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January
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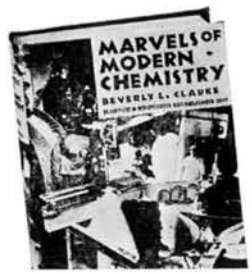

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SCIENTIFIC AMERICAN

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EIGHTY-NINTH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

Of General Interest

Aviation

Chemistry in Industry

Health Science

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

A Message from an Advertiser

RALPH STARR BUTLER of New York, vice president of the General Foods Corporation, in an address at a recent luncheon of the Association of National Advertisers, urged the delegates to investigate the type of circulations instead of the total net paid figure alone when placing their advertising.

"It took the depression, with its reduced appropriations to make the advertisers understand that they must get a dollar's worth for a dollar. If we are to go further toward deflation of costs we must have more careful buying. We must get away from quantity and place more stress on the quality of circulation.

"Reliance on the net paid circulation figure has been detrimental to the advertiser. We ourselves are responsible for the publishers striving for quantity rather than quality. The advertisers asked for big circulations and the publishers were forced to produce these figures. Many resorted to certain practices that they would not have otherwise employed. We got the large circulation figures and in addition the heavy costs which the publisher was forced to throw back on the advertisers.

"You can remedy this situation by looking into the make-up of your circulation report instead of the total at its end. If you find that this circulation is built up on premiums and you don't care for premiums, don't buy the space. Look inside your circulation figures and see how they are obtained. If you don't like the methods, you can stop them. Just don't buy it. Or if you doubt the substance of the circulation, tell the publisher you don't believe it and refuse to buy.

"There is no law forcing you to keep paying these heavy costs of quantity circulation. If enough advertisers take the stand the publisher will realize that quality and not quantity is wanted and will work toward this end. He will have to come to your way of thinking."

He urged the delegates to try and help the publisher reduce the circulation costs as a means toward lower lineage rates and said that their cooperation would be welcomed.

SCIENTIFIC AMERICAN invites you to investigate the Quality of its Circulation

ACROSS THE EDITOR'S DESK

EVER since we began the popularization of amateur astronomy in 1925, we have frequently received letters from readers who urged us to open a parallel campaign for the amateur microscopist. This, after many hesitations and weighings, we are now planning to do. We shall not, however, plunge headlong into the subject, nor shall we attempt to tell the amateur how to make his own microscope, since it is vastly harder to design and construct a microscope than a telescope. To start the ball rolling, our next number will contain an article which will tell the uninformed tyro how to start the amateur microscope hobby. If the interest thus aroused is sufficient, we shall publish other articles on the same subject in future issues.

●

Safety on the highway involves to a large extent the mechanical fitness of vehicles; but how is this fitness to be determined without placing an undesirable burden upon the motor-car owner? Certain communities have solved the problem by providing a way whereby the car owner may, of his own volition, receive a free inspection of the vital parts of his car. The checking and testing is expedited by a series of mechanical units that show such things as headlight adjustment, wheel alignment, and brake equalization. How the cars are rapidly inspected, and how the various mechanical aids operate will be told in an article, illustrated with a special series of photographs, scheduled for publication next month.

●

The importance of inorganic matter in our daily diet is rapidly becoming more clearly recognized. Ignored but a few years ago, 11 inorganic elements have been found to play vital parts in maintaining our health. How these elements have been placed in our diet as the result of scientific research will be told in an article to appear next month.

●

When you watch an historical drama unfold on the motion-picture screen, you may often wonder how the costumes and settings are obtained with such fidelity to the originals. Back of such a picture is a vast amount of research and painstaking labor that results in reproductions that will satisfy the most critical. Of course, there is a certain amount of "faking," but where does absolutely accurate portrayal end and faking start? You will be interested in an article on this subject that is scheduled for next month. Some of the movie methods that are used will surprise you with their lavishness, while others show how thousands of dollars are saved by legitimate trickery.

●

In the examination of paintings it is often desirable to know definitely what underlies the surface layer, or the relative thicknesses and exact composition of various superimposed films of paint. An examination that will reveal these facts often leads to the restoration of a valuable masterpiece that has been painted over by a more recent artist. A microsectioner has been developed to make such examinations more accurate and less likely to damage the painting. An article telling of this device and the work which it accomplishes will be published in our next number.

