SCIENTIFIC AMERICAN

DECEMBER · 1931 35 CENTS

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AND A DIGEST OF APPLIED SCIENCE

Blacksmith Shop in the Ford village of Greenfield, Michigan

WHEN WE WERE YOUNGER

THE blacksmith's calm, ruddy face took on an astounded look when the first gas-buggy came to a jerky stop in front of his shop for service! Staring him in the face, was an idea new to the world!

If you or your father owned a Ford, you learned something in those days that did more to speed up the automotive age than anything else, except the automobile itself. You learned that when Ford sold a car to a customer he followed up the sale by going to the best mechanic in town . . . the blacksmith, bicycle-repairman, or plumber . . . *and giving him a complete lesson in the mechanics of servicing automobiles!* For Ford not only designed, built and sold automobiles, but he also established the principle that a sale does not complete the transaction between maker and buyer, but creates a new obligation on the maker to see that the car gives good service. Ford's cars were bound to give good service, because he saw to it that there was always a local and well-respected mechanic who would guarantee that the car would do its job.

No estimate has ever been made of the part played by these town mechanics and metal-workers in the development of the automobile industry. Yet it was they who adopted the automobile first . . . just as it was from their shops that the first airplane took wings. It was they who made possible today's system of service stations.

Many of them, and the young men they trained, are essential elements of the nation-wide community of Ford . . . repairmen, service men, agents, bankers, even business men of prominence, distinguished members of their communities wherever they may be.

Growing with the industry of which they are an integral part, the entire Ford dealer organization has been specially trained and equipped to service all Ford products . . . automobiles, trucks, tractors and airplanes!

FORD MOTOR COMPANY

SCIENTIFIC AMERICAN

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

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ACROSS THE EDITOR'S DESK

"HOW would you like to live in a certain section of Kentucky where, owing to a double bend in the Mississippi River, there is an area about ten miles square belonging to Kentucky that cannot be reached from the rest of the state without passing through a part of Missouri or Tennessee?" With this question Guy Elliott Mitchell of the United States Geological Survey starts an absorbing article entitled "Making the Nation's Boundaries," scheduled for publication in our January issue. The importance of marking accurately the boundaries of a state or nation can hardly be over-emphasized, for, as history shows, errors in this work have often led to war. You will be intrigued by the mass of information about the boundaries of our states that Mr. Mitchell has compressed within the confines of an article, and by the human-interest illustrations which accompany it.

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In the early days of the automobile, license laws were lax and regulation of traffic played but a small part in the life of the motorist. As the numbers of cars increased, however, it became necessary to provide for proper licensing of the driver and of the car, and for the handling of traffic. Almost paralleling this has been the course of the airplane. At first there was no regulation, then spasmodic attempts at control, and finally a constantly amended group of laws designed to further operating safety for both the aviator and the public. Colonel Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, has prepared for us an article on the regulation of air traffic. Succinctly he points out that ". . . aeronautical regulation . . . must be in the interests of safety . . . but it must not retard the normal advance of the industry or hamper the growth of aeronautics along any practical line." His article will appear next month.

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Why is it that the Western world is so far ahead of the East in the matter of industrial development, when in the 13th Century China was a highly civilized country as compared with the rest of the world? Dr. Arthur H. Compton, Director of the Ryerson Physical Laboratory of the University of Chicago, has answered this question with four words: "The idea of science." In an article to be published in the near future, Dr. Compton explains further: "The idea of science is simply an attitude that men may have towards the world. It is a desire to find out how . . . outside environment . . . works, coupled with the desire to increase their power to control it." Summed up, his article explains what science really is, and presents that explanation in a clear-cut, concise manner.

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It is axiomatic that Nature preserves a balance in her various duties, but when man steps in and adapts the works of Nature to his own needs, he often upsets that balance—and often to his own detriment. For example, he clears land of all growths so that he may cultivate the soil. Rain falls, runs over his clearings, and washes away the rich top soil, rendering the land barren. Why? Because man has removed the natural barriers to soil erosion, without thought of the consequences. He conducted his logging and cattle grazing operations with the same thoughtlessness. But all this is changing. We are learning the lesson of unrestricted land clearing and the devastating soil erosion that inevitably follows, and are proceeding with more caution. The story of erosion—its causes, results, and remedies—is told in an article soon to be published.

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Probably the most interesting of all mammals are those which bear a resemblance to man. Thus we are always attracted to stories and articles about gorillas, especially when they deal in particular with the animals in their native habitat. H. C. Craven, of the American Museum of Natural History, spent some time in Africa collecting specimens for exhibits, and has told the story of his adventures in an article which will appear next month.

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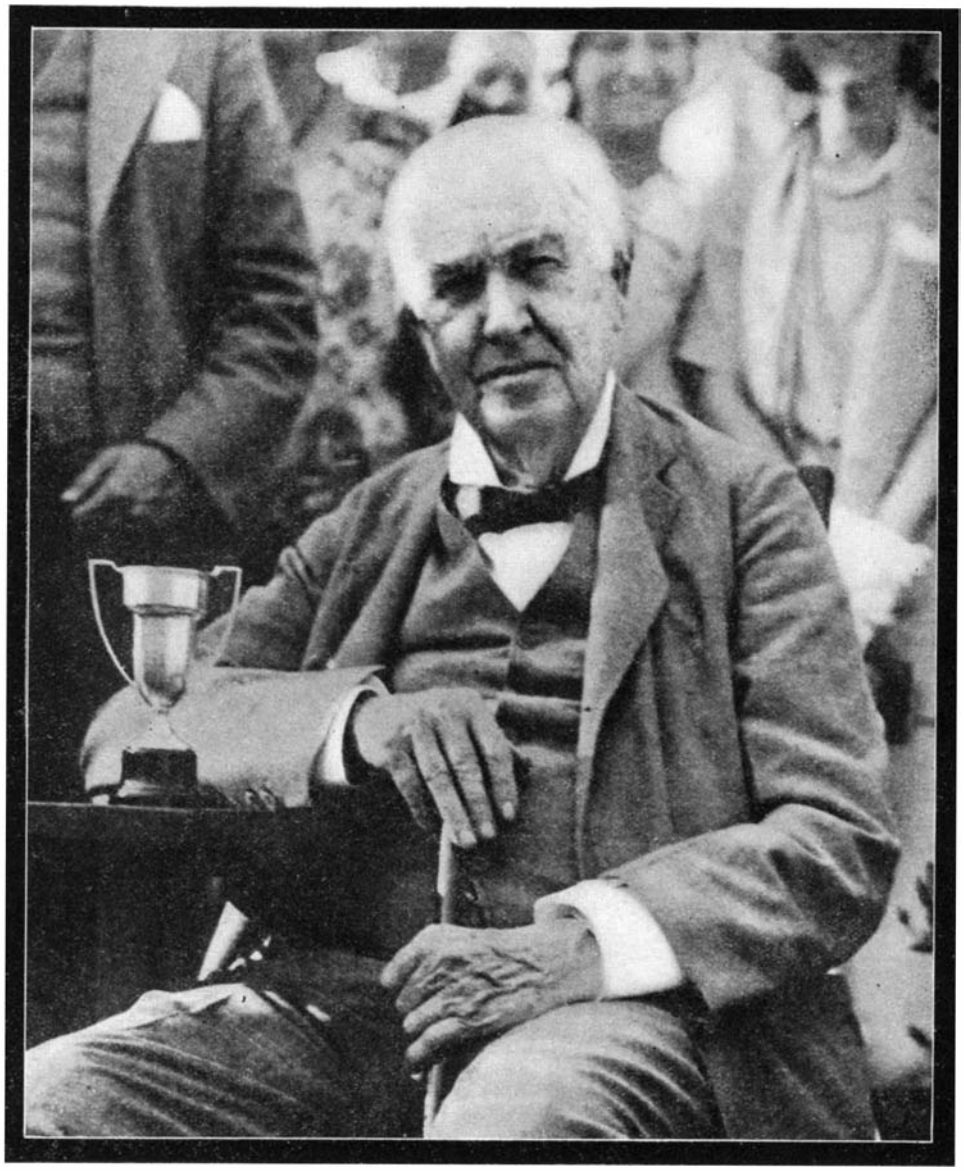
A man with poor vision, who, in fact, had to leave school because of eye trouble, was the first man to be able to see things 9000 times smaller than the naked eye can see! The man is Francis F. Lucas, and the instrument that made possible this seeming paradox is the ultra-violet microscope. The invention of this microscope is 26 years old. What Dr. Lucas did was to work out the technique of applying it. The possibilities for research that have thus been opened are almost without limit. The story of the development work and the present applications of the instrument is told in an article scheduled for next month.



THOMAS ALVA EDISON

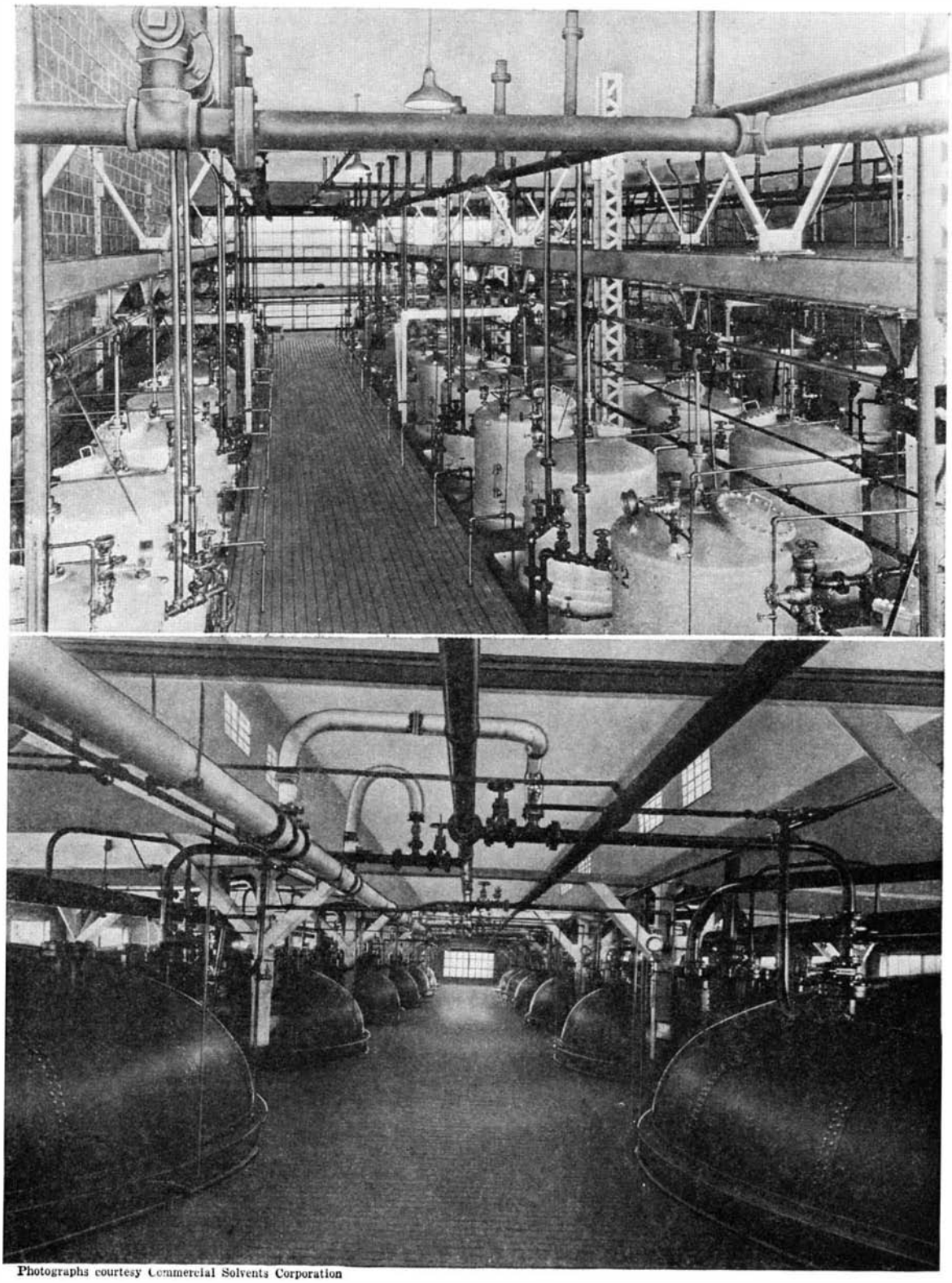
WE have lost a sincere and valued friend, one who for over half a century of eventful activity has ever been willing to respond where he could give aid and encouragement. Mr. Edison died on October 18, 1931.

From the historic day in 1877 when he gave the first public demonstration of his phonograph in the offices of this magazine, to his recent favor of permitting us to reproduce his favorite portrait on our cover, his association with us has been constant and his courtesies innumerable.

Born in Milan, Ohio, February 11, 1847, the son of parents of comfortable means, he early embarked on his own account in a variety of businesses. It was while a telegrapher in Boston that he took out his first patent, No. 90,640, granted June 1, 1869, for an electric vote recorder. From a monetary standpoint this was a failure. His next invention was a stock ticker and this he sold for 40,000 dollars—thus starting a line of inventions represented by over one thousand patents, which placed him among the immortals of industry and science.

The world will mourn the loss of a master intellect; his associates will miss a courteous, kindly gentleman.

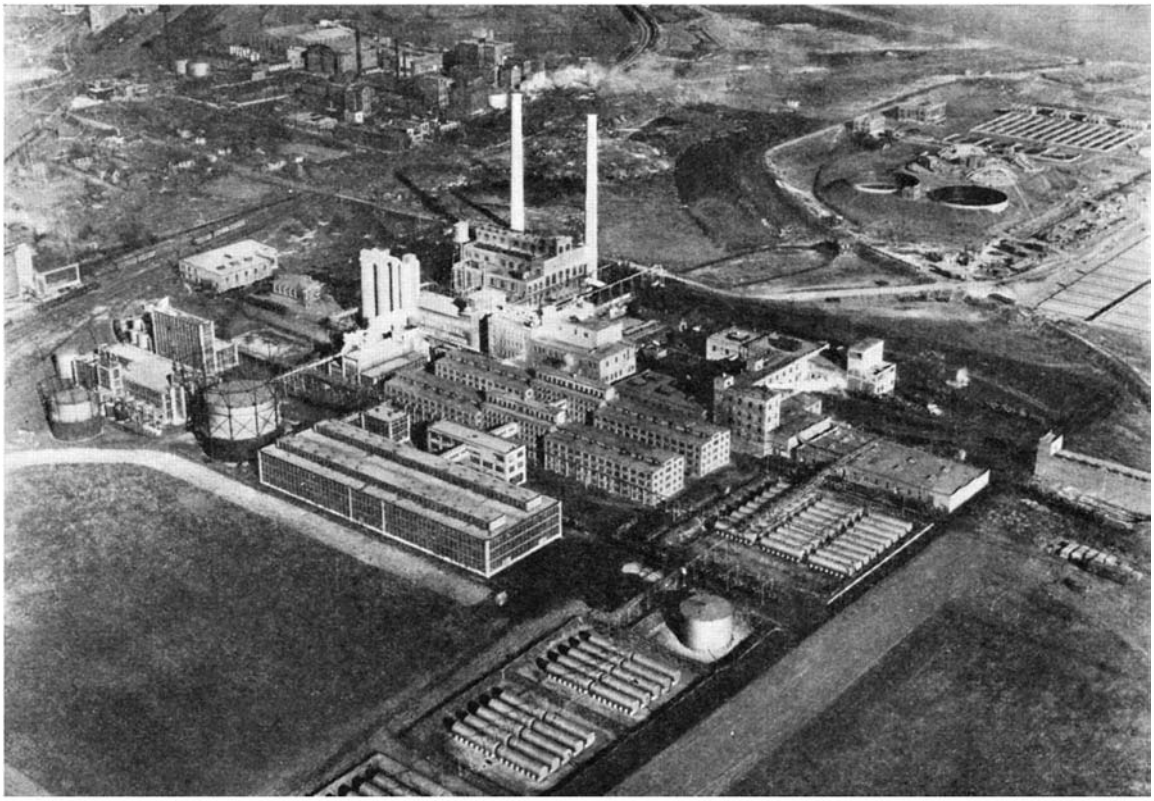
Well may his epitaph be his answer to the question "What is your philosophy of life?" to which he replied "Work—bringing out the secrets of Nature and applying them for the happiness of man. Looking on the bright side of everything."



Photographs courtesy Commercial Solvents Corporation

WHERE BACTERIA HOLD THE CENTER OF THE STAGE

CERTAIN solvents are essential to the conduct of many industries, some of which are mentioned in the article which starts on the opposite page. Four solvents—Butanol, acetone, ethyl alcohol, and methanol—are obtained as the direct result of bacterial action. Starch, obtained from milled corn, is thoroughly cooked and the mash is inoculated with the bacteria. In 48 hours the fermentation is finished and distillation separates the solvents. The upper illustration shows the 800-gallon tanks where the bacteria are cultured, while the lower one shows the 50,000-gallon tanks where fermentation takes place.



This huge plant for the production of commercial solvents from corn has a corn-grinding capacity of 25,000 bushels a day. The storage tanks shown will hold a total of 2,000,000 gallons of solvents

THE CHEMIST LOOKS AT BUSINESS CYCLES

By D. H. KILLEFFER

IDEAS, conceived and discarded during periods of intense business activity, form the centers for that economic growth which cures depressions. The cycles of economic activity and depression have been painstakingly charted and studied but the rôle played in these ups and downs by immaterial by-products of industry has so far escaped proper valuation.

Economists are far too much inclined to look for causes of improvement of business among political and purely economic factors which are, certainly in our modern world, the ultimate manifestations of ideas previously ignored or cast aside as impractical. Yet it seems quite obvious from the viewpoint of science and engineering that these are of prime importance and that we must look to just such apparently remote causes to bring us out of our present business despondency as they have from previous ones. Whether this thesis holds for all past depressions and recoveries is not easy to determine, but certainly it does apply to the depression of 1921 and it seems highly probable that it is in process of applying to that of 1931.

If we consider the lines of activity most emphasized during the World War period and the by-products of these in the form of ideas, the recovery from the 1921 depression becomes quite understandable.

THE prime requirements of the World War each involved the development of materials. Iron, steel, and a variety of metals and alloys, many of them relatively unimportant for peace use before, were essential to ordnance manufacture. Cotton, nitrocellulose, solvents, and other materials used in making them, were needed in great quantity for smokeless powder manufacture on a huge scale. Vastly improved radio equipment was required in coordinating troop activities. Lightweight alloys for airplane and engine construction as well as dopes to render wings and balloons air tight made air operations possible. Automobile trucks, capable of moving vast numbers of men and huge quantities of materials safely and economically over long distances, were needed to make armies mobile.

Thus briefly sketched are the principal new developments forced upon the world by its last great martial orgy. Each of them was imperative and required that great numbers of highly trained men be put to work and driven to the quickest solutions of the many problems involved. No breathing spell could be allowed for stock-taking to decide whether discarded ideas were valuable or not. If they failed to give promise of immediate and valuable application, they must be thrown aside. Yet, in the feverish bustle of doing things, many ideas of great importance, as subsequent events have shown, were conceived. Perhaps it is more important to the outcome that many fertile brains were forced to think intensively along new lines and that the recorded thoughts and discoveries of the past were ransacked for grist for the mills of war.

Considering the five lines of activity noted above along with the developments of the post-war years it is a simple matter to follow their profound effects on business and industry.

Modern weapons and armament required new and stronger steels than existed before. Strength and resistance to corrosion and other destructive agen-

cies were put into steel by the introduction of special alloying metals, and serious investigation of these modifying factors was given extraordinary impetus by the war's demands. An industry in alloys of iron and other metals existed before the war but the forced growth of the war period taught great numbers of men the value of alloys and the technique of their production. The ultimate results of this accumulated knowledge and acquired ability has been the creation, largely on the basis of previously existing industry, of a huge production of many new alloys, both ferrous and non-ferrous, and the finding of important new uses for them.

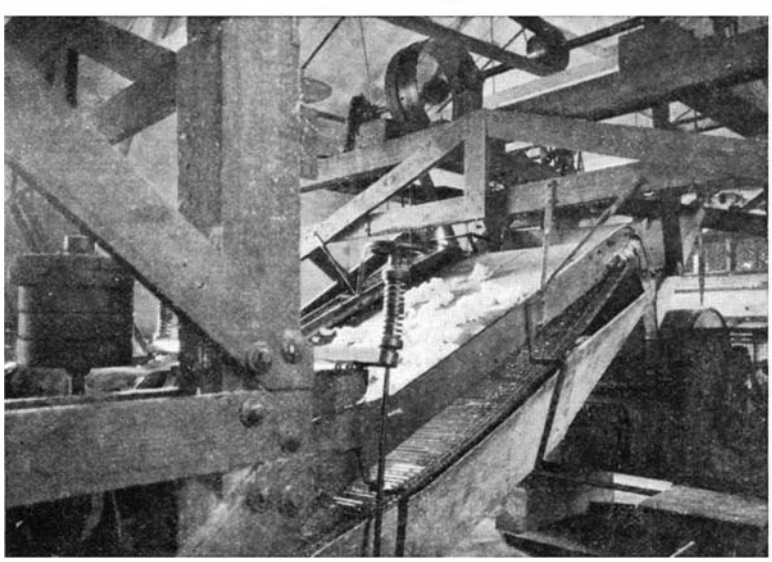
Steels of extraordinary strength, others which remain as bright as silver despite weather, smoke, grime, and the thousand and one agencies which destroy exposed iron and steel completely and quickly, and still others possessing properties quite ideal for special uses of various kinds, all have contributed in great measure to the industrial prosperity of the last decade. In addition to alloys of this type, a host of special metals characterized by special properties—strength combined with lightness, machinable alloys of aluminum, and many others—have come into real industrial importance and aided materially in the recovery from the economic slump following the war activities.

FAR more spectacular has been the growth of new industries on the basis of the "cellulose-consciousness," if one may be permitted to coin such an expression, resulting from the huge accumulation of knowledge of this very common material through smokeless powder manufacture. Smokeless powder is made by the interaction of nitric acid and cotton and the treatment of the resulting fibers with solvents to convert them into solid particles instead of filaments. Of course, there are many refinements in the process of making powder accurately, such as the purification of the raw cotton, the precise control of the nitrating process, the careful sizing of the powder grains, and so on, all of which require intimate knowledge of the properties of cellulose. During the war scores of thousands of men were employed in carrying out these processes to feed the guns at the front and each acquired a certain new knowledge which he sought to make valuable later when jobs were scarce.

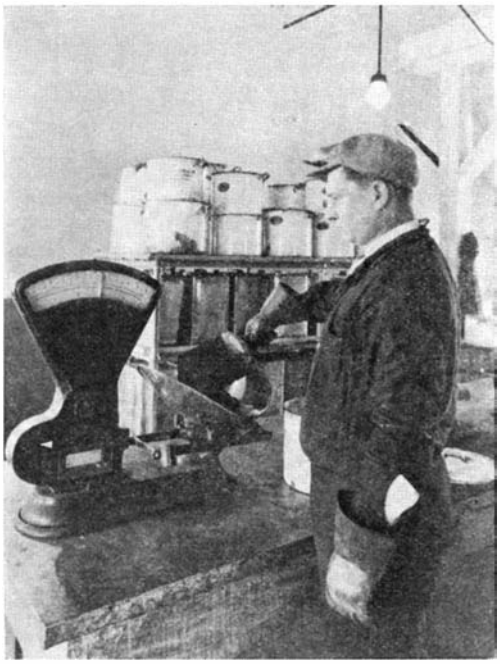
Already before the war there was a small and relatively unimportant industry attempting with indifferent success, as compared with later efforts, to produce silk-like fibers from cotton. Since the processes involved were somewhat similar, the powder makers, after the war, turned to this little industry with their newly acquired knowledge to find a market for themselves. Very few could be absorbed in this way and hence old processes were revived and new ones developed to form the basis for a new industry of sufficient size to care for many more. The perfection of rayon, produced by several different processes, and its development into a major factor in the textile industry which resulted from this sudden acquisition of man- and brain-power is too fresh in the minds of us all to require repetition here.

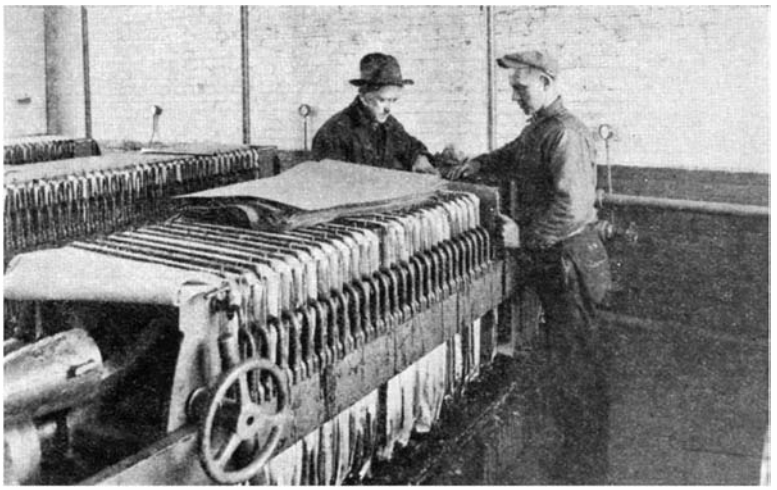
The intermediate step between smokeless powder and rayon from a production point of view is celluloid and in this field, too, war-trained men found an outlet for their abilities. The remarkable tendency thus introduced into this industry of plastic materials was soon away from cellulose and its products to a variety of other materials,

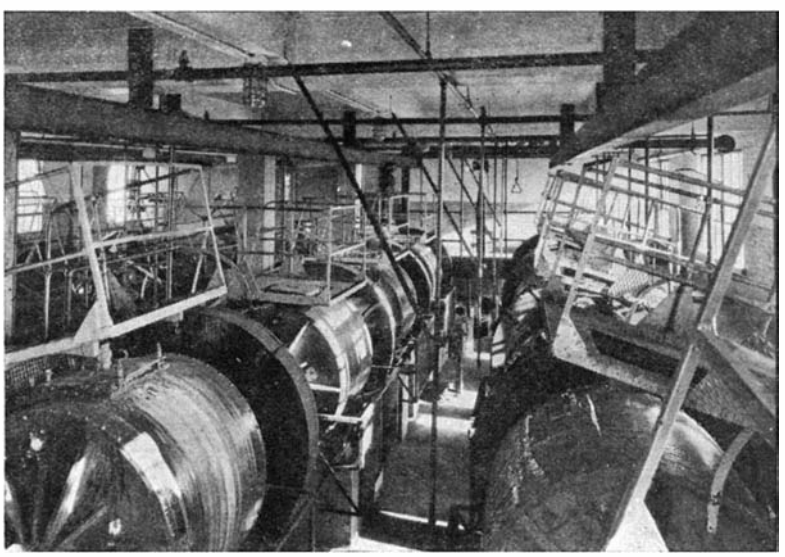
Photographs courtesy E. I. duPont de Nemours and Company



As told in the accompanying article, lacquer was an outgrowth of war activities. The "dope" used in airplane construction was thought to present many properties that would be desirable in paint, but in its original form, it was unsuited for such application. After much experimenting, a point was reached where a practical lacquer could be produced. The development from that point to the present day has been rapid, and entirely due to the unceasing activities of the chemist. The photographs on this and the opposite page show some of the steps in the commercial production of Duco. At the left is the "devil duster" where the raw cotton is shaken loose from dirt. The lower photo at left (*Continued at right above*)







shows the continuous conveyor dryer used to dry the cotton thoroughly after it has been washed. In the third photograph on the opposite page an attendant is removing from a powerful press a cotton "cheese," the form which the raw material takes after dehydration. The cotton is then subjected to an involved chemical process, and the base solution of the lacquer is ready to be passed through the layers of filter paper in the press shown at the right above. Before the base liquid can become the versatile lacquer of commerce, it must be colored in a variety of shades. The pigment is carefully weighed (see photo above) and incorporated by grinding with the base liquid in the machine shown at the right

such as casein from skimmed milk, urea synthesized from ammonia, and so on, all capable of conversion to moldable compounds.

A similar off-shoot from the same parent stem of ideas is our now important and rapidly growing industry of nitro-cellulose lacquers. This industry, which sprang more completely than the others from war needs, involves some of the technique of powder manufacture, materially modified and coupled with a much changed celluloid practice. The old lacquers of even the war years produced flimsy, thin, strongly contracting coatings. To replace paint, for ordinary use, they were out of the question. However, with the push of constructive imagination for an outlet that followed the war, the necessary modifications of the old lacquers to make them generally useful as protective coatings were devised and a new industry born.

The development of the radio industry into virtually a public utility, regulated and controlled by governmental agencies, from the crude wireless of the days before 1914 has resulted quite directly from the knowledge of it acquired by many during war days.

War's powerful effect in developing air travel and the airplane's requirements of light-weight power units resulting in great progress in automotive engines are too obvious to require review here.

Probably it is in a sense unfair to omit from the picture the importance of surplus stocks left from war operations. Millions of pounds of smokeless powder, tons upon tons of steel alloys and countless other materials, begging for an outlet, and huge tanks of butanol, acetone, alcohol, and other solvents kept only because they could not be dumped into the streams, as well as vast plants for the fabrication of war needs, interested capital as well as brains and brawn in the forwarding of new ideas.

EACH of these several typical factors powerfully influenced the return of prosperity after the post-war depression, for upon them were built virtually new industries, new consumers of raw materials and labor, and new wealth.

In our present industrial depression one who seeks the sound and substantial solution must retrace the industrial progress of the past decade and dig out the cast-off or half-completed ideas, for among them one is sure to find the keys to future prosperity. Now, if ever, is the time to take stock of what has been discarded in the rush of prosperity, to clean up wastes and to refurbish ideas in preparation for the hurry of activity to come.

One may see suggestions of what the future holds in the revision of food handling methods to apply the new processes of quick freezing; the use of light metal alloys as strong as steel but only a fraction as heavy in building railroad cars and highway trucks; corrosion resistant alloys to replace other materials of building construction; chemical utilization of excess farm products to manufacture useful materials for industry; synthetic plastics as materials of construction on a scale far beyond a cigar holder or a fountain pen; synthetic resins which impart to oil paints and varnishes the valuable qualities of lacquers while retaining the advantages of oil. These and numbers of other developments, crudely embryonic at present, may confidently be expected to become the important factors in the new industrial growth that must soon follow the present depression.

OUR POINT OF VIEW

Extreme Naval Economy

FROM the appearance of things, we have about decided that we do not need a Navy. President Hoover has promulgated the order that, of the 11 destroyers that were authorized in 1916 and were not appropriated for until the last Congress, only five are to be built; and that there is to be no building of naval vessels in 1932. Coming so soon after Secretary of the Navy Adams' expression of the Navy's policy to build up to full treaty strength, the Administration's move comes as a surprise and a distinct shock. Obviously, questions of economy overshadow all other considerations, numerous and potent though they may be, and yet the Navy is told to accept the decision meekly and keep its mouth shut.

As was pointed out in our preceding issue, our Navy building program is already far behind. We were happy to note that 11 destroyers were to be built, for that seemed a reasonable start toward the 150,000 tons of destroyers necessary to give us our treaty quota by 1936. Now, however, we are building only five; and, in other categories that should be engaging our attention, we are to build nothing in 1932 except the relatively small tonnage already laid down. Before 1936 all our present destroyers will have passed the age limit, will be worn out, useless; and other categories will lose—but why continue fatiguing details! There is one thing that we may add and that is that paring down our naval building program has the immediate effect of increasing unemployment tremendously for *70 percent* of the cost of a naval vessel is for labor. Furthermore, it will have a tendency toward faulty construction later on for, as Secretary Adams has said, a continuous building program is absolutely necessary if our naval designers and constructors are to gain the proper experience in the evolution of types.

Public opinion properly marshalled for any purpose exerts a powerful influence. International public opinion marshalled for world peace has borne fruit in the form of the Kellogg Peace Pact and other treaties of a like nature, one of which is the Nine-Power Treaty guaranteeing the integrity of China. And yet at this very moment China and Japan, both signatories to these treaties, are on the verge of war. Perhaps public opinion expressed in diplomatic notes from our State Department and from the League of Nations will have averted actual war by the time this is in print but there is no way of knowing, for this is the first time the world's peace plans have been threatened by a major crisis. Already there is warfare of a sort in Manchuria, and war hysteria is holding sway in both China and Japan. We seem to recall that, after the World War when Japan wished to absorb China, the strength of our fleet was one of the strongest arguments against the move. The present situation, however, in the face of two supposedly strong treaties, becomes a world crisis. Well might those treaties become scraps of paper as others have done in the past.

The United States should not commit the foolish blunder of attempting to dictate to another nation, but it has committed itself to use its influence to help guarantee the peace of the world. This influence is indeed but a puny thing when our strongest argument is simply a diplomatic note. Notes should have something of power behind them, and that something must be a fleet that measures up to the respect we wish accorded us.

Thrift is often a splendid characteristic but economy can become both a weakness and an emasculator. It is a travesty on our national scheme of things that we who—to exhume an ancient formula—spend billions annually on luxuries and billions in filling the Pork Barrel to pander to the smugness of the constituencies of our politicians, can not spend a hundred million or so to build our fleet to the proper balance and maintain our standing among the nations!

Farm By-products

SOME amazing facts were brought to light in a recent address by Dr. W. W. Skinner of the Department of Agriculture. Of the "by-products" of the farm, commonly called "farm wastes," the United States produces annually, he said, cornstalks, 100,000,000 tons; cereal straws, 115,000,000 tons; corn cobs, 20,000,000 tons; cotton stalks, 18,000,000 tons; and so on to a total of 250,000,000 tons.

As Dr. Skinner said, these by-products are composed, approximately, of: cellulose, 40 percent; lignin, 30 percent; and carbohydrates, 30 percent. Of these three, cellulose has the widest use, being the material from which rayon and paper are made. So far, however, little success has been attained in making paper pulp from these farm by-products because of several factors. One of these is the base cost of the material which must take into account the fact that if it is not allowed to rot in the fields, the organic matter it would thus supply can only be replaced by expensive fertilizers; others are the expense of collection, transportation, and storage of the bulky materials.

As far as the chemists are concerned there is no difficulty in this matter. But where they leave off, economists and engineers must step in and make comparative investigations of wood pulp and farm by-product pulp. Furthermore, Dr. Skinner believes that actual mill-scale production for several years will be necessary before the question can be answered. Farmers need not hold too sanguine hopes, therefore, that this additional source of income will be theirs for years to come.

One Dollar For Ducks

CIVILIZATION has many black marks on its record but one of the blackest is its failure to protect and perpetuate our native wild life. Settlements have encroached upon the habitat of animals and wild fowl. Man has cleared land of coverts for agricultural purposes; has drained lakes and thus destroyed resting, breeding, and feeding grounds of waterfowl; and despite the fact that he has made it impossible for game to hold its own naturally, he has failed to make adequate provision either for restoring conditions favorable to the natural multiplication of game or for artificial breeding for restocking purposes.

Sportsmen have been the backers of every game conservation or propagation movement of any consequence in this country. It is they who have sponsored or forced legislation to prevent commercial exploitation of game; for it must be confessed that all who shoot game are not sportsmen. There are still many "bootleggers" of ducks who shoot more than the allowable bag and sell the birds. Sportsmen have fought to prevent such illegal shooting—have, in fact, sponsored the legislation that prohibits it, which limits the open seasons for shooting migratory birds, which increased hunting license fees, and which provided for conservation and re-stocking.

In this country today there are several large game associations the aim of which is to see that ways and means are

found for multiplying the numbers of game. To their great credit, it may be pointed out that the programs of these associations, composed chiefly of sportsmen, include education in the observation of game laws, restoration of old natural game bird refuges and the establishment of new ones, breeding of those birds which may be successfully bred in captivity, re-stocking far beyond the bag they are allowed, adequate enforcement of the regulations to stop poachers, duck "bootleggers", and game hogs, and above all, the adoption of an adequate Federal game program.

In the November issue of *Field and Stream*, a lengthy article calls attention to the urgent need of a new Game Refuge Bill with a Federal tax of one dollar over and above the state hunting license fee. This small additional charge which would be paid gladly by all true sportsmen in the event a Federal program of this sort were planned, would make possible the purchase of lakes that have been drained and their restoration as resting, feeding, and breeding grounds for waterfowl. It would pay the wages of a greater number of conscientious Federal game wardens who would bring to court those ruthless killers of game who have little or no respect for game laws. One dollar a year from each duck-shooter would in time provide such a quantity of game that no shooting season would have to be curtailed because of a drought in Canada, as was necessary this year, and great duck clouds like those we used to see will again swarm in our skies.

No Dole For Us

WHEN Congress convenes in December, it will be called upon to consider some form of compulsory unemployment insurance. Its proponents will vehemently deny that their scheme even remotely resembles the dole; but past experience has shown that wherever the state has compelled the accumulation of reserves against unemployment, it has later on had to supplement them with the dole. So far no system of compulsory unemployment insurance has ever been so well-guarded as to continue to function in all contingencies without an allotment of funds from the public treasury.

The disastrous consequences of the British dole have been so widely discussed that there should be no necessity of warning against the adoption in this country of any scheme of insurance or relief that might degenerate into a similar costly muddle. Human nature being what it is, however, it behooves us to repeat that unemployment benefits, of whatever character they may be, stifle initiative and discourage the will-to-work; and the American workingman, possessing a large degree of pride in his own independence and capabilities and in American institutions, does not want them except perhaps as a temporary thing. It has been said that the American plan for unemployment insurance, while being based on the British plan, "does not contain the elements which turned the British plan into a partial dole," but we are not so sure of that. When the British unemployment insurance scheme took effect in 1912, no one foresaw the war and the depressions that so radically changed its nature.

Call it compulsory unemployment insurance or dole—we are not in favor of governmental interference in business. Rather do we look to business and industry to take care of their economic casualties. Jobs must be made for the millions now out of work, for the millions who do not desire governmental charity or handouts. Those jobs can and must be made by business and industry out of the lessons learned from sad experience during the past two years; by those individuals who have hoarded their money and have swelled the balances of the savings banks to an enormous total; and by the government itself. Help for the unemployed must have a practical, dynamic quality; not a passive, sorry-you're-out-of-work nature that will make the justly proud American workingman disgusted with himself for accepting it.

Science's Aim

NOT long ago a layman asked us to explain the practical benefits accruing from Einstein's Theory of Relativity. From the manner of his asking, it seemed as though he expected us to tell him that this theory could be applied to the design of a new carburetor for his car, in the manufacture of a new paint, or for curing some disease. This is not intended to be facetious but merely illustrative of the haziness and even the misconceptions concerning the aim of pure science that have widespread existence in the minds of people in this day of almost universal knowledge.

Recently Professor Einstein explained the aim of physicists in words which fundamentally, in our opinion, are applicable to all pure science. He stated that physicists are spurred on in their work, not by a desire to add to human comfort nor for technological advancement, but merely to arrive at a better understanding of the nature of the Universe. The theories resulting from the physicist's work have their birth in speculation and are the product of observation and experience. They lead, Professor Einstein said, to a simplification of our knowledge.

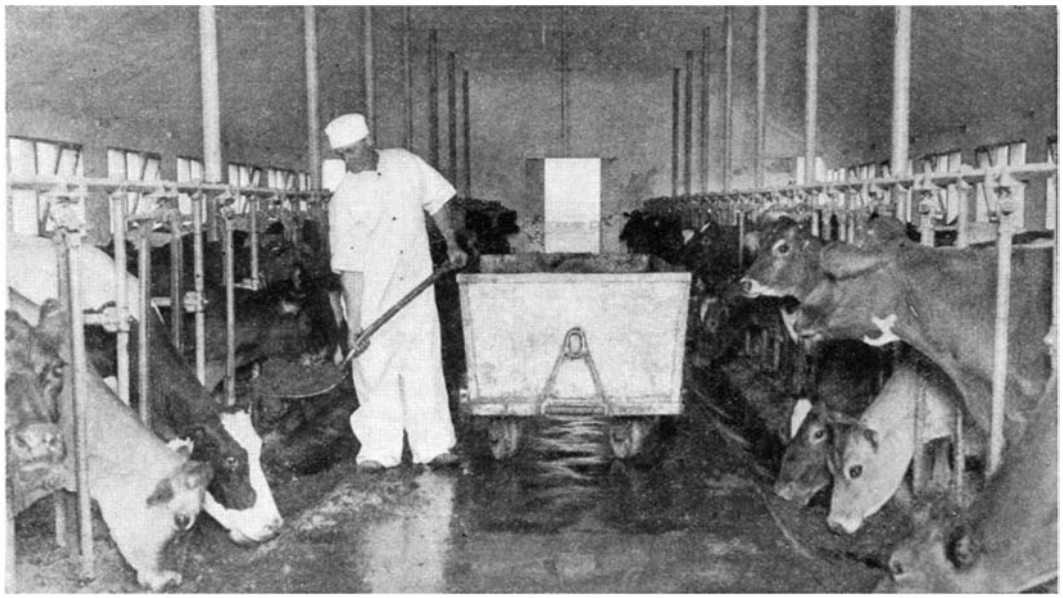
In recent years mankind has drifted farther and farther away from the classical idea of culture for its own sake, but we think there are still but a few people so practical as our questioner who, apparently, must see an everyday application for scientific research or declare it entirely worthless. Abstract science leads on to thoughts of higher things, to the answer of such questions as "What is matter?" and "What is life?"; and has as its ultimate goal, whether declared or not, the uplifting of man to a mental plane beyond anything he can now conceive.

