid and sodium phosphate. All rhenium baths possess good throwing power and give a highly lustrous deposit that requires no polishing. The resistance to hydrochloric acid is so great that rhenium plated brass articles submerged in this acid for three days showed no effect.—*A. E. B.*

CURRENT BULLETIN BRIEFS

THE DIRECT CONTROL AUTOGIRO is the title of a 20-page pamphlet, illustrated with drawings, which gives general information on the present status of the autogiro aircraft. It is of value to students of aeronautics as well as those particularly interested in the unique characteristics of this type of ship. *Write for Bulletin 336A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

ORGANIZATION, AIMS AND ACTIVITIES OF THE HIGHWAY RESEARCH BOARD is a 16-page booklet published by the *Highway Research Board, National Research Council, 2101 Constitution Avenue, Washington, D. C.—Gratis.*

SHORT WAVE TRAVEL TIPS is a six-page pamphlet written for the short-wave listener which gives information on tuning, and on antennas to be used. It includes a compact list of short-wave stations, as well as a list of "don'ts" for short-wave listeners. *Allied Engineering Institute, 98 Park Place, New York City.—10 cents.*

AERIAL FERTILIZATION OF WHEAT PLANTS WITH CARBON-DIOXIDE GAS, by Earl S. Johnston, covers the subject of this important agricultural work, giving the results of numerous experiments so far conducted, together with a summary and general conclusions. Illustrated with six photographs. (Publication 3346.) *Smithsonian Institution, Washington, D. C.—Gratis.*

RADIAL WIRING SYSTEM describes a newly developed type of home wiring, particularly adapted to the "New American Home." The pamphlet describes the inadequate, earlier wiring systems and the newly developed type which uses a primary circuit breaker to protect against short circuits and over-loads. *Write for Bulletin 336B to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

CHEMICALS BY GLYCO is an interesting collection of formulas for the making of liquid soaps, polishes for floors, metals, automobiles, and shoes, and also gives other valuable information on the uses of chemicals in similar products. Prices of the chemicals are listed. *Write for Bulletin 336C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

PRODUCTS FOR THE HOME CRAFTSMAN, by Emanuel E. Ericson and Walter E. Burton, deals particularly with the sharpening of various tools used in the home. Numerous photographs illustrate the correct ways of doing the work. Included are listings of abrasives and sharpening stones, together with prices. *Write for Bulletin 336D to Scientific American, 24 West 40th Street, New York City.—10 cents.*

AIR CONDITIONING FOR COMFORT AND PROFIT covers the installation of air conditioning equipment in various types of plants, offices, and laboratories. *Write for Bulletin 336E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

SACCHARIMETERS describes and illustrates a new half-shadow type of saccharimeter designed according to suggestions offered by a large number of sugar chemists. *Write for Bulletin 336F to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NICKEL-CLAD STEEL is a 24-page booklet, thoroughly illustrated with photographs showing numerous industrial uses of this particular metal. Comprehensive tables accompany the photographs, giving a general coverage of applications. *Write for Bulletin 336G to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

INDUSTRY'S RESPONSIBILITIES BROADEN, by Alfred P. Sloan, Jr., is a reprint of an address delivered before the Congress of American Industry and sets forth clearly the views of an industrialist on the present and future responsibilities of "big business." *Write for Bulletin 336H to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Books SELECTED BY THE EDITORS

THE CHEMISTRY OF SYNTHETIC RESINS. In Two Vols.

By Carleton Ellis

SYNTHETIC resins have in very recent years developed a sizable and important industry. In spite of that fact, the literature on the subject has been slow in coming. Here at last is a two-volume set which totals over 1600 pages of information on all phases of chemistry relating to these new products. Types of synthetic resins, their uses, chemistry, and manufacture are fully covered. An indispensable set for the advanced chemist.—Both Vols. $20.00 postpaid.—*F. D. M.*

MAKING A LIVING IN RADIO

By Zeh Bouck

THE radio industry today has more or less settled down to a point where its many ramifications offer openings to thousands of educated technicians. In this book the author reviews the phases of the industry and gives many hints as to how to get in. A careful perusal of it may change completely a young man's plans for his future, and lead him into a large and growing industry.—$2.15 postpaid.—*A. P. P.*

ASTRONOMY

By John Charles Duncan, Ph.D., Prof. Astron., Wellesley College

A THIRD and revised edition (August, 1935) of this widely used, elementary college text-book is now available. "While assuming the degree of mental maturity commonly expected of college students, it avoids difficult mathematical discussions and requires no previous study of any science." This 434-page text is unusually attractively produced—nice type, well leaded and easy to read; copiously illustrated with 183 figures, 67 fine plates on filled paper, 8 unusually attractive star maps, and a multi-colored spectrum plate; rugged and attractive binding.—$3.95 postpaid.—*A. G. I.*

TEST PILOT

By Jimmy Collins

ONE of the most remarkable books on flying ever written. The author was a young pilot of 31 years of age whose career was filled with every incident and experience in aviation it is possible to imagine. Mr. Collins was recently killed after a dive test in a Navy airplane. This flight was to have been Jimmy's last job as a test pilot. It was his last flight. It is a strange thing that in fun he had once written a newspaper piece entitled "I Am Dead," in which in simple but poetic language he described his own death in a dive crash to the ground. Born in 1904, Mr. Collins graduated from Kelly Field in March, 1925, in the advanced Army flight school. Incapable of submitting to the discipline of a factory he became a free lance test pilot, testing bombers, single seater fighters, making shallow dives, speed dives, and so on. His book is written without heroics, in clear, simple language, and whether as a document or as a literary effort approaches perfection.—$1.40—*A. K.*

OUR ENEMY THE TERMITE

By Thomas E. Snyder

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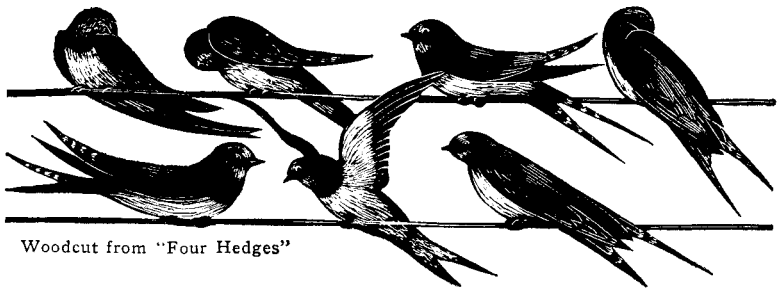

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