●

Much of the future economic progress of this country will depend upon the development and use of the vast potential wealth that lies in the flowing streams of America. With this fact in mind, we will publish soon an article by Calvin V. Davis in which is presented a remarkable study of the complex problem of water conservation in all its economic and engineering aspects. In this article Mr. Davis surveys the technical advances in the development of water resources, and the improvements in our economic structure that will parallel the application of these advances.

●

Here is what one of our readers, Paul W. Kuhlman, thinks: "I must express great satisfaction in the fine work done in 'The Scientific American Digest.' Surely there is nothing of the same general nature which could satisfy me better. Being an electrical engineer, I might desire more radio articles, for example, but the excellent articles by prominent astronomers and scientists would make me say: 'More space to them.' Although radio is my hobby, I never miss reading Mr. Ingalls' 'Amateur Astronomer.' The Boulder Dam articles gave a broader description than any I happened to see in the electrical magazines; thanks for them." Has anyone else an opinion to express? The welcome mat is out. Come on in!

Editor and Publisher

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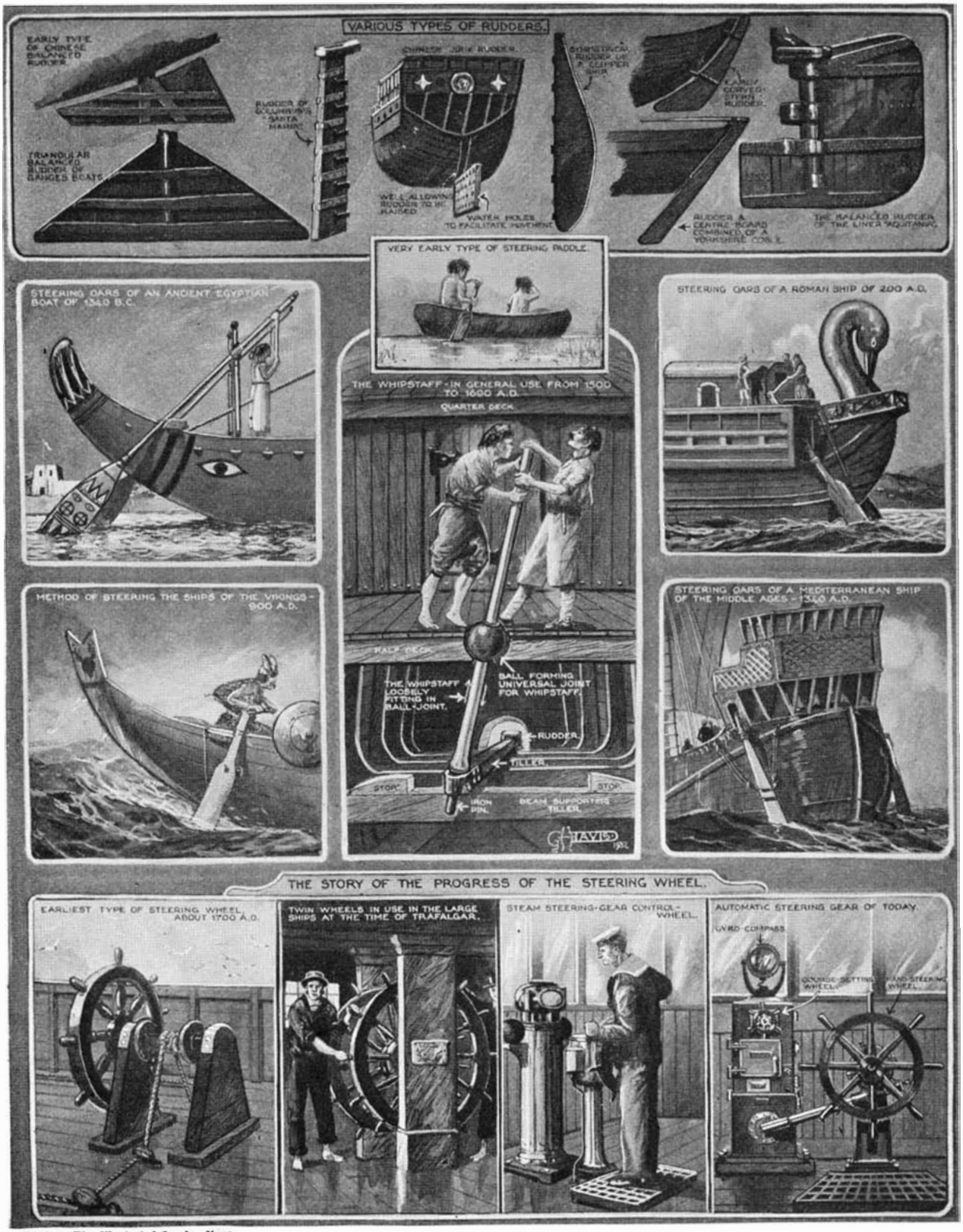
WILLIAM DAVID COOLIDGE