Pilotless Planes of the Future

EIGHTEEN persons stepped aboard a large transport plane of Eastern Air Transport. The Chief Pilot of the company, Harold A. Elliott, took off from the Newark Airport, set his compass course for Washington, threw a clutch, and abandoned his post at the controls. The plane flew on steadily under perfect control for 10 minutes and then Elliott threw in the clutch, turned the plane on a course back toward Newark, again threw out the clutch, and let the plane fly with no hand at the controls. In 11 minutes, so unerring was the aim and so perfect the control that the plane passed over the center of Newark Airport.

This flight was the first public demonstration of the Sperry gyro-pilot which does everything but take off and land a plane. The gyro-pilot is simply the efficient "Iron Mike" of the sea, invented by the late Elmer Sperry, changed and adapted to use in the air. The entire equipment weighs less than 100 pounds and is enclosed in two small aluminum boxes beneath the pilot's seat.

Since the "Dumb Major," as the new device has been nicknamed, handles a plane along a constant compass course under all conditions of wind and weather with undeviating precision, it is said to eliminate the need for pilots trained in blind flying. That is the way of all progress: as soon as we perfect methods of training in blind flying, something is invented to make such training not always necessary. In the future, planes equipped with the "Dumb Major" may fly on regular schedule regardless of weather conditions as long as the visibility at terminals is good enough for taking off and landing. New possibilities, therefore, can be seen for a wider and more confident use of airplanes.



Feeding the cows which give milk that has a vitamin-D content 20 to 30 times that of ordinary milk, due to the irradiated yeast which is mixed with ordinary milk-producing rations

A NEW WAY TO CONTROL RICKETS

By JAMES A. TOBEY, Dr.P.H.

AFTER three hundred years of searching for a simple and convenient remedy for rickets, science has discovered a new and improved method for the prevention and cure of this widespread malady. The prompt adoption of this novel means for coping with the bone disease which now afflicts more than half of all babies in the North Temperate Zone would soon make this scourge as rare as the once dreaded scurvy.

This new anti-rachitic procedure eliminates the use of costly and troublesome medicines, chemicals, and therapeutic devices for the treatment of infantile rickets. It consists merely of pure milk, the normal food of all babies, but a milk in which the content of vitamin D, the rickets-preventing factor, is augmented from 20 to 30 times by natural methods. All milk contains some vitamin D, but the quantity has never been sufficient by itself to prevent rickets.

The increase in the anti-rachitic value of milk is accomplished by scientific feeding of the cattle. A portion of their daily rations consists of feeds which have been skilfully irradiated with ultra-violet light, with the result that vitamin D is transmitted from the feed into the milk secreted by the animals. The process is simple to tell about, but a vast amount of carefully controlled scientific research has been necessary in order to evolve a practical and efficacious method.

The beginning of this work goes back to 1924 when Dr. Alfred F. Hess of New York and Dr. Harry Steenbock of Wisconsin announced independently but almost simultaneously that certain foods could be irradiated under controlled conditions so that their anti-rachitic powers could be increased. Subsequently Dr. Steenbock secured a patent for the process, which he turned over to the Wisconsin Alumni Research Foundation. Under this patent various foodstuffs, such as milk powder, bread, ergosterol, and yeast have been irradiated and placed on the market. The proceeds from the licenses are devoted chiefly to further research for the benefit of humanity.

Dr. B. H. Thomas has conducted research on the anti-rachitic milk

None of these foods is, however, exactly suited for curing or preventing rickets in infants, although they may often be employed with success in the diets of older children. So the quest turned to a method for improving the vitamin-D content of milk itself. After much experimentation, including irradiation of the cows, which proved unsuccessful, Dr. Steenbock and his co-workers announced in 1930 that the vitamin-D activity of milk could be improved by supplementing milk-producing rations with irradiated yeast. Somewhat later Dr. W. E. Krauss reported similar results with irradiated ergosterol.

ACTING on these premises, Dr. B. H. Thomas of the Walker-Gordon Research Laboratories and Dr. Florence L. MacLeod of Columbia University worked out a method for incorporating irradiated yeast or irradiated ergosterol in the rations of Holstein-Friesian cows in a certified milk herd. Irradiated yeast was found to give the better results, as 10,000 units of the yeast were equivalent to 15,000 of ergosterol, and 60,000 units of the former equalled 135,000 of the latter. The yeast is powdered, spread out in a thin film and then irradiated for a brief period with ultra-violet light.

The vitamin D potencies of the butter fat from the cows fed on these irradiated feeds were tested on white rats,

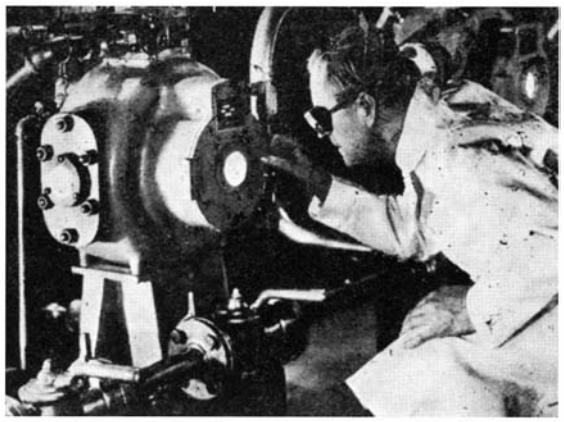
as these experimental animals are the standard for such investigations. Drs. Thomas and MacLeod reported last June (*Science* 73:618, 1930) that the vitamin-D content of this certified milk could be increased at least 16 times over that in butter fat obtained from cows which did not receive irradiated rations.

If this plan works so well on rats, the query arises: Will it be equally successful in human rickets? Dr. Hess provided the answer to this vital question by placing 102 infants on certified milk from cows fed on these irradiated foods. These babies were treated throughout the winter of 1930-1931, a period which provides the most severe test, as rickets is more prevalent in the winter months than in the summer when the ultra-violet rays of direct sunlight operate to activate vitamin D in the human skin of those exposed to such rays.

"THE results exceeded our expectation," Dr. Hess announced at the meeting of the American Medical Association in Philadelphia on June 11, 1931. "The best prevention was obtained with the milk from cows which received the greater supplement of irradiated yeast. This milk not only prevented rickets, but was able to effect a cure in a small number of cases in which a test of this kind was undertaken. In addition, the infants thrived well and gained normally in weight. It may be added that the health and nutrition of the cows also was excellent."

Further confirmation of the success of this new milk in combatting rickets has been given by Dr. Edwin T. Wyman of the Infant and Children's Hospital in Boston, where babies have been fed on this product with excellent results. These two clinical tests, carried out independently by competent physicians, have amply proved the efficacy of fortifying fluid milk with vitamin D as a treatment for rickets.

The great advantage of this new method of dealing with rickets lies in the fact that it works automatically. The physician does not have to prescribe anti-rachitic agents the administration of which to the infant requires the intelligent co-operation of the mother. The method is also economical, as the retail price of the milk need not be increased. Most important of all, a scheme is provided by which rickets can be controlled on a large scale as a public health measure instead of through individual efforts only.



One of the ultra-violet producing machines used in the irradiation of yeast for cow feed

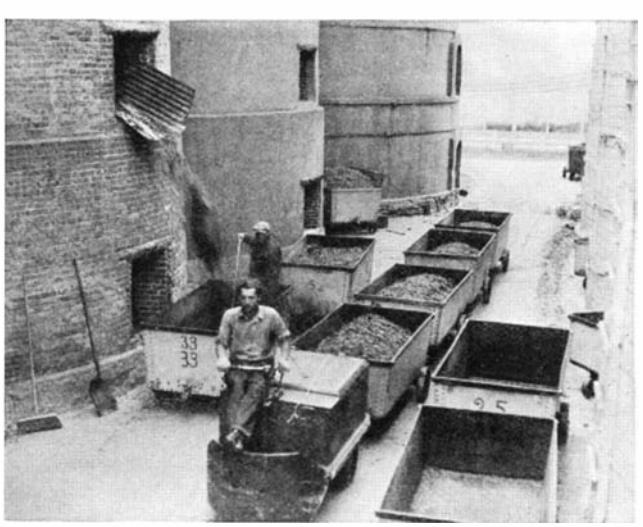
A further advantage of this new procedure is the availability of certain essential minerals in the anti-rachitic agent itself. Bone deposition can not occur unless calcium and phosphorus salts are present in the human system and these can be obtained only from the diet. Vitamin D acts as the stimulating agent, but it must have materials to work upon.

MILK is the best known source of calcium, providing this mineral in ample amounts and in a particularly assimilable form. The calcium of milk is, in fact, utilized to better advantage in the human body than is the same mineral as it occurs in vegetables, although certain vegetables, particularly the green, leafy ones, are well supplied with calcium and are helpful in furnishing it in the well-balanced diet.

According to the consensus of scientific opinion, vitamin D operates to increase the solubility of calcium and phosphorus in the blood, thus permitting of an increased content of these minerals in the blood stream and facilitating deposition at the bone sites needing calcification. If the intake of calcium is too great for the amount of vitamin D present, the kidneys excrete an abnormal amount of the mineral. Although massive doses of vitamin D, as in concentrates such as viosterol, may do harm, there is apparently a tremendous range of safety between therapeutic and injurious doses. The amount of vitamin D in the milk reinforced with this element is far below the factor of safety. If a person drank a quart of this milk, ate half a loaf of vitamin D bread and took several tablespoonsful of cod-liver oil, there would still be absolutely no danger from hypervitaminosis D.

Since June, when Dr. Hess announced his successful clinical test with the anti-rachitic milk, this product has been available to physicians and the general public, although it is produced only at one certified milk farm in New Jersey. As time goes on, however, it will be more widely obtainable, especially since the Walker-Gordon Laboratory, where the new process was perfected, is a unit in a national milk distribution system.

By this method of dealing with the age-old scourge of rickets, whole communities of babies can be protected simultaneously against the disease.



Where many cows are to be fed, mechanization is of great value. At left above, a series of carts are being filled from storage. At right above, the irradiated yeast has been added, and a mash suitable for feeding cows is made with water

SPACE AS YET UNFATHOMED

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

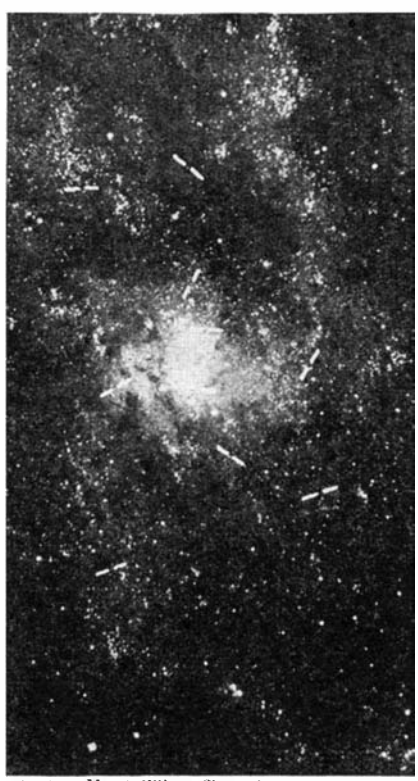
THERE has been no more remarkable advance in astronomy, even in our stirring times, than the discovery of the real nature and magnitude of the white nebulae. These objects, distinguished from the gaseous nebulae by their color and spectrum, send us light of just the composition that might be expected from a vast cluster or cloud of stars similar on the average to the sun. But it was less than a decade ago that Hubble, photographing with the 100-inch telescope, found that the outer parts of the two brightest and presumably nearest of these nebulae are actually clouds of exceedingly faint stars.

How some of these stars turned out to be variables of the important Cepheid type, and how this gave a measure of their distance by comparing their apparent and their real brightness, has long ago been told in these pages. Revised data for the real brightness of the variable stars have cut down the original estimates of distances a little, but they are great enough still. For the great spiral in Andromeda, Hubble's latest result is 800,000 light-years. The fainter but more open spiral in Triangulum appears to be a little nearer 750,000 light-years. Three other nebulae in which variable stars have been found lie at distances ranging from 1,300,000 to 2,400,000 light-years. The thousands of fainter nebulae of the same general type must be farther away, but how may their distances be found?

THERE are about 40 other nebulae in which separate stars may be detected on plates made with the 100-inch telescope under the best conditions. These must be relatively near us and it is obvious that we are getting only the very brightest stars among the multitudes which compose them.

Now in the nebulae whose distances had already been determined the brightest stars turn out to be much alike, their (photographic) brightness ranging from about 30,000 to 50,000 times that of the sun; and much the same upper limit of brightness is found in the Magellanic Clouds which are nebulae which lie near enough to us to permit their individual stars to be visible with ordinary telescopes. This makes it pretty safe to assume that among the 40 remoter nebulae the brightest stars in each give 40,000 times the sun's light. The resulting distances range from 1,500,000 to 5,000,000 light-years. Beyond this limit we can no longer hope to see the separate stars—only the hazy light of the whole swarm is strong enough to be recorded.

To go further, Hubble makes the bold step of calculating the brightness of the whole nebula. Comparing the light of the whole mass with that of the separate stars for the 40 cases in which these can be seen, he finds that on the average the nebulae are 15,000 times as bright (photographically) as the stars; so that a typical system gives out 600,000,000 times as much light as the sun. If then we know how bright the nebula looks, we can estimate its distance. The results are rougher than



Courtesy Mount Wilson Observatory

Cepheid variables (between dashes) in a spiral nebula in Triangulum

before, for the nebulae vary considerably in real brightness. Occasionally our estimate might be twice too great or too small, but the evidence is that this would happen in only one case in eight, so that we would usually get a good idea of the real distance.

Now at last we can realize how far it is possible to sound the depths of space. With the greatest existing telescopes it is possible to photograph a nebula of the 21st magnitude—2,000,000 times farther than anything that can be seen with the naked eye. If such a tiny speck of light is really as bright as has just been figured, it must be at the enormous distance of 250,000,000 light-years. An unusually bright nebula indeed might just be caught by our telescope if it were half a billion light-years away.

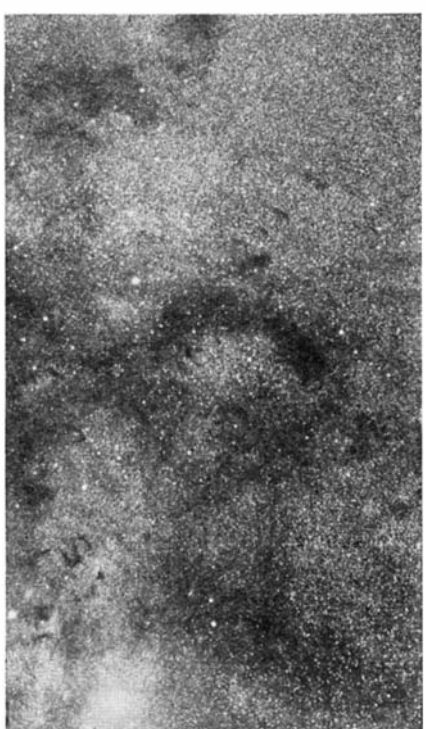
There must be more nebulae beyond even this limit, so remote that no existing telescope can reveal them. The evidence for this is remarkably simple, depending on mere counts of the numbers of nebulae down to successively decreasing limits of faintness. Suppose we count all the nebulae in the sky down to a given apparent brightness; or if this task is too heavy, in the series of sample regions covering a definite fraction of the whole heavens. Then let us take a lower limit one quarter as bright as before and count again. We will evidently now include objects to twice our former limit of distance, hence we will get all that lie within a sphere of eight times the volume we had at first. Hence if the nebulae are scattered uniformly through space we will get eight times as many as before. If they thin out at great distances the number we find will increase less than eight-fold.

HUBBLE'S counts, when analyzed in this way, show that on the average the eight-fold rate of increase actually occurs right down to the faintest object which can be accurately measured for brightness. The nebulae are still there, scattered no more sparsely than the nearer ones, to the farthest limit of telescopic vision. The material universe extends beyond the utmost limits of our observation. We have sounded its depths with the longest line that human skill has yet devised—perhaps with the longest that human means can supply—and our final report is "No Bottom."

An important corollary from this investigation is that the depths of space are almost perfectly transparent—clear of any sort of obscuring matter. If part of the light of distant nebulae is lost in transit, the limiting distance at which one can see them with a given telescope will be reduced. To get the observed numbers into the smaller volume of space we must assume that the nebulae

are more and more thickly scattered in space the farther one goes from the neighborhood in all directions—an obviously inadmissable conclusion.

Though inter-nebular space is clear, inter-stellar space is sometimes clouded. The great dark patches of obscuration which lie between us and the Milky Way are in many cases conspicuous to the naked eye on a clear dark night. Some of these are associated with stars only a few hundred light-years away. Others are more remote. Now along the central line of the galaxy and for some distance on each side of it, no white nebulae of the extra-galactic type appear, even with long exposure. There must be vast opaque clouds skirting the outer part of the Milky Way which hide everything that lies beyond. The boundary of this obscured region can be traced on the heavens by plotting the regions where one observes distant nebulae or does not. It turns out to be a zone following the course of the galaxy, but of uneven width and with quite irregular boundaries, as might have been anticipated. Here and there a few distant objects are visible through a gap in the clouds, and in other spots



From Barnard's photographic atlas. Courtesy Carnegie Institution of Washington

Obscuring matter in inter-stellar space. Cosmic dust in Ophiuchus

the obscuration appears to be incomplete. But the outer boundary is perfectly definite, and beyond it the skies are really clear. Near the nebulae themselves, however, obscuring clouds reappear. Some of the flat disc-shaped nebulae are turned edgewise toward us, and these are very often crossed by a dark band, obviously caused by opaque clouds lying at the outer edge of the luminous portion.

Though the nebulae are scattered here and there through the whole observable region of space, they are gregarious and cluster in definite regions. In these clusters there are so many more nebulae than in an average bit of sky of the same size that there can be no doubt that we see a real grouping. Making allowance for the minority that lie in front of the cluster or behind it, we find from the rest more about the properties of nebulae than we previously knew.

The range in brightness, for example, is about five magnitudes. That is, the brightest nebulae in a cluster are about ten times as bright, and the faintest one tenth as bright, as a typical member of the majority. The corresponding range in real brightness is from 60,000,000 to 6,000,000,000 times the sun's light.

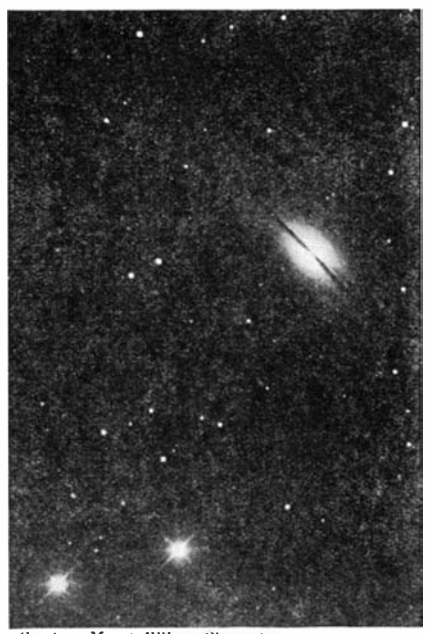
The differences in size are more important and depend upon the character of the nebula. The smallest are the nearly circular ones which average about 1000 light-years in diameter. The largest are the spirals with widely extended arms for which the average diameter is 6000 light-years. The intermediate shapes, more and more oval in outline or with less extended arms, are of intermediate size if measured across their widest extent. If the thickness rather than the breadth is taken, all the nebulae are of about the same extent.

THE largest individual nebulae are of about twice the average size for their class and the smallest, so far as can be judged, hardly more than one-tenth the average; so that the brightness of a nebula gives a better idea of its distance than does its apparent size, especially since a nebula has no sharp edge and the longer the exposure the bigger is its image on the negative.

A few nebulae are still larger; for example the great Andromeda nebula which by all tokens is really a giant, is 40,000 light-years across. Our galactic system is still larger and Shapley's epigram still rings true: "If the nebulae are island universes the Milky Way is a continent."

Concerning the masses of these vast systems we know little as yet, but that little is important. Spectra of some of the flattened nebulae show that they are in rotation, one side approaching us and the other receding, compared with the nucleus, at a high velocity. Assuming, as we can hardly avoid doing, that the outer parts are moving in orbits under the gravitation of the central condensation, the attracting mass can be found when the distance of the nebula is known. Results have been published for the Andromeda nebula and one other. In both cases this mass comes out about 3,000,000,000 times the sun's. Enormous as these values are, they are reasonable. The Andromeda nebula and one other gives out a billion times the sun's light and if it was made up of stars like the sun it would have a billion times the sun's mass.

Further evidence in favor of this interpretation is found in the spectrum of the central regions of this nebula. Here no stars are visible even on the best photographs, but the light is strong enough to permit the use of a spectroscope of considerable power. The details of the spectrum, according to Adams, indicate definitely that the light comes from dwarf stars averaging somewhat later in spectral type and fainter than the sun.

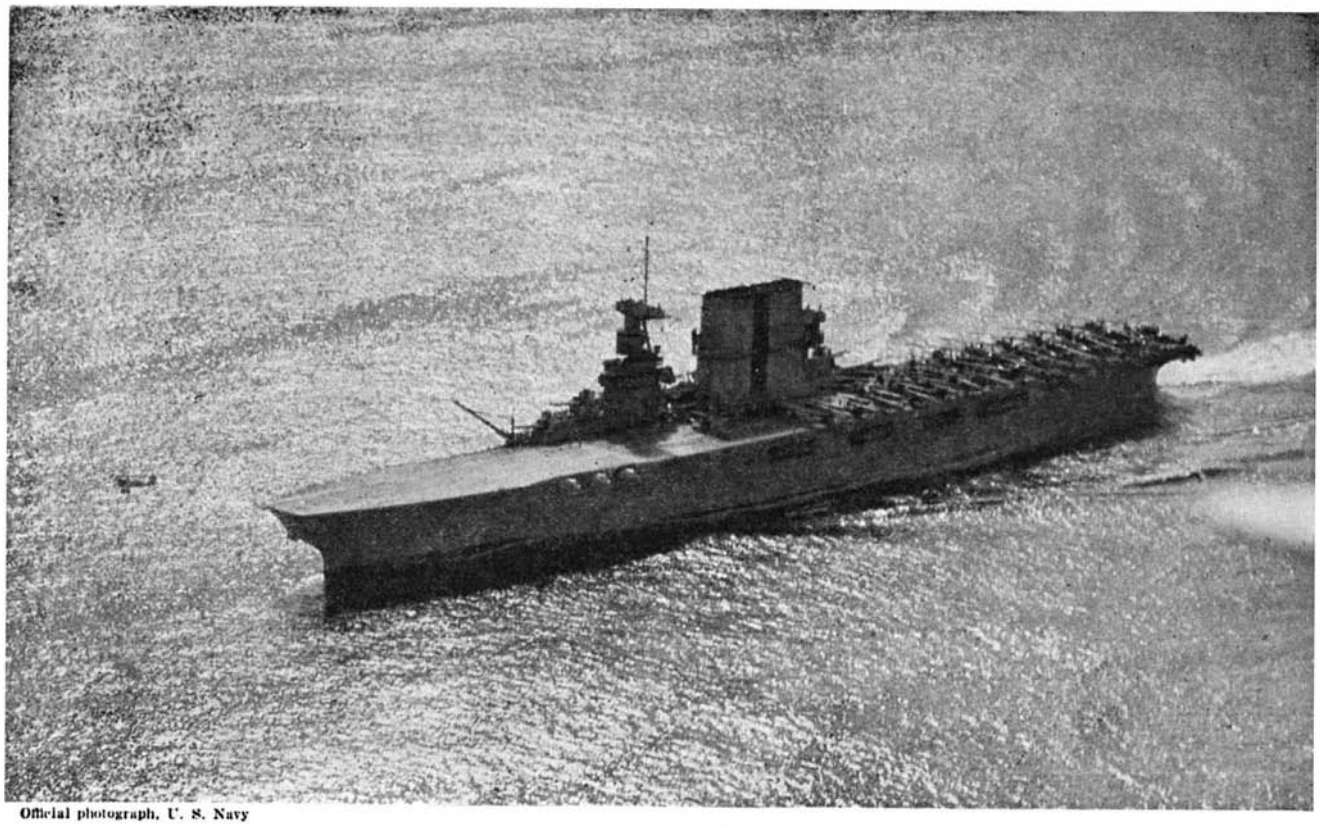


Courtesy Mount Wilson Observatory

A disc-shaped nebula turned edgewise toward us, crossed by a band. The inference has been made that, if our galaxy could be seen from without, a somewhat similar band of cosmic dust would be observed

Such stars give out less light in proportion to the mass than the sun does, and the swarm of a few billions of them would closely resemble the Andromeda nebula both in brightness and mass. If, however, the stars were bright enough to be photographed separately at the distance of the nebula they would have to be giants hundreds of times as bright as the sun but on the average only five to ten times as massive. A cloud of such stars as bright as the Andromeda nebula would not be nearly as massive.

The spectroscopic evidence, therefore, that the central part of the nebula is made up of smallish stars, suffices to explain why it is so massive and why our telescopes do not resolve it. Why there should be numerous very bright stars in the outer regions of the nebula and none in the dense central portion is a problem whose answer must be left for the future.—*Mount Wilson Observatory, October 3, 1931.*



Official photograph, U. S. Navy

A land plane taking off from the flying deck of the U. S. S. *Saratoga* with others prepared to follow

BETTER ENGINES FOR NAVY PLANES

By COMMANDER C. A. POWNALL, U. S. N.
Head of Power Plant Design, Bureau of Aeronautics

BY a process of normal engineering improvement, our naval aircraft engines are rapidly approaching the limitations of the basic type. Strangely, since the Navy's air force must of necessity keep pace with those of other nations, the Navy has not enjoyed the privilege of engaging in scientific research in engines—the original development of new and untried engineering ideas. Congressional appropriations for this specific purpose are badly needed, not only for the distinct advantage that the Navy may gain thereby, but also that commercial aviation may benefit, as it always has done by naval developments.

At our request, Commander Pownall treated this important subject in the manner we suggested and the resulting article is presented here with the approval of Rear-Admiral W. A. Moffett, Chief of the Bureau of Aeronautics, Navy Department. —*The Editor.*

AMERICAN aviation engine development is a subject which deservedly is receiving more consideration daily from the American public. This fact was clearly emphasized during the last Congress when a special appropriation of 220,000 dollars was allotted to the Navy to be spent specifically for high-speed development of naval aircraft. The remarks which follow have to do with aviation engine development solely as it applies to naval aeronautics.

To draw accurate comparisons between the military effectiveness of the planes of one nation and those of another is a difficult if not impossible task. Short of war, there is no clearly defined yardstick for measuring military effectiveness of aircraft. The defense plan of any nation is individual and distinct. The fact that one nation chooses to use certain load and power factors in the design of its various types of aircraft, and another nation chooses differently, is no criterion of the lack of design skill of one over the other. The law of gravity shows no favorites as between nations or individuals. It follows then that the fact that America has had no entry in the famous and much publicized Schneider Trophy classic since 1926 does not imply directly that the air forces of the United States are woefully lacking in performance and effectiveness as compared to the air forces of other nations.

THE more experienced and enlightened we become in the knowledge of aeronautics, and the better we understand both the limitations and capabilities of the modern airplane, the more clearly do we realize that each aviation operating project is distinct in itself. Mail planes, passenger-carrying planes, pleasure planes, and Army and Navy types, although in the same general class as airplanes, are in reality vastly different from the standpoint of aerodynamic design characteristics, and as such are not readily capable of interchangeability. The Navy's operating problem is peculiar to the Navy, for the simple but basic reason that the majority of our planes base on board ship and operate over the sea.

This major fact exerts considerable influence upon the design factor of the airplane. The daily operating routine on board the carriers *Saratoga* and *Lexington*, in which squadrons of so-called

land planes take off from the carrier decks, perform their allotted battle tactics against planes and ships distant from shore and the carrier decks, and upon completion, return and alight on board, illustrates more clearly than words the true story of naval aviation development. The fact that such operations are carried out with continuous success almost daily, far distant from shore or any suitable landing place, placing almost sole reliance in the reliability of the airplane power plant, bespeaks of itself a standard of engineering reliability and perfection that one scarcely appreciates, so commonplace has it become. In this respect, the airplane follows the automobile. It is not so many years ago that the automobile was anything but a reliable form of transportation. Its short-comings were numerous. Today we place dependence upon it as an assured means of transportation throughout our daily life, and scarcely bother to ponder the reasons why.

A FEW years ago the airplane engine was basically unreliable as compared to modern standards; consequently the airplane was basically a dangerous machine. Hardly a pilot of those days who has not experienced one or more forced landings due to engine trouble. Today, airplanes nose their way across the sky, over sea and plains, with the methodical constancy of one's own heart beat. Such air achievement, simple as it may seem, deservedly ranks with the great scientific accomplishments of all times. It is a fine testimonial to the brains and courage of the American engineering profession. It is fitting that in an article of this kind we should pay homage to those early fliers and engineers whose faith and perseverance have made aviation what it is today. Many paid the price of pioneering with their lives or fortunes.

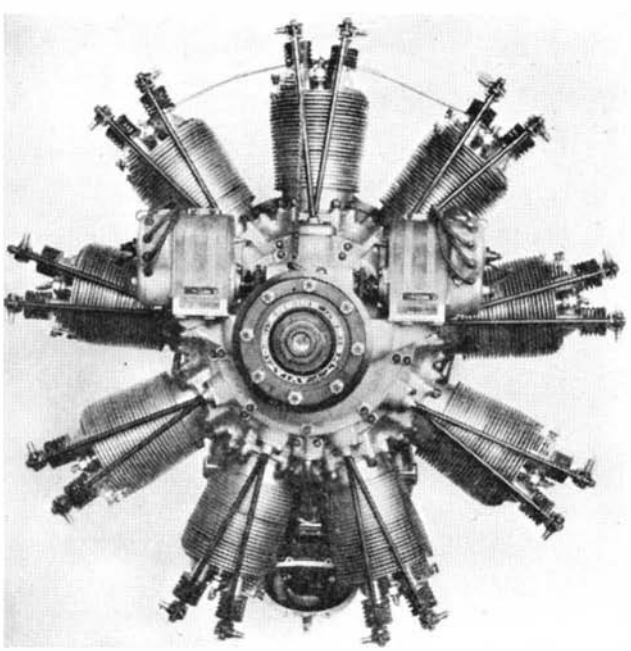
It is an interesting commentary on the design ability of the aviation engineers to note that as the airplane engine has improved in performance throughout the years, it has likewise improved in reliability and durability. For example, a few years ago, a Navy service engine of a given piston displacement was rated to develop 350 horsepower at 1800 revolutions per minute. Today the same basic engine is capable of 500 horsepower at 2200 revolutions per minute and with a greater degree of reliability than existed in the 350 horsepower engine. Another engine which was originally rated at 525 horsepower is today a 650 horsepower engine.

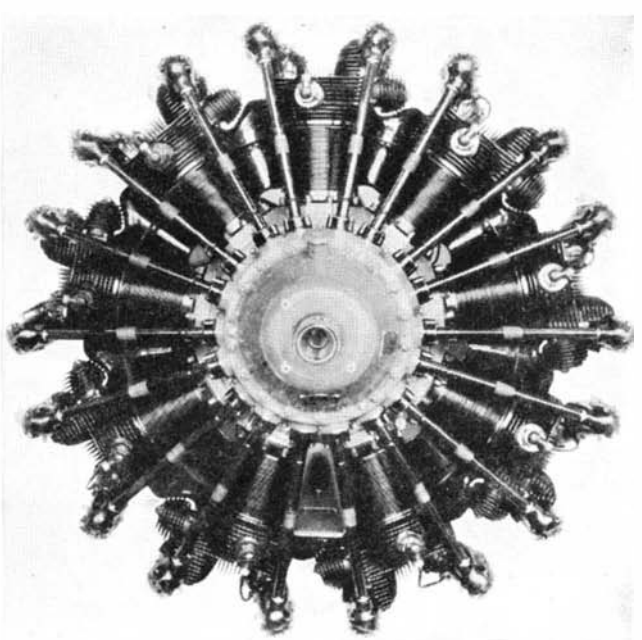
Of far-reaching importance in obtaining added performance with the same or better standard of reliability, has been the improvement made in fuels. It can be said with a fair degree of accuracy that for a given piston displacement, the power output has been increased some 40 percent in 10 years. Of this 40 percent increase, it is estimated that from 10 percent to 15 percent can be credited to better fuels available. Our oil companies are initially air-minded and have contributed a very important part in making the airplane better and more useful to us all. It is my opinion that the succeeding years will be as prolific of development as has been the past.

As stated by an eminent engineer, "The price of progress is trouble," and to "trouble" may be added: dollars. Both the automobile and airplane industries have maintained a rather conservative engine development policy. No radically new theory has been forthcoming. The accepted service engine of both the automobile and the airplane still operates on the old basic conventional Otto four-stroke cycle. Concentration has been placed upon perfecting this type. Compression ratios have been increased gradually, comparable to the improved fuels available. The various systems of the power plant upon which power-producing elements are ever dependent—the fuel, ignition, cooling, lubrication, and transmission systems—have been greatly improved. Today the modern automobile and airplane power plants are gradually reaching the high point of development and perfection, approaching the limitations of the basic type.

WHEN we consider development, there are two courses to pursue. They are parallel and closely allied, but in reality they are distinct in themselves. One we may label as *normal engineering improvement*, the other one *scientific research*.

Normal engineering improvement is carried out continually by both the automobile and airplane industries. This year's car is better mechanically and thermodynamically than last year's; incidentally it is a better value. Likewise this year's Navy fighter is a little better and a little faster than last year's. The boards of directors of the automobile industry decide how much improvement is necessary to stimulate sales. In the aviation industry, the Army and Navy to date constitute the largest individual buyers of aircraft. The airplane industry has not enjoyed the large and steady profits of the sister industry. If the Government would have





Two Wright engines used in Navy planes. The one at the left is the older and the one at the right is the modern engine. The latter represents an improved design with better aerodynamic characteristics and is of much greater power

improved airplanes, it must of itself pay for such improvement. Congress annually appropriates about 2,000,000 dollars to the Navy for this purpose. This amount is broken down and subdivided to take into account every aliquot part of the airplane from propeller to rudder. Approximately one fourth of this amount is usually allocated specifically for power plant improvement. The initial purpose for such expenditure is to make our naval aircraft in their entirety and of all types, more effective as weapons of our national defense. Development under this category is predicated upon the basic design consideration of obtaining added performance with the same or better standard of reliability and durability.

Official Photograph, U. S. Navy

A line of Navy planes, chocks under the wheels, being warmed up

AMERICAN commercial aviation benefits greatly by this development work. Many of the improvements periodically accomplished for the military forces find resultant application in commercial aircraft. The degree of improvement obtained is predicated proportionally to the amount of funds available for such specific purposes. The point of saturation of the design ability of the American aviation engineering profession has not been approached.

Neither the aviation industry nor the Navy has enjoyed the privilege of engaging directly in scientific research as such. By scientific research is meant the development of new and untried engineering ideas. It is recognized that to increase the effectiveness and usefulness of the airplane, it must go faster, and its engine must weigh less per horsepower developed, must be smaller in frontal area, and must burn less fuel. Notwithstanding the enormous prestige now enjoyed by the steam locomotive as a means of transportation, progress has decreed that it must give way to something new and better in the form of the electric locomotive and the internal combustion engine. By the same token it is felt that the time has arrived to supplant old with new ideas in aviation power-plant development.

There is no lack of ingenuity on the part of the engineering profession, nor is there a desire to sit back and avoid the cost and trouble of progress. Various reputable engineers throughout the land and abroad have formulated their ideas, but simply lack the capital with which to design, test, and build. For example, Mr. Ricardo of Great Britain advocates the sleeve valve engine as a practical means for greatly increasing the B. M. E. P. over that obtainable with the conventional poppet type engine. Others advocate the revival of the two-cycle type, whereby it may be possible to increase the power output per cubic inch of piston displacement twofold. Others advocate laying the cylinders parallel to the longitudinal axis of the airplane, thereby greatly decreasing the frontal area; others advocate the specific design of an engine to lay within the wings, not to mention the development of the airplane Diesel engine, and many others.

TO confront these men with the demand that they produce, on the first attempt, something the equal of or better than a perfected type, is an unreasonable requirement. The path of engineering progress is not so simple. The price of development of the German Diesel engine is readily expressed in terms of years of time and in millions of dollars, trial and re-trial.

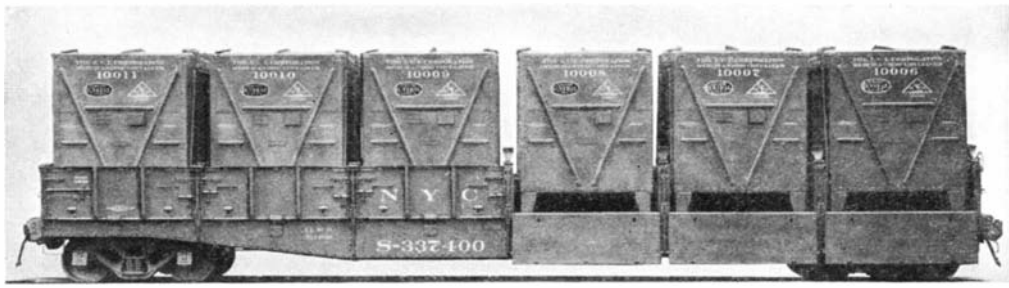
From the beginning of time, man has delighted in deeds of skill, whether it be physical combat, business sagacity, athletic contests, or pure racing. With the advent of the gasoline engine into our daily life, a new conception of the term "speed" was evolved. Our conventional automobile increased in speed along the highway from 15 miles an hour to 60, 70, and more. Most of us delight in the thrill of going fast. Automobile racing, motor boat racing, and airplane racing became a new and absorbing form of sport and recreation. Unlike other forms of sport where personal skill and physique of the contestant are controlling factors, power racing is a test, not only of the operator, but of the designer as well. It is in reality a race of engineering design wits.

Equitable competition develops perfection. Without competition the designers are inclined to become complacent and contented with their offerings to the engineering art. The designer knows better than anyone else the inherent weakness of the man-made machine. The effect of competition has psychological as well as material aspects. Power speed racing, in which the child of the designer's mind is pitted against that of another, awakens him from his prosaic mathematical point of view and tempts him to trust the gods just a little in the hope of winning. The racing machine, whether it be automobile, motor boat, or airplane, becomes a sort of stimulated robot.

IT is clearly recognized that the Navy cannot of itself act as a promoter of airplane racing chassis. At the same time such races as the Schneider Trophy, Thompson Trophy, and others, achieve their objective—aviation development—by resorting to man's inherent sporting instinct to stimulate mechanical and aeronautical skill in the effort to make the airplane better and more useful to mankind. It is a means best suited to pull out into the open a practical thesis from scientific laboratories. As such, the Government would be short-sighted if it remained aloof.

By reviewing the record of the Schneider Trophy Races, it is interesting to note that in 1913 the race was won at a speed comparable to the ordinary highway cruising speed of today's automobile, that is, 45.75 miles per hour. Few in those days could imagine that in 16 years' time it would be possible to develop an engine and airplane capable of speeds in excess of 300 miles per hour. It is significant to note that the stimulated racing performances of 1923, 1924, and 1925 now find duplication and application in the fully loaded and accepted combat plane of 1931.

It is the earnest hope that Congress will see fit to entrust to the Navy such funds as they deem proper to engage in progressive scientific research with the American aviation industry. Through such action on the part of the Government, American aviation, in its entirety, can and will develop the best that man can devise, and in the end make the airplane increasingly useful not only to our national defense and to commerce, but to mankind in general.



Gondola car with its full complement of merchandise containers. The sectional sides allow the containers to be removed

SPEEDING UP RAILWAY FREIGHT

AN improved type of container for railroad freight use which does away with the use of cranes for loading and unloading has just been put into service and will go a long way to assist the railroads in handling small shipments economically. This smaller container is largely dependent for its success on a cleverly designed gondola car, the invention of Mr. G. C. Woodruff, Vice-President of the L. C. L. Corporation, which leases equipment to the railroads. In this car the sides drop in sections which permit the containers to be removed sideways by means of lifting tractors. Each section of the side of the car forms a bridge or gangway in connection with the fixed platform of the station. After the containers are removed from the cars they can be loaded by the tractor onto a trailer for transportation to the consignee's premises or hauled directly to an exchange distributing station.

The containers themselves have a capacity of 426 cubic feet. They measure 7 feet 2½ inches in width, 8 feet 2 inches in height, while the length is 9 feet 3½ inches. Eyes and straps are provided so that they can be lifted if necessary. The containers weigh about 3000 pounds each and have a carrying capacity of from 7000 to 10,000 pounds.

The container is used in two ways as follows: First, for transportation from one shipper to one consignee where the shipper has enough tonnage to warrant using containers; second, by consolidators who substitute themselves for the individual shipper or consignee and by gathering up a large number of small packages produce a container load very near the maximum, and act as distributors at the point of destination. For express shipments small containers are ideal as a whole car load of containers can be emptied much quicker than can an express car, and two gondola cars with containers have a carrying capacity equivalent to that of three express cars.

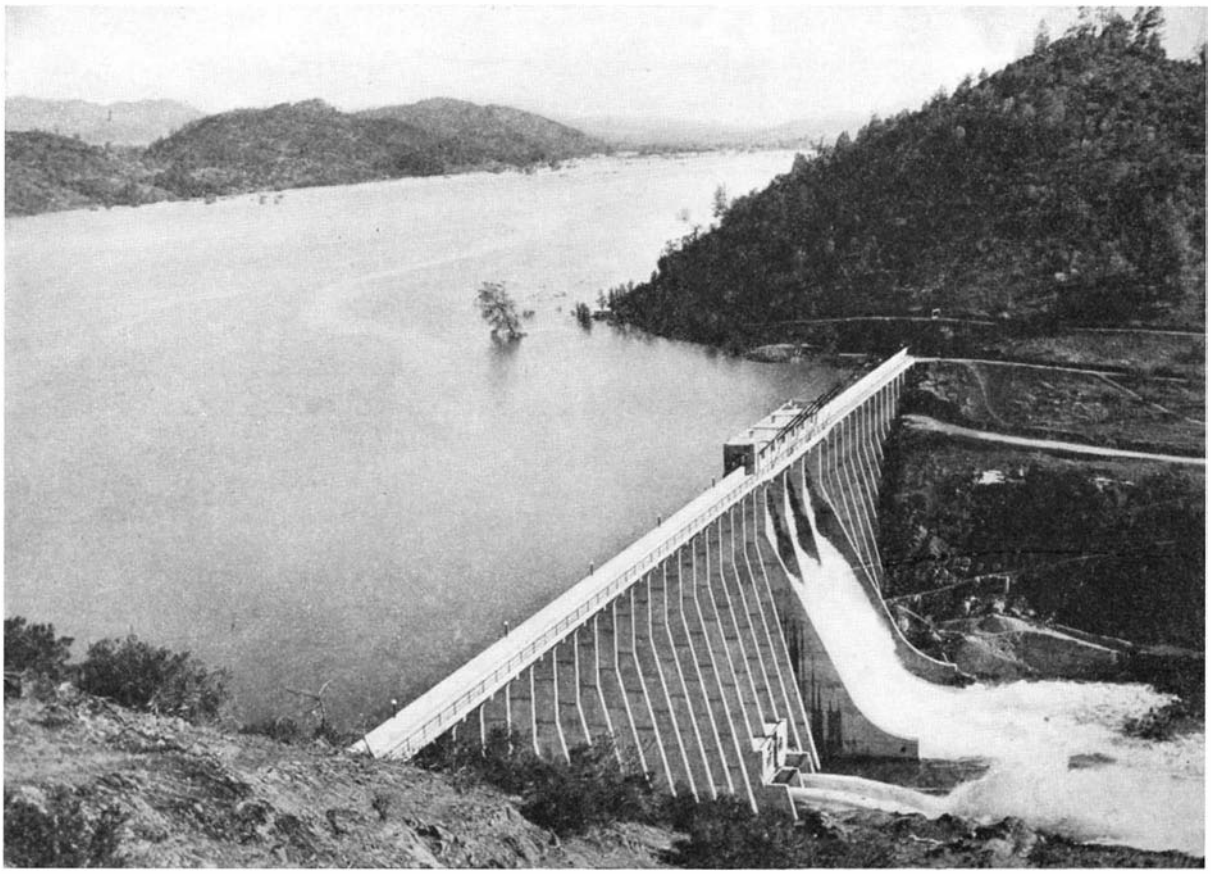
The process of lowering the sectional sides of the car is simple. Each forms a gangway

Bulk freight may be broken either at the freight station or at consignee's own place of business

Here is shown a busy freight exchange station at an important junction. The movable containers present an easy way of classifying freight for all stations

Freight for separate stations can be placed in containers which can be drawn off with a minimum loss of time. This time loss is considerable with the usual "way freight" method of handling. The container cannot be opened while it is on the car. It is either locked or sealed prior to being put on the car so that theft is well nigh impossible; therefore claims for damages are practically eliminated.

This plan of transporting merchandise seems to afford an excellent means of meeting motor truck competition which is making such inroads in both the freight and the express businesses. In the comparatively few months that the containers and special cars have been in use, their number has increased rapidly. The cars and containers were fabricated at the Berwick, Pennsylvania, plant of the American Car and Foundry Company where the writer of these lines recently saw them under construction.



The Stony Gorge Dam which stores up a wealth of water for the Orland Project, California, and thus has all the potentialities for the production of luxuriant crops and the consequent prosperity of farmers

MAN-MADE OASES IN AMERICAN DESERTS

By DR. ELWOOD MEAD
Commissioner, Bureau of Reclamation

THIS year the Subcommittee of the House of Representatives on Appropriations for the Interior Department spent a large part of the summer in the far West, studying the operations of three bureaus of the Department: Reclamation, Parks, and Indian Affairs.

"Why are you doing this?" one of the members was asked. "Is it a junket or is it preparation for an economy program?" "It is neither," was the reply. "It is preparation for an efficiency program. We need first hand knowledge of conditions."

For many years the Interior Department has been the principal settlement and development agency of the country. As custodian of the public domain, with its potential farms and mines, it held the door of opportunity that attracted the adventurous and enterprising. When settlement reached the arid region where irrigation is necessary to grow crops, then the water of streams rather than the land in their valleys became the important resource. Whoever controlled the water controlled the use of the land.

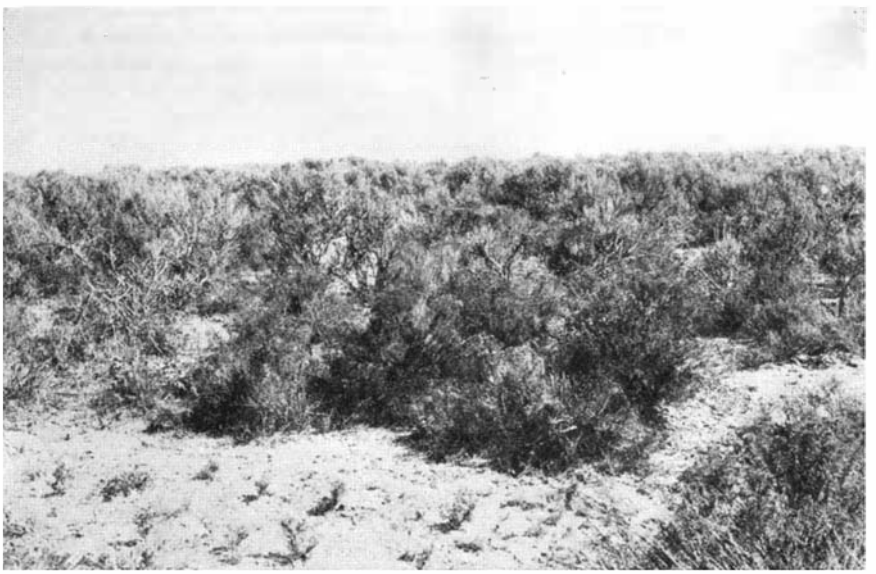
This was a new idea to people whose ancestors came from rainy, foggy England. It took a half century to understand its significance, and public opinion is not yet fully informed of the imperative need of water conservation or the great national benefits received each year from the diversion and use of streams.

AS population has increased, the demand for water has increased and the controversies over the ownership of streams have increased in like measure. The West needs above all things plans and policies for conserving and using its large rivers. That need is becoming acute by the growth of cities. Cherry Creek once furnished all the water Denver needed. Denver authorities filed on Cherry Creek and were content. Farmers filed on the water of South Platte River on which Denver is located. When Cherry Creek was exhausted, Denver had to go to the mountains and tunnel through them to get the water its people must have. The water of City Creek was once sufficient for Salt Lake City. Now, however, a dozen streams contribute to its water supply. San Francisco and Oakland once depended on storages in the surrounding hills. Now they have to go to the high Sierras.

With rare exceptions cities can provide their own water supplies. They have wealth and the necessary organization, but with irrigators it is different. They have neither the money nor the credit required to build the storage and diversion works needed to conserve and use the important rivers of the arid region. Outstanding examples are the Hoover Dam and All-American Canal now being built at a cost of 165,000,000 dollars to regulate and make possible the use of the Colorado River. Hence, so far as reclamation was concerned, the investigation of the Committee was confined to Federal irrigation projects, completed, under construction, and proposed, 20 such projects being visited in

the course of the trip. Some of the economic and engineering results of the Federal reclamation policy, as found by the Committee, are summarized as follows:

The area irrigated in 1930 with water from Government works was 2,790,856 acres, and the area cropped was 2,805,460 acres, producing crops valued at 119,661,820 dollars. Since water was first available in 1906, the cumulative value of crops grown on land irrigated from Government works is 1,761,929,500 dollars, which is about seven times the amount the bureau has expended to date. In 1931 there were on the projects 40,354 irrigated farms, with a population of 165,956; 213 cities and towns, with an additional population of 472,723; 688 schools; 724 churches; and 120 banks, with deposits of 134,261,170 dollars and 226,014 project and nonproject depositors.



What has been achieved by the bureau and the water users on the Federal irrigation projects is an indication of the economic importance of irrigation in the development of the West. A tremendous change has taken place in the West during the past half century in its attitude toward irrigation and its relation to the welfare of this section of the country.

The activities, the hopes, and plans of the arid states of 50 years ago were as unlike those of today as the covered wagon of that period is unlike the automobile of today. A few illustrations will show this. Cheyenne in 1880 was, as now, the capital of Wyoming. It was also a center, probably the chief center, of the range stock industry. The dominating idea was that no life was so alluring as to range cattle and sheep on the free and unrestricted public domain. The grass eaten by the flocks and

On the Minidoka Project, in Idaho. The upper photograph illustrates the character of the land that is reclaimed: a section of the desert covered with sagebrush. In the center is a field of sugar beets irrigated by means of ditches of flowing water. It is to be noted that this crop does not compete with those of the east. *Below:* Thoroughbred sheep in alfalfa

herds cost nothing. There was little provision for winter feed. If anyone realized that the grass could be destroyed by over-stocking and that the industry could survive only by combining it with irrigation, he kept it to himself. The universal desire was to keep conditions and their business unchanged.

Julian Ralph, seeking facts for his book "Our Great West," came to Cheyenne, was told by one of the leading stockmen that irrigation and farming in Wyoming were impossible, that only deluded visionaries advocated it, that Wyoming was suited only to the range cattle business, and that those who talked irrigation would spoil a horn without making a spoon. Today Wyoming has one of the best administered irrigation systems of any arid state. Irrigation saved the livestock industry and no one works harder for more canals and more reservoirs than the cattle and sheep owners of Wyoming who in summer pasture their stock on the public range.

In place of mines, like the Comstock in Nevada, the Little Pittsburgh in Colorado, or the Ontario in Utah, we have great irrigation projects like Imperial Valley in California and Yakima in Washington. We have power projects like the Southern California Edison in California, and the Idaho Power Company in Idaho. One pumps water to irrigate thousands of acres, the other provides electricity to light 10,000 farm homes. We are creating a new industrial empire based on the conservation and use of water.

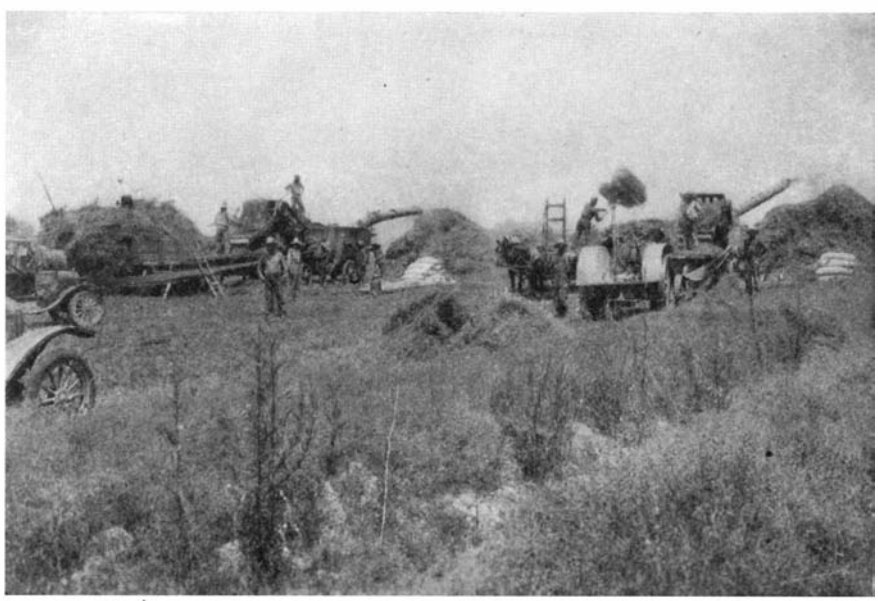
Statistics are tiresome, but they show as nothing else can how the collapse of the West, threatened by the decline in mining, was averted by the growth of irrigated farming. In 1900 the gold and silver output of Colorado was about 50,000,000 dollars; in 1930, it had shrunk to 6,000,000 dollars. The great Argo and Grant smelters at Denver have been torn down. There are no others to take their place. The processions of ore trains that once came out of the rich canyons of Boulder Creek and the Platte and Arkansas Rivers are gone, and hundreds of miles of railroad tracks have been torn up and carried away. The leading railroad from Denver to Leadville has been abandoned. If in Colorado there had been no other resource to take the place of the declining minerals, if some other profitable employment for labor could not have been found, Denver today would be a decadent mining town with grass growing in some of its streets as it does in Leadville and Cripple Creek.

The resource was there. It was the water of its streams replenished from the snows on its mountain summits and the wonderfully fertile soil of the valleys which border those streams. Together they have created an agricultural industry giving employment to more people and yielding more certain and larger returns than the mines ever did. Denver has become a center of production of crops requiring intense culture and having high acreage value. The Rocky Ford cantaloup and the Greeley potato are known in the markets of every large city. As a result, the dismantled smelters have been succeeded by beet sugar factories. One of the largest creameries in this country is in Denver, and the value of the dairy products of Colorado has grown in 30 years from less than 4,000,000 dollars to nearly 23,000,000 dollars. Meat packing plants and canneries for fruits and vegetables rival those of the large cities of the Middle West. Water has replaced gold and silver as the mineral of first importance in this state.

The glistening silver that is not mined but flows in ditches made possible this up-to-date home of an irrigator-farmer on the Carlsbad Project, New Mexico

THE experience of Colorado has been repeated in every state where the mining of gold and silver was once important. The gold and silver output of Montana in 1900 was over 13,000,000 dollars. By 1930, it had shrunk to less than 4,000,000 dollars. The returns from the gold and silver mines of Washington in 1930 were less than one tenth of what they were in 1900. The Comstock Lode in Nevada turned out in 20 years bullion worth 278,000,000 dollars. Today the costly homes and business houses of the city it created are ruins, the great mine is worked out and nothing like it exists in any state.

Gold is not renewed when the mine is worked out; the miner must look for a job elsewhere, and the store and the boarding house have to migrate with the worker and his wages. This situation has been saved wherever irrigation was



Threshing alfalfa seed, Valley Division, Yuma Project, Arizona-California. The machinery on irrigation projects comes from eastern industrial centers

possible, where the miner could shift from digging the precious metals to digging canals to divert water and reclaim deserts. Boise, Idaho; Phoenix, Arizona; Yakima, Washington; and Denver, Colorado, are only a few examples of the prosperous transition from mining to irrigated farming wrought by the conservation and use of streams.

ONCE a river is diverted and the arid, sunburned land below the ditch is subdued, there are employment and income. Irrigation not only brings the surest return of any form of agriculture, but the water on which it depends is renewed each year. It will last as long as snow and rain fall and rivers run. Complete development of the West could, however, come only through reservoirs to store floods, and the costly regulation of large rivers. This task was too great for the individual or group of individuals. It was beyond the resources of the undeveloped states with their shrinking income from mines. Federal reclamation was born to meet a national economic need and a crisis in the business and industrial life of the arid region.

Starting in 1902, the Reclamation Bureau took over works begun by oversanguine and inexperienced pioneers. It became a rescue agency. The Salt River project in Arizona needed a reservoir to store its floods; the Government spent 12,000,000 dollars and built the great Roosevelt storage work and rebuilt the canals and laterals. Marooned settlers on the Yakima Valley in Washington were out of money. Their canal was unfinished. They lacked means of borrowing. The Government took it over, spent 23,000,000 dollars, built four reservoirs, and is building the fifth, which is badly needed, this year. The same kind of development has gone on in every arid state. What has been the result? This extension of irrigation has saved these states from grass-grown streets, declining population, and bankrupt railroads. In the 10 years from 1920 to 1930, the carload shipments of fruits and vegetables from Arizona increased from 1615 to 16,835. The value of fruit produced in 1899 was less than 97,000 dollars. By 1929 it had grown to 3,952,000 dollars.

A pioneer of the new day irrigates his garden, the water soaking into the parched soil, the desert just beyond. Klamath Project, Oregon-California

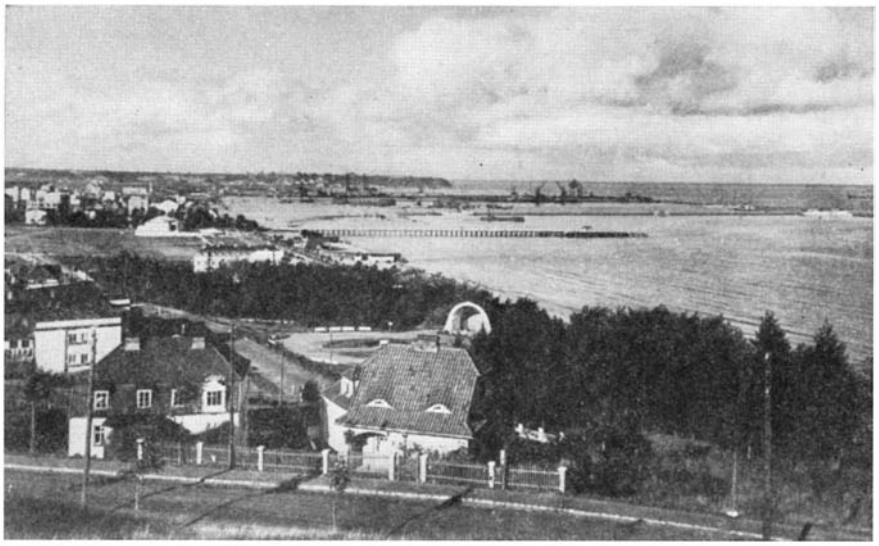
An irrigated, healthy orchard produces an abundance of fruit where perhaps only sagebrush grew a few years ago, on the Grand Valley Project, Colorado

In Washington, in 1909, the orchards, nearly all irrigated, turned out 2,672,000 bushels of fruit. In 1929 this had grown to 26,656,000 bushels. This explains why the nearby mining towns were not abandoned. The value in money of these orchard products and small fruit in 1899 was less than a million dollars; in 1929 it was 50,625,000 dollars. In Idaho the value of dairy products has grown in 30 years from a little over a million to more than 17,000,000 dollars. A similar record of increase in value of the products of irrigated farms is shown by every arid state. Those products require skill. They give good wages to labor.

Few in the East realize how much irrigation has contributed to the income of their factories and to the payment of interest on the stock and bonds of transcontinental railroads. This support is needed now and will be increasingly needed in the future. The continuation of irrigation development as a national policy insures the progressive growth of every western city, with all that this connotes in the economic life of the Nation as a whole.

POLAND BECOMES A MARITIME NATION

By JACQUES BOYER



General view of the bay and part of the new city of Gdynia

THE famous Polish corridor, formerly having as its only outlet to the Baltic the Free City of Danzig, now has a large bay-window, an all-Polish port, looking directly north upon the freezing water of the Baltic Sea. This corridor had long been a bone of contention between Germany and Poland. Now, with Danzig and the new Polish port, Gdynia, it promises to become a powerful rival of its European maritime competitors.

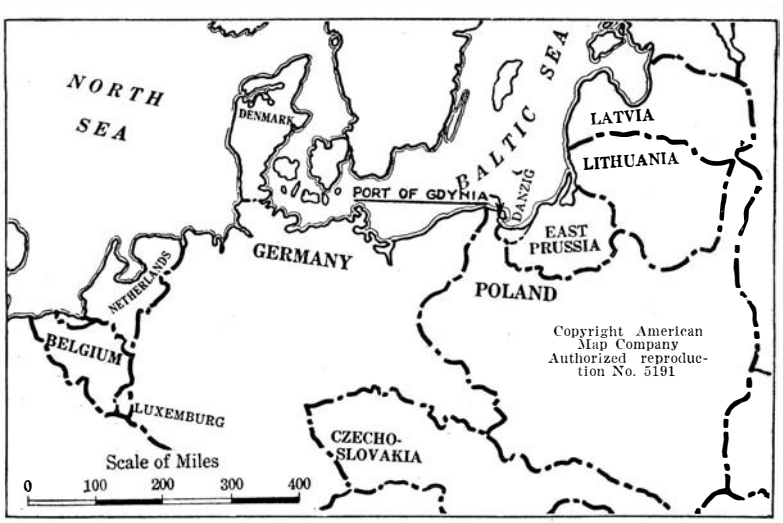
For over five centuries Poland has been dreaming of and mapping out a route to the sea—a route which would enable her to build up a merchant marine—but her ambitious wish remained only a mental picture until after the World War brought devastation and bloodshed. The Treaty of Versailles gave Poland the opportunity to carry out her plans and she can now send her products out to the cities of the world through her own port. The problem of laying out this port has not been an easy matter, and credit for its success is equally due to the far seeing men of Poland and to the French capitalists and engineers. One without the other would have been futile, and the Danzig bay-window would still be nothing but a blue print.

THE ink on the great Versailles document was hardly dry, when, to the discomfiture of the German Imperialists, the Allies sliced off a portion of East Prussia and handed it over to Poland with the recommendation that she use it for peaceful trade. She was also given the right to use the port of the newly created Free City of Danzig. Then a new problem arose upon the discovery during Poland's struggle with Soviet Russia in 1920 that Danzig could not be used by Poland for military purposes. After more delay and more conferences the matter was adjusted by the decision to create a new outlet to the sea.

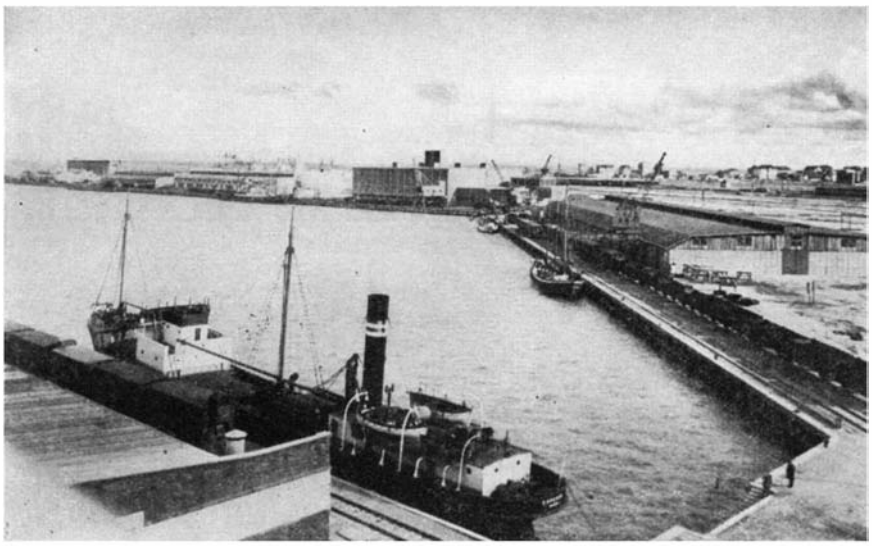
So in 1921 Poland's problem was to find a suitable spot for a port on the narrow strip of land allotted to her on the shores of the Baltic Sea. Technical studies of several sites were made. The small fishing village of Gdynia, some 12 miles northwest of Danzig, was finally selected as the most appropriate location for a port because of the natural conditions of the surrounding territory. All about the fishing village was a vast semi-swamp country with the few patches of higher land rising not more than a few feet above sea level.

This entire territory is cut into two sections by a small stream some 4500 feet long and at some places 30 feet in depth. There is no great danger of the port being filled up by earth brought down by the torrential rains because the hills which form the watershed for the stream are low and the current is not rapid. These same hills, together with the peninsula of Hel, 21.7 by 1.5 miles, form a natural wind break against strong north and northeast breezes common to this district. Thus the engineers could plan for a safe harbor for ships. Other water courses on neighboring terrain make possible future expansion of the port as the establishment of new industries and towns make such a harbor necessary.

It took Polish politicians three years to decide on the location and to sign the contract. The engineers had their plans ready and as early as 1921 the Diet voted necessary credit for the construction of a pier over 1312 feet long. But there were technical difficulties and many consultations. Finally, after many discussions with French, Italian, and English firms, on July 4, 1924, Joseph Kiedron, then Minister of Commerce and Industry, signed a contract with the firm of Schneider Hersent and Societe de Constructione des Batignolles in which the latter assumed the responsibility of supervising the whole task. The contract has been modified somewhat during the construction in order to meet new and unforeseen conditions. In its original form, the contract called for the construction of a mole or jetty on the northeast section 2427.8 feet long; a breakwater and a second mole 4039 and 18,553 feet respective-



The Port of Gdynia, on the Baltic, in relation to nearby countries



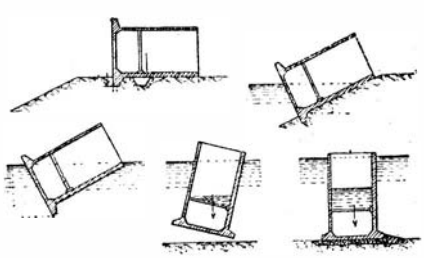
Marshal Pilsudski Basin, one of the several that have been constructed in the port to take care of the vessels of large naval, commercial, and fishing fleets

ly; a pier-head from 26 to 32 feet in depth and 10,166,000 square yards capacity.

The enterprise progressed with remarkable rapidity because of modern engineering and favorable local conditions. Two methods were chiefly employed in the construction of breakwater and jetties. The first used was the well known method of "joined piles" filled with stones to support a solid barrage; the other method called for the construction of reinforced concrete caissons. The foundation of the walls of the piers were constructed of sheeting piles in shallow water and concrete caissons in deep spots.

THE first work was started on the northern mole which follows the line of the Oksyvia Hills. This jetty is of frame construction, it having been found that the wood would resist deterioration due to the scarcity of ship worms and devastating mollusks in the Baltic Sea. The first two 26-foot piers, namely the northern basin and the coal basin, are constructed from ordinary piles with casings of sheet-pile. Over these is built the superstructure of reinforced concrete. These piles are from 9.8 to 11.9 inches in diameter. Some are placed in vertical positions and others at an angle so that the structure may better withstand the pressure of sand and water and the agitation caused by vessels. The concrete superstructure consists of a horizontal slab built on the top of the piles. Vertical concrete walls rise from the sea and are crowned by a granite structure. The slabs are filled with sand up to their crown.

The east mole, the south mole, and the breakwater, also piers 8, 9, 10, and 12 are built upon caissons of reinforced concrete placed one above the other upon bed rock and all are filled with sand. After several trials, a uniform type of caisson was adopted. They measure from 27.8 to 41 feet high and from 19.6 to 59 feet long, and are divided into compartments by transverse bulkheads. These caissons were built on sandy ground only 35 or 40 inches above the sea level, lying on their sides, with bottom ends turned towards the water. The engineers used a very ingenious method to float the completed caissons. The sand was gradually washed away from under them until they stood upright and floated into the sea by themselves. They were then towed to their designated place, filled with water, and sunk. Later the water was pumped out and they were filled with sand. The superstructure of reinforced concrete was then built over them in the ordinary manner.



The manner in which caissons were constructed on the shore, washed into the water, floated, and sunk

The military port, which was built before the commercial port, consists of a basin 984 feet square situated near the end of the northern jetty. These works were constructed between 1926 and 1928. On the south side of the commercial basin, the contractors have undertaken the construction of a fishing port. For this there is a jetty of 931 feet and a mole of 328 feet, thus creating a basin large enough for a sizeable fleet.

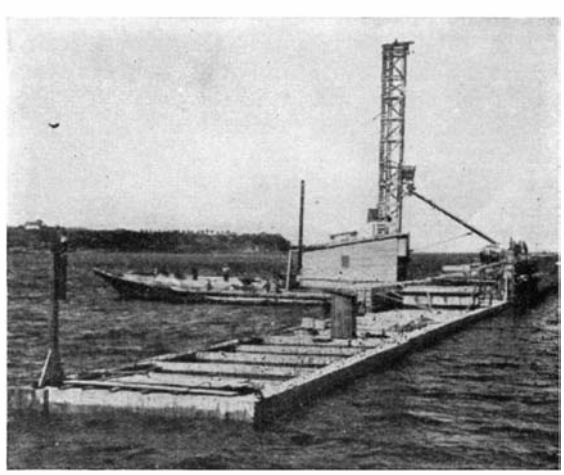
As the traffic of the port of Gdynia increased rapidly, the Polish government in October, 1928, provided for the construction of a greater port. These new facilities are scheduled to be completed in 1934 and include a new basin 10,625 feet across with piers from 20 to 32 feet in depth. The fishing port mentioned above will be further developed by deepening a present canal. This is being constructed jointly with Czecho-Slovakia and will be used by that country as well as by Poland.

It is estimated that at the end of 1933, Poland will be able to handle through this port a vast quantity of merchandise. As a matter of comparison we note that Havre, with all her improvements, has a port of only 11.18 miles and Marseilles has one of 13 miles, while Gdynia has 74.5 miles completed and in 1933 it will exceed 93 miles.

THE increase in Gdynia's shipping tonnage is phenomenal. In 1924, only 24 ships entered her port, with a tonnage of 14,352. In 1927 there were 530 ships with a tonnage of 432,939; in 1929, 1500 ships entered the port with a total tonnage of 1,445,288. This year the tonnage will far surpass 2,000,000.

The important products which pass through the port of Gdynia include rice, chemicals, minerals, tobacco, shell for buttons, herring, and similar commodities. Poland exports through the city a great deal of wood, cement, and eggs. There are vast modern cold storage plants to take care of the perishable food stuffs. For the coal brought from the Silesian mines, there is a separate basin which alone can take care of 1,694,000 tons at one time.

At this writing the little village of Gdynia has developed so rapidly that it has a population of 30,000 and modern homes, schools, and theaters. Poland has the vision, the capable men, and the capital (partly French) to back her future maritime expansion.



After the caissons were sunk in place, the superstructure of reinforced concrete was built up

HAS FOREST CONSERVATION CREATED A FALSE ALARM?*

By WILSON COMPTON
Secretary-Manager, National Lumber Manufacturers Association

THE condition of the timber and lumber industries is perilous; in fact, it is ominous.

In timber ownerships and the timber and lumber industries $10,000,000,000 are invested, and they ordinarily furnish employment to hundreds of thousands of men in regions which offer no other industrial employment. The lumber industry has been in depression during much of the past decade, the present crisis being only an accentuation of its particular troubles by the general depression. Lumber stocks are excessive and yet lumber operations are 50 percent less than in 1929, with the result that 150,000 men are out of work. Lumber production and consumption are at the lowest level in half a century. At no time in the last decade has lumber production been as much as 60 percent of the installed capacity.

THIS overcapacity has resulted in heavy and nearly continuous overproduction. The 1929 census determined the production of 1167 sawmills which cut over 5,000,000,000 feet annually, as over 26,000,000,000 feet, or 70 percent of the total cut of 36,000,000,000 feet. These mills—about 6 percent of the total—could readily have produced more lumber than the total consumption of the United States in that year.

Lumber prices of some of the principal species are today about where they were a quarter of a century ago. The average wholesale price for all species was $16.54 a thousand feet in 1906 and $22 in 1930, with almost continuous further declines since the middle of last year. During the past two years Douglas fir prices have fallen 35 percent, southern pine 33 percent, western pines 30 percent, and southern hardwoods 40 percent.

Notwithstanding low lumber prices, the per capita consumption of lumber in the United States has fallen during the last decade from 500 to about 275 feet. So far this year it is proceeding at the rate of less than 150 feet. This decline is attributed in part to changing styles, customs, and industrial and housing standards and, in a large part at the moment, to the fact that residential building is only a third that of three years ago.

Present and prospective timber supply and present and prospective timber needs have been a prolific source of controversy for nearly half a century. The present generation in America has been periodically warned of imminent "timber famine" and "timber shortage." The purpose of these predictions has been almost uniformly sincere, constructive, and courageous. In some important respects, however, their cumulative effect has become destructive of their very purpose. The succession of published official estimates of national timber stand for the past half century has been in part as follows:

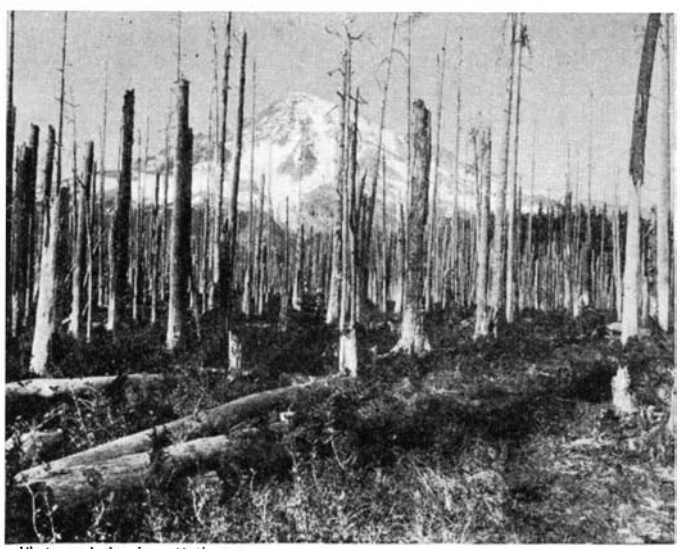
1880	856 billion feet
1896	2,300 billion feet
1900	1,390 billion feet
1905	1,088 billion feet
1911	2,826 billion feet
1917	2,700 billion feet
1920	2,215 billion feet

In 1880 the late Senator Hale, of Maine, predicted that within 40 years thereafter Maine would be barren of timber. At that time the estimate of timber stand in Maine was about 6,000,000,000 feet. Since then Maine has cut nearly 44,000,000,000 feet of lumber and has a timber stand officially estimated at about 35,000,000,000 feet. New England forests generally are now competently reported as growing more timber than is being currently utilized (although of course not as much as is being currently consumed in New England).

A quarter century ago there were repeated and dramatic forecasts of a timberless America within 30 years. Perhaps the most noteworthy result of that stream of publicity was to inspire a furious and—as it has turned out—an untimely and unwarranted speculation in western timber. Thousands on thousands of persons financially of high and of low degree bought small tracts and large tracts of timber, much of it "sight unseen." Much of it in isolated small holdings in the mountains of the Pacific Coast is worth less today than when it was bought. With the taxes and carrying charges, thousands of these properties represent a net and in some instances a total loss to the investor.

Again in 1919 official and unofficial forecasts predicted that within ten years the southern pine lumber production would have declined from 30 to 50 percent. Ten years later the production of southern pine had declined 10 percent, to about 12,000,000,000 feet annually.

ACCORDING to present admitted estimates of timber stand and of lumber production at the average annual rate of cutting for the five-year period from 1925 to 1929, the timber supply of Washington is sufficient for 35 years, Oregon 91 years, California 141 years, Louisiana 22 years, and Mississippi 26 years. This is without allowance for the extensive new growth of timber, particularly in the western forests. Moreover — being merely arithmetical — it does not make allowance for the extent to which some of this timber is economically inaccessible. These are the five leading states in lumber production,



Photograph by Jennett Spencer

Ghosts of former grandeur. A once beautiful forest devastated by fire. Snow capped Mt. Rainier in the background

*Courtesy, *American Forests*, Washington, D.C.

representing one half of the total lumber production of the United States.

Even within the last decade there have been official and semiofficial proclamations of "imminent pinch" of timber scarcity, and of prospective high lumber prices. These and similar statements, sincerely intended as a stimulus to forest conservation, have been exploited, amplified, and exaggerated by other industries seeking to secure the substitution of other materials for wood, and have in fact gone far toward defeating the very purposes they were intended to foster.

I WELL understand that this bare recital of occasional incidents in the last half century's history of timber supply, conservation publicity, and public understanding of forest facts does by no means tell the entire story. Nor in mentioning them am I trying to prove anything except that the succession of forecasts during the past half century have been for the most part inaccurate as to present fact; unsound as to future implications; and correspondingly harmful. I suggest that these facts, and many others which might as well have been cited, may indicate the timeliness, the wisdom, and the probable constructive value of a complete and impartial reexamination of the facts with respect to present and prospective timber supply and present and prospective timber needs.

I do not believe that anything but good will result from a public understanding of the great difference between adequate permanent lumber supply and adequate permanent forests. Lumber supply is only one—probably the most important—of the important purposes of forests. It is readily possible to have an ample national lumber supply without having solved the important forest problems of maximum productive land use and the protective, recreational, spiritual, and other values of forest growth. The two have been unwisely and harmfully confused.

THE perennial flare-ups over forest conservation have brought out some odd human psychology. Apparently there are some who would resist all tree cutting; these regard lumbermen as they would regard wolves. Others seemingly would butcher all the trees and let the devil pay; these regard conservationists as fanatics. Between these two "lunatic fringes" stand the saner majority; these, like the American Forestry Association, would regard the forests just as they regard any crop—to be used and replaced, but to be used nevertheless. Just as with corn, beans, potatoes, and so on, we need—enough. While we do not necessarily subscribe to all the views contained in the accompanying article, we believe that it will provide food for worthwhile thought and discussion.

—The Editor.

Much of the displacement of lumber has been because of the clear superiority of other materials. Such substitution is sound, constructive, and should be permanent. But there is reason to believe that much of it also has been due to unfounded anxieties over the continued availability of suitable lumber supply, unwarranted fears of prohibitive lumber prices, and a vague but potent under-current of public impression, fanned by zealous competitors, that it is rather a patriotic duty to aid forest conservation by refraining from the use of forest products. Abandonment of the use of lumber for these reasons is unsound and should not be encouraged.

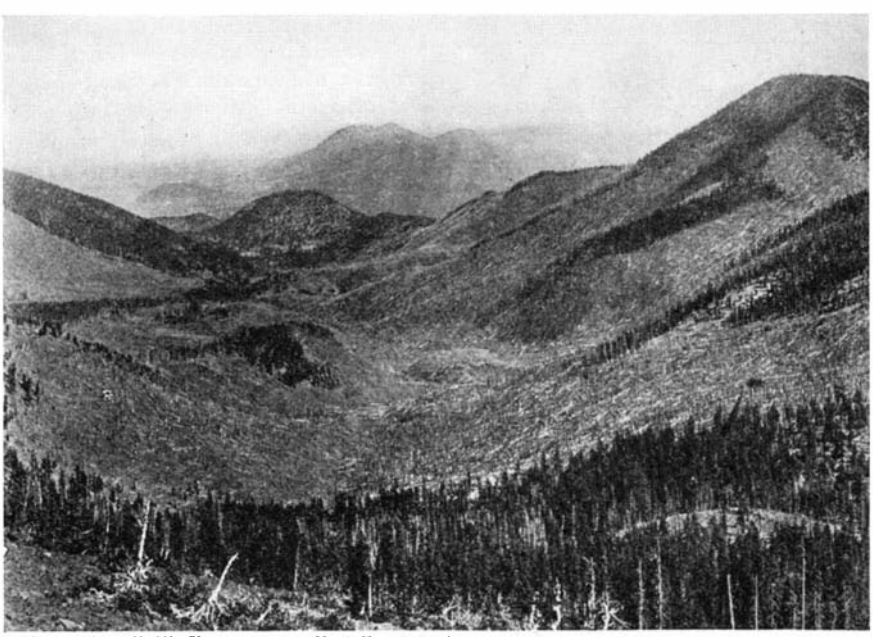
I am prompted, therefore, to believe the public agencies, the forest industries and the foresters alike may willingly unite in a deliberate reappraisal of national timber supply and timber needs in terms of present facts, unbiased and unfettered by previous pronouncements.