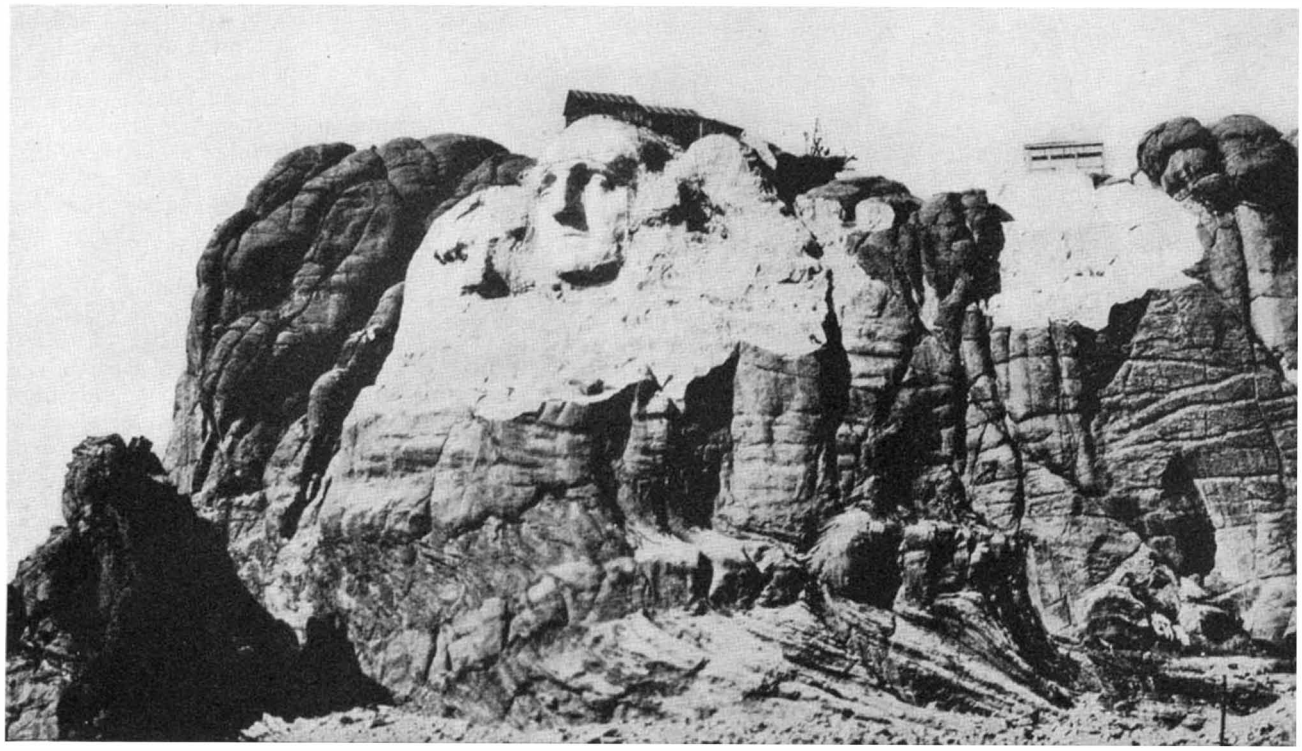
THE myriads of incandescent lamps which flash on all over the world at dusk proclaim the genius of Dr. W. D. Coolidge, who, after 27 years as a member of the staff, Assistant Director, and Associate Director of the General Electric Research Laboratory, was recently appointed to succeed the retiring Director, Dr. Whitney. Dr. Coolidge's contribution to the incandescent lamp as we know it today was his development of ductile tungsten for the manufacture of the filament. This one achievement was a greater step in the history of illumination than any other before or after Edison. Dr. Coolidge's fame does not, however, rest on that achievement alone. He it was who developed the hot-cathode type of X-ray tube bearing his name, which rendered highly practical what previously was scarcely more than a laboratory device. As a result of this and other important developments of his—notably the wrought tungsten target for the X-ray tube, the development of various types of X-ray generating equipment, and modifications of the original Lenard cathode-ray tube which have greatly increased its power—the science of radiology has made long strides forward in recent years. Among Dr. Coolidge's many other developments, for which he has received a number of gold medals and international honors, is the "C-Tube," a listening device for submarines and for underwater signaling.