Until the last decade the principal financial motive power in the lumber industry has been the appreciation in value of standing timber which often resulted in great fortunes. During the past several years values have become stagnant or have declined. The result is that vast timber holdings have become a financial burden on the lumber industry. The total privately owned saw timber is equivalent to about 50 years' reserve of raw material at the present cutting rate, whereas a 20-year reserve, on the basis of present taxaton, is all that a well-ordered enterprise can stand. This leaves a 30-year supply that the lumber industry cannot afford to carry, making it a business liability instead of an asset.

THE present volume of Russian lumber imports is relatively small; its promised future volume is colossal. Its importance to the American lumber industry is in four facts: first, Russia has the largest timber supply of any country in the world; second, timber is its most accessible and readily convertible natural resource; third, the United States lumber market is the declared chief objective of the Russian export program; and fourth, nationalized timber, confiscated plants, forced labor, and state monopolies in production and distribution afford Russia great competitive advantages which are, properly, denied by law to American lumber manufacturers and distributors.

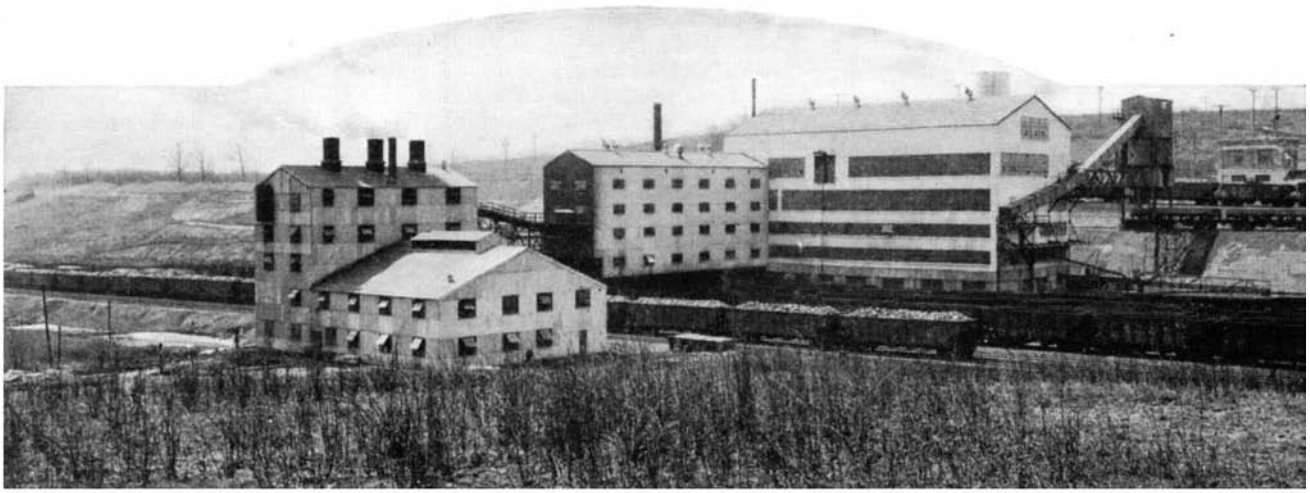
The remedy for unfair Russian competition may perhaps be found in Section 337 of the present tariff law, which prohibits the importation of goods offered under unfair methods of competition. Under this section the President may suspend the importation of goods against which unfairness is charged, pending final determination of the question by the Tariff Commission. If the law should prove ineffective new legislation should be promptly enacted to remedy any undesirable situation.

The facts that have been presented here point to five outstanding needs in practical timber conservation; viz., dependable control of lumber production, reduction in cost of carrying reserve timber, research, diversification of production and distribution of forest products, and protection against unfair competition, foreign and domestic.



Photograph by F. W. Cleator, courtesy U. S. Forest Service

Another example of the damage that can be done by fire. A watershed on the northeast slope of the San Francisco Peaks, Coconino National Forest, Arizona



The Champion cleaning plant of the Pittsburgh Coal Company serves a number of their mines and gives mechanically cleaned coal prepared to requirements of various industries. This is one of the achievements in the coal industry

MODERN COAL FOR MODERN MARKETS

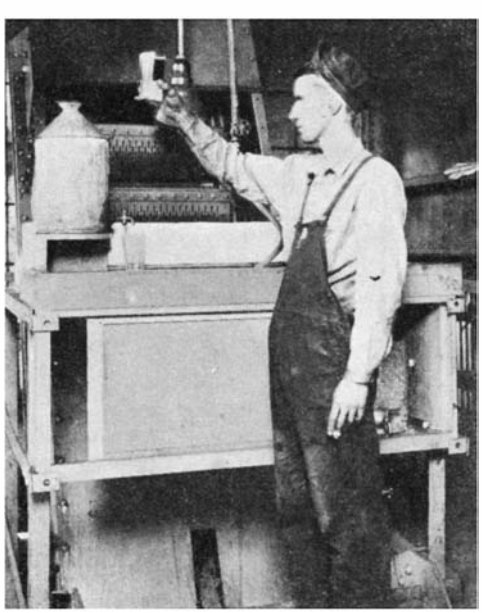
By ALBERT A. HOPKINS

THERE was a time when coal was just coal black coal—hard or soft. We are greatly indebted to Mother Earth for putting the coal into the ground and it is up to us moderns to get it out safely and economically. We have made great progress in coal mining in the last decade. The exigencies of war and the troubles with labor gave the consumer a varying product which in time convinced the buyer that there was coal—and coal; he became the discriminating buyer.

This was the time that opportunity knocked at the door of the Pittsburgh Coal Company. They are large operators having 150,000 acres of bituminous coal lands in western Pennsylvania and 20,000 more acres in Ohio and Kentucky. The coal business was sick, very sick, and an antidote or specific was required. Evidently the old adage about the kinship of cleanliness and godliness occurred to the astute officials. Probably they remembered packaged goods and the Ford assembly line. So the long and the short of it was that the company invested a few million dollars, based on the idea that the coal consuming public would rather buy clean fuel than dirty, poorly treated coal or coal that had never been treated at all. They started out with a proposition that they would "engineer" coal for the market. This required accurate and scientific knowledge of the chief uses and conditions to which the fuel was to be put as well as great financial resources.

The whole matter is summarized by the company's president, Mr. Morrow, who says: "After we had studied our markets we formulated our program. This first involved the construction of combined cleaning and preparation plants to dress our product to the user's requirements. It next required the reconstruction of our production department to conform to the new standards and kinds of output."

As a result of this decision four mechanical preparation plants were built, three using the wet process and one the dry process. The capacity of all these plants is 9,250,000 tons annually of cleaned coal, sized and mixed to individual specifications when required. These cleaning plants do three things: First, they give a clean and carefully graded coal; second, they put out a product which meets the chemical requirements as to ash, sulfur content, et cetera; third, they so standardize deliveries that each shall be the same as regards physical and chemical properties. Thus, coal merchandising has been placed almost in the rank and file of trademarked breakfast foods or low priced automobiles.

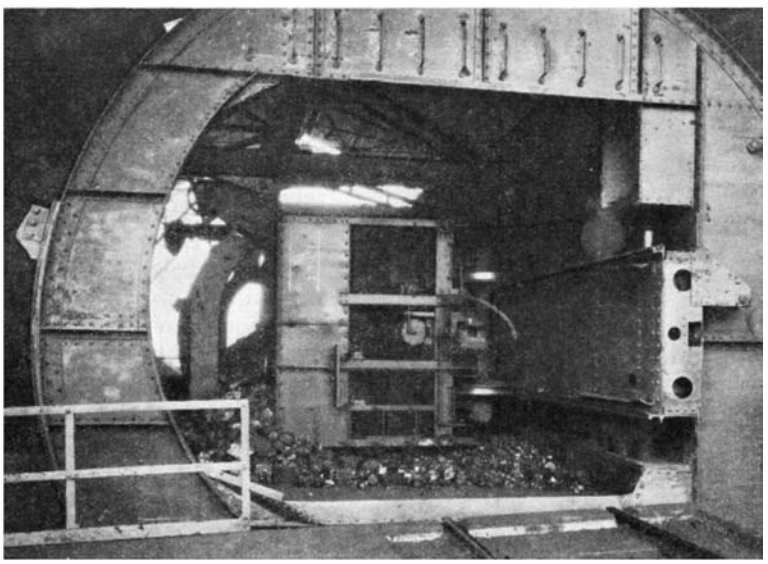


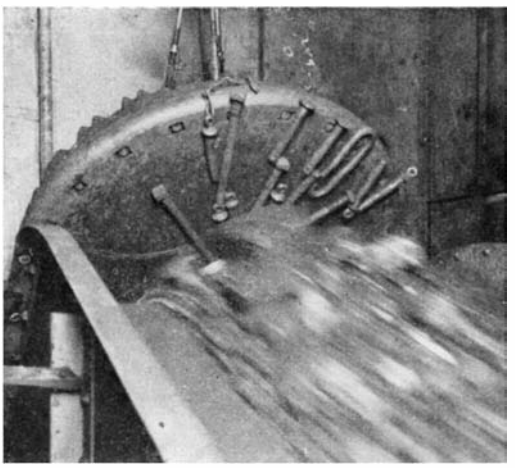
Float and sink test shows how well the cleaning operations have progressed

The cleaning plants often serve several mines and the coal is brought to them by railroad cars or aerial trolleys but naturally they are located at or near one mine to save haulage. It was the writer's good fortune to visit the Champion cleaning plant about 13 miles from Pittsburgh, which uses the wet-cleaning process.

The "raw" coal, as it is called, comes in cars which are emptied by a rotary dumper that takes one car at a time and rotates it so that the contents are spilled out over a grating. The coal falls on an apron which is designed to hold the coal back until the car is tilted still farther, so that when the coal finally falls into the hopper under the grating breakage will be minimized. Twenty cars of a capacity of 40 to 90 tons can be dumped per hour.

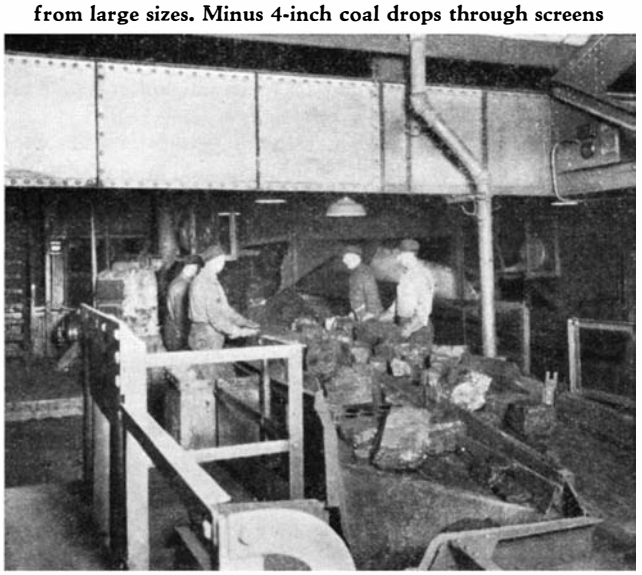
The raw coal is fed from the hopper to a 60-inch belt conveyor capable of conveying 700 tons of coal an hour to the shakers. At the discharge end of the belt there is a

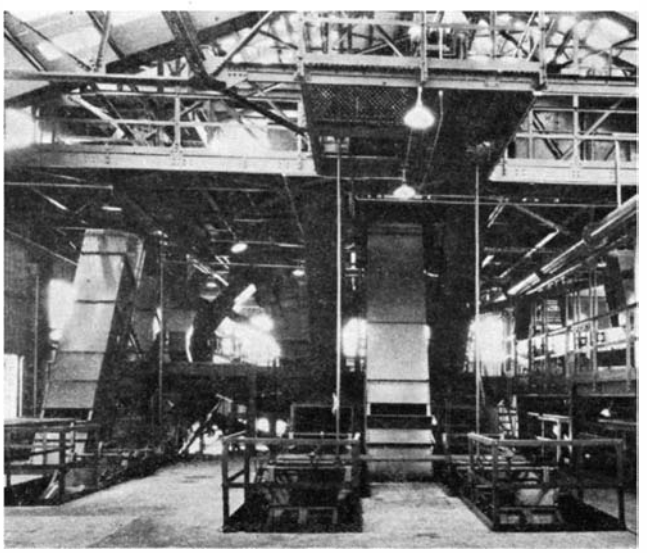




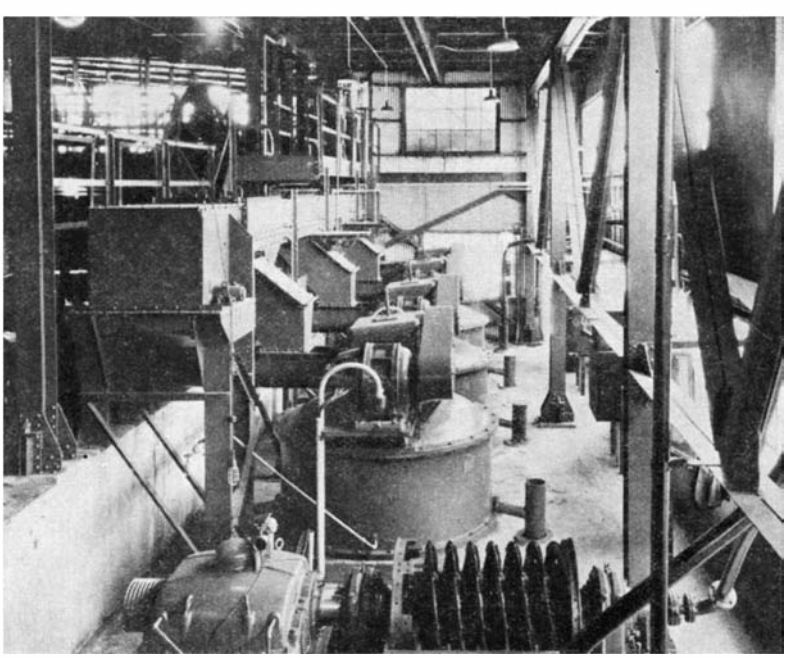
Left: Dumping raw coal as it comes from mine. An apron delays the fall. *Above:* A 65-inch lifting magnet at discharge end of feed conveyor picks out the "tramp" iron. Much of the salvaged material is usable

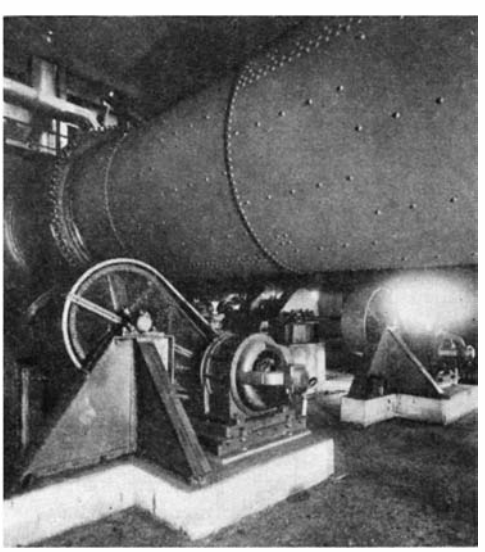
Below: Hand picking removes no fuel value material from large sizes. Minus 4-inch coal drops through screens



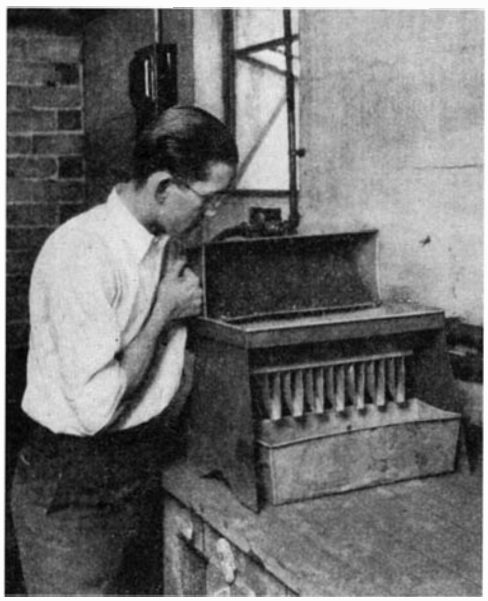


Part of the coal cleaning equipment which not only rejects the refuse but also assists in the sizing and grading





Left: Sludge filters and fine coal centrifugal driers where moisture is reduced before entering heat driers. *Above:* The heat driers are constantly turned to remove the last of the remaining water



All the coal shipped is under the supervision of chemists who make constant tests

65-inch lifting magnet which takes care of the "tramp" iron, such as coupling pins and links and assorted bolts and nuts. This salvaged material is well worth saving. The belt conveyor finally deposits its load of coal, which is "run of the mine," onto a shaking screen where the "minus 4-inch coal," as it is called, drops through the screen perforations. The plus 4-inch coal is carried on to a second screen where the larger pieces of coal are still further separated as to size. The larger sizes, plus 6-inch and 4 by 6-inch, are shunted on to two parallel shaking tables where hand pickers, all experts, remove rock and other foreign material which is thrown down through pockets. The larger sizes are not washed as this is unnecessary and this coal is run out directly on the loading booms which dump the coal into waiting cars on three of the tracks.

WHAT about the coal waiting for its bath? The tubs and the masseurs are all ready. The minus 4-inch coal, separated from its larger brothers, is stored in bins at the time of separation and is now taken to the top of the plant by a conveyor which dumps it into two primary washers (technically called Rheolaveur launders).

A feature of the launders responsible for the thoroughness of the cleaning is the continuous recirculation of the doubtful pieces of material. With the aid of de-watering and shaker screens the following sizes are separated: furnace, stove, stoker, pulverized, and slack. Clear water sprays play on the classifying screens to remove fine particles adhering to coarse pieces.

If necessary, other treatment is given by means of seeming intricate but really simple machinery. Bucket elevators raise the coal when necessary. Provision is made to avoid any added moisture in the coarse sizes of coal by means of de-watering screens, air jets, small unit heaters, and steam coils located at strategic points on the conveyors.

The fine coal has more attention given to its toilet. After it is cleaned, the fine coal with its clinging water passes into two concrete tanks to allow it to settle, the super-natant water being removed by de-watering elevators. A scraper conveyor line discharges the coal into centrifugal driers which reduce the moisture considerably prior to its admission to the rotary kiln driers. The fine coal is then run through great driers heated with hot gases and constantly rotated. A conveyor takes the coal to the mixing and loading plant where the cars are filled and sent out into the world to help keep us warm or to help our industries. All the refuse—slate, rock, dirt, and so on is a total loss to the company but a saving to the coal consuming public.

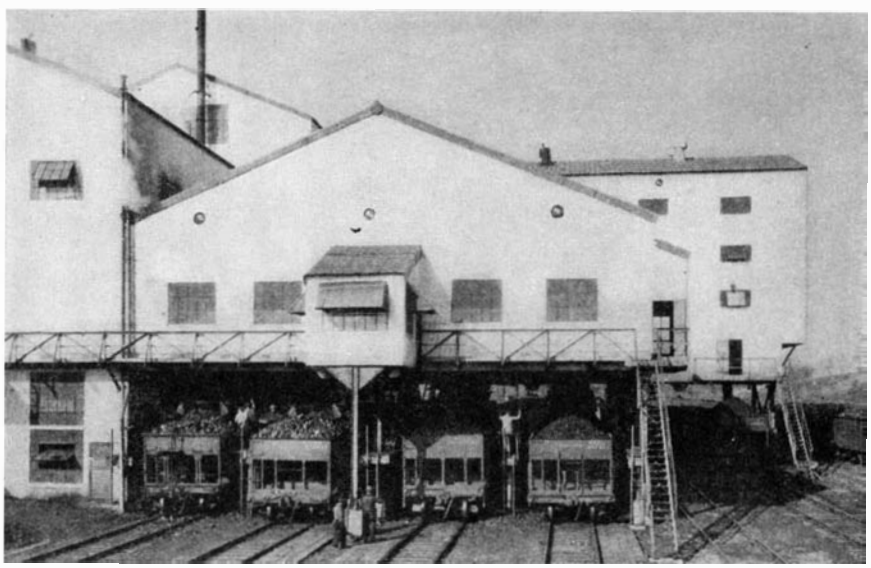
The loading booms have a gate which can be manipulated to divert the flow of coal from the cars just loaded to the incoming empty car. Any size or combination of sizes can be delivered to the car, thus meeting any specifications of the consignee. This feature alone cost as much as the average or ordinary coal tipple. The shipping clerk has an elevated office over the loading tracks.

The sampling of the product is done automatically. On each of the clean coal conveyors is an automatic sampling gate through which the samples drop into a bin from which they are conveyed to a gyratory crusher which crushes the coal down to ¼-inch pieces. Then about 10 percent is cut out automatically and this is quartered down still farther until the required quantity is obtained. All the samples which are rejected are returned mechanically to the raw coal fed to the plant.

The dust nuisance seems inherent in the coal industry but here it is hardly noticeable. Everything is concrete and steel and the old idea that a dusty plant is inevitable has been exploded. In the Champion plant over 50 percent of the wall area is window space. The artificial illumination is excellent and the ventilation is good. The psychological effect on the workmen of a light, clean plant with fine showers, lunch room, and above all safe conditions, can hardly be over-estimated.

THE dry-cleaning is accomplished on a different plan. Gravity flow is utilized as far as possible so that only four men and a foreman are required to operate the plant. The entire screening operation is performed on the top floor, and the air cleaning on the floor below. Cyclone dust separators remove all but the finest dust from the air as it leaves the tables. Nine hundred horsepower is required to treat 320 tons of coal per hour.

"Enjoyment of poor health has been so fashionable in the bituminous coal industry" says *Coal Age* "that it is not always easy to distinguish between chronic invalidism and hypochondria." The companies that are making outstanding progress in building for permanent gains are doing so by intelligent and sound management, plus coal sales engineering and the modernization of both mines and treating plants. The Pittsburgh Coal Company has done what the industry as a whole must do eventually and their great success was gained only by painstaking scientific research and is a tribute to the potency of the research laboratory.



Loading coal on six tracks. The lump coal is all loaded on left hand tracks. All the screened sizes are loaded by adjustable booms to avoid breakage

TRADEMARKS IN DISGUISE

By SYLVESTER J. LIDDY
Member of the New York Bar

THIS article is not intended as publicity, or perhaps more aptly, as ballyhoo, for a new and amusing magazine which appears to have taken the country by storm. That delightful publication wends its merry way without visible assistance—except from advertisers who appear to be quite content to have their well-known brands fantastically disguised and burlesqued. "Disguised," yes, but not beyond recognition and therein lies one not-so-amazing secret of its success.

Advertisers and advertising agencies have long been aware that the public is "brand conscious." But we were not always aware that we could recognize trademarks in their new and often hilarious disguises. Thus we chuckle when we are advised to use "Blisterine" to cure "Athlete's Foot." The addition of the letter "B" to "Listerine" has not fooled us—except willingly.

When we are told that a well-known missing Justice of the Supreme Court used "Bond's Vanishing Cream" to efface himself completely, we grin and think it would be great if someone would use Pond's Vanishing Cream on the current depression. And so it goes.

THERE are those, however, who disguise and simulate trademarks for an entirely different purpose. Attorneys who specialize in handling trademark cases and suits for unfair competition based essentially on trademark infringement find that it is a common experience to have a stranger drop in on them at the office, unfold a drawing or sketch of a proposed trademark, and after glancing about furtively and sometimes involuntarily, whisper, "Can I use this mark?" or "Can I register this in the Patent Office?" "This," usually turns out to be a poorly disguised imitation of some well-known trademark. The answer to both questions is of course "No," and the visitor is told that even if he should secure registration of his deceptively similar mark he will continue to use it only at his peril. Rarely, if ever, do these trademark pirates present for consideration a "Chinese copy" of the pirated mark. That would be too flagrant. They change a letter here or there, if it is a word mark, or substitute a similar symbol, device, or arrangement of elements, if the mark to be stolen is a design or pictorial representation.

The underlying theory on which these infringers work is that the average purchaser will not stop to examine closely the trademark on the goods he is purchasing, but will give it a casual glance and just as casually jump to the conclusion that he is buying the genuine brand. It is rare that an opportunity is afforded for a side by side comparison of the genuine and the spurious.

But all infringers are not crude in their methods. The man who exactly copies another's mark is soon detected and finds himself paying damages. So too with the less subtle infringer who makes merely immaterial changes in the trademark to be simulated. But the clever crook is careful as to which mark and, more important, which *type* of mark he selects for pirating. And right here lies the danger in adopting as brands, trademarks which are technically weak, if in fact they are trademarks at all.

THE purpose and function of a trademark is to indicate ownership and origin of the goods bearing that mark. If a trademark does just that and does it well the owner should be satisfied. But frequently the merchant, manufacturer, or distributor places too much of a burden on his trademark. He expects the mark itself to do all his advertising for him and at the same time describe the virtues of the product on which it is placed. He forgets that a purely descriptive word is a poor trademark at best and frequently no trademark at all. He attempts to appropriate exclusively to himself a word which has long found lodging, as an adjective of merit, in Mr. Webster's excellent Hostelry for Words. He wants his trademark to "carry a message" and that is just the trouble. The descriptive word *has* carried a message from the day it was conceived. Perhaps many messages. But he wants it to carry his message *only* and therein lies the rub. In order that a descriptive word serve only his purpose it must cease to serve all other purposes and must cease to function as it has always functioned. Consequently, he is attempting the impossible when he tries to take exclusively to himself a word which has long since been dedicated to the public. It cannot be done. The trademark pirate knows this and profits by it.

"Ivory" for soap is a good trademark, but "ivory" for elephant's tusks is not and the reason is obvious. Any one may use and properly use "ivory" to describe elephant's tusks.

"Delicious" for prunes is either descriptive or deceptive depending on whether one likes prunes. At all events the word "delicious" as applied to a food product is not a good trademark.

Owners of trademarks, however, frequently spend considerable sums in attempting to popularize, as a trademark, a descriptive word. After the advertising campaign is well under way, but before the owner (?) of the descriptive mark (?) has a chance to build up a possible secondary meaning in the descriptive word, the pirate steps in and, with an air of innocence, begins using the same word in a purely descriptive sense on a directly competing product. If such use is challenged his defense, of course, is that he has a right to use such a descriptive word in a descriptive sense in common with everyone else. In the absence of other acts of unfair competition the defense is a good one, the damage is done, and the proprietor of the descriptive mark belatedly decides to change his brand, adopt an arbitrary mark, and keep away from descriptive terms in the future.

THE wise merchant adopts as his mark a word such as "Kodak." When the Eastman company adopted this coined word it meant nothing, but by effective advertising and the excellence of the product itself, "Kodak" has become probably the best known trademark for cameras in the world. The trademark pirate fights shy of a mark of this kind. With wholly arbitrary marks, such as "Kodak," there is absolutely no excuse for another to adopt as a trademark for a competing product, a word which even faintly resembles it. A trademark thief would have a hard time explaining for example why he used "Kodac" or "Rodak" for cameras. No longer could he argue that he is using a purely descriptive word in a descriptive sense.

Experience has taught the business man that a few hours devoted to the careful consideration of his trademark may later save him years of litigation in a possibly vain attempt to protect a technically weak mark, thoughtlessly adopted, from infringement by an unfair competitor.

HOW STABLE IS THE EARTH'S CRUST?

By HARLAN T. STETSON
Director of the Perkins Observatory at Ohio Wesleyan University

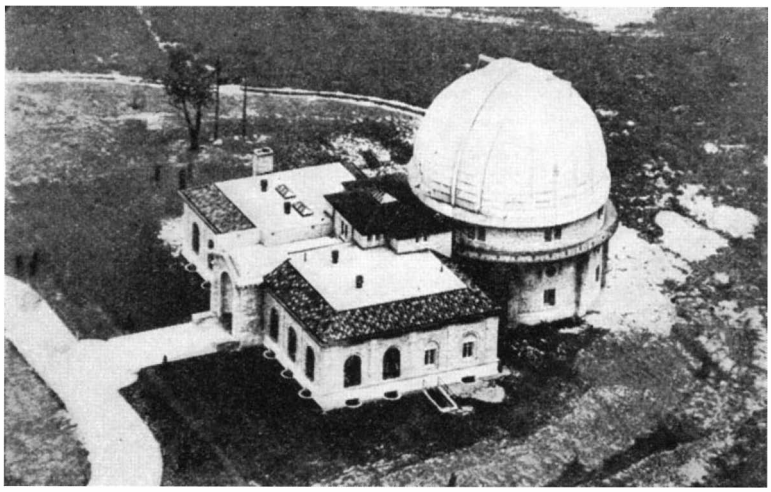


Figure 1: **An aerial view of the Perkins Observatory at the Ohio Wesleyan University, where investigations of earth-tides are being made**

EVERYONE is quite familiar with the fact that tides in the ocean are caused by the gravitational attraction of the moon. Perhaps, however, few realize that, while the water of the earth's surface yields readily to the moon's tide-raising force, the supposedly solid crust of the earth itself also yields slightly for the same cause. Years ago it was pointed out by Lord Kelvin from the study of ocean tides that the earth itself could not be a perfectly rigid body, but must yield a small amount in order to account for a somewhat lesser height of the ocean tide than would any theory allow which was based on the supposition of an absolutely rigid earth.

What appears to be a new method for studying tides in the earth's crust under the pull of the moon's gravitational force results from an extensive study of astronomical observations of latitude now being conducted at the Perkins Observatory (Figure 1).

Various experiments have been made at various times and places for detecting a theoretical tide in the earth's crust. Perhaps the most successful of these was one carried out by Michelson and Gale, of the University of Chicago, in the grounds of the Yerkes Observatory at Williams Bay, Wisconsin, some 15 years ago. These scientists buried a horizontal pipe, half filled with water, 500 feet long, many feet below the earth's surface. By ingenious optical devices they were able to photograph the advance of the tidal wave as the moon went about the earth. The difference in the height of the tide observed in the pipe and that computed on theoretical grounds, assuming the earth perfectly rigid, showed just how much the earth's crust yielded to the moon's gravitational pull. They determined that the earth yielded with approximately the same elasticity as steel. What this experiment really gave was the amount of tilt of the buried pipe with respect to the water level, and could not give any indication as to a change in absolute direction of the plumb-line with respect to the stars.

Investigations now in progress at the Perkins Observatory, Delaware, Ohio, consist in the analysis of many thousands of observations of latitude at a given place on the earth's surface extending over considerable periods of time. Results already published show that the latitude of a given place on the earth's surface varies, not only with the month in which the observation is made, but depends in a very real way upon the position of the moon in the sky at the time that these observations for latitude were made.

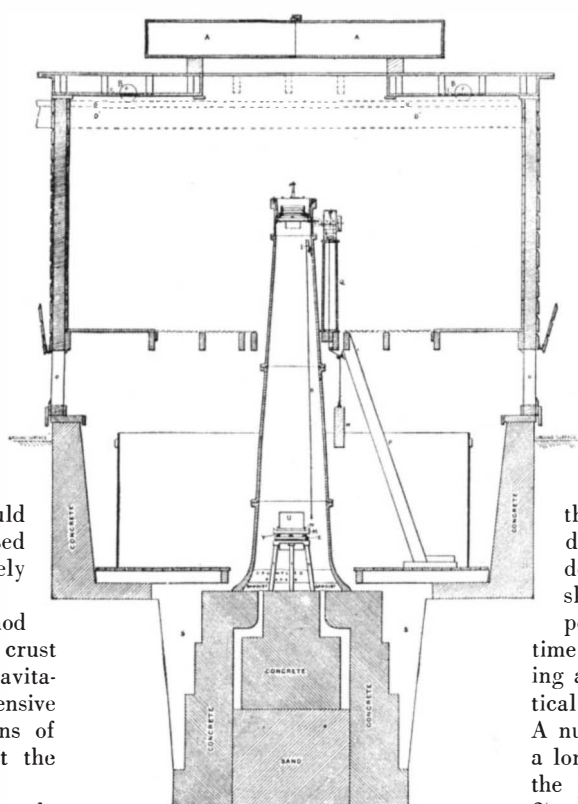


Figure 2: **A diagram of the east-west section of the Gaithersburg zenith tube, an astronomical instrument with which the latitude of a point from the equator is determined with great accuracy. The analysis of many observations made with this instrument first led to the discovery that the moon distorts the vertical as it passes overhead. See Figure 4, opposite**

THE most precise method for determining latitude known to science is to photograph stars at the zenith of the observer. If the plumb-line, which represents the direction of gravity, is extended indefinitely upward it will pierce the sky in the true zenith. Fixing this point among the stars from time to time is, then, a very nice way for studying any change of direction of the vertical at any point on the earth's surface. A number of years ago Dr. Ross made a long series of such observations with the photographic zenith tube (Figure 2) at Gaithersburg, Maryland. It was from a careful analysis of such observations that the author, with the assistance of a student at Radcliffe College, first obtained definite evidence that the position of the zenith changes with the altitude of the moon above the horizon. A shift in the position of the zenith means that theoretically the latitude of the observer changes, for as the observer wanders north and south over

the surface of the earth he carries his zenith with him.

It was not a new idea in astronomy that the latitude of a given place on the earth's surface varies from time to time. This was definitely shown by Chandler in this country from observations made many years ago at Cambridge, Massachusetts. The variation in latitude, however, which Chandler discovered, was due to a migration of the earth's axis within the sphere of the earth itself, consuming a period of something like 428 days. In every-day language, this is equivalent to saying that the earth's north pole wanders about over the arctic ice fields, the maximum migration being something less than 60 feet.

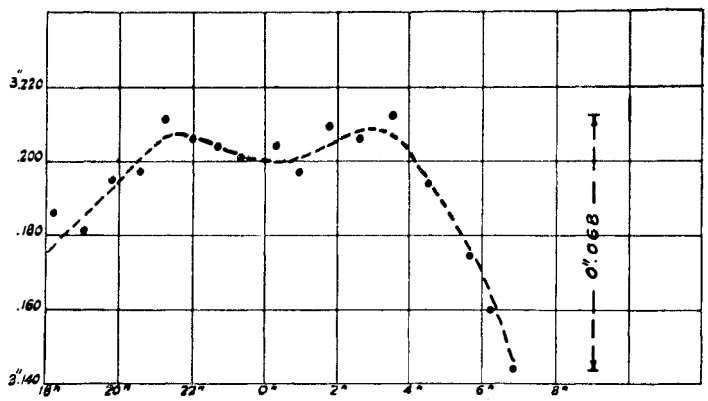


Figure 3: **Variations in latitude plotted against the moon's hour-angle, 1913-1914. Each point is based on 300± observations**

As this meandering of the north pole causes a considerably greater change in the position of the zenith than any tide in the earth's crust could possibly produce, corrections had to be made to all the published observations before they could be used in the present investigation. Several thousands of these observations were entered into a card catalogue and duly corrected for this known meandering of the north pole before the present search for a tidal variation was undertaken. After the cards had all been carefully prepared and the numerical work checked, the position of the moon in the sky at the time the observations were made was then entered upon the cards. The cards were then sorted with respect to the number of hours that the moon was east or west of the observer's meridian. The result is shown in Figure 3.

THE most casual glance at this curve shows that the latitude of Gaithersburg was appreciably greater when the moon was near the meridian than when the moon was rising or setting. As the magnitude of the variation is small, only the seconds of arc and decimals of seconds are written on the vertical scale of the curve. The horizontal scale represents the hour angle of the moon, or the time elapsed since the moon was on the meridian, when the values of the latitude as represented by the several points were obtained.

If we suppose that this change in the value of the latitude is due to a slight bulging of the earth's crust as the moon passes overhead, we see from Figure 4 that the change in the perpendicular to the earth's surface is toward the north. This means that the measured latitudes in the northern hemisphere will be somewhat greater as the moon nears the meridian. This is in agreement with the results of the latitude curve in Figure 3. On the basis of the earth being as rigid as steel, however, we should not expect a change in the vertical of more than one one-hundredth of a second of arc. It will be seen that the observed change was actually much greater than this.

The displacement of the vertical at a given moment would seem to depend quite directly upon the actual distance of the observer from a point directly under the moon, which we call the sub-lunar point. It was therefore decided to calculate for each of the cards in the catalogue the actual altitude of the moon in degrees above the surface of the horizon at the time a given group of observations was made. Whereupon the cards in the catalogue were rearranged according to the increasing value of the lunar altitude.

The result of this new approach to the problem is shown in Figure 5, and gives a more startling curve than that in Figure 3. Here it will be seen that the extreme range in value of the latitude at Gaithersburg is nearly 0".1 of

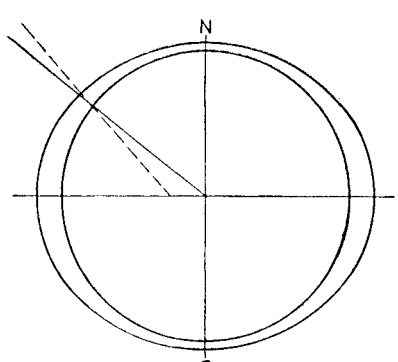


Figure 4: **Earth tides (exaggerated) showing change in perpendicular**

arc, the maximum value of the latitude occurring on the average when the moon is some 30° above the horizon. The fact that the range of variation is nearly 30 times as large as the probable error of the point representing the observation leaves little doubt as to the reality of the phenomenon. Furthermore, as this range is nearly ten times as great as would be expected from any tidal effect in the earth, on the assumption that the earth is as rigid as steel, the interpretation is all the more puzzling. Are we to assume that the earth's pole is shifted in some way so as to account for the peculiar behavior, or can it be that the crust of the earth has shifted in an unknown way to account for this peculiar behavior? Is it possible that the earth's crust is a sort of loose-skinned affair which yields far more than would have been expected, and that our older theories based on the idea that the earth is rigid throughout must be abandoned or modified?

Geologists of late have been coming to the conclusion that, while the core of the earth is rigid, there is a semimobile layer between the core and the earth's crust, lying about 70 miles below the earth's surface. If such is the case, then indeed it may not be unthinkable that the skin of the earth yields in this somewhat uncanny way.

IT will be seen then that the investigation of this problem of the variation of latitude is quite as much a concern for the geologist and the geophysicist as it is for the astronomer. The astronomer himself must be very much concerned, for the observed positions of the stars and all astronomical bodies depend even as much upon the position of the observer at the moment of observation as upon the motions of the celestial bodies themselves.

It was not unnatural that we should wish further confirmation to such startling results, and accordingly a similar card catalogue was prepared which should include all the observations made with the photographic zenith tube after its removal to the Naval Observatory in Washington. The government astronomers kindly provided us with all available data, and a further investigation of the variation in latitude with the position of the moon was made on the basis of these new data. The results when plotted in curves give the graphs depicted in Figures 6 and 7. The graph in Figure 6 shows the change in latitude at Washington throughout a whole lunar day, the hour-angle of the moon being represented as before in the horizontal coordinate. The portion of the curve existing between 18 hours (moon rise) and 6 hours (moon set) bears a close resemblance to the general form of the curve shown in Figure 3.

Then the results were again translated in terms of the altitude of the moon, this being in effect a measure-

ment of the distance of Washington from the sublunar point at the time the several observations were made. This gave another striking graph—Figure 7. The portion of the curve represented between 0 degrees and 70 degrees corresponds to the observations made when the moon was above the horizon, and shows a fair resemblance to Figure 5 based on similar conditions in the Gaithersburg work. The portion of the curve between 70 degrees and 0 degrees shows what happened when the moon was passing under the earth. Perhaps the lack of symmetry between the two branches of the curve shows the difference in geological structure of the earth in the two hemispheres. The fact that the curve in Figure 6 shows a different form when the moon is east of Washington than when it is west of Washington, may represent a different structure of the earth's crust in the denser portion under the Atlantic than in the less dense portion under the continent of North America.

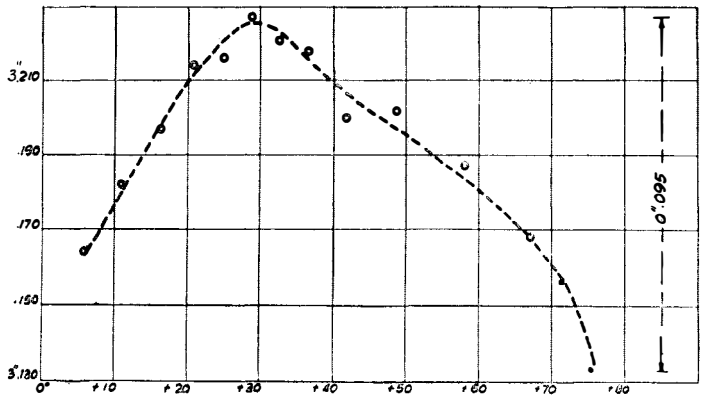


Figure 5: **Latitude-variation and moon's altitude, 1911-1914. Circles are based on 600± observations, dots on 300± and 74±**

SOME years ago Wegener proposed the theory that the continents were more or less detached affairs which floated about on a semi-fluid layer beneath. The theory seemed so fanciful and, so far, lacking in observational evidence for its support that scientists were rather reluctant to give serious consideration to Wegener's ideas.

Just recently, U. P. Lely, a scientist, reasoning on theoretical grounds, has come to the conclusion that there are distinct tendencies for a hypothetical floating continent to move either toward or from the pole under gravitational forces. The direction of motion, whether north or south, would depend upon the position of the center of gravity of the continental mass. If we were to allow a displacement of Gaithersburg or Washington along the earth's surface laterally, we might well account for the extraordinarily large variation of latitude with the rising and setting of the moon. After all, the entire movement would be probably less than ten feet, which is quite a microscopic amount when we consider the size of the earth as a planet.

Furthermore, a lateral displacement of the observer would cause an immediate displacement in his zenith, which would not necessarily be evident through any appreciable tilt. This would appear to make the rather large value for the change in latitude found from our study entirely consistent with the results obtained from the Michelson and Gale tide experiment already described. It is obvious that the level of the water in the 500-foot pipe would change with the slightest tilting of the earth's crust with respect to the water level. We should, however, get no effect if the whole pipe were shifted bodily at right angles to gravity. A crustal shift, however, would be immediately discerned in the shift of position among the stars since this would be equivalent to the motion of a moving ship sailing north or south.

Of course it is entirely possible that, with extended studies of latitude changes at widely distributed stations, we may find a certain amount of continental twisting with the rise and fall of the crustal tide. The prevailing direction of certain mountain ranges and other topographical features of the globe suggest that something of this kind may have happened in geological history.

Geology tells us that, whatever may be the primal origin of the earth, through unthinkable but rather definitely measurable epochs, our planet has undergone drastic changes. Earth movements throughout thousands of millions of years have created continents; raised mountain ranges; depressed shore lines; evaporated seas; united and severed, and again united, the Americas. Huge ice sheets crowded southward from Canada, scouring valleys and carving canyons. The ice shrunk, leaving vast moraines, lakes, and roaring torrents. Sedimentation built up plains and silted ocean beds. Suppose that a cinematographic record of the last half billion years were compressed into the 15-minute showing of a single reel. How the earth would appear to heave and writhe, its surface wrinkle and straighten, its rock grow and vanish with unceasing change.

SUCH interesting questions have already stimulated further investigation and the investigators at the Perkins Observatory are now carefully analyzing another set of observations obtained near the west coast at Ukiah, California, another one of the stations adopted by the International Latitude Survey. Preliminary results already obtained appear to indicate that the station at Ukiah goes through a cycle of latitude changes with the rising and setting of the moon, but with a marked difference in phase from that of the eastern stations. It is believed that if one of these photographic zenith tubes were to be set up in a mid-continental section, further observations would render a curve quite different from those obtained at either Washington or at Gaithersburg. One hopeful sign for the furtherance of observations on this problem comes with the news that the old station at Gaithersburg, formerly operated by the Coast and Geodetic Survey, will soon be reopened and a new set of photographic data acquired.

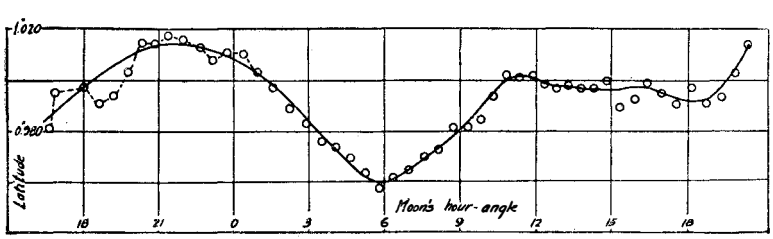


Figure 6

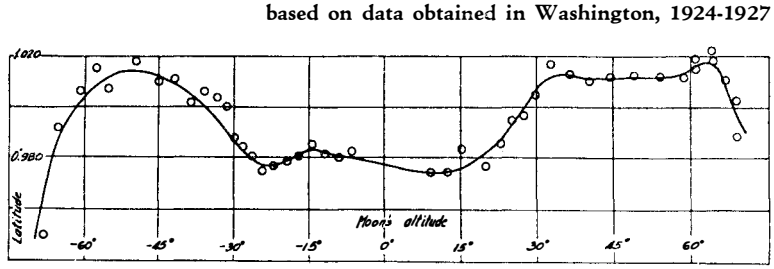
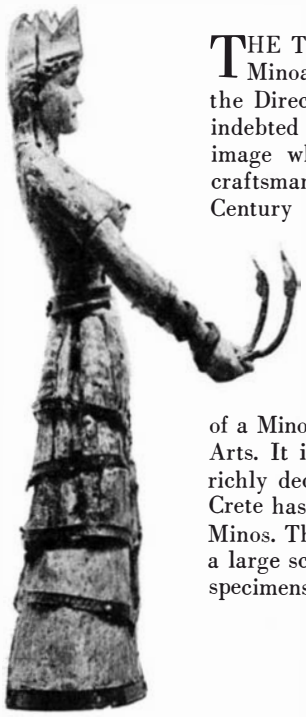


Figure 7

The curve at the left shows latitude variation plotted against moon's hour-angle. The one below, latitude variation and moon's altitude. Both were based on data obtained in Washington, 1924-1927

FROM THE ARCHEOLOGIST'S NOTE BOOK



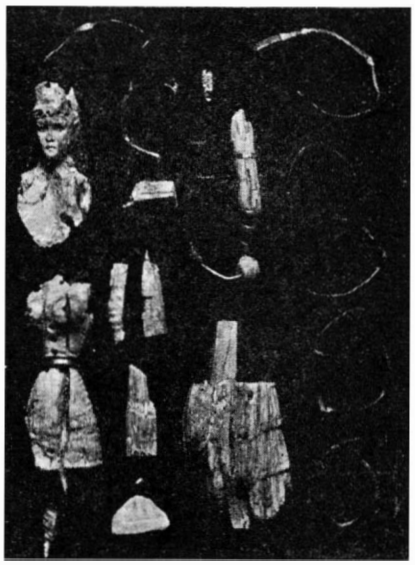
Masterpiece of Minoan Art

THE Toronto Museum has a unique specimen of Minoan art secured through the enterprise of the Director, Mr. C. T. Currelly, to whom we are indebted for our photograph. It is a gold and ivory image which is a masterpiece of Minoan (Cretan) craftsmanship of, roughly, the first quarter of the 16th Century B.C. It was in private possession in Crete for many years. Sir Arthur Keith, the great authority on Minoan art, says: "We have here in fact 'Our Lady of the Sports' though still the Mother Goddess in one of her numerous impersonations." It clearly bears a relation to the old Cretan sports of the bull-ring. It is 10⅕ inches tall. We also illustrate a statuette of a Minoan Snake Goddess in the Boston Museum of Fine Arts. It is 6½ inches in height, is carved in ivory, and richly decorated with gold. The whole prehistoric age of Crete has been called "Minoan" from the legendary king Minos. The Minoans have left us little or no sculpture on a large scale so we must rejoice that such beautiful small specimens have come down to us.

Above: **"Our Lady of the Sports," a figurine of the Minoan Mother Goddess from Crete.** *Extreme left:* **Figure of Minoan Snake Goddess**

Babylonian Brick Reliefs

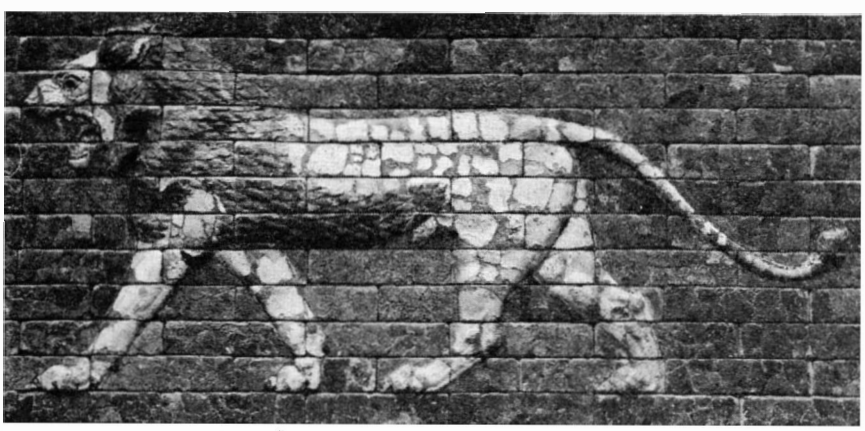
TWO important examples of wall decoration of enameled brick from the famous Procession Street of Babylon have been acquired by the Metropolitan Museum of Art. The lions are in relief with colored manes on a turquoise blue background. There were about 60 lions on each side of the street. It is believed that each brick was modeled and a separate mold made for it. The bricks were baked, the outlines of the design were painted in black and filled in with colored enamels, and the bricks were fired again. They sometimes show enamels in three colors which, owing to the great skill of the Babylonian craftsmen, do not flow into each other. The potters of Mesopotamia evidently understood the artistic uses of both lead and tin glazes.



It was an extremely difficult job to piece together the fragments of this little ivory and gold figurine. The body was made in two pieces and the arms were attached. The restored statuette is shown above, left

A Link Between Hellenistic And Roman Painting

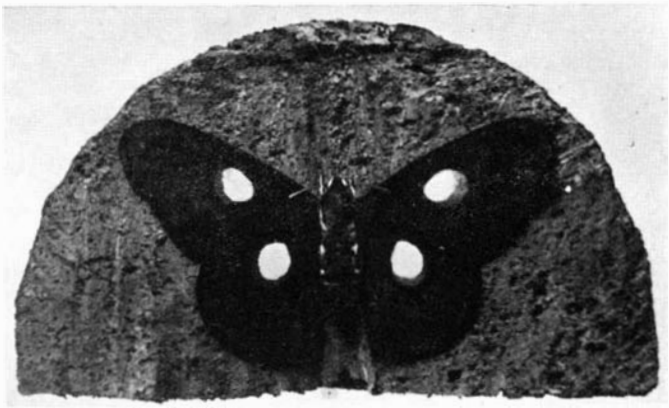
WHEN the Metropolitan Museum received this polychrome vase from Centuripe it was badly broken but has been cleverly joined together. Evidently the Sicilians of ancient Centuripe expressed their somewhat flamboyant taste in the forms of their pottery but adhered to the earlier Greek tradition in the character of the decoration. The cover is removable and is painted in tempera, a delicate medium which does not make for good preservation and makes us thankful for the Athenian black glaze. It probably dates from the 2nd or 1st Century B.C.



Panel of enameled brick from the Procession Street at Babylon, dating from the 6th Century B.C. The bricks were refired after painting with colored enamels

Polychrome vase from Centuripe dating from 2nd or 1st Century B. C.

BUTTERFLY FAKING—



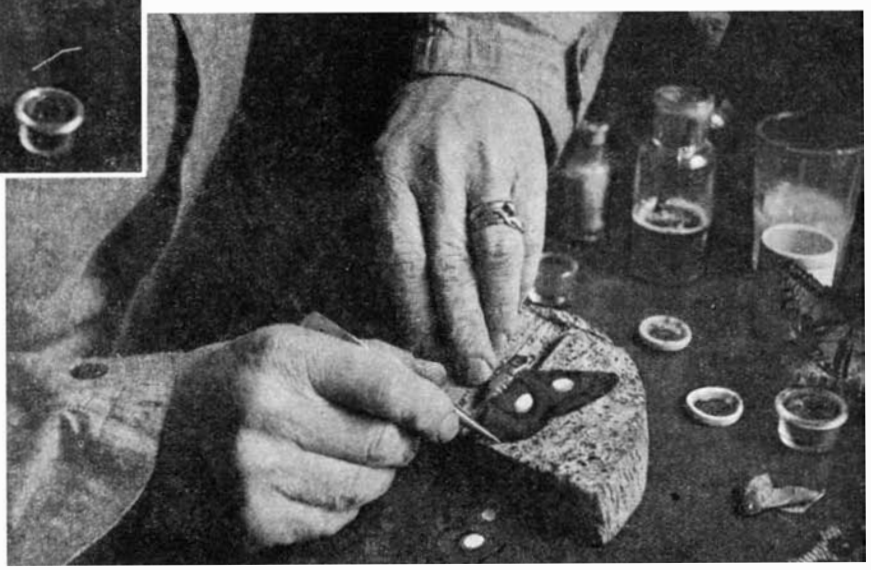
Specimens of rare butterflies bring high prices from collectors and this fact has led to the latest "racket" described on these pages. Illustrated above, pinned to a block of cork, is one of the genuine butterflies which the artists use as models

COLLECTORS of rare objects in many diversified fields appear to be considered "fair game" for hoaxers the world over. When a person becomes inoculated with the desire to collect a certain class of objects, he usually goes about it with an enthusiasm that all too often is not tempered with the good judgment that will enable him to avoid the pitfalls placed in his path by the unscrupulous. Such enthusiasm has been responsible for the many spurious specimens of Roman bronzes, ancient statuettes, antique furniture, and paintings of the old masters that have flooded the markets of the world for many years. As long as there are uninformed buyers who are willing to pay the price, such products will be produced.

One of the latest industries to grow up in answer

The first step in the preparation of a butterfly reproduction is to remove the dust-like scales from a common moth or butterfly, so that the artist can replace them with colored metallic powder which simulates the scales of the rare butterfly that is to be reproduced

Below: Putting the artificial scales on a wing which has been reconstructed from the wings taken from common butterflies



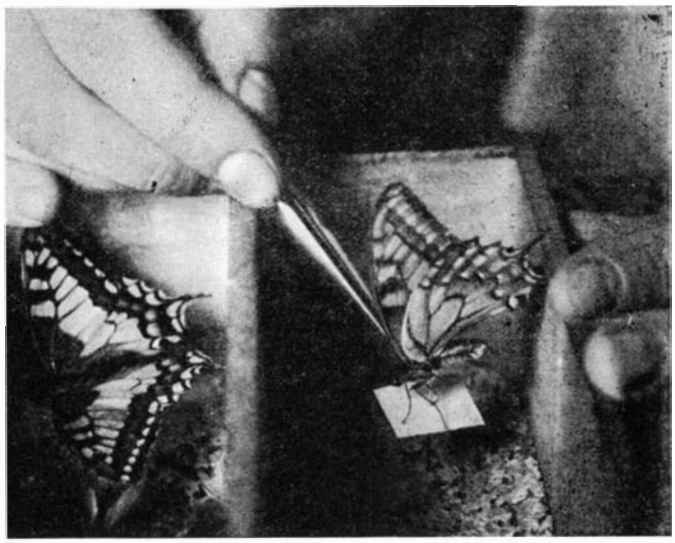
Right: The reconstructed wings are carefully attached to the body of a common specimen, which body closely resembles that of the butterfly being reproduced

A NEW INDUSTRY

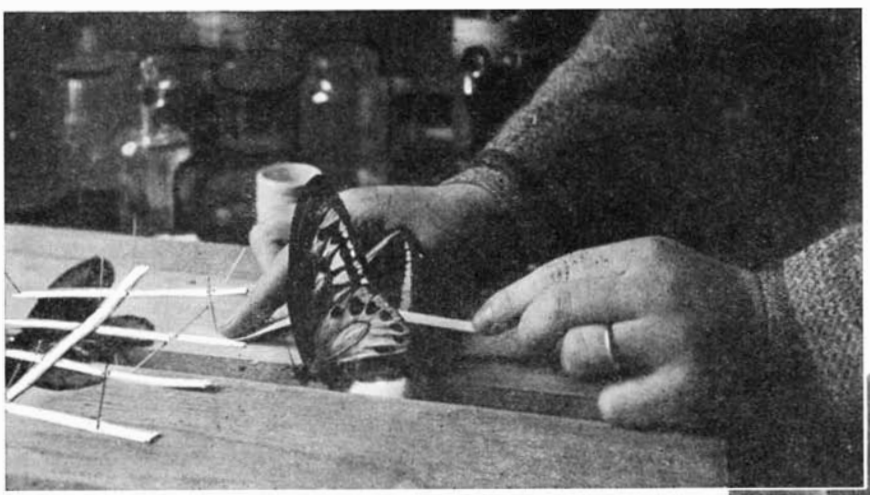
to the demand for rare objects has recently been uncovered in Paris and reported to us by our Paris correspondent. This industry has to do with faking butterflies -changing common moths and butterflies so that they can be sold, even to the more cautious collectors, as genuine rare specimens.

The initial investment in this rare butterfly reproduction business consisted of the purchase of several genuine specimens that cost a total of several thousand dollars. These are carefully guarded when in use by the artists, and are kept in a safe at all other times.

The concern conducting this business employs collectors to furnish them with quantities of common specimens. The wings of these are removed, and the bodies classified as to their resemblance to those of rare specimens. Sometimes the wings are used whole, but more often large wings are built up carefully from smaller ones, making sure that the tiny veins match exactly. A transparent waterproof glue is used for this work. From this point on, the operations are illustrated.

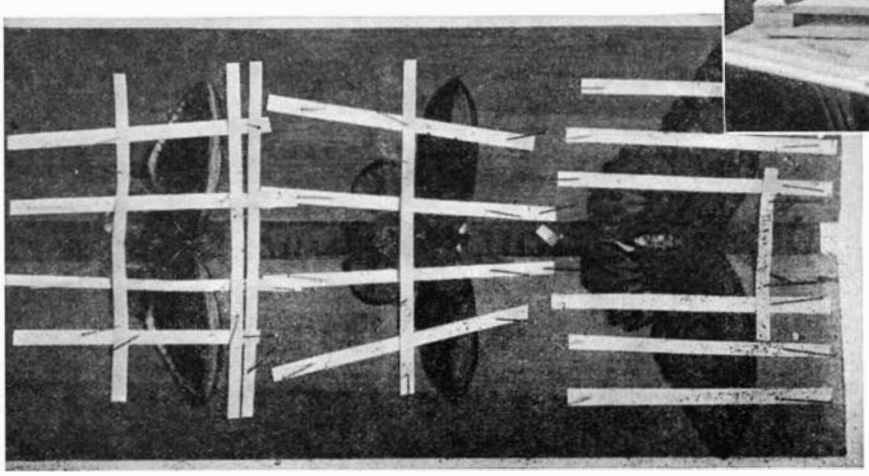


After the wings have been attached to the body, and all changes made, the reproduction is placed for some time in a box with damp sand, so that the delicate wing structures will be rendered pliable



After the reconstructed butterflies are removed from the box shown at right above, they are mounted on this special board. The wings are then carefully spread apart and held in position by pinned tapes

Below: **An expert putting the finishing touches on a specimen that has been prepared, made pliable, and mounted. A finely pointed pencil brush is used here**



Left: **A top view of the mounting board on which the reconstructions are allowed to dry before being offered for sale. Accurate reproductions bring high prices**

STONE AGE MAN'S WORLD-WIDE CULTURE

By J. REID MOIR
Fellow of the Royal Anthropological Institute
Author of "The Antiquity of Man in East Anglia," "Pre-palaeolithic Man"

THERE are few departments of science which have advanced more rapidly in recent years than that of prehistoric archeology, and it would seem as if at last the early history and development of the human race is to be regarded from a rational standpoint. It is, however, not so long ago that it was generally and tenaciously held that paleolithic man inhabited only western Europe and southern England, and that during his sojourn on this earth, upon which he was but a late comer, he had

Figure 1

lived in a state of degraded and unchanging savagery. There is, in fact, no other subject in which the innate conservatism of the human mind is more plainly exhibited than in that of prehistoric archeology, and it has been only by the courageous interpretation and making public of the results of recent researches that the old and stultifying opposition has been at last overwhelmed. In the new era which has now opened, our whole outlook upon the past history of the human race is being transformed and some of the conclusions to which recent discoveries are pointing are remarkable, to say the least.

IT is my purpose in this article to deal with one of these conclusions which, it appears to me, is of the highest importance to all those numerous people who take an interest in their remote ancestors. The great activity in archeological research which is now manifest over practically the whole of the earth is showing, among other things, that the people of the Stone Age had an enormous area of distribution. In Egypt, Palestine, India, and in south, east, and central Africa, it may be stated with confidence that paleolithic man existed. This fact in itself is of much significance and constitutes a great step forward from the days when it was believed that he had lived only in western Europe and in southern England.

The material which has been recovered in these widespread researches is now becoming available for study, and I have had the opportunity of closely examining some portion of it. The modern archeologist is not content with merely the recognition that any given

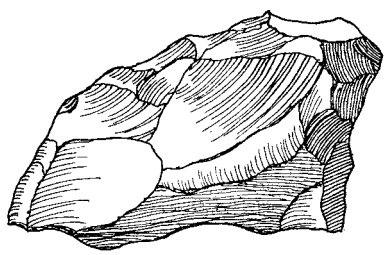


Figure 2

Rostro-carinate implements from (1) eastern England, (2) India, (3) Rhodesia, and (4) Palestine, illustrating the similarity of implements flaked by widely separated pre-historic groups

Drawings by the author

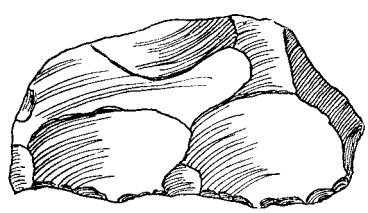


Figure 3

piece of flint has been flaked by man, and is either of paleolithic or of neolithic form. The exact manner in which these implements were made is now a subject of study, and it is becoming possible to say that at different periods of the stone age very distinct techniques in flint flaking were in vogue. This has, of course, long been recognized in France where the differing manner in which artifacts of upper paleolithic industries were made is now generally accepted. In England, where the lower paleolithic industries are so splendidly represented, a like recognition in regard to them has come about, and as I have pointed out in one of my articles in the SCIENTIFIC AMERICAN,[1] it is now possible to realize exactly how lower paleolithic man set out to make his implements. Moreover, this study has made it clear that he proceeded upon a definite and carefully thought out plan, the execution of which was possible only to an expert flaker of flint.

[1] July, 1928.

It is necessary that these facts should be recognized by all those who wish to be in a position to appreciate the real significance of recent archeological discoveries. The development of the primitive point of eolithic times into the earliest forms of the rostro-carinate, or beak-shaped, implements (Figures 1, 2, 3, 4) was no mean feat for the dawning human intelligence of the remote days when this progressive transformation was carried out. This development was undoubtedly the result of experi-

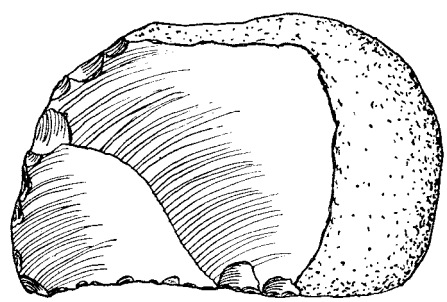


Figure 4

ence and careful thought, but it does not imply the same order of intelligence which was able to produce the hand axe with its two opposed cutting edges (Figures 5, 6, 7, 8) from the rostro-carinate with only one. Here, it seems obvious, a better type of brain was in charge of matters, and to study the large number of rostroid hand axes now available for examination is to realize that these specimens testify beyond cavil that man was indeed using that wonderful organ, his brain, to some purpose.

As one examines these rostroid hand axes it is possible to see clearly the object which their makers had in view and how they set about attaining it. The implements show by their forms that the old age-long habit of making rostro-carinates was, as it were, struggling for supremacy with the new desire to produce an artifact possessing a massive butt for comfortable prehension, opposed to a tongue-like projection with two cutting edges capable of more numerous and skilful uses than the single sharp keel of the rostro-carinate. These transitional implements usually exhibit a beak-like profile, while the remains of one or other, and sometimes of both the dorsal and ventral planes of the rostro-carinate are retained. It is because the specimens

show so clearly these characteristics that I have called them rostroid hand axes.

But it is not only in these transitional forms that the relationship of the rostro-carinates to the earliest hand axes is observable. When an examination is made of the kind of flaking which both types of implements exhibit, it becomes obvious that they were made by means of a very similar technique. This particular method is known as "free flaking," in which the side of the flint from which the flakes are removed is not supported by the hand or by some other object. It results in the detachment of flakes which tend to be thick and to possess prominent bulbs of percussion, and which are of greater width than length. Thus it is possible to claim that the rostro-carinates and the earliest hand axes show by manifold signs that they are closely related to each other.

It was from a study of the large series of specimens found chiefly in eastern England that the above conclusions were made possible, but when I first published my conclusions they were met by considerable opposition on the part of archeologists. Since those days, however, further evidence has been forthcoming in England, and now corroboration has come to light in places as far apart as Palestine, Africa, and India. Not only is this gratifying but it is also astounding, and brings up for solution certain problems regarding ancient man which in interest and importance are unsurpassed.

In the first place it may be said that, to those who have made a really close study of flint flaking and the manufacture of implements, it is not possible to believe that it was, for example, merely a "coincidence" that a race of people living in India proceeded to make their stone implements on a precisely similar and highly specialized plan as did another race living in eastern England. No school of a common necessity would produce results of this kind. Such a school would probably bring about the production of simple implements with rough cutting edges, but to imagine that it would give rise to artifacts of a precisely similar and complex manufacture is to ask too much of probability. If we found, for example, that a certain type of specialized carved furniture was present over wide areas of the earth's surface, we would not think of attributing this widespread similarity merely to coincidence; and in the same way it is necessary to shut out this explanation in regard to the flint implements under discussion.

I have recently had the opportunity of examining a large series of rostro-carinates and rostroid hand axes found in Palestine by the British School of Archaeology in Egypt, by Wayland in Uganda, by Neville Jones at Hope Foundation, Rhodesia, and by Cammiade in eastern India, and it is literally true to state that these specimens were all made upon the *same specialized and complex plan* as was being followed in eastern England in early Pleistocene times. I illustrate here rostro-carinates and rostroid hand axes in order that readers may be able to recognize the similarity to each other of the specimens from four very widely separated regions. There would not seem much doubt, though this is not yet finally established, that the implements from India, Rhodesia, and Palestine are, like their counterparts from England, of early Pleistocene date.

It would indeed be strange if a race of people living, say, in South Africa at some recent period, went through the same process of evolution of their stone implements as was carried through in England only in the early Pleistocene Epoch, and all the evidence now coming to hand is definitely against such a supposition. To what conclusions, then, are we to come about these remarkable facts?

THERE appears to me to be only one, and it is this: that the knowledge of how to make rostro-carinates into hand axes spread from a common center and was carried over a great part of the earth's surface.

If, as seems to me inevitable, we must adopt this explanation (not only for the culture of early Chellean times but for most other prehistoric industries as well), then other considerations of outstanding importance immediately arise. First, as to the time element; there could not have been much incentive, nor the means, in those remote times for the rapid spread of a prehistoric culture, and a very great period must have been taken up in the dissemination of a special technique in implement making from England to India, for example.

It may here be pointed out that the geological evidence relating to the antiquity of man in no way clashes with these conclusions, for it is becoming ever more fully realized that the human race must have appeared upon this earth many hundreds of thousands of years ago. The recognition of the spread of prehistoric cultures from common, though at present unknown, centers makes it also necessary to believe that ancient humanity was much more organized and advanced than has been supposed. But if there is one thing above all others that recent research in prehistoric archeology is teaching, it is that stone age man was not the hopeless and degraded savage which some have depicted.

It is now seen that stone implements alone can give us but a very imperfect picture of the cultural attainments of our remote ancestors and, as new discoveries are made, so our attitude to these matters is undergoing profound change. Prehistoric man is, in fact, slowly but surely entering into his rightful kingdom.

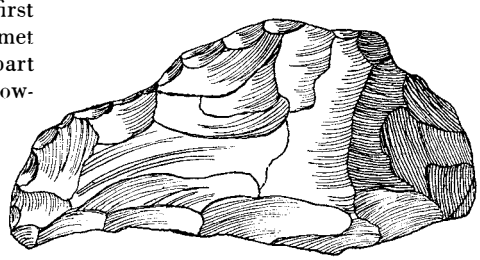


Figure 5

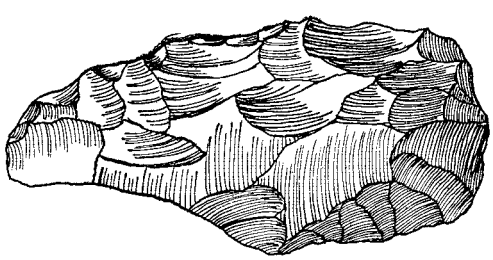


Figure 6

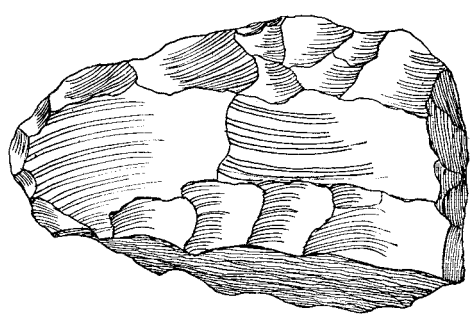
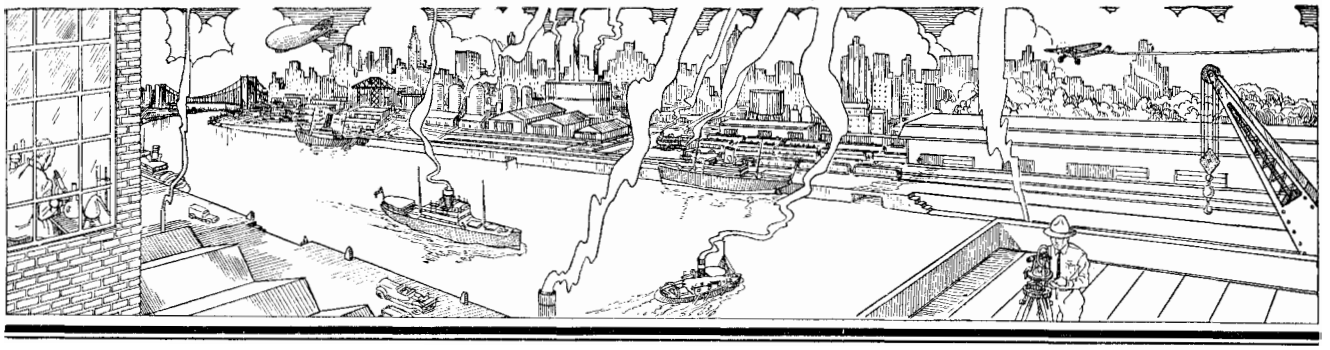


Figure 7

Figure 8

Rostroid hand axes from (5) southern England, (6) India, (7) Rhodesia, and (8) Palestine. Such artifacts indicate that Pleistocene man used his brain to advantage



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

New Waterproof Lime

WHAT is claimed to be the greatest advance in the lime industry in a century is the recent development of a waterproof quicklime suitable for masonry work. This new product is a pulverized quicklime so treated that the heat generated during the slaking creates a chemical reaction of such a nature that the resultant mortar made with the lime putty, with the addition of the necessary sand and cement, makes a water repellent mortar.

This should be of great interest to architects and contractors who in recent years have been worried considerably by leaky walls. It would appear that there is some connection between the prevalence of efflorescence and leaky masonry and the decrease in the use of lime in recent years.

This seems to be borne out by the tests carried on by the Bureau of Standards on the subject of "Volume Changes in Masonry Materials," which tests apparently show that a mortar composed of two parts of lime putty, one of portland cement, and nine of sand, shows the least volume change after hardening. This subject is treated in paper No. 321 by the Bureau of Standards.

The waterproof quicklime now on the market is not recommended at the present time for use in concrete work as complete tests have not been made covering its usage in this way.

First Translations of Maya Glyphs

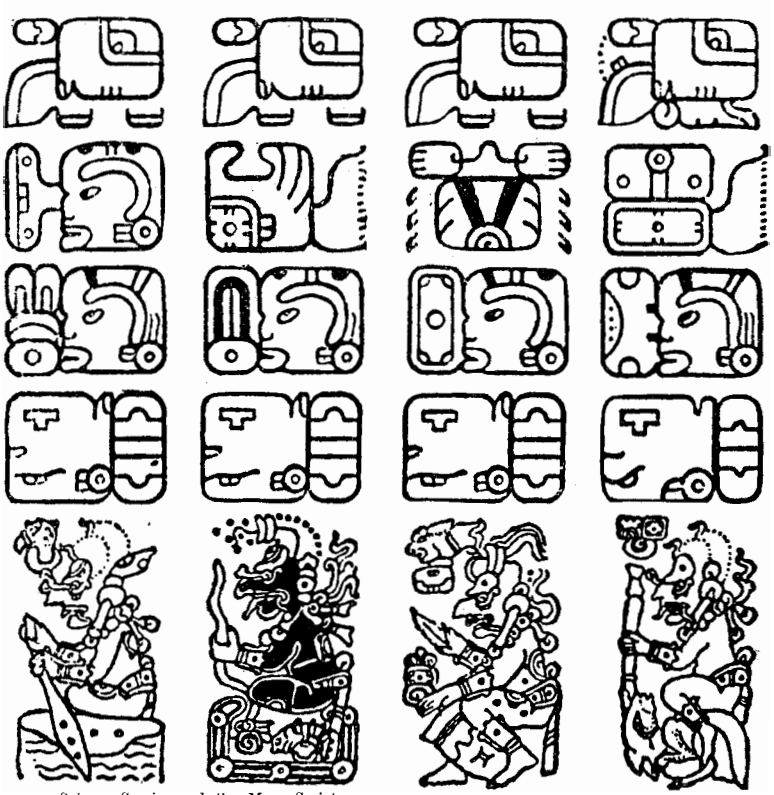
THE first translations ever made from Maya hieroglyphic writing are tentatively offered by Dr. William Gates, research associate in Mayan history and language at the Johns Hopkins University.

Dr. Gates has succeeded in definitely translating various isolated glyphs, the first actually deciphered since scientists took up this study.

Dr. Gates has treated Maya hieroglyphs as experts do code. He has tabulated all distinct glyphs found in the three ancient Maya books that survived the Spanish conquest, grouping each symbol in all the combinations and modifications in which it appears in these ancient texts. Some 2500 distinct glyphs were found in these books, and about 100 minor glyphs. The Mayan language has a system, Dr. Gates says, and it was possible to determine that certain elements were affixes to major glyphs, modifying, classifying, and describing them. It is in these affixes, Dr. Gates says, that the true key to Maya writing lies.

These tabulated symbols he has gathered in an "Outline Dictionary of Maya Glyphs," just published by the Maya Society through the Johns Hopkins Press. This glyph dictionary is in reality a skeleton form on which other glyphs as identified have a place. Thus placed in order, many characteristics of the language have become apparent. Calendric and astronomical glyphs, and others relating to crop and hunting activities and the like, came out. Pairs of opposites and likes, such as earth and sky, food and drink, could be distinguished.

The American Indian languages are like no others, Dr. Gates says, and the hieroglyphs, too, are different from those found anywhere else. The languages spoken by seven main groups of Mayas in Middle America today are related to an ancient common mother tongue as modern Italian and French are related to ancient Latin. The "Mayance" languages, as he calls them. were split from the main Maya stem about the time the modern "Romance" languages were split from the mother Latin. A study of Mayance languages revealed that their



Science Service and the Maya Society

Hymn to the four gods, one of the Maya glyphic inscriptions which have been deciphered by Dr. Gates. His translations are: 1. Do honor and sacrifice (a turkey) in the North, to the White Lord, Wise Itzamna (at his task); 2. Do honor and sacrifice (an iguana) in the West, to the Black Lord, Wise Itzamna (at his task); 3. Do honor and sacrifice (a fish) in the South, to the Yellow Lord, Wise Itzamna (at his task); 4. Do honor and sacrifice (a deer) in the East, to the Red Lord, Wise Itzamna (at his task). These four are to be read vertically

structure and syntax were reflected in the glyphs and their arrangement.

Dr. Gates is now ready to say that Maya writing has symbols standing for things, like nouns, and others standing for names of actions, like verbs. These latter follow the Egyptian method of expressing action, as of a man walking or striking, or doing something. Then there are minor symbols that accompany and modify these main ones in various ways. Some appear to be adjectival, expressing such things as color. Others seem to be determinators or classifiers. Glyphs are also sometimes joined, expressing compound ideas as our word "greenwood" might.

The Mayan language is not rebus writing, "like Aztec," as some have said. No instance of such rebus writing has ever been found in Mayan writing. In fact, Aztec was not rebus writing either, but picture writing, Dr. Gates explained, although some of the pictures were already partially abbreviated and conventionalized. The Mayan writing had gone further than Aztec. The original pictures had long been "worn out," and had become "ideographs." Probably before America had been discovered, the original meanings of these had been lost, and "ideas" had become attached to them by convention.—*Science Service*

Synthetic Atmospheres

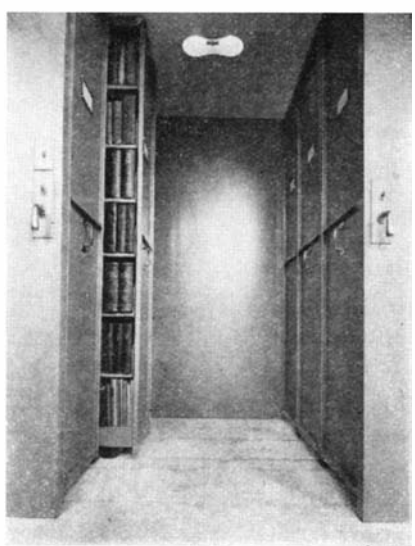
OXYGEN, since the time of Lavoisier, has been considered the vital component of the air. The remaining gases, comprising 79 percent of the air, have had little use assigned to them. It is, however, a problem of immense interest to learn what limits of variation can be tolerated by animals and also whether some changes from normal might be beneficial rather than harmful.

Carefully conducted experiments on this problem covering a period of eight years, have been carried out by Professor J. Willard Hershey, of the Department of Chemistry, McPherson College, McPherson, Kansas, and his assistants who have produced a wide range of "synthetic atmospheres" and noted their effects on animals confined in them.

It is understood that animals cannot live in an atmosphere of oxygen alone, in nitrogen, carbon dioxide, helium, or argon. A series of 30 experiments using different varieties of animal life has shown that in an atmosphere of pure oxygen, with other conditions normal, life would cease to exist after two to five days.

One of the most surprising results of these experiments is that animals die in from a few to ten days when confined in an atmosphere composed of nitrogen and oxygen, the normal proportion, but without carbon dioxide and the rare gases, such as helium, neon, krypton, and so on. On the other hand, an atmosphere consisting of 79 percent helium and 21 percent oxygen permitted animal life to exist normally, or in some cases apparently better.

By using argon instead of helium and with the same percentage mixture the animals (mice) would not survive as they did with helium. The argon mixture would

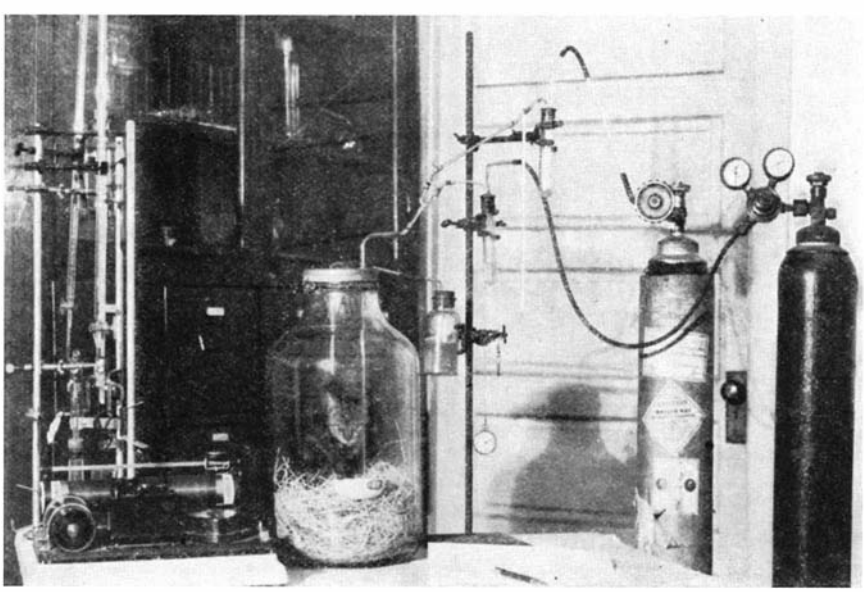


diffuse through the living cells less rapidly than the natural air and the helium more rapidly, which might account for this difference. By decreasing the argon to 75 percent and increasing the oxygen to 25 percent, life was supported, so far as could be observed, better than in normal air.