Courtesy The Illustrated London News

FROM STEERING PADDLE TO GYRO-COMPASS

WHEN early man used his primitive paddle to steer his dug-out canoe, he swung it alternately from side to side in order to keep on his course. Later he learned to steer by twisting the blade. For ages, paddles in one form or another were used to steer even large vessels, until the introduction of the rudder placed on the center line of the ship. Then came the whip-staff, the steering wheel, and finally the automatic gyro-compass steering gear of today. The drawings admirably depict this evolution.



Mount Rushmore, showing the Washington head nearly completed and the Jefferson head taking form. The completed group will include the likenesses of these two Presidents and two others: Lincoln and Roosevelt, with an historical entablature

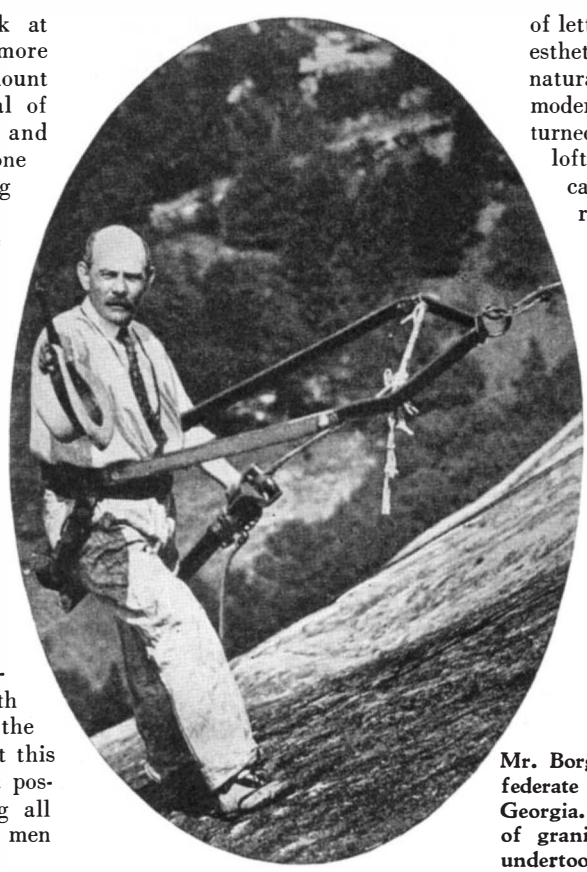
MOUNTAIN SCULPTURE

By GUTZON BORGLUM

WHEN undertaking the work at Stone Mountain, Georgia, more than 10 years ago, the paramount problem I faced was the removal of granite in great quantities, quickly and without danger or injury to the stone that must be saved for carving purposes.