A large number of experiments were conducted with different mixtures of nitrogen and oxygen by varying the respective percentages. With these experiments as with some of those above, it was found that the animals not only survived but appeared to be stimulated and benefited when the mixture contained from 40 to 50 percent nitrogen and from 50 to 60 percent oxygen.

In the field of practical application of synthetic atmospheres there is a wide range of commercial uses and values. In deep-sea diving, mines, and submarines, foul air is encountered and there is often a lack of sufficient pure air to sustain life. Aeronauts may carry a supply of prepared atmosphere aloft with them, and it may be provided for large factory and office buildings with more satisfactory results than when natural air from outside is used.

Medical men have a fair knowledge of the action of oxygen in the air, but little is understood by them concerning the other gases, especially the rare gases. It is possible that a knowledge of atmosphere may aid in the control of diseases. The widest field probably will be in pathological applications.



A contented kitten looks out into the world from a glass bottle into which is pumped the proper mixture of oxygen and other gases to keep him healthy

Courtesy Snead and Company

A new form of book cases for reference libraries. Being on rollers, it is claimed that it holds 50 percent more volumes than may be stored in stacks. The closed one at left protects against dust and fire

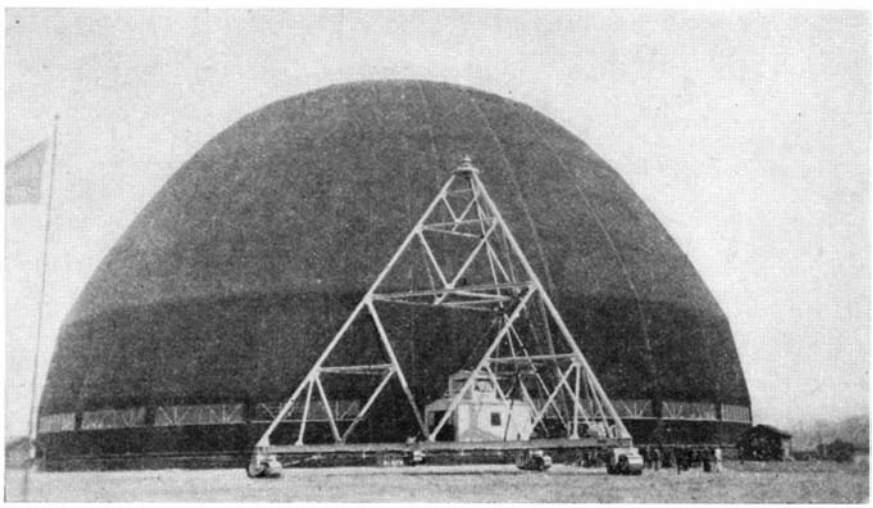
Sweet Potatoes May Yield Tasteless Stamp Glue

A TASTELESS dextrin inoffensive to lickers of postage stamps will have sweet potatoes as its source if experiments conducted by the Bureau of Chemistry and Soils of the United States Department of Agriculture are successful. In an oral statement reported in the *United States Daily*, H. S. Paine, Bureau chemist, told of efforts to obtain such dextrin from starch-producing plants of the United States.

The substance used at present comes from the lower grade of starch obtained from the cassava plant, grown chiefly in Java and Cuba. Several million dollars' worth is imported for this purpose each year. Many native starch-producing plants have been tried, but the dextrin has lacked

adhesive qualities or has been too bitter for the palate of the stamp-licking public.

The fact that between 10 and 30 percent of the sweet potato crop is rejected each year because the potatoes are either too large or too small for ordinary food uses offers a strong economic argument for the development of such an industrial use.—*A. E. B.*



The self-propelled airship mooring mast at the Akron, Ohio, dirigible hangar

The Earth's Rainfall

EVERY day sufficient rain falls upon the earth to fill a reservoir 400 miles square to a depth of about 10 feet.—*Tycos-Rochester*

And Now for a Cold Cure

DOUBTS concerning the nature and cause of the common cold "have now been settled beyond all dispute" by the masterly investigation which Professor A. R. Dochez and his colleagues have conducted at the Johns Hopkins University in Baltimore. So says *The Lancet*, foremost British journal of medicine, in an editorial.

In an article in the same journal Dr. Dochez and his immediate assistants, Katherine C. Mills and Dr. Yale Kneeland, Jr., have described the findings of a piece of research which may ultimately lead to the discovery of a way of curing or even preventing an ailment too often regarded as minor but one which nevertheless accounts for immense loss of productivity. Dr. Dochez is a member of the faculty of the College of Physicians and Surgeons at Columbia University and his name has figured prominently in connection with many previous pieces of medical and biological research.

The findings indicate that the germ of the common cold is not the visible form of bacteria found when a cold exists but a smaller invisible filter-passing germ—one so small that it passes through the finest pores of porcelain filters, so small that it is not made visible under the strongest microscope. The visible form previously suspected of causing the ailment has now been assigned a secondary rôle; it is present when the other form is actively engaged in making you miserable, but apparently it is not the chief culprit.

The research which revealed the true culprit was performed first on chimpanzees, and then on human volunteers. Since this germ or virus cannot be seen, the only practicable way to isolate it is by passing the washings from the nose of a sufferer through a dense filter and inoculating new animals with the filtrate. It was satisfactorily established that the agent of the cold is a true "filter passer," a sub-microscopic germ, for those who were inoculated with the filtrate developed colds with consistency. In the experiments, this routine was repeated through 15 cultures—that number of volunteers being infected one by one, each from the last. It was calculated that the virus at the end of the series represented a dilution of 1 in two quadrillions, yet it remained active and capable of infecting a new victim with a cold.

Now that the cause of the cold has been hounded out of obscurity and its hide, as it were, nailed to the barn door, all that remains is to find a cure! This may prove more difficult. Yet—let the cynic say what he will—in science it nearly always holds true that, once a hidden cause has been uncovered, the cure soon follows, for research workers are no longer forced to fumble in the dark.

Self-Propelled Mooring Mast

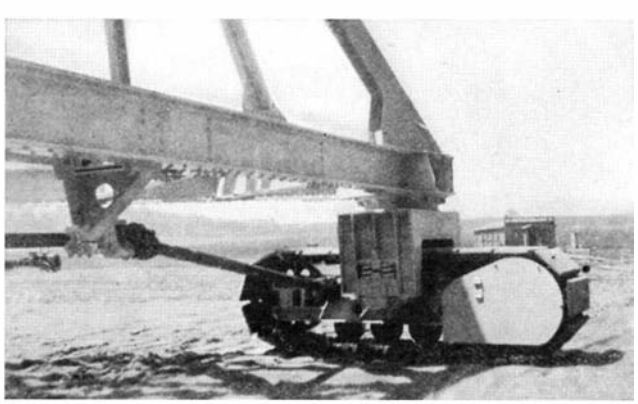
THE Wellman Engineering Company, Cleveland, Ohio, has recently designed, built, and installed at the Air Dock of the Goodyear Zeppelin Corporation at Akron, Ohio, a mooring mast of the mobile type for handling rigid airships at the dock. The mast is designed primarily for outdoor service.

This mast is of the self-propelled type mounting the electric motors for its propulsion and steering. It carries a complete eight-cylinder gasoline engine driven Westinghouse generating plant for supplying power and lighting circuits. The structure comprises a three-sided pyramid, its base corners being located approximately 85 feet from each other, this arrangement permitting the crawlers to be equidistantly located on a 100-foot diameter circle. The height from the ground to the top of the mooring cup is 76 feet.

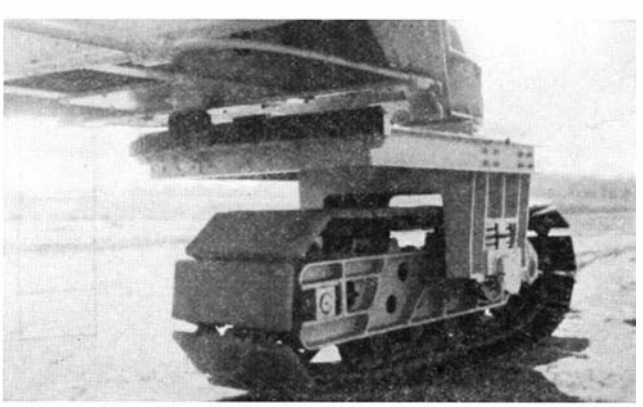
The machine is provided with the usual rigging for the "hauling-in" and other mooring lines; the apex of the tower is fitted with a mooring cup. This device is conically-shaped to receive the mooring cone carried on the nose of the airships. This cup is provided with a number of locking pins mounted on a rotating spindle fitted with anti-friction bearings, and having a hole to allow the passage of the "hauling-in" lines. Bell and spindle rotate in a housing especially designed to exclude dirt and moisture and secured to the corner posts of the framework. A circular platform is installed around and directly below the mooring cup.

The structure was proportioned to resist the horizontal pull produced by the largest ship riding against the wind in any direction, in combination with either an upward or downward wind load.

The triangular base of the framework carries the saddle castings on which the crawlers are mounted. Two of the crawlers are driven by a Westinghouse direct-current shunt motor which is operated by variable voltage or resistance control giving a wide range of traveling speeds in either direction, from "creeping" up to two miles per



Drive shaft to one of the driving crawlers of the mooring mast. A direct-current motor provides the motive force



The crawler with which the mast is steered is secured to a saddle casting on a swivel bearing with heavy king pin

hour. The front or steering crawler is secured to a similar saddle casting mounted on a swivel bearing with heavy king pin and arranged to swivel through a sufficient angle to permit turning in a reasonable space for ready maneuvering. This steering mechanism is electrically operated. The crawlers are spring mounted and equalized on the saddle castings.

The power plant is contained in a house of all-steel fireproof construction. The control cabin, of similar construction, is located on top of the house and contains all the controls for the full manipulation of the machine.

A low, smooth-top locomotive to steer the *Akron* around its mooring mast

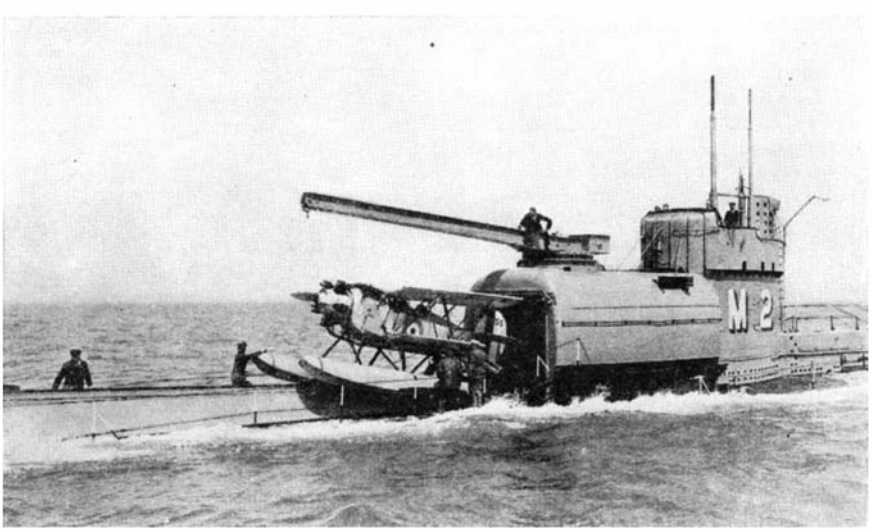
A Submarine Aircraft Carrier

WE have, in these columns, described small planes designed to be carried on a submarine and launched by hand from the upper deck into the water. The British have now gone a step further and have actually converted a submarine, the *M-2*, of some 1950 tons submerged displacement, into a regular aircraft carrier, fully equipped with catapult. The photograph shows a Parnell *Peto* emerging from the submarine, prior to its travel on the catapult. The seaplane is a conventional two-seater biplane with folding wings. No armament is carried.

The pilot is placed in the rear position with the observer in front of him. When in the "hangar" this little twin float biplane is locked upon the carriage resting on two rails. The large door in front of the hangar is raised mechanically. The men of the crew find but little room for working round the seaplane and are dressed in long waders.

The sequence of events is as follows: As soon as the submarine reaches the surface, the door is opened, and over a large slab of steel which falls flat in front of the hangar, rails are quickly laid, connecting those in the hangar with the end of the catapult rails. The aircraft is run out on this trolley and locked into position on the after end of the catapult. The submarine is turned into the wind and runs at a speed that will assist the take-off of the seaplane. The pilot of the seaplane opens the engine "full out" and when he is satisfied that it is running correctly, he signals that all is ready; a stoker pulls the release, operates the catapult, and by the time the aircraft reaches the end of its run, it has attained a high speed.

The cleanest sort of take-offs have been made in spite of the very short run provided. The pilot and the observer are naturally banged against the back padding in their cockpits but are still able to handle the controls with perfect precision. The submarine aircraft carrier should be of great help to any fleet.—*A. K.*



The British submarine which has been converted to carry a seaplane. The seaplane just emerging from the deck hangar will be catapulted into the air

A Dirigible-Handling Locomotive

ONE of the most important problems to be solved in making the airship practical lies in the task of ground handling. Strange to say, a locomotive comes to the aid of the airship. This locomotive, built for the Navy by the H. K. Porter Company, will operate on a circular track around the mooring mast of the airship, in front of the hangar at Lakehurst, New Jersey. The locomotive is powered with a 250 horsepower, eight-cylinder gasoline engine. The engine drives a hydraulic pump and motor so that there is the utmost flexibility in speed control.

The locomotive pulls a large beam to which the stern of the airship is held by yaw lines until the dirigible assumes a position parallel to the hangar. It is said that the locomotive in this position does work that could hardly be performed by 1000 men. A special feature of the design is that the height of the locomotive is only six feet from the top of rail. Moreover, its top is absolutely smooth so that there is no projection for the airship to catch on when swinging around the mooring mast. The hydraulic transmission of the locomotive permits absolutely smooth operation without jars or jerks. It would be a fine thing if this last feature were embodied in our ordinary passenger trains!—*A. K.*

An Air Ferry for New York

THE main objection that hitherto has been made to the air transport services out of New York has been the time required to get to Newark Airport from various parts of the city and its suburbs. Now the Curtiss Wright Corporation has incorporated a new airline, the Metropolitan Air Ferry Service, which on regular schedule will connect Newark Airport with Floyd Bennett Field in Brooklyn and the Glenn H. Curtiss Airport on Long Island, thus bringing the two most important airports of the city within a few minutes flying distance of Newark and incidentally providing a splendid sight-seeing trip over Manhattan, Jersey City, upper New York Bay, Brooklyn, and Queens.

The flying time between each airport is less than 15 minutes and the new services are of course made to coincide with the schedules of the air liners. The airlines operating at Newark Airport enable one to fly anywhere in the United States within 30 hours. Even now, 10,000 passengers a month come in and out of this great air center. With this new ferry service there is no doubt that this number will be greatly extended.—*A. K.*

Photography During a Parachute Jump

EVERYONE wants to know how it feels to jump from a plane high in the air. The man who jumps can seldom describe his sensations after his parachute has brought him down safely. The strain of the descent disappears immediately and the possible look of concern is apt to give way to a broad grin of satisfaction.

Corporal Garland E. Kane of the Army Air Corps, Technical School Detachment, determined to take some pictures of him-

self in the act of making a parachute drop. If successful, the photographs would be a permanent record of facial expressions on the way down. A Brownie box camera, taking vest-pocket size pictures, was used. The only adaptations required were the soldering of an extension piece on the finger lever for easier snapping and the riveting of a ring for a lanyard to lessen the risk of losing the camera. Two of these cameras were fitted up.

Corporal Kane jumped from a bomber at 4000 feet. He descended 800 feet before he was ready to take pictures of himself. He succeeded perfectly in taking eight snaps from arm's length, getting his face into each picture. The surprising thing about these pictures was that they showed a pleasant and confident expression in each case!—*A. K.*

The Aviator's Artificial Horizon

AN airplane pilot has three senses which are affected by the position of his airplane in relation to the horizontal: 1—His eyes which usually use the natural horizon as a reference; 2—His inner ear which is really a minute form of liquid level; 3—His deep "muscle sense" or the feel of his own weight.

If poor visibility prevents the use of the eyes to observe the natural horizon, it has been found that the deep "muscle sense" and the inner ear cannot cope with the problem of defining the horizontal. This is due to several causes; the most important of which is that a man's senses are taught to indicate the pull of gravity and he cannot distinguish between this and other forces such as centrifugal force. Figure 1 illustrates the point. The pilot is making a turn. The pull of gravity acts vertically downward as shown, but in addition to gravity, the centrifugal force comes into play and the pilot's impression of the vertical is the resultant of all forces and quite distinct from the true vertical. In complicated maneuvers and blind flying, therefore, the pilot's senses fail to help him.

Under the same conditions the ordinary liquid level also fails in the task of indicating the true horizontal because the liquid of the level also is susceptible to forces other than gravity. A pendulum fails for the same reason as the liquid level. The solution, therefore, must be the use of the gyroscope.

As shown in Figure 2, the gyroscope is a spinning mass universally mounted. If a free gyroscope were mounted in an airplane the axis would tend to remain rigidly pointed in the direction in which it was originally set, but the friction of the bearings and other forces would influence it, and the direction of the axis would gradually change.

The most important resultant of the forces which may influence the gyroscope is known as "precession." If a force is applied to the axis of the gyroscope it will move or precess in a direction at right angles to the applied force, as shown in Figure 2.

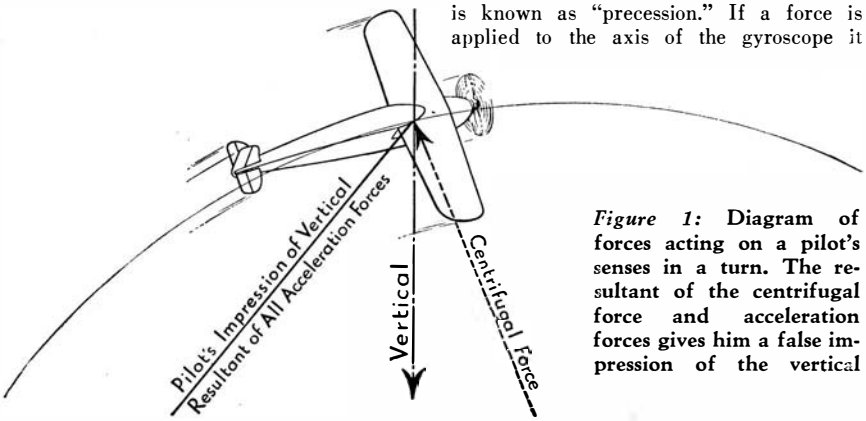


Figure 1: **Diagram of forces acting on a pilot's senses in a turn. The resultant of the centrifugal force and acceleration forces gives him a false impression of the vertical**

To maintain the gyroscope in a horizontal plane one possible solution is to hold it in place with a pendulum. Many attempts at making horizon instruments have depended on making the gyroscope pendulous. Every acceleration force acting on an airplane, however, will energize the gyroscope and cause it to "fall off" or precess in a direction at right angles to the force applied. The pendulum, as it tends to pull the gyroscope back to the vertical again, causes precession at right angles to the pull. Due to this precession, the gyroscope will never return directly to the vertical, but will follow a spiral path, continually seeking the vertical but never coming to rest.

Figure 2: **Pushing the gyroscope causes it to precess at right angles to the direction of the force**

To make the gyroscope indicate the horizontal, and to insure its rigidity by eliminating the precession of the pendulous gyroscope, a form of "pendulum-controlled" gyroscope has been developed.

The gyroscope is mounted within an airtight casing and is rotated by two air jets, (drawn into the casing by suction from a venturi in the slipstream), which impinge on turbine blades on its periphery. The exhaust air is conducted to the lower part of the casing where four ports, spaced 90 degrees apart, divide the exhaust into four escaping air jets of equal volume.

Each of the ports through which these air jets escape is covered by a pendulous swinging vane which can enlarge or decrease the size of the orifice as it swings, thus increasing or decreasing the volume of the air jet which escapes. The normal position of these vanes, when the gyroscope is vertical, permits four equal air jets to escape, holding the gyroscope in position.

When the gyroscope tends to precess, due to acceleration forces, these vanes will alter the volume of one or more of the air jets so that their reaction force against the instrument casing will force the gyroscope to follow directly the "vertical-seeking" pendulous vanes.

As shown in Figure 3, if a movement of the airplane causes the gyroscope to swing on its gimbal rings to the position illustrated, the pendulous vane "A" will uncover the exhaust air port "B." The vane on the opposite side swings to decrease the volume of its air jet and the increased air jet from port "B" will precess the gyroscope in the direction "C" back to the vertical, the volume of the air jet being decreased as the vane swings back over the exhaust port. The gyroscope always follows the pendulous vanes in a straight path; there is no tendency to precess unless it is caused by the movements of the controlling or dampening vanes.

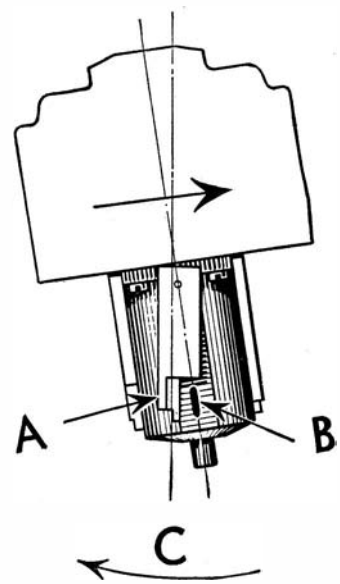


Figure 3: **Action of vanes**

It is this entirely novel development of the "pendulum-controlled" or "pendulum damped" gyroscope which has enabled the

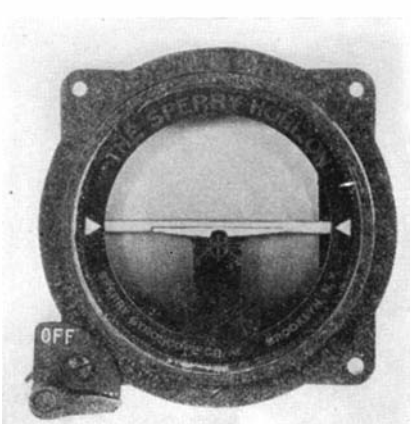
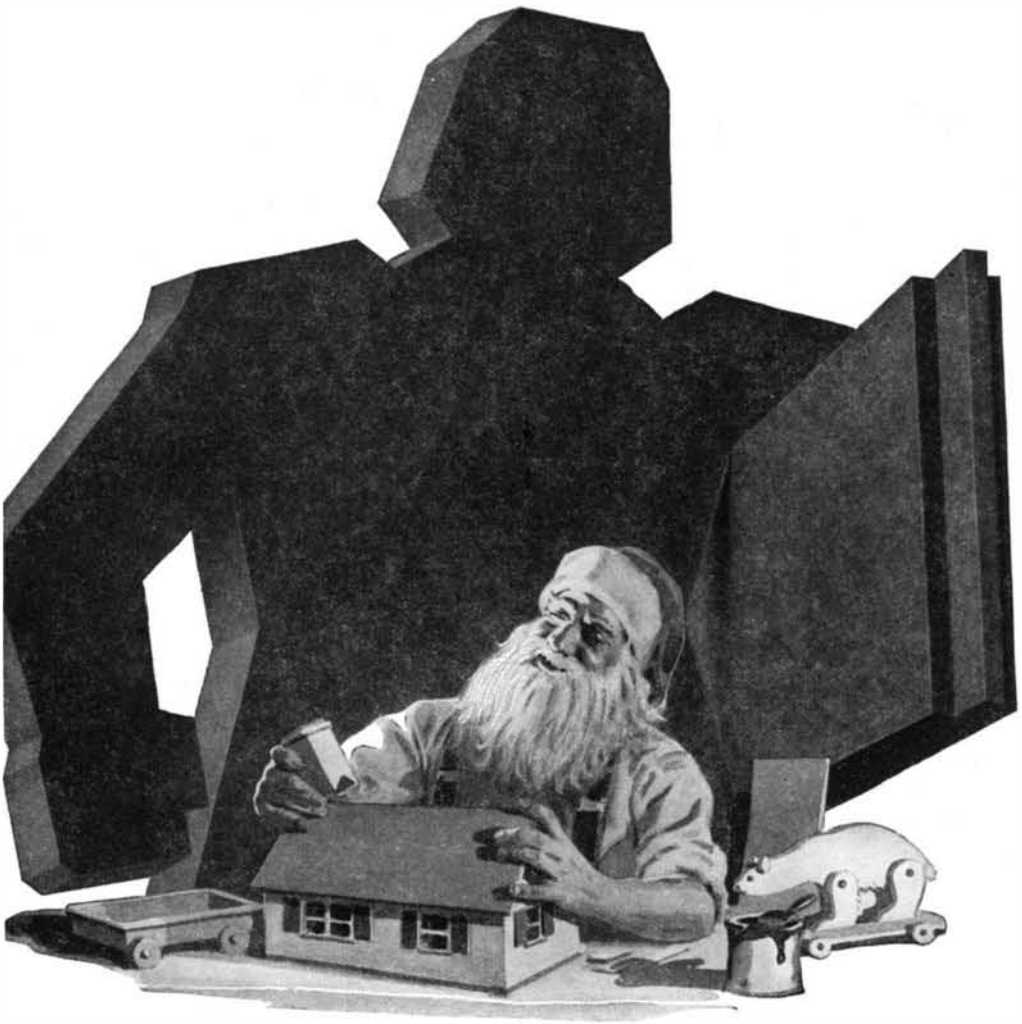


Figure 4: **The Sperry instrument to indicate the natural horizon**



PRESDWOOD
works with Santa Claus

Countless homes will be brightened this Christmas with gifts that Masonite Presdwood helped make...beautiful, durable gifts that come from factories all over the world.

The makers of these articles are Presdwood enthusiasts. Naturally! Presdwood is bettering their products, cutting their costs, speeding up their production. Articles such as those shown on the right, and many others, are being made of Presdwood with great success.

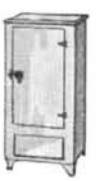
The men at your presses, planers, drills and saws will take kindly to these modern industrial boards. So will the machines themselves—and the men who work with hand tools. You'll have little concern over waste and rejections, for Presdwood is rigidly graded at the mill.

Get acquainted with Presdwood, the smooth, grainless, water-resisting board that doesn't crack, chip, split, splinter or warp. Use it in your factory. The free Presdwood booklet will give you the complete story. Write for your copy today, or consult your lumber dealer.

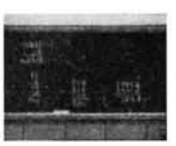
Masonite
PRESDWOOD
STRUCTURAL INSULATION INSULATING LATH
QUARTRBOARD Cushioned FLOORING
"Made in Mississippi"

Presdwood makes an ideal bed for juvenile billiard tables, says the Brunswick-Balke-Collender Co., Chicago

Toys made by "Play-Skool", Inc., Milwaukee, Wis., are better because they're made of Presdwood



Presdwood serves perfectly for backs of electric refrigerators manufactured by Servel, Inc., Evansville, Indiana



Valleyco Company, Cincinnati, use Presdwood, with slate finish, to make ideal blackboards

At RCA Victor Company, Inc., Camden, N. J., the backs of radio cabinets are cut from Presdwood

Sturdy, attractive toys are made of Presdwood by the H. M. Miller Company, Jeannette, Pa.

Masonite *Cushioned* **FLOORING of TEMPERED PRESDWOOD**

This new, all-wood flooring with the in-built shock absorber offers tremendous advantages in beauty, durability and convenience. Outer layers of Tempered Presdwood assure beauty and long life. Inner layer of QuartRboard provides resiliency, insulation and sound absorption. Tongue-and-groove construction makes perfect, interlocking joints. Two-color reversible squares and borders make possible endless variety of design. Send for booklet describing this modern flooring.

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Please send your free illustrated booklet that describes Masonite Presdwood and its many uses.

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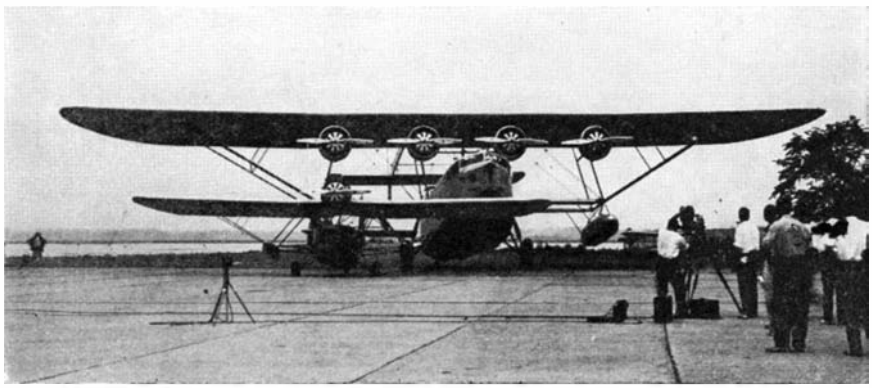
☐ If interested in Cushioned Flooring, check here.

Sperry Gyroscope Company to produce an instrument, Figure 4, which will continuously indicate the natural horizon. We have mentioned and illustrated this device in the past, but this is the first time that details of its operation have been available.

The dial of the instrument has a white bar across it to represent the horizon. The dial also carries the silhouette of an airplane, viewed from the tail, which is used as a reference point. The position of the white horizon bar at all times corresponds with the position of the natural horizon. Index arrows are provided on the side of the dial to show when it is horizontal. For an illustration showing the various indications under different attitudes, see page 470, June 1930, SCIENTIFIC AMERICAN.

The Sperry Horizon has been entirely successful and is proving of inestimable value in aircraft blind flying.—*A. K.*



Front view of the *S-40* behind the smaller flying boat for comparison

The World's Largest Amphibion

IGOR SIKORSKY, of the Sikorsky Aviation Corporation, has been in the front rank of airplane designers for more than 20 years. In recent times he has increased his reputation by designing and building a series of splendid flying boats and amphibions. The latest of this series, the *S-40*, is the largest amphibion ever built. It has passed its trial flights in excellent fashion, and two amphibions of the *S-40* type are to be put in use by Pan American Airways in their South American service.

The *S-40* is a high-wing monoplane, powered with four Pratt and Whitney 575 horsepower Hornet engines, with the engines installed in nacelles supported from the wing. The wing spread is 114 feet; the overall length is 72 feet, 11 inches; and the gross weight of the ship is 34,000 pounds. The plane is capable of a top speed in excess of 130 miles per hour; and with a gasoline capacity of over 1000 gallons the *S-40* has a cruising range of 1000 miles. In spite of its enormous size, the draft of the hull is only 3 feet, and the ship can be landed in 6 to 8 feet of water.

While the principle of a retractable landing gear applied to a flying boat hull is not new, the gear employed on the *S-40* is remarkable by virtue of its size. The retractable gear is in two distinct units: each consists of a telescoping strut, hinged at its top to the upper part of the hull and attached at its lower end to the wheel assembly.

One of our photographs shows the amphibion gear down and the plane ready for land work. In the second photograph, which shows an artist's conception of the plane, the strut has been telescoped hydraulically and the wheel has swung outward and up so that it is completely clear of the water. Tests have shown the gear to be entirely satisfactory.

It will be noted that the tail surfaces are mounted on out-riggers so that the hull need not extend right to the tail surfaces of the plane. This makes for a shorter and lighter hull.

The flight of the *DO-X* and the discussion of a possible airmail service across the Atlantic have greatly revived interest in the possibility of trans-oceanic air transport. Flights in single-engined planes with one or two occupants at most, and with nothing but an overload of gasoline to carry, are now of but little interest. The true path of progress lies in building bigger and bigger flying boats, large enough to be seaworthy under difficult circumstances, capable of carrying many passengers in perfect comfort, with several men in the crew, and having every type of safety and navigational equipment.

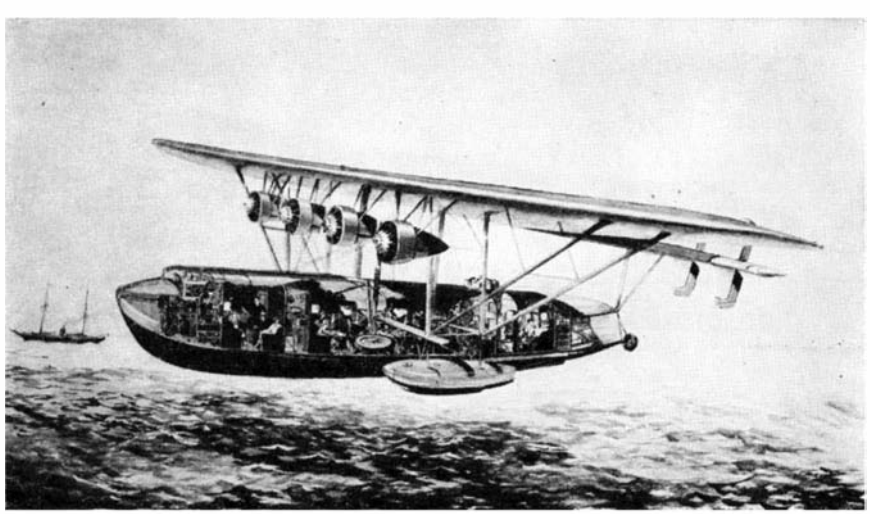
The artist's imaginative conception of the *S-40* is of the highest interest and keeps very closely to the actual design.

In the bow of the hull is located the anchor department. The next compartment aft is the pilot's cockpit with provision for radio. This compartment seats the pilot, the co-pilot mechanic, and the radio operator, with ample room for all. The third compartment contains four passenger seats on the port side. In the fourth compartment are sixteen and in the fifth compartment eight passenger seats. The sixth compartment is a smoking room with comfortable seats for six people. A personal visit to the *S-40* fully confirmed the artist's impression of the roominess of the passenger quarters. There is over seven feet of head room and the width of the hull is considerably greater than that of a Pullman car. A pantry, icebox, and room for extra storage space are provided.

Five hundred square feet of half-inch-thick sound-proof material under walnut panels are used to reduce noise to a minimum. Reading lights, ash trays, cigarette lighters, a call system for the steward, and individual ventilation units, add to the comfort of the passenger. Here we have something that approaches the ideal of airplane travel.

It is noteworthy, also, how carefully seaplane designers are going into the question of safety equipment. Six air rafts are stored in three tubes located near the passenger entrance toward the rear. Water-tight covers may easily be opened from the outside of the boat and rafts pulled out while compressed air bottles, stored in containers attached to the rafts, supply air for inflation. The container has merely to be thrown overboard, the oars assembled from their pocket in the raft, and the whole is ready for service. With a capacity of five persons for each raft, a total of 30 passengers may be accommodated. Two similar rafts are placed in the forward part of the ship, accommodating the crew of five and the rest of the passengers. Emergency food is provided with each raft, as are also life jackets and furniture cushions that may be utilized as life preservers. All the furnishings of the ship are fire-proofed and automatic fire extinguishers protect each engine.

When we consider the reliability of the modern engine and the fact that four engines are provided, it will be seen that ocean flying in these large seaplanes is assuming at least a workable hazard. It might be interesting to recall a recent flight which ended in disaster but is still reassuring from the safety point of view. Three Portuguese flyers who attempted to fly to New York from the airport at Juncal Do Sol, Portugal, in a much smaller ship (a Junkers seaplane), were adrift, as the reader will recall, seven days in the rough waters off Newfoundland. The flyers had a terrible time clinging to their frail craft, drinking, in carefully measured quantities, the water from their radiator, and suffering from cold and hunger. Nevertheless, they

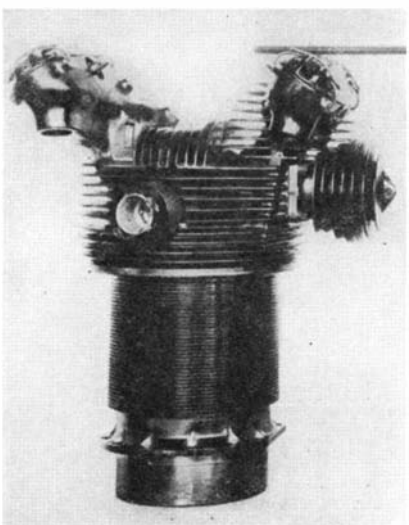


Artist's conception of crew and passenger accommodations of the *S-40*

stayed afloat for seven days. The *S-40*, with its greater size and additional equipment, could encounter a similar mishap with much less discomfort.—*A. K.*

Cooling the Cylinder Head

ONE of our photographs shows the new "E" type cylinder head now used on Wright Cyclone engines. The reader will note how carefully all parts of the cylinder head are finned for maximum cooling effect. Even spark-plug coolers, as shown at the center of the photograph, are finned



Maximum cooling effect obtained by use of a larger number of fins

for cooling. These spark-plug coolers are composed of bronze inserts of standard design, cast in one piece with aluminum alloy cups which are finned on the outside to provide cooling area for the inserts. It is to this careful attention to such details of design that we owe the increasing reliability of our aircraft engines.—*A. K.*

High Airspeed Records—Schneider Trophy

ON September 13 at Calshot, England, Flight Lieutenant J. N. Boothman won permanently for England the Schneider trophy with an average speed of 340.08 miles an hour. This average speed was made in seven times around the triangular course of 31.7 miles. On his first two laps he made an average of 342.9 miles an hour, thus setting a new world's record for speed for 100 kilometers (62.1 miles).

A third record was made by Flight Lieutenant G. H. Stainforth who broke the world's speed mark for a three-kilometer (1.863-mile) straight course with an average of 386.1 miles, more than 28 miles an hour better than Squadron Leader A. H. Orlebar's 1929 record of 357.7 miles an hour.

Shortly after the Schneider races, on September 20, Lieutenant Stainforth established a new airspeed record of 408.8 miles an hour. This remarkable record was the average of five runs over a three-kilometer course on the Solent at Calshot in an S6B seaplane. On his fastest lap, he made 415.2 miles an hour.

For this latter record flight, Lieutenant Stainforth had available, in a Rolls-Royce engine built especially for this trial, 300 horsepower more than has hitherto been available in this class of Schneider Trophy racing seaplane. Also, the fuel was a special blend of refined gasoline, wood alcohol, and tetraethyl lead.

Handling the "Akron"

THE *Akron* has passed its tests in a most satisfactory fashion. Once in the air, the airship is one of the safest flying craft possible, but undocking the *Akron* was not at all an easy task.

The ground equipment at the Goodyear-Zeppelin airship factory comprises two 10-ton side-handling cars, a taxi-wheel, a tail drag, more than a mile of railway tracks, and a great three-legged mobile mooring mast. The railroad tracks run on each side of the ship through a total of more than 5300 feet. On these parallel tracks run the heavy side-handling cars, with lines attached to the side of the ship to hold it steady against side gusts as it leaves the dock. On each side of the cars are mounted a drum and a capstan, with 1000 feet of cable wound on each drum. Thrust rollers extending downward below the top of the tracks enable the side-handling cars to withstand the largest cross-wind forces. The tail drag, a sturdy axle mounted on solid rubber tires and weighted down with a load of five tons, is attached under the ship as an anchor against upward gusts. It is the last piece of equipment detached before the take-off. The taxi-wheel is a great six-foot castored pneumatic tire. As the ship prepares to leave the dock, the side cars and tail drag are attached and the mobile mast moved to the ship at a speed of two miles per hour. The steel nose cone of the ship is locked into a huge metal cup at the top of the mast and the mast is again set in motion, towing the ship after it.

In the actual first handling of the *Akron*, the Navy crew prepared the most definite instructions to officers and men alike, with a rigid system of signals and commands. After the ship had been towed out of the hangar with the aid of rails and side car, the last command was "up ship." At this command the ship was released from the mooring mast and the men in the forward control car used long poles with padded broad Y-shaped ends—called "crutches"—lifting the ship into the air by pushing with the crutches against the hand rails on the control car. The men at the after control car lifted it into the air and pushed it with their hands as long as it could be reached. The ship, carefully balanced, left the ground as a free balloon without any of its motors running until it attained a safe altitude of about 200 feet. After the desired altitude has been attained, the forward engines were started and the *Akron* may be said to have been definitely launched.—*A. K.*

New York to Washington in 68 Minutes

THE Ludington Lines—New York, Philadelphia, Washington—have inaugurated a 68-minute service between these three great cities. Four round trips each day are scheduled.

The service will, undoubtedly, be the fastest in the world. The plane shown in our photograph is a low-wing, seven-passenger transport Lockheed Orion, equipped with a retractable landing gear and capable of a top speed of over 200 miles per hour. Surely the inauguration of a 68-minute service between New York and the Capital is something of an historic event!—*A. K.*

Carbon Monoxide Extracted from Coal Gas

ATTEMPTS to free illuminating gas from its content of carbon monoxide have been made for many years but so far have never produced a serviceable product of commercial utility, says a recent issue of *Gas Age Record*. The separation of the carbon monoxide not only increases the cost, but also alters the heating value of the gas so that a complete change of the consumers' burning appliances would be necessary.

It is announced that the Berlin Municipal Gas Works has lately succeeded, after long experiments, in removing the poisonous nature of the gas at a cost of only one tenth of a cent per cubic meter. It remains to be seen whether this laboratory success can be equaled in large-scale commercial production.

The experiments were a variation of processes already known; in particular, the gas was conducted across an iron contact heated to between 400 and 500 degrees Centigrade.

The seven-passenger plane used in a 68-minute New York-Washington service

the carbon monoxide being thus converted into carbonic acid and the water vapor reduced to hydrogen. The carbonic acid is then removed by washing the gas with water under pressure. At times another process is combined with this, so that methane and hydrogen are derivatives.—*A. E. B.*

Cooking with Cold

NOW that low temperatures have become available to the housewife through the introduction of the modern refrigerator people are becoming more interested in what may be termed "cooking with cold." As a result, many new desserts and chilled dishes have made their appearance on the dining table. A wider choice of foods is possible. This means better food, less waste, and more pleasure in life for the housewife. Health authorities are in accord that food, to be safe and free from bacteria, must be kept below a temperature of 50 degrees Fahrenheit. Cold is the conqueror of those tiny micro-organisms which cause food to spoil. The danger point is 50 degrees. When the temperature of food rises above that point while awaiting consumption, harmful bacteria multiply rapidly. Thus artificial refrigeration the year round becomes the only safe and satisfactory way to preserve perishable foods. A reliable thermometer should, therefore, form part of the equipment of every kitchen.—*Tycos-Rochester.*

Motor Transport Across Country

IN order to obtain a record of the uniformity of performance of motor equipment over a long haul, a large truck with an equally large trailer, of the Southern California Freight Lines, Ltd., recently made a remarkable run across the country from Los Angeles to New York City in September. Leaving with a load of package freight on the fifth of the month, the truck and trailer stopped at several cities to unload part of their freight, and reached New York on the sixteenth, the running time for the 3200 miles being 117 hours. When the truck was finally unloaded it was found that the perishable freight in the refrigerated truck body was in a perfect state of preservation. No trouble was experienced on the way except for one puncture which was caused by a railroad spike. Engineers kept an absolute log of the trip every 10 miles by recording the readings of instruments in the instrument room which was combined with sleeping quarters just behind the driver's seat.

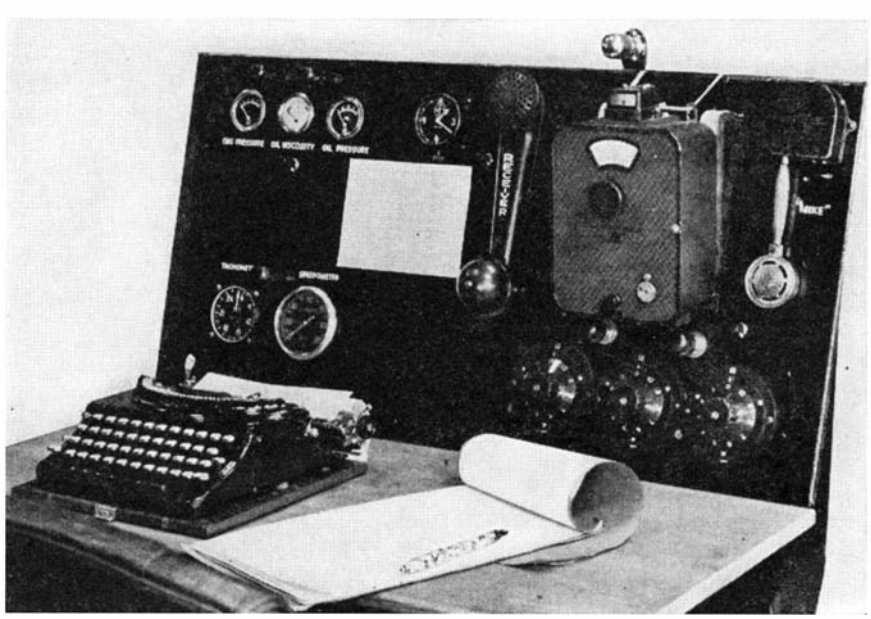
All stock equipment was used throughout. The chassis was a General Motors T-95, the engine being a Buick 525 of 135 horsepower. Weight of the truck was 23,060 pounds, and of the trailer 11,000 pounds. The truck body was refrigerated by a Frigidaire unit mounted, with its separate gasoline motor, behind the instrument room. This cold room was insulated against heat by means of Dry Zero blankets, a very light material made of the fiber from the pods of the ceiba tree. The trailer was attached to the truck with a Smith Safety Coupler, which is said to be simple and most efficient.

The entire unit was 52 feet long overall and was mounted on 22 tires, 10 of which were on the truck and 12 on the trailer. All wheels except the front steering wheels were equipped with Westinghouse-Bendix brakes. With these brakes, tests showed that the truck and trailer unit could be stopped in its own length when going at the rate of 30 miles an hour.

The equipment in the instrument room kept a check on the performance of 53 different parts of the unit. The instruments included thermometers, tachometers, hygrometer, gradometer, and various others for determining gas and oil consumption and so forth. For the trip of 3200 miles, the gasoline consumption totaled 1145 gallons and the oil used amounted to 13 quarts. The average speed was something over 27 miles an hour, and the average miles per gallon of gasoline 2.79.

This test run was made because the Southern California Freight Lines, Ltd., contemplate establishing a transcontinental freight service by truck. Colonel G. D. Davis, of the company, believes the demonstration fully warrants such operation. He says that the fact that the running time was less than five days is evidence that with motor transport equipment, package freight can be handled with a saving of five or six days over rail shipments, or as fast as express at freight rates. Incidentally, he expresses himself as unequivocally in favor of regulation of motor trucks by the Interstate Commerce Commission.

The truck and trailer which made the record cross-country run, and below, its very complete instrument board



Total Weight of Atmosphere

THE pressure of the atmosphere at sea level averages about 14.7 pounds to the square inch, which corresponds to a reading of 29.92 inches of the barometer. The density and pressure of the air decrease rapidly as we ascend. At an altitude of 3.6 miles above sea level they are reduced one half. The atmosphere extends, however, many hundreds of miles above the earth, becoming rarer and rarer with increase of altitude. Above six miles it is too rare to support life. Still higher it becomes more tenuous than the best "vacuum" we can attain with an air-pump. The total weight of the atmosphere is about 5,633,000,000,000,000 tons.—*Tycos-Rochester.*

Smallpox Menace

LARGE parts of the United States are in grave danger of epidemics of that horribly disfiguring and highly fatal disease, smallpox, members of the American Public Health Association were told by George H. Van Buren of the Metropolitan Life Insurance Company.

The fact that over half a million cases of the dreaded disease occurred in the United States during the period 1920-1930 came as a surprise to this important gathering of public health officials and authorities, in view of the fact that vaccination, sure preventive of smallpox, has been known for over 130 years.

The largest number of cases per thousand population was reported from the eight Rocky Mountain and the three Pacific Coast states. The fewest cases were found in the most densely populated parts of the

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There is no more appreciated compliment that you can pay to a friend than to give for Christmas, a year's subscription to the *Scientific American*. It will give pleasure and profit and be a reminder every month throughout the year of your thoughtfulness. But more than that, it will be an expression of your appreciation of his intelligence, culture, and breadth of vision.

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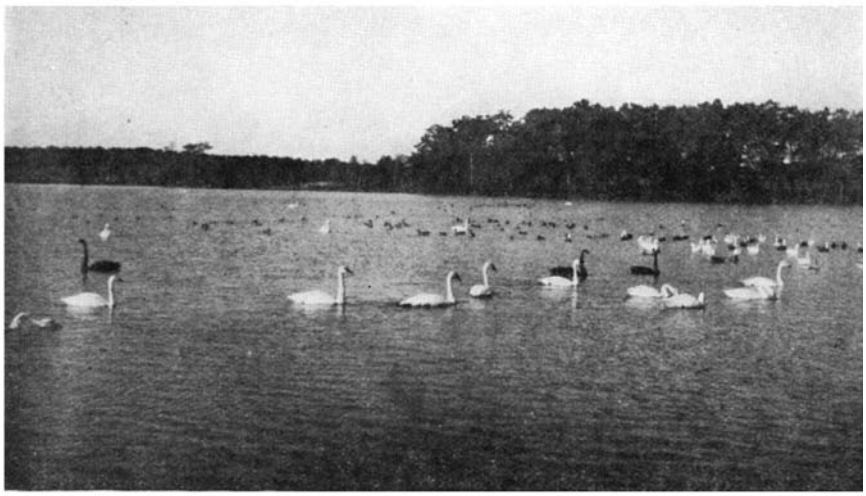


Trumpeter and black swans on Wintergreen Lake, W. K. Kellogg Bird Sanctuary

country, the New England and the Middle Atlantic states. These are the states in which public sentiment has been most active in supporting constituted health authorities in measures for the prevention of smallpox, Mr. Van Buren pointed out. "On the other hand, *the states where the incidence of the disease is high are those where opposition to compulsory vaccination has been strongest.*

"Until there is more general vaccination and re-vaccination, there will always be grave danger of severe and extensive outbreaks," he concluded.—*Science Service*

Saving the Trumpeter Swan

ALWAYS interested in conservation movements designed to preserve native species of birds and animals, we are pleased to present below a letter to the editor written by Mr. George Hebden Corsan, Sr., on trumpeter swans:

"It is more than 25 years since I wrote the SCIENTIFIC AMERICAN on the advantage of dredging the peat and marl from the lakes of Michigan, Wisconsin, and Minnesota, instead of draining them and the marshes.

"Again I call your attention to a most urgent conservation matter calling for immediate action. For the last four years I have been building the W. K. Kellogg Bird Sanctuary near Battle Creek, Michigan; when Mr. Kellogg gave the Sanctuary to the State College of Agriculture, my wife and I motored west to Whittier, California, to start ornithological and avicultural studies in connection with other work at Whittier College. On our way, we visited Yellowstone Park as I wanted to get first-hand information about the trumpeter swans reported as breeding there.

"On inquiring of the Park Rangers, I was told there are two pairs of trumpeter swans in the Park; that they are the only ones known to be in the country; and, further, there are only 30 live trumpeter swans left in the world. The Rangers advised me that one pair lays five or six eggs each year and the ravens eat the eggs. That pair doesn't even get a chance to hatch their young. The other pair raises from four to six young each year and the otters and eagles eat them as soon as they are mature enough to fly a bit.

"This is a terrible condition of affairs among the trumpeter swans. Park and Federal authorities must at once try other plans to save this most interesting of all our wild waterfowl. As a matter of fact, I consider the trumpeter swan the most interesting of all the world's game wild waterfowl! I say this after viewing alive some 85 varieties of wild ducks, and all the varieties of wild geese and wild swans. Consider that I left on Wintergreen Lake, at the W. K. Kellogg Bird Sanctuary, some 14,000 wild ducks, 100 wild swans, and 400 wild geese. Even the black neck swan of South America is not as interesting as our North American trumpeter swan (*Olor buccinator*), everything considered.

"The key to their successful propagation is domestication, for the trumpeter swan lends itself most readily to domestication, more so, in fact, than any other variety except the black swan of Australia which I have had frequently breeding twice a year. On the other hand, our whistler swan, *Olor columbiana*, the wild swan of today, is a most difficult bird to propagate in a domestic state. They will readily become quite tame but they refuse, so far, to nest, lay eggs, and raise young.

"We have allowed our whooping crane to be exterminated and the trumpeter swan is rapidly headed in that direction. Our wood duck, on the other hand, was saved by domestication. So was the muscovy duck. So were horses, cattle, sheep, pigs. Even fish are domesticated! Breeding fish under domestication has resulted in 95 percent of their eggs maturing, while only 5 percent of the eggs of wild cut-throat trout mature, according to Yellowstone Park authorities.

"If we want to save the trumpeter swans from extermination, we must at once trap the two pairs in Yellowstone Park, place them on a small favorable lake close to the coast, say, in the state of Washington, and take care of them so they will not be molested by their enemies. Canada should act similarly with the few remaining birds in British Columbia. By brailing the wings of adult birds and by pinioning the wings of young trumpeters while in the down, they can be easily domesticated, or semi-domesticated enough to save sufficient numbers to preserve the species.

"Barley, placed in water from one to two feet deep, will be all the feed they will require for trapping, or to feed them afterwards, as no wild waterfowl will distinguish between wild rice and barley. Wild rice is the most favored of all foods by ducks, geese, and swans.

"A gentleman in Holland has a pair of trumpeter swans which he secured many years ago, and which he breeds every year. From this pair I secured the trumpeter swans which are at present on Wintergreen Lake. Two pairs will be four years old next spring, ready to breed, and should breed, if all is well."

Administering Calisthenics

WOULD you like to have the benefits of golf without an effort? Exercise without leaving your arm chair? Keep physically fit despite broken bones? Maintain muscle tone even when encased in a plaster cast?

These things are made possible by a new electrical apparatus which causes graduated contraction of muscles. It has won the approval of the medical fraternity and is being used by hospitals to prevent strength from ebbing as a result of the inactivity of a patient who is recovering from illness or injury.

Prominent medical authorities have stated that an hour and a half of "exercise" with this apparatus is the physical

(*Please turn to page* 417)

Using the apparatus which administers calisthenics to a patient

"I'll see it through if you will!"

"THEY tell me there's five or six million of us—out of jobs.

"I know that's not your fault, any more than it is mine.

"But that doesn't change the fact that some of us right now are in a pretty tough spot—with families to worry about—and a workless winter ahead.

"Understand, we're not begging. We'd rather have a job than anything else you can give us.

"We're not scared, either. If you think the good old U. S. A. is in a bad way more than temporarily, just try to figure out some other place you'd rather be.

"But, until times do loosen up, we've got to have a little help.

"So I'm asking *you* to give us a lift, just as I would give one to you if I stood in your shoes and you in mine.

"Now don't send me any money—that isn't the idea. Don't even send any to the Committee which signs this appeal.

"The best way to help us is to give as generously as you can to your local welfare and charity organizations, your community chest or your emergency relief committee if you have one.

"That's my story, the rest is up to you.

"I'll see it through—if *you* will!"

—Unemployed, 1931

THE PRESIDENT'S ORGANIZATION ON UNEMPLOYMENT RELIEF

Walter S. Gifford
Director

COMMITTEE ON MOBILIZATION OF RELIEF RESOURCES

Owen D. Young
Chairman

The President's Organization on Unemployment Relief is non-political and non-sectarian. Its purpose is to aid local welfare and relief agencies everywhere to provide for local needs. All facilities for the nation-wide program, including this advertisement, have been furnished to the Committee without cost.

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

So many descriptions of amateur's telescopes made from the instructions in the book "Amateur Telescope Making" have reached the editor that it has been necessary to crowd many into this month's number, to the sacrifice of a large portion of the interesting accounts of the jobs as sent in by the makers. However, here are a few fleeting glimpses of them.

The one below, made by Warren A. Donaldson, 3235 Gaylord Avenue, Pittsburgh, has a six-inch mirror. "When the polishing was complete," writes Mr. Donaldson, "I had the most unearthly figure imaginable." Much work reduced this to what a Pittsburgh professional telescope maker called "the best amateur job he had ever seen." The instrument has exceptional definition, and easily separates the double-double star in Lyra.

The telescope to the right of the last

Donaldson

one mentioned was made by William E. Mueller of Sutter, California, who says he commenced work all confident and expecting the job to be completed in a week or so. It took three months. The grinding consumed 12 hours, the polishing 25, and the figuring five. Eight laps were made. "Figuring was difficult, as per guarantee in 'Amateur Telescope Making,'" Mr. Mueller writes. "The cost was around 40 dollars. The rings of Saturn and any number of other things seen. The effort was fully repaid."

Mueller

Next, to the right, is a job by Walter W. Gaulka, 4203 Waverly Avenue, Detroit, who writes: "I had occasion to compare my instrument with a Zeiss four-inch refractor. In definition mine was on a par with it. At 92 diameters Jupiter's bands are very distinct." This worker used a flat for a diagonal and mounted it adjustably on a rack and pinion. The mounting was extemporized largely from old Hupmobile parts.

Below at the left is a six-inch reflector by Taylor Bethel of Southold, New York, who says "grinding and mounting a telescope mirror is the most intensely interesting work I have ever attempted. All work went smoothly until the silvering. I made three trials before I succeeded at that."

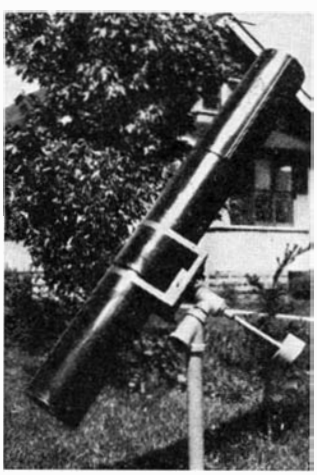
Rupert H. Olson, 3629 25th Avenue, Minneapolis, whose telescope is shown next to the right, writes briefly: "I ground several four-inch glasses from the five-and-ten store to get a little experience, so the eight-inch mirror was a small job to complete, by following the instructions in your book." Mr. Olson's method of preliminary practice is commended. That kind of approach to the job will pay in the long run.

H. B. Donahay, of Blake, Moffitt and Towne, paper dealers, Portland, Oregon, sends in a snapshot of his six-inch, and says: "I cannot agree with those who say that making a reflector is tedious. I enjoyed every hour of the work from grinding the mirror to assembling the optical train."

Gaulka

"The mirror proved to be a 'peach,'" says Oscar R. Knab, 309 South Monroe Avenue, Green Bay, Wisconsin. "It was made in the customary manner, and the usual pitfalls presented themselves. The results with this instrument, which cost me less than 13 dollars, are extremely gratifying. I am

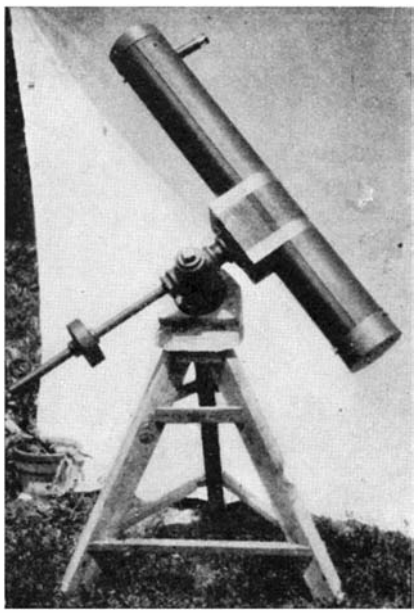
Bethel



Olson

Donahay

Knab

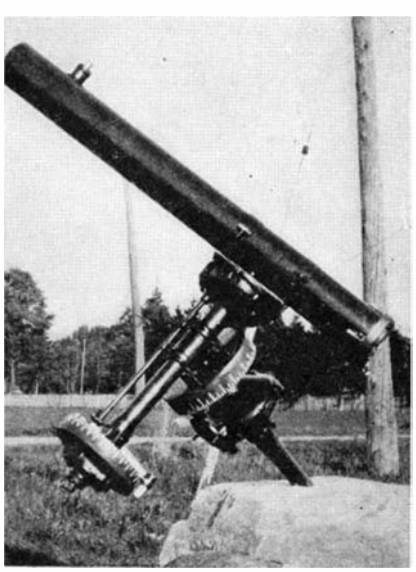


Walden

now engaged on a 14-inch reflector."

M. C. Walden of the Mackay Radio and Telegraph Company, San Francisco, made his telescope partly by radio. That is to say, whenever he ran into a fix or "picklement" in the work he communicated with the telescope editor by radio, through a third person in New York, got his answer the same day, and applied it to that evening's work. He says he is satisfied with the job —as a first attempt. But he does not get the definition he would like. Has this anything to do with San Francisco atmosphere, or was the telescope ed's radiod advice shaky?

Science teachers find telescope making just the thing. E. E. Gale, instructor in "math" and physics in the Port Perry, Ontario, high school, assisted by his students, made the telescope shown. He appears to be enthusiastic about the work. His mounting is cast into a base which doubtless "stays put" pretty well—a big glacial boulder. This reminds us of the biblical wise man who built his house upon a rock. "And the rain came, and the wind blew and beat upon that house and it fell not, for it was founded upon a rock." Is our quotation (from memory) correct? We can't find the original.



Gale

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

AIRPORT DESIGN AND CONSTRUCTION (Aeronautics Bulletin No. 2) is a valuable contribution to the subject giving attention to the problems of municipalities, terminal facilities, airport planning and construction, airport lighting, servicing equipment, roof marking, et cetera. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

TREND IN AIRPLANE DESIGN AS INDICATED BY APPROVED TYPE CERTIFICATES (Aeronautics Bulletin No. 21) gives the result of recent investigations and the substantial changes made by manufacturers. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

CONVEYOR ELEVATOR (Catalogue C-37) gives full particulars as to a method of economically conveying liquids as well as coarse, fine, and granular products, dry or moist. Tables and a classified list of materials to be handled are included. *Bailey-Burruss Mfg. Company, Atlanta, Ga.—Gratis.*

INVESTIGATION OF VARIOUS FACTORS AFFECTING THE HEATING OF ROOMS WITH DIRECT STEAM RADIATORS (Bulletin No. 223) by Arthur C. Willard, Alonzo P. Kratz, Maurice K. Fahnestock, and Seichi Konzo describe experiments conducted and results obtained. It is a valuable monograph giving unique studies. *Engineering Experiment Station, University of Illinois, Urbana, Illinois.—55 cents.*

ANNUAL REVIEW OF LEGAL EDUCATION IN THE UNITED STATES AND CANADA FOR THE YEAR 1930 by Alfred Z. Reed takes up such subjects as responsibility for inadequate bar admission requirements, different types of law schools, the check in the growth of evening law schools, and the lengthened period of preparation. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

PAPER SEALING TAPE (Bureau of Standards No. R 114-30) deals with a simplified schedule of widths and lengths of rolls of plain and printed tape. This material is of considerable importance, particularly for sealing fiber and corrugated shipping containers. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

SERPENT WORSHIP IN AFRICA (Anthropological Series Vol. XXI. No. 1, Publication No. 289) by Wilfrid D. Hambly gives a survey of Africa in relation to the nature, distribution, inter-relationship, origin, and migration of serpent cults, worship, and belief. It is a monograph of great interest to those studying anthropology. *Field Museum of Natural History, Chicago, Illinois.—75 cents.*

TO make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.*

CHEMICAL INDUSTRY AND TRADE IN POLAND (Trade Information Bulletin No. 762, Department of Commerce) by Clayton Lane presents all available information in connection with Polish production, imports, and exports of chemicals. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

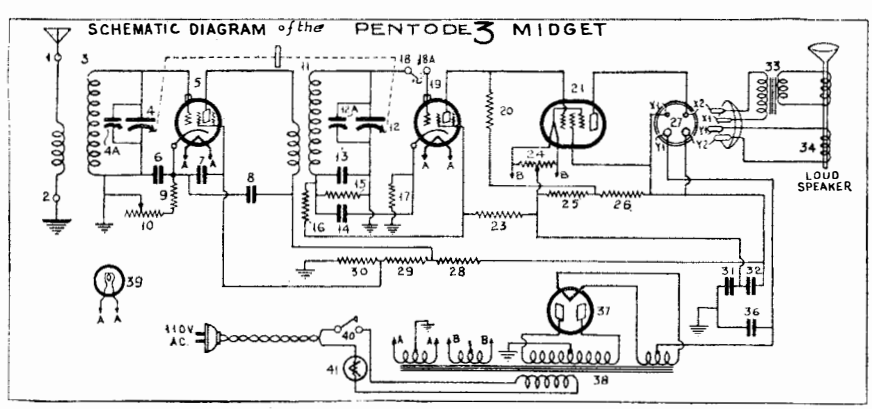
PRESENT AND IMPENDING APPLICATION TO EDUCATION OF RADIO AND ALLIED ARTS (Information Series, No. 5) by Levering Tyson presents information of great value, a knowledge of which would prevent much misconception of the entire subject. For example we learn that a 1000-watt station costs 44,900 dollars capital investment while a 50,000-watt station costs 338,000 dollars. *National Advisory Council on Radio in Education, 60 East 42nd Street, New York City.—Gratis.*

THE PROGRESS OF AMERICAN CHEMISTRY SINCE THE OUTBREAK OF THE WORLD WAR (Reprint, *Industrial and Engineering Chemistry*, Volume 23, January 1931) by William A. Hornor and Lawrence W. Bass gives a table, showing year by year, notable chemical discoveries and inventions, the beginnings of the manufacture of new chemical products of importance, and outstanding changes in established chemical manufactures. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

WHAT NEW YORK'S TELEPHONE MEANS TO NEW YORK by James L. Kilpatrick is a lecture given before the School of Engineering of Princeton University and is replete with interesting diagrams and illustrations showing some of the engineering problems which must be solved. *New York Telephone Company, 90 West Street, New York City.—Gratis.*

THE SEDGWICK AUTOMATIC BRAKE INVALID ELEVATOR describes a great boon to the sick and those for whom stair climbing is dangerous. It makes the whole house available to those who have heretofore been confined to a single floor. Such elevators can be readily installed in existing houses. *Sedgwick Machine Works, 150 W. 15th Street, New York City.—Gratis.*

GLOSSARY OF BOTANICAL TERMS COMMONLY USED IN RANGE RESEARCH (Miscellaneous Publication No. 110, U. S. Department of Agriculture) compiled by W. A. Dayton is an exceedingly valuable pamphlet with a wealth of definitions and many illustrations. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*



Those radio enthusiasts who like to build their own sets will be interested in the Pentode Midget Three, shown in the above schematic diagram, which is so compact that it can be housed in a cabinet formerly used for a standard dynamic speaker. The circuit consists of a tuned radio-frequency stage using a type 551 variable mu tube, a 124 screen-grid power detector, and a single audio output stage using a PZ power pentode. The control grid of the pentode is directly coupled to the plate of the screen grid detector, using the Loftin-White system. Conoid coils add to the efficiency of the circuit. A new-type midget dynamic speaker is another feature of the receiver. This little set is very powerful, has lots of volume, and is amply selective. Further details and a complete set of diagrams and views can be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York City—5 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 412)

equivalent of 36 holes of golf. It has been used with great success in the treatment of stiff neck, lumbago, and charley-horse.

Arms or legs, held motionless in plaster casts while recovering from injury or operation, need no longer emerge weak and powerless from lack of exercise. At the St. Francis Hospital, Pittsburgh, idle muscles are "exercised" by flashing interrupted electric currents through them, causing rhythmic contractions, a small Westinghouse motor driving the interrupting mechanism.

Tired business men, overworked executives, hurried socialites and others may, in the future, choose to take their exercise electrically with this new apparatus. It may bring us a step nearer to the synthetic living that has been predicted by many.

Food from Coal

INSTEAD of depending upon meat for the protein of his diet, man may eventually get this essential food element from coal. At least, German chemists have proved to their own satisfaction that coal chemistry has already advanced to the point where, by technically practicable processes, it is possible to obtain directly from coal and coke such substances as are used by nature in the synthesis of the animal and human body.

Work in this direction has been prosecuted in the Gesellschaft für Kohlentechnik for more than a decade, and it has bridged the gap between chemicals and the materials occurring in coal, which falls within the range of protein formation. One cannot at present imagine artificial subsistence, but surely a definite direction is being marked in this field, and it is shown that the production of albuminous materials from a coal base is ready to be disclosed.—*A. E. B.*

Average American Chews 109 Sticks of Gum a Year

CHARACTERIZING the inferior social status of shop-girls by their gum-chewing proclivities is now but the sign of an outdated novelist. Per capita consumption of chewing gum in the United States has risen to well over 100 sticks a year, three times the 1914 figure. In 1929, factory value of the production of chewing gum was almost 60,000,000 dollars and retail value of that sold in the United States is estimated at 114,000,000 dollars.

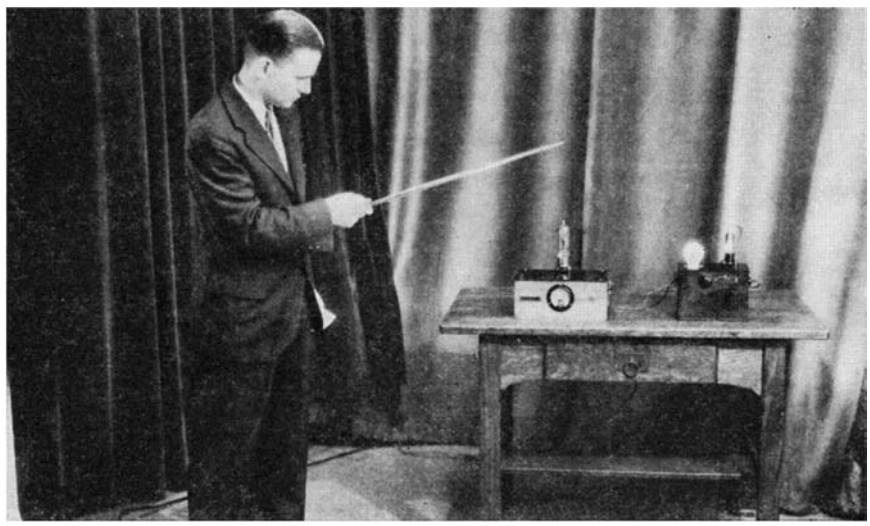
Even more rapid than the rise in home consumption has been the increase in exports. Ascribed in large measure to its introduction into Europe by the American soldier, chewing gum exports have increased in value from less than 200,000 dollars in 1914 to about 1,500,000 dollars last year.

The basic gum entering into the manufacture of the product is chicle, obtained by coagulating the latex of the sapota tree, *Achras sapota*, a native of Central America. The largest part of the gum comes from the southern part of Mexico, particularly Yucatan. The trees average 75 feet in height,

with a diameter of 34 to 40 inches and yield about 5 pounds of chicle per tree. As the trees are tapped again only after the previous incisions have healed—a five- to eight-year interval—the average annual yield per tree is less than a pound.

The milky juice is heated until the milk coagulates into a compact mass. Molded in blocks for export, the crude gum contains about 50 percent water and other foreign matter such as sand and sticks. Cleaning of the gum has been one of the more difficult steps in the manufacturing operation.

Thirteen pounds of chicle as it comes from the final purification ordinarily will make about 5000 standard pieces of stick chewing gum. For export purposes, packets of six sticks are in demand, rather than the five-stick packet common in domestic trade. —*A. E. B.*



E. S. Darlington of the vacuum tube engineering department, General Electric Company, demonstrating the great sensitivity of the low-grid-current tube

As a means of demonstrating the remarkable sensitivity of the low-grid-current tube, Mr. Darlington utilized the relatively small amount of current generated by rubbing an amber rod with a piece of paper to turn on and off a usual incandescent lamp, with the amber rod at varying distances of from 5 to 15 feet from the small box on which the sensitive tube was mounted. On the front of the box was a meter which showed plainly to what degree the tube was being affected by positive and negative charges obtained by rubbing the rod. Connected to the box was another one, on top of which were mounted a Thyratron tube and incandescent lamp. Current was supplied to the lamp by the Thyratron tube; the minute charge from the amber rod was amplified by the low-grid-current tube sufficiently to operate the Thyratron tube and turn the lamp on or off according to whether the charge was positive or negative. A current of 10^{-17} ampere thus directly controlled the 0.1 ampere used by the lamp —introducing an amplification factor of ten thousand million million times.

Hail Sometimes Kills

THOUGH hailstones of large size frequently fall in the United States, it is not often that people are killed by hail here. But India often has hail of sufficient size and violence to kill people. In a remarkable storm which occurred on April 30, 1888, in a region about 100 miles east of Delhi, nearly 250 persons were killed, principally by hail. In a near-by district 16 more persons were killed by hailstones, during the same storm. One day during the summer of 1930, hailstones falling in Greece killed 20 persons and injured more than 40.—*Tycos-Rochester*

An Amplification of Ten Quadrillion Times

A DEVICE which amplifies an electric current 10 quadrillion times was exhibited recently by E. S. Darlington of the vacuum tube engineering department of the General Electric Company at the radio and electric show of the Electric League of Washington. The device is a low-grid-current tube which, in conjunction with a Thyratron tube, is capable of utilizing 0.00000000000000001 (10^{-17}) ampere to control 0.1 ampere—100 milliamperes—directly. The grid cap or terminal of the tube which picks up these minute charges from space is smaller than an ordinary thimble.

Gold Production Rises Due to Placer Mining by Jobless

DESPITE the substantial reduction in the mining of complex ores, from which is derived a large part of the gold output, the production of the yellow metal during 1930 was considerably greater in the United States than in the previous year, due to the increased activities of individual prospectors working with pick and shovel in placer deposits, according to information released by the Department of Commerce.

There has also been an increase in the production of scrap or secondary gold which, together with the gain in new gold output, has made available the largest supply of the metal for currency purposes in many years. The following additional information was furnished by the Department.

Gold production during 1930, based on arrivals at the United States mints and assay offices and at private refineries, was estimated at 2,285,603 ounces valued at 47,247,600 dollars, an increase of approximately 1,600,000 dollars over 1929. These figures include the output in Alaska and the Philippine Islands.

Economic conditions have stimulated gold prospecting in the United States during the last two years. Some months ago the President's Emergency Committee for Employment issued a statement which told of the activities of unemployed miners in Nevada and other states in placer operations. It was estimated that hundreds of jobless had taken to the pick and shovel—in some cases machinery was supplied—in an effort to earn a few dollars in the pursuit of the precious metal. In some cases the owners of large claims had thrown their lands open to the unemployed.

Along with the increased activity in gold staking and the resultant added supply thus made available, there appears to be a larger production of secondary gold, which comes from jewelry, art goods, dental work, and so forth, which has been turned into the melting pot. The output of secondary gold in 1929 amounted to approximately 24,000,000 dollars. The figure for 1930 is not yet available but it is believed will show an increase of about 2,000,000 dollars.

Being used principally for currency or currency reserve, the price of gold remains stable. The average value of the metal in 1930 was $20.671835 per ounce and in 1929 it was exactly the same amount. Silver, on the contrary, averaged 38.5 cents per ounce in 1930 and 53.3 cents in 1929. It is natural, therefore, that those deposits which are in any way promising be exploited to the utmost.

The major part of the domestic supply of gold has come from complex ores in which the yellow metal forms an incidental but important proportion. It is found in combination with silver, copper, lead, and other metals, the proportion of gold varying with the nature of the ores.

Because of the reduced demand for these other metals, and the consequent decreased production, there has necessarily been a decline in the gold output, as it does not often pay to treat tons of these ores solely for the gold they contain, although the gold is decidedly worth recovering during regular operations.

An interesting illustration of the effect of reduced mining operations on the production of gold is seen in the case of Arizona. In 1929 silver production in this state totaled approximately 7,500,000 fine ounces but in 1930 the output fell to approximately 5,550,000 ounces.

Copper production in this state fell from approximately 830,000,000 pounds in 1929 to 576,000,000 pounds in 1930. The reduced output of these metals is reflected in gold production which declined from 202,318 fine ounces in 1929 to 169,390 fine ounces in 1930. It is to be noted, however, that the amount of ore treated in Arizona declined from about 26,000,000 short tons in 1929 to about 20,000,000 short ton in 1930 and that there were 342 producers operating in 1930 as against 412 in 1929.

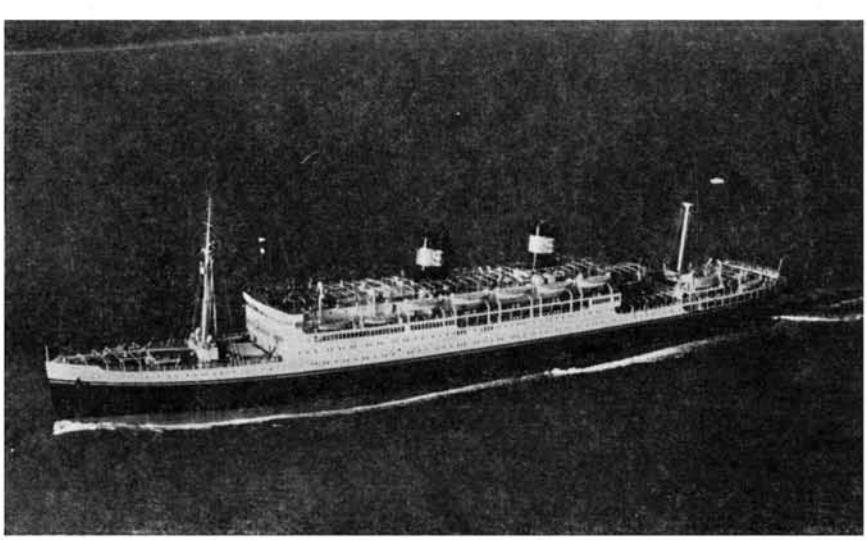
Gold was produced in 1930 in 18 states, Alaska and the Philippines. California produced more than 9,000,000 dollars worth, Alaska and South Dakota more than 8,000,000 dollars worth, Colorado and Utah more than 4,000,000 dollars worth. Next in importance were Philippine Islands, Arizona, Nevada, Montana, New Mexico, Idaho, and Oregon. Small quantities also came from Alabama, Georgia, North Carolina, Pennsylvania, Tennessee, Texas, Washington, and Wyoming.

The Union of South Africa (Transvaal, Natal, and Cape Colony) produces about half the world's gold supply. Along with Australia, Canada, and Russia, its production has been increasing while the rest of the world has been declining. Whether the increased output in the United States represents a trend cannot yet be determined.—*United States Daily.*

Chemical Preservation of Wood

THE chemical treatment of wood to preserve it against decay and attack by insects has become so widespread that the wood preserver is beginning to wonder whether he may not in time find himself in the anomalous position of being injured by his own success. If treated wood lasts from three to five times the life of untreated wood, can the market continue indefinitely? asks a writer in *Chemical Markets.* The answer to that question depends upon the ingenuity of the wood preserver in creating new markets for treated wood.

There are many possibilities for treated wood, and their development will have a



The magnificent new 'round-the-world Dollar liner, *President Coolidge*, on her recent sea trials, making 21 knots passing Cape Henry, Virginia. She is propelled by electricity and is equipped from engine room to pilot house electrically by Westinghouse. She is the largest electric ship in the world at present and the largest commercial ship ever built in America, her tonnage being 33,800

tremendous influence on the future of wood preservation. Just as markets for treated wood were built up largely by the demands of the railroads for treated ties, so now they are being affected adversely by the lessening demand for treated ties resulting from decreased tie renewals. Many railroads now use only treated ties, and on one railroad tie renewals per year decreased from 336 per mile to 48 per mile in a period of 19 years. That this reaction is being felt in the treating industry is evidenced by the tendency of treating companies originally concerned chiefly with treatment of ties to turn now to treatment of other forms of timber also.—*A. E. B.*

Chromium in the Battle Against Corrosion

ONE of the major metallurgical problems that has never been solved satisfactorily is that of corrosion. In almost every industry there is some material that has a corrosive effect on metal parts. Acid mine waters take their yearly toll of rails, pipes, pumps, and valves. Salt water, rust, and atmospheric oxidation cut down the life of exposed steel on ships and structures in general. Boiler plates, fire tubes, fire box sheets, and stacks are eaten away by the corrosive gases with which they come in contact. The innumerable acid and salt solutions encountered in the chemical and dye industries soon cause the parts of apparatus through which they pass to be relegated to the scrap heap. Oil refineries find it necessary to replace cracking plant equipment continually. In the automotive fields much difficulty in the past has been encountered in the corroding of valves, pump shafts, and so on, and the rusting of bumpers and trim after the surface of the nickel or chromium plating has been broken. This list is but a small portion of the applications open to some inexpensive corrosion-resistant metal.

It appears that the chromium and chrome-nickel series of alloy steels have made the nearest approach to filling this demand in its entirety. Not that one certain type of chrome or chrome-nickel steel will completely cover the corrosive field from acid-resisting pumps to high-temperature high-strength fire box sheets, but, by varying the percentage of the alloying materials it is possible to impart to the steel physical properties most suited to the specific type of work.