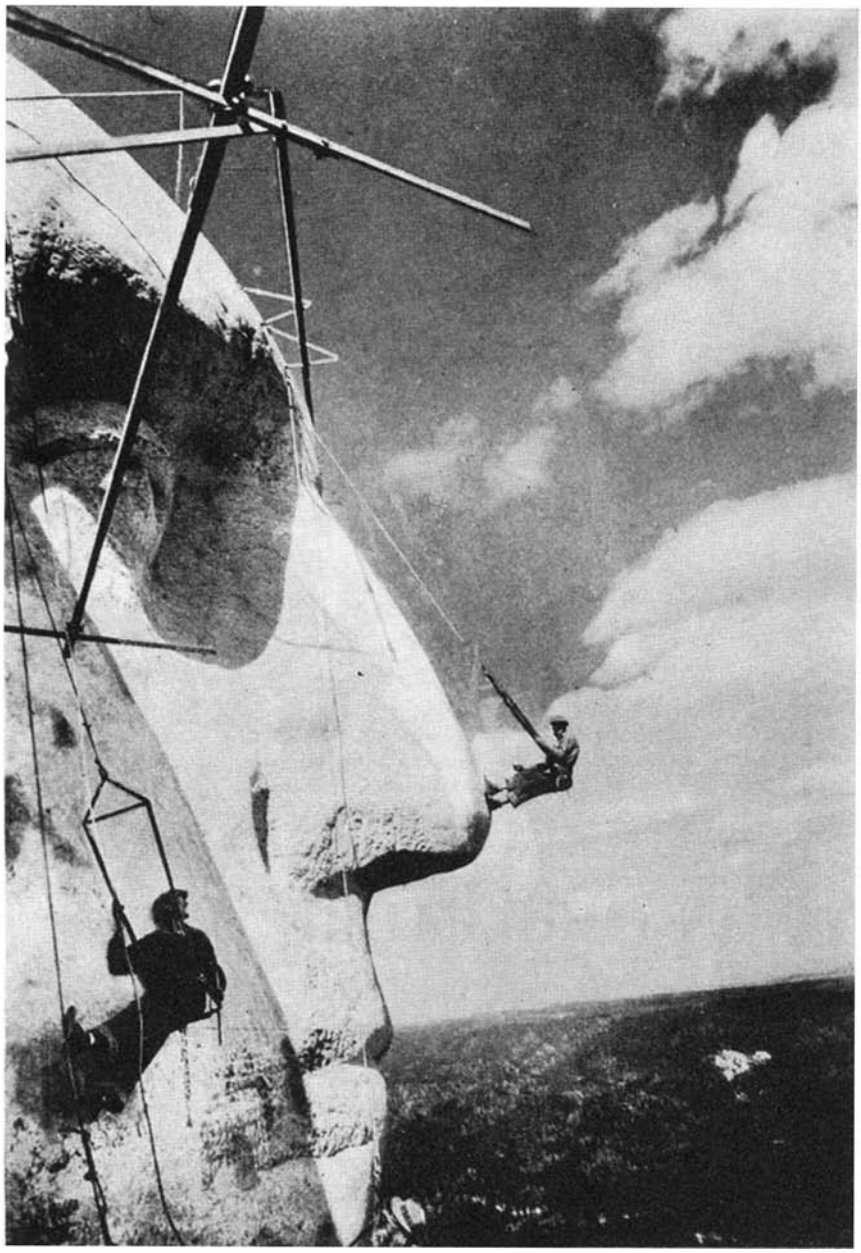
Modern work, through the use of machinery developments and inventions of all kinds, has naturally and necessarily increased in volume. Everything in modern civilization has so expanded that the very scale, the breadth of one's thought, is no longer limited by town, city, county or state, but daily reaches to the boundaries of the world. Telegraphy, the telephone, transportation, roads, automobiles, flying machines, and now the radio have literally put the farmer in the mountains, on the plains, in our remotest provinces, in instantaneous touch with the doings and the thought of the world. It has occurred to me that this physical metamorphosis could not possibly take place without affecting all creative minds—artists, inventors, men of letters and music—and every form of esthetic expression. I believe it was natural and consistent with the great modern awakening that I should have turned to the huge cliffs of our land, the lofty granite ledges, and in them carve monuments and there leave records of the founding of our great nation and the development of our civilization.