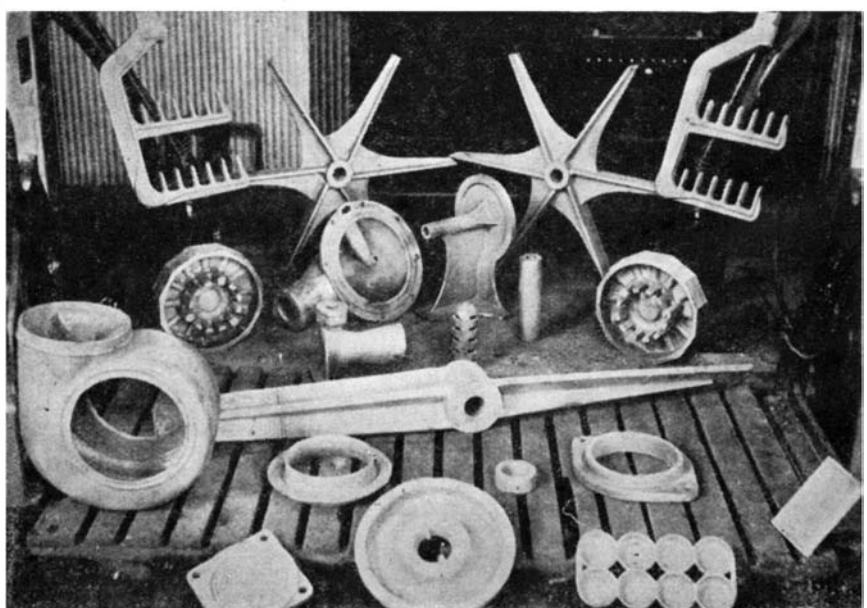
Chromium has a very great affinity for oxygen. It is this property that, peculiarly enough, gives it its corrosion-resisting quality. This paradoxical statement can readily be explained by the fact that the oxide formed is practically impervious and very stable. According to Mr. E. C. Bain, of the U. S. Steel Corporation, it is believed that a thin film of this oxide is formed as soon as the metal becomes exposed, and that this invisible film acts as a protective coating against further oxidation and corrosion. This property of self-protection, furthermore, is bestowed upon its solid solution in steel when the percentage of chromium is high enough.

Chromium tends to combine with the carbon in steel to form a carbide that is not corrosion resisting. Therefore, to retain this highly desirable property it is necessary to introduce a sufficient amount of the alloy to distribute a solid solution of chromium and iron throughout the piece after the carbon content has combined with a correspondingly proper amount of chromium and destroyed the corrosion-resisting qualities of the alloy to that extent.

In the lower ranges of chromium such as are found in the so-called stainless steels, the chromium imparts to the steel air hardening properties. Where carbon steel must be quenched in water to be hardened, stainless steel, if heated above its critical range, will harden if allowed to cool in air.

The addition of nickel to chromium steels lowers the critical temperature, so that the tendency of the solid solution of the alloys and iron to decompose is reduced. These alloys are fine grained in structure, and are strong, tough, and ductile. They work-harden very readily, making them highly resistant to abrasive wear.

In the chemical industry, innumerable applications for all varieties of chromium and chrome-nickel steels can be found. The



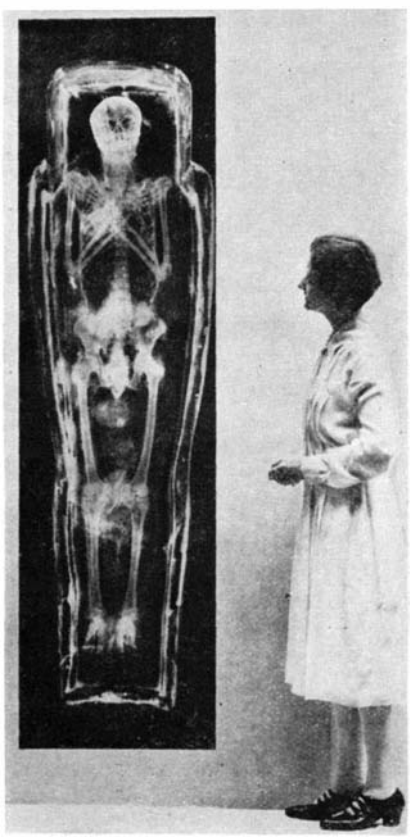
Courtesy The Duriron Company

A few samples of alloy steel parts that are used to combat corrosion in the following industries: petroleum refineries, steel (in the pickling bath), food handling equipment, dye preparation, air conditioning, and food preparation

high chromium, nickel-free alloys are used when strength at high temperatures and resistance to oxidation, or resistance to sulfides is desired. Chrome-nickel gives greater strength at elevated temperatures. The addition of other elements such as tungsten, copper, and silicon further widens the field for resistance against certain corrosive liquids and gases.

In the automotive fields, stainless irons having a typical analysis of: carbon, 0.12 percent; chromium, 12-14 percent; and maximum silicon, 0.50 percent are used for nuts, bolts, bumpers, and so on. Body trim such as radiator shells, headlights, cowl beading, and fittings are frequently made from 18-8 chrome-nickel steel. Valve steels containing 9 percent chromium and 3 percent silicon are becoming more prominent because of their heat-resisting properties. Carburetor needle-valves, pump shafts, and all parts where greater hardness or strength than can be found in the stainless irons is desired, may be fabricated from stainless steels containing about 0.30 percent carbon and 12 percent chromium.

These applications are but a few of those that could be mentioned; but they help to illustrate the many uses to which chromium and chrome-nickel alloy steels may be put in the great battle of the industries against corrosion.—*A. E. B.*

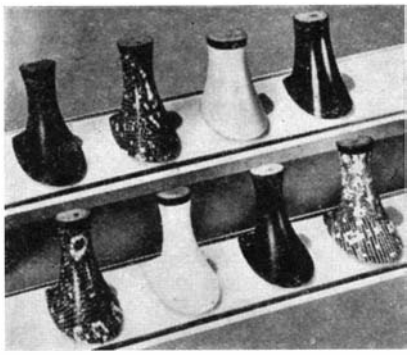


Courtesy Field Museum of Natural History

The world's largest X-ray picture measuring seven feet by two feet

Seven-Foot X-Ray Picture

AFTER a long series of experiments, a new departure in X-ray work has been successfully made in the division of roentgenology at Field Museum of Natural History, resulting in what is believed to be the largest X-ray picture ever taken, it was announced recently by Stephen C. Simms, director of the museum.



Some of the new scuffless shoe heels made of Pyralin as described in our October issue. As may be noted, besides imitating reptile skins with this chemical substance, standard finishes may be obtained

It is expected that this development will mark the opening of a new chapter in X-ray achievements, the possibilities of which for application in various fields cannot yet be definitely determined, but which appear to be very broad, according to Director Simms.

The first roentgenogram of this large type has for its subject one of the museum's Egyptian mummies, and has been made on a film seven feet long by two feet wide, which would be an enormous film even for ordinary photography. This film represents the first successful effort ever made to photograph an entire adult mummy in its casket on one film, and with only one exposure, it is stated by Miss Anna Reginalda Bolan, who is in charge of the museum's X-ray laboratory. So far as can be learned from any available authority, it is also the largest roentgenogram ever made anywhere of any subject. The film is remarkably clear in showing anatomical and other details, and Miss Bolan, through whose efforts the work was successfully carried out, claims it possesses great value from the diagnostic standpoint.

Heretofore mummies have been X-rayed at the museum in sections on the regulation size film, 14 by 17 inches. These smaller films were then pieced together and from this "mosaic" the specimen was viewed and its anatomical relation to cartonnage and casket estimated. The advantages of being able to X-ray so large a subject on a single large film are obvious, assuring greater accuracy and reducing the amount of work involved.

The museum's roentgenological laboratory was established and equipped about five years ago by Stanley Field, president of the museum. Special apparatus was recently built and installed to produce the new type of work.

Excess Fat of Body Changed into Sugar

IF you eat too much fat and not enough sugar, will your body automatically transform some of the excess fat into carbohydrate fuel food? Dr. John R. Murlin of the University of Rochester has suggested that the versatile human body thus answers its own demands for proper food by manufacturing the needed sort even if the raw materials fed it are not just what are needed.

Volunteers lived on a diet of pure cream

for five days in the experiments reported to the Federation of American Societies for Experimental Biology by Dr. Murlin and Miss Estelle E. Hawley, his associate. Each morning and evening they were fed their meals of cream and then they were put through tests to ascertain how the body used this unbalanced food ration. One brave temporary martyr to science remained in an ice box for an hour and a half in order to test his metabolism on the fat diet under the influence of reduced temperature. He shivered for an hour during this experience.

Sufferers from diabetes seem to be able to eat fat without filling their blood with sugar that is dangerous to them. This has caused physiologists to believe that the body could not manufacture sugar or other carbohydrates from fatty foods.

Physicians have recognized heretofore that sugars could be converted into fat by the body and they have repeatedly warned pleasingly plump people against eating too much sugar and starches. Now, if Dr. Murlin's experiments are further confirmed, they can feed their obese patients high fat diets in necessary cases with the assurance that the body will look out for itself and make the sugar that it needs to supply its energy.—*Science Service*

Start Early to Salvage Deafened Child

URGENT need of discovering defective hearing in very young children, and of salvaging what hearing they have before it is lost forever, was brought out recently by Dr. Richard O. Beard of the University of Minnesota.

The child of today, in the first five years of his life, is surrounded by a world more varied and stimulating than babies have ever before experienced, Dr. Beard declared, and babies have become more precocious in their development in consequence.

"Watch the baby of today in his reactions to the electric door or telephone bell," he said, "or to the flash of electric light, to the sight and touch of his many toys, to the taste and odor of his varied diet, to the vocal attentions of his family and his ubiquitous friends."

In this speeding up of mental and emotional development, hearing plays the major rôle, the speaker continued. The young child whose hearing is even partially impaired needs to have intelligent first aid as soon as the handicap is discovered.

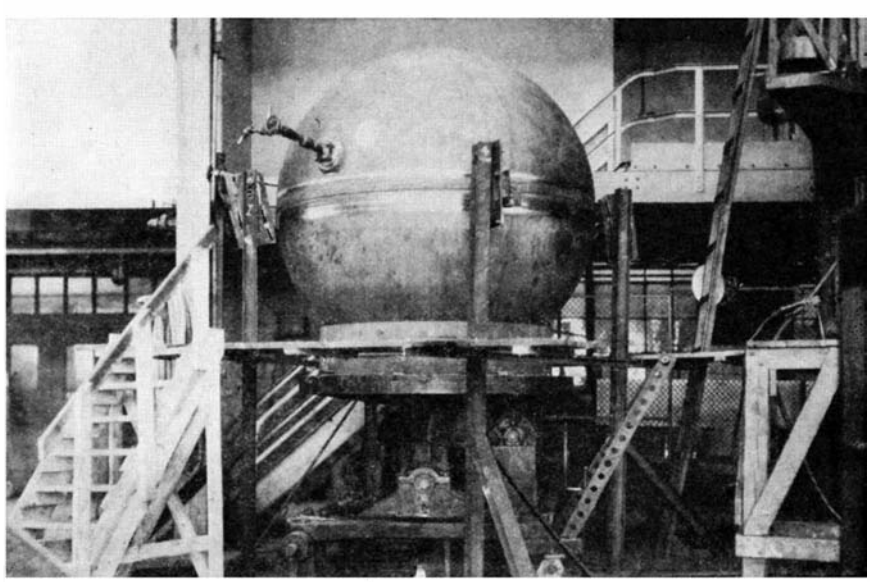
The tendency of parents to try to hide the fact of a child's defective hearing was deplored by the speaker, who said that such a policy robs the child of a start in life.

Physicians are coming to doubt whether more than a very small percentage of young deafened children are totally stone-deaf, Dr. Beard continued, and a residue of hearing, even though small, may be put to good use in teaching the child to use its voice, to use what hearing it has, to read the lips, and to live a more normal social life. But if the remnant of hearing is not salvaged by proper educational methods, the child who cannot hear distinctly may lose the habit of listening at all, and with disuse the organs of hearing become still further impaired.—*Science Service*

Ball Tank for Shipping Helium

THE punishment inflicted on a baseball by the bat of "Pepper" Martin or "Babe" Ruth fades to insignificance when compared to the gruelling ordeal to which engineers of the A. O. Smith Corporation, of Milwaukee, Wisconsin, recently subjected the huge chromium-steel ball illustrated here. This ball is really a storage tank designed for the shipment of compressed helium which the United States Navy uses to inflate its dirigibles.

The idea of using spherical containers for the transportation of gas under high pressure was conceived by the A. O. Smith Corporation, and a tank car, based on this idea, was developed for the Navy. This new type of car carries six spherical containers capable of transporting 210,000 cubic feet of free helium at a pressure of 2000 pounds per square inch. The spherical container has the inherent advantage of being approximately 25 percent lighter than a cylindrical container of the same capacity. It also is much simpler in design and construction if made of two formed heads welded together.



The helium shipping sphere set up for the repeated hammer test

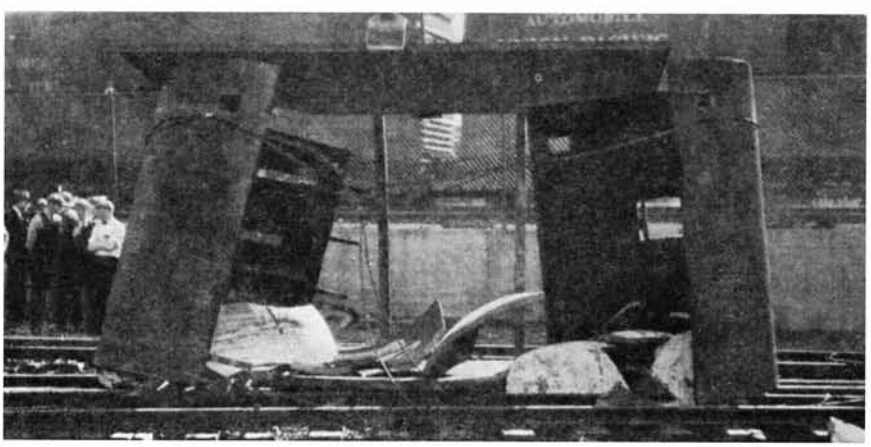
The tests illustrated here were made on a chrome-vanadium sphere 94 inches inside diameter and $1\frac{11}{16}$ inches minimum wall

thickness. The results definitely established the practicability of this unique form of container and proved that both the steel and the welded joint were far stronger than required by the Interstate Commerce Commission's exacting specifications.

The test consisted of three parts: repeated hammer test, single blow impact test, and pressure test to failure. Before these tests, the sphere was subjected to the customary acceptance test involving hammering the seam under a pressure equivalent to 60 percent of the yield point and a final test at 80 percent of the yield point. At failure the tank had expanded 8.1 percent.

The vessel was filled with water under pressure of 34,200 pounds per square inch. It was hammered continuously for 75 hours, equivalent to a total of 35,000,000 blows, each of five foot-pounds energy.

The single blow impact test consisted of dropping a "skull cracker," weighing 1718 pounds on top of the vessel from a height of 23.5 feet while the vessel was under the water pressure. The blow had an energy of 30,000 foot-pounds. The weight was dropped on the apex of the sphere (thinnest portion) and made a dent one fourth of an inch deep. Then the vessel was turned around and the weight dropped on the weld, making a dent three sixteenths of an inch deep.



All that was left of the helium sphere after the destruction test

For the destruction test the vessel was covered with lime wash to show first point of deformation. It was found that the yield point was reached at a stress of 59,200 pounds per square inch. The vessel failed at a pressure which was equivalent to a calculated ultimate strength of 83,400 pounds per square inch. The vessel broke in a number of parts, as shown in the picture, and it has been calculated that the total energy in the vessel at the time of fracture was 2,500.000 foot-pounds.—*A. E. B.*

Natural Gas Fuel for New Engine

FOLLOWING the widespread distribution of natural gas, a Minneapolis implement company has placed on the market a low-speed, heavy-duty internal combustion engine, to use the new fuel.

The new engine, said to be the first of its kind to be manufactured for commercial use, is being successfully employed in cotton gins of the Southwest. It is especially adapted to slow moving stationary machinery, and its makers claim unusual economy where natural gas is available.

It is a modification of a type of slow-speed motor built to use kerosene or gasoline fuel. Instead of the 1500 to 3000 revolutions per minute usually developed by the ordinary internal combustion motor, the natural gas motor has a range of about 800 to 1000 revolutions per minute.

Television "Sputtering" Reduced

IN the neon lamps used in reproducing television pictures, the metal plate tends to throw off minute particles of itself which blend with the gases, states Hollis Baird, chief engineer of the Shortwave and Television Corporation. The ultimate result of this action, called "sputtering," is that the pictures grow dimmer and dimmer since the impedance of the tube goes up as the metal goes off, and the glass of the tube darkens as well.

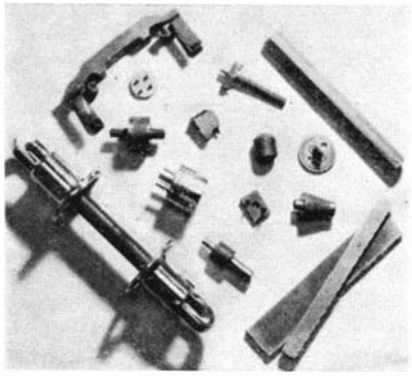
Aluminum, tungsten, and tantalum have a low sputtering characteristic, but tungsten and tantalum are too expensive for general use and aluminum is too soft. Copper, gold, silver, and lead have a sputtering factor of from 75 to 100 times as much as these other metals, making their use impossible. The best solution of the sputter problem has been the use of common iron. Iron has but five times the sputtering characteristic of the good metals, compared with the 75 and 100 of the other metals named above.

Discovery of these facts is now permitting the design of lamps for television which have a long life and which give a steady light during this long period, and which need not be too expensive to make. Thus in solving the "sputtering" problem, better pictures are assured.

Borax King Ends Colorful Career

WITH the death on August 27, of F. M. Smith, known as "Borax" Smith, the chemical industry lost one of its most picturesque personalities. Mr. Smith, who was 85, once possessed a fortune estimated at many millions, but died a relatively poor man. Forty years ago, Smith was a miner, picking at mineral pockets here and there, sleeping under the stars wherever night chanced to overtake him, oblivious to hunger.

After wandering in the arid wastes of Arizona, Mr. Smith went north into California and entered Death Valley, where it had been believed no man could live, and finally came upon traces of the borax that finally made him the "Borax King." In 1872,



Group of Mycalex parts and fittings

while prospecting for gold, his imagination first became really fired when, a few yards from the door of his camp, he saw the glistening white surface of a dried saline lake called Teel's Marsh. Convinced that the snowy substance was rich in chemical values, Mr. Smith took a specimen to an assayer in Columbus, Nevada, who pronounced it the finest grade of borax he had ever seen. Within two years Smith controlled the borax market of the United States.

After several years he sold out his interests only to return again to the borax fields when most of his original fortune had been lost. At the age of 75 he rode 80 miles on horseback to purchase a borax mine. —*A. E. B.*

Mycalex—A Unique Molding Material

SOME 15 years ago a young English chemist working in India in behalf of London mica interests became interested in the possibility of finding a use for the great quantities of scrap or waste mica left after preparing for the market the well-known white mica of India, says L. E. Barringer in the *General Electric Review*.

The "mica dump" of refuse mica is characteristic of all mica mines, since only a relatively small percentage of the mica rock taken from the mines is of commercial value. Furthermore, there is again a large percentage of scrap remaining from splitting, trimming, and cutting operations, and this secondary scrap is, of course, even more attractive for utilization than the mine scrap.

The chemist, Percy B. Crossley, conceived the idea of mixing ground mica scrap with an easily fusible glass, in powder form, heating briquettes of such a mixture to a temperature sufficient to soften the glass particles (about 675 degrees, Centigrade) and then molding the mass under hydraulic pressure while still hot and plastic.

With crude apparatus and unskilled Indian labor, Crossley produced plates of stone-like material up to 8½ inches by 11½ inches and in thickness up to three-fourths of an inch. These plates gave a clear, bell-like tone when struck with a piece of metal, thus indicating at once their comparative hardness and density. Crossley made tests which indicated that his material possessed to a high degree both mechanical strength and effectiveness as an electrical insulating material.

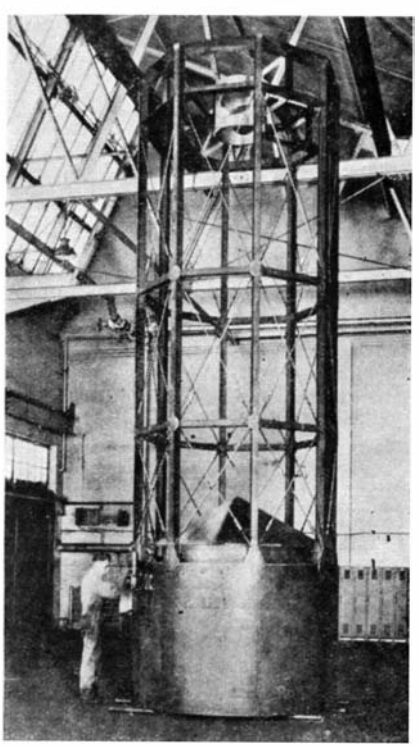
The combination of ground mica and soft glass was named "Mycalex" and is now being used to make a wide variety of electrical parts and fittings. Mycalex is an impervious, heat-resistant, inorganic material with which metal members may be combined in molding or subsequent casting, which is machinable and which possesses unusual insulation value, especially at radio frequencies. In addition, it possesses high compressive strength, high transverse strength, and resiliency.—*A. E. B.*

Arc-Welded Telescope Tube

FOR the first time the tube of a large astronomical reflecting telescope has been assembled by the arc welding process, instead of by the more familiar method of riveting. The skeleton structure shown in an illustration is the tube for the 69-inch telescope which is now being assembled at the Perkins Observatory of the Ohio Wesleyan University at Delaware, Ohio. It was welded by means of the stable arc process of the Lincoln Electric Company of Cleveland.

Rigidity is a definite requirement in structures of this nature, since the integrity of the optical image of a star depends in final analysis upon that quality. The tolerance in an example like the present one, where the tube has a length of 25 feet and a diameter of 90 inches, is only about ⅛ of an inch. (SCIENTIFIC AMERICAN, September, 1928, pp. 237-239.) In other words, a structure of this great bulk must be turned from a vertical to a horizontal position without suffering greater deflection than that amount at the outer end which carries the secondary mirror.

Readers will recall the favorable comment which was aroused in 1928 when the National Bureau of Standards succeeded in casting a 69-inch disk of high-grade glass. (SCIENTIFIC AMERICAN, February, 1928, page 158.) This disk, which has since been ground, polished, and figured (SCIENTIFIC AMERICAN, October, 1930, pp. 274-275) by J. W. Fecker of Pittsburgh, will be placed

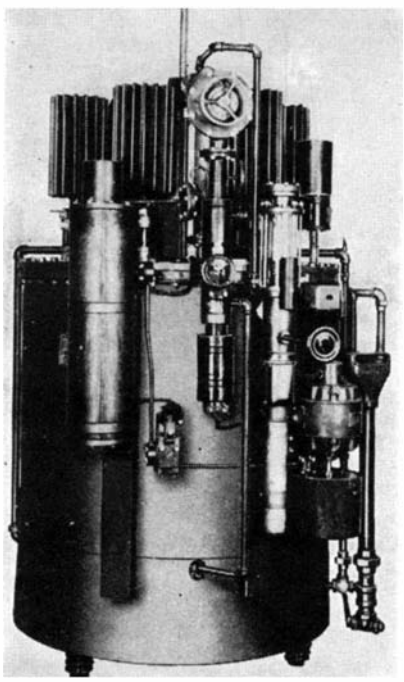


The tube which is to hold the 69-inch Perkins Observatory telescope

in the tube shown in the illustration. The tube itself, and the other parts of the mounting, are the work of the Warner and Swasey Company of Cleveland. The pyramidal feature which shows in the illustration is a shutter which furnishes mechanical protection to the valuable mirror when the latter is not in actual use. It consists of eight metal triangular hinged leaves.—*A. C. I.*

New Mercury-Arc Rectifier

MERCURY, the ubiquitous friend of the chemist in his laboratory, is the secret of the efficiency of a mammoth rectifier, just introduced by the Westinghouse Electric and Manufacturing Company to convert alternating current to direct current. The most general use of this equipment is in supplying power for electric traction systems, although it has certain industrial applications. For some electrochemical processes, the power supply requirements are such that rectifiers provide the preferable means of conversion.



The new steel tank mercury-arc rectifier developed by Westinghouse

The operation of these rectifiers is based on the principle that in an ionized gas only a small positive potential with respect to the gas is required to cause current to flow to an electrode while a large negative potential can be applied before appreciable current flows. The rectifier consists of a mercury pool cathode and an anode inside a steel tank, with facilities for condensing the mercury vapor, and the necessary auxiliary apparatus for maintaining the vacuum and temperature conditions of the rectifier within the limits required for proper operation.—*A. E. B.*

New Sealing Compound

A NEWLY discovered micaceous mineral that is said to be a natural lubricant and a preserver of metal, and to possess the property of expanding to several times its normal volume when exposed to heat, has been made the base of a plastic sealing compound that retains all the characteristics of that mineral, says a recent issue of *Gas Age Record*. The product is called "Q-Seal", and has been put on the market by the Quigley Company, Inc., of New York.

After the mineral has been ground to a fine powder, it is mixed with other ingredients, the principal one of which is noncorrosive, and impervious to crude oils and their derivatives, to acids, gas, steam, ammonia, brine, vapor, creosote, tar, and air. Q-Seal is easily applied with a brush. In addition to making joints leakproof and preventing rust and corrosion, the manufacturer claims that the compound will fill any imperfections in threads, flanges, and gaskets owing to its inherent tendency to expand.—*A. E. B.*

Frozen Pulp Retains True Fruit Flavor

EXPERIMENTS in the food research division of the Bureau of Chemistry and Soils, United States Department of Agriculture, have developed a new type of frozen fruit pulp which promises a new outlet for the fruit grower and packer, a new fruit base for the ice-cream manufacturer and soda-fountain operator, and a new product for direct consumption in the frozen state. By pulping the pitted fruit, adding a sugar sirup of proper concentration, mixing it thoroughly, and then freezing at very low temperatures, chemists have developed a product with a remarkably smooth texture and full retention of the original flavor. Experiments have included peaches, apricots, plums, cherries, pears, raspberries, and strawberries.—*A. E. B.*

Nickel Safe for Three Milk Vitamins

THE vitamins in milk are unaffected by nickel, according to a study made by Avery D. Pratt of the Department of Vital Economics, University of Rochester, which has been published in *The Journal of Nutrition.*

"Since nickel is being used more extensively in industrial machinery and especially in dairy manufacturing equipment," he said in explaining the reason for the study, "it seemed important to investigate the possibility that it might act as a catalyzer in the destruction of vitamins during the pasteurization of milk. If only a comparatively small percentage of the vitamin content of milk or other foods was destroyed by such a catalysis, this would in the aggregate be of very great importance in human nutrition."

The results of the study showed that:

"There was no appreciable destruction of vitamin A by pasteurization in either a glass or a nickel container.

"The antineuritic factor of the vitamin B complex was partially destroyed by pasteurization but there was no evidence of a catalysis of the destruction by nickel.

"Vitamin C was partially destroyed by pasteurization but nickel did not seem to increase the destruction.

"Unless it can be demonstrated that nickel itself is beneficial to animals on vitamin deficiency diets, it is impossible to interpret the data as indicating any catalytic destruction of vitamins A, B, or C by nickel during pasteurization."

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Radio Tube Suits Settled

COMPLETE stabilization of the radio tube industry of the country was presaged with the recent announcement by David Sarnoff, president of the Radio Corporation of America; C. G. Munn, president of the De Forest Radio Company, and representatives of other tube makers, of the amicable settlement of the controversy which has been waged for years over vacuum tube patents.

The terms of the settlement, Mr. Munn announced, included the payment by the Radio Corporation to the De Forest company of 1,000,000 dollars in cash. "Cross license agreements on tube patents only have been entered into by both companies," he said, and these agreements affect 20 other manufacturing concerns as well.

The understanding reached settles all anti-trust law suits instituted against the RCA by vacuum tube makers who were not operating under license of the patents of the Radio Corporation. It covers all triple-damage actions brought against the RCA for alleged violation of the Clayton act, by reason of the so-called Clause 9 effective in 1927 and 1928 in the licensing agreement between radio set manufacturers and the Radio Corporation. The suits, brought from time to time against the RCA by the independent tube makers, are said to have involved demanded damages of more than 47,000,000 dollars.

Twenty companies, besides the De Forest organization, have been joined in the understanding with the Radio Corporation. They are the Arcturus Radio Tube Company of Newark, Mellotron Tube Company, Vesta Battery Company, Van Horne Company, Schickerling Products Corporation, Gold Seal Electric Company, Universal Electrical Lamp Company, Republic Radio Tube Company, Mutual Electric Lamp Company, Continental Corporation, Sunlight Lamp Company, Marvin Radio Tube Corporation, Radex Corporation, Globe Electric Company, Duratron Radio Tube Corporation, Gold Seal Manufacturing Corporation, Supertron Manufacturing Company, Cleartron Vacuum Tube Company, Diamond Radio Tube Company and Poughkeepsie Gold Seal Company.

The terms of the understanding also include the acquisition of licenses under RCA patents by the active tube companies, including De Forest, Gold Seal Electric Company, Arcturus, Republic Radio Tube Company and Diamond Radio Tube Company. In the same understanding, the RCA and licensed concerns acquired tube-making rights under the patents held by the De Forest company.

It was stated by Mr. Munn that:

"The De Forest Radio Company, after 25 years of pioneering in the development of the radio tube and radio communication arts, has finally been accorded its proper place in the present-day industry by virtue of recent court decisions and the present settlement. It is now in an exceptionally strong financial position not only for the production of receiving tubes, transmitting tubes, amplifying systems, transmitters, television equipment, and other products, but for the furtherance of its extensive research and engineering program. The organization can now devote the necessary efforts required in bringing about an early realization of popular television through its subsidiary company, the Jenkins Television Corporation.

"The radio public gains by this settlement through having the radio industry concentrate once more on the development and production of new and better radio products, in place of the long litigation which has severely strained the resources and attentions of the contestants during the last few years."

Mr. Sarnoff said: "In a number of instances patent infringement suits brought by the Radio Corporation of America have been pending against companies seeking damages in the Clause 9 cases. The active manufacturing companies that are parties to the settlement have recognized patent rights of RCA by acquiring licenses under its patents, and these patent infringement suits will be dropped. The Radio Corporation of America has also obtained rights for use both by itself and its tube licensees under radio tube patents owned by the De Forest Radio Company.

"The termination of this large number of suits, on terms satisfactory to all parties involved, will do much to free the radio industry from litigation with which it has been burdened and impeded for several years, and which entailed heavy expense to all concerned. It will enable the industry to devote more of its attention to the development of new products and new services for the public and should have a stimulating effect on business as a whole."

Clause 9 of the RCA licensing agreement, which was the basic cause of the litigation, was in effect during part of 1927 and 1928. Under it, set makers licensed by the RCA were required to see that their sets were equipped with RCA tubes when first sold. This resulted in litigation between the De Forest company and the RCA to test the validity of the clause. The Federal Court in Delaware and the United States Circuit Court of the Third District held in favor of De Forest company. The RCA then applied for a writ of certiorari, but the United States Supreme Court declined to review the decision. The suits settled by the agreement just announced were based on the same clause in the former licensing contract with broadcast set makers.

The announcement reported above may be followed by a compromise of the government's anti-trust suit against RCA and affiliated companies, involving alleged patent pools.

Officials at the Department of Justice said that negotiations would be resumed between government and RCA counsel to determine what action would be taken.

The suit against the Radio Corporation followed several years of investigation by the Department of Justice and the Federal Trade Commission. The suggestion was made last summer that a patent pool be formed to administer the patents held by the Radio Corporation and affiliated corporations. Through these patents it has been alleged that the Radio Corporation monopolized the radio manufacturing industry.

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

"Developing" Cream Advertised As a Body Builder

THE vendor of a cream alleged to have the power to fill out and develop the neck, arms, busts, legs, and other parts of the human body, having been charged with publishing false and misleading advertisements in the sale of this cream, signed a stipulation with the Federal Trade Commission in which he admits that the cream is primarily a lubricant. If any development results from use of the preparation it would be due to the massage recommended rather than to the cream, according to the terms of the stipulation.

The vendor agreed to discontinue publishing the misleading statements, particularly the following: That he has made research or experiment or incurred a large expense in developing the cream or the health instructions sold with it; that mere application of the cream will develop a beautiful, well-rounded bust, eliminate the hollows from the neck, round out the arms, develop the legs, or beautify the complexion; and that he is in possession of body beautifying secrets.

The vendor also agreed to discontinue using the word "studio" as part of his trade name, unless and until he actually maintains a studio for the teaching and practice of beauty culture.

"Kanetex" Refused Registration

IN the case of The Celotex Company versus John H. Mitchell, Assistant Commissioner Moore held that John H. Mitchell, of Chicago, Illinois, is not entitled to register, as a trademark for wall board and thermal insulation, the term "Kanetex" in view of the prior adoption and use by The Celotex Company, of Chicago, Illinois, of the term "Celotex" as a trademark for the same class of goods.

In his decision, after referring to certain decisions of the Court of Customs and Patent Appeals in which the marks "Flametex," "Opal-Tex," and "Fir-Tex" were respec-

tively held confusingly similar to "Celotex," the Assistant Commissioner said:

"There is no greater distinction between the applicant's mark 'Kanetex' and the opposer's mark 'Celotex' than there is between the marks involved in each of the above decided cases, and I am of the opinion that said decisions of the Court of Customs and Patent Appeals are controlling in the instant case."

Mexico is Largest Airplane Market

MEXICO led the nations of the world as a market for airplanes, airplane engines, and parts of United States manufacture during the month of May, according to figures made public by the Department of Commerce.

The United States' southern neighbor during the month took three airplanes totaling in value 91,237 dollars, one engine valued at 7800 dollars, and parts of a total value of 2872 dollars.

In addition to sales to this country, The Netherlands took two planes, valued at 5266 dollars, the United Kingdom one, valued at 60,348 dollars, and the Philippines one, valued at 5050 dollars. Sales of 18 engines, valued at 77,957 dollars were distributed among nine countries: Belgium, Canada, Guatemala, Panama, Mexico, Trinidad and Tobago, Brazil, Colombia, and Peru, while sales of parts totaling 87,438 dollars were distributed among 28 countries.

In addition to these sales to foreign countries, parts valued at 1223 dollars were shipped to Hawaii, and Porto Rico received two engines, valued at 11,208 dollars, and parts valued at 28 dollars.

Motion Picture Screen Patent Claim Allowed

THE primary examiner of the Patent Office rejected claim 6 in patent No. 1819776. Applicant appealed to the Patent Office Board of Appeals, and Examiner-in-Chief Thurber handed down a decision in favor of applicant. The following claim was the one rejected, but finally allowed on appeal:

"6. A moving-picture screen adapted for coordinated sound transmission, composed solely of a single-thickness finely-woven textile-fabric screen having a front light-reflecting surface to receive the projected picture and provided with perforations therethrough in number and size sufficient to permit passage of sound-waves therethrough of appropriate volume without blurring, while at the same time preserving the light-reflecting properties of such surface sufficiently to constitute an efficient screen for the presentation of the pictures, the walls of said perforations being at substantially right-angles to the body of the screen."

The references relied on are: Amet, 1308-468, July 1, 1919; De Forest, 1710922, April 30, 1929.

This application relates to a moving picture screen provided with small perforations so that the sound reproducing apparatus may be located behind the screen and the sound pass through the perforations.

It was old to perforate a screen as shown by De Forest but De Forest thought that it was necessary to place an additional screen in the rear of the picture screen in order properly to reflect the picture. Amet employed a single wire screen but he considered that it was necessary to provide peculiarly cup-shaped reflectors provided with holes in their bottoms.

We have no evidence, therefore, that anyone prior to appellant realized that it would be practical to place small parallel sided holes in a single screen and by proper selection of the size and number of the holes permit the sound to pass through without disturbance while at the same time permit the picture to be reflected properly. The examiner states that appellant has done nothing more than omit the secondary screen of De Forest but we find nothing to indicate that the size and number of the openings in the De Forest screen are such that the front screen could be used without the rear one nor do we regard the omission of the rear screen as obvious. We also do not agree with the examiner in his statement that Amet anticipates the claim except for the material. The claim specifies perforations at right angles to the bottom of the screen. Amet clearly specifies cup-shaped openings with holes at their bottoms. In the absence, therefore, of any suggestion that a simple screen of the nature disclosed in this application could be employed for the dual purpose it is considered that the subject matter of the claim is not properly anticipated.

The decision of the examiner is reversed.

Oil-Sand Process Patent Claims Valid

AN appeal from the action of the examiner by the holder of a patent covering a method of recovering oil from oil sands was decided in favor of the patentee. The examiner had rejected claims 1 to 6 of which claims 1 and 6 may be considered as typical.

"1. Process of recovering oil from oil sands in situ which comprises flowing therethrough an aqueous liquid comprising a highly dispersed colloid material which is physically and chemically stable in the presence of said sands."

"6. Process of recovering oil from oil sands in situ which comprises flowing therethrough an aqueous liquid comprising a highly dispersed colloid material including a hydrocarbon sulfonate which will not form a precipitate when mixed with water that has been in contact with said sands."

The references relied on by the examiner are: Squires, 1238355, Aug. 28, 1917, Rogers, 1299385, April 1, 1919, Fyleman (Brit.), 163519, May 26, 1921, Barnickel, 1555818, Oct. 6, 1925.

The decision of the Patent Office Board of Patent Appeals follows in part:

The claims relate to a method of recovering oil from oil sands in situ and is for use with such sands as are spent in-so-far as substantial oil recovery by flowing and pumping is concerned. The method involves introducing into the sands a material in water solution which tends to liberate such oil as surrounds the individual grains of sand in the oil bearing stratum. The material used is broadly defined as a dispersed colloid material which is physically and chemically stable in the presence of said sands, in other words a material which will not unite with chemical substances found in the sand such as compounds of lime and magnesia to form an insoluble substance which would tend to clog the sand and thus prevent further oil recovery.

In our opinion, none of the references clearly teach appellant's basic method. The Squires patent relied on by the examiner introduces water into the oil stratum to displace the oil therein to a higher level in the stratum where it may be moved toward a well by air or gas pressure or picked up in vapor form by the same gaseous medium. As we read the patent Squires sought to displace free oil from pockets and had no thought of recovering such oil as was in emulsifying relation to the sand. Mention is made of using alkali with the water and also of using heat but this may well have been intended to increase the fluidity of the heavy free oil. At any rate there is no mention of effecting appellant's specific purpose.

The British patent to Fyleman broadly suggests in the provisional specification that his process is applicable to the treatment of sand or rock in situ. But in the complete specification no definite mention is made of such treatment. It is pointed out on behalf of appellant that many, if not all, of the substances proposed by Fyleman do not meet the requirement of physical and chemical stability which he considers essential to the practical working of his process and that therefore Fyleman had no real conception of a solution of the problem. With this contention we are constrained to agree.

The use of materials such as suggested by Rogers or Barnickel in the manner vaguely suggested by Fyleman would doubtless meet the claims but in our opinion this involves something more than a mere substitution of equivalents. Appellant by the substitution has converted an unpractical suggestion into a practical and meritorious advance in the art and in our opinion is entitled to the corresponding protection involved in the appealed claims.

The decision of the examiner is reversed.

Air School Name Censored

A WASHINGTON, D. C. correspondence school, Aviation Institute of U. S. A. Inc., giving instruction in aviation, has been ordered by the Federal Trade Commission to stop using as a part of its trade name the letters "U.S.A." or other letters, words, or insignia in ways that would indicate affiliation with the United States Army, Navy, or some department of the Government; or that its course is conducted according to government requirements.

The Commission found that use of the letters "U. S. A." both in trade and corporate names, and of the address "Washington, D. C.", and of the title "Lieutenant" in referring to the school's president, as well as a general use of insignia consisting of wings separated by a shield in its advertising literature, has a tendency to deceive the public, and to cause many to enroll as students under the erroneous belief that the school is officially connected with the Army, Navy, or some government department, and that its instruction is conducted in accordance with government requirements, and that because of such supposed official connections this school is in better position to give instruction than competing institutions teaching the art of aviation by correspondence.

Books SELECTED BY THE EDITORS

THE PHYSICS OF HIGH PRESSURE

By P. W. Bridgman, Prof. Physics, Harvard

FOR years the physicist Bridgman has been performing unusual research on matter at exceedingly high pressures (see article "Stupendous Pressures," in SCIENTIFIC AMERICAN, July, 1927, in which the same author describes work at pressures of 600,000 pounds per square inch). Now he has put together in a book the findings of all his investigations of the properties of solids, liquids and gases at these stupendous pressures. Heretofore there has been no book on this subject. Now there is—one of 387 text pages. Part of the text is somewhat abstruse, but a large part is graspable by others than physicists. The interesting technique is described.—$5.70 postpaid.—*A. G. I.*

TEXTBOOK ON SPHERICAL ASTRONOMY

By W. M. Smart, D.Sc., Astronomer, Cambridge Observatory

AMATEUR astronomers with mathematical leanings will revel in this new book which fills a gap that has previously been but poorly filled. It covers in separate chapters: spherical "trig," the celestial sphere, refraction, the meridian circle, planetary motions, time, heliographic coordinates, aberration, parallax, precession and nutation, proper motions, astronomical photography, navigation, binary star orbits, occultations and eclipses, and is almost wholly mathematical; 408 pages.—$7.20 postpaid.—*A. G. I.*

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