I am sure it was an unconscious or subconscious response to this world demand that led me to undertake the work on Stone Mountain, not realizing then what was back of the impulse and without any experience in that kind of work, for which there was no precedent; the ways, means, and methods had never been worked out. Somehow it seemed quite natural to approach a wall 800 feet high and 3000 feet long, containing some 60



Mr. Borglum working on the Confederate Memorial, Stone Mountain, Georgia. It was on this great mass of granite that Mr. Borglum first undertook to carve colossal figures

Courtesy *The duPont Magazine*



A close-up profile of the Washington head on Mount Rushmore, as it nears completion, showing two of Mr. Borglum's assistants at work on facial features

acres of granite available for carving. But it is not reasonable to suppose that anyone would undertake such a task, under such conditions, without question and much guessing, and without a dominating anxiety as to the mechanics of the work in hand. What could I do, what should be done to remove the stone with the rapidity and facility that one works over a marble bust in one's studio? This thought occurred to me before I had measured the acreage I intended to use for my carving: How could I whip those enormous dimensions and reduce the mountain to a handful?

When I first put drill to that 800-foot block, directing the hands of men I could hardly see at a distance of 1500 feet, I was still more impressed that without some effective substitute for the thousands of enslaved craftsmen of the Egyptian days, our undertaking would never come to an end. I spent days and weeks experimenting with ways and means of blocking out masses of unnecessary stone and trying, by plug and feather wedge and drills, to split them off. All these efforts proved childish and inadequate. After months of trials and failures and careful calculation of costs, I began to see that the work would be next to interminable with the labor we could afford and by the then known methods at our disposal.

I had thought some of explosives but, knowing little about them, had vetoed their use. The general idea is that high explosives can only be used to destroy, disrupt, tear asunder, and wreck. As I thought this subject over, much as I am writing it, another thought came to me: Why not control the explosive force? Firearms control it; why not develop some means by which we could blow off just what material we wanted to be rid of, in precisely the quantities we wished to remove and at the same time preserve the stone left in place, intact and without injury? That problem I pondered over for months without discussing it with anybody.

Just at that time a Belgian engineer, who was passing through Georgia, visited me at Stone Mountain. I told him what our difficulties were, quite apart from the safety problem of carrying men to such a height, apparently unprotected, to work on the side of the mountain. The removal of stone was costing too much and was too slow; the old methods were detaining, hindering the development of the design; the cost was prohibitive.

"Why don't you use dynamite?" he calmly asked.

"I have been thinking of it," I replied, "and am on the point of making experiments."

He then told me that he had recently enlarged a tunnel through a ledge of granite, only a few inches, and that by arranging his drilling and adjusting the charges of dynamite, he was able literally to cut the six or eight inches from the main ledge as cleanly as though it had been channeled.

OF course, any one who knows anything about granite knows that it splits easily in some directions, while in others it is stubborn and "cranky." I spoke of this and he said he had met with that in his tunneling and had found mechanical means of overcoming the trouble.

"Where I cross the grain of the granite," said he, "I put my drill holes closer together. While I drilled my holes to the same depth, I did not place my dynamite at the bottom of each one, but scattered the charge, zigzagged it up and down the wall." And then he added, "I measured carefully my charge, kept it so light that the six-inch shell often only cracked the stone loose, and sometimes a hand bar would be required to release it."

If I ever had the gentleman's name and address, I have lost it, but that night in the lamp room I projected the photographs of my models of Lee, Jackson, and Davis on Stone Mountain, which was a little over 1100 feet from our location. The slide was small enough so that I could hold it in the hollow of my hand, but the picture, projected without distortion, covered nearly an acre. We studied it together. It was this traveling engineer who gave me the assurance and impetus that resulted in the practical use of dynamite for carving the gigantic figures, in dimensions to harmonize with the colossal thought and life of our day.

I spoke of this experience to a great

friend of the mountain memorial idea, the late Coleman duPont and, following his suggestion at the time, I communicated with the duPont powder people at Wilmington, requesting that one of their experts be sent to Stone Mountain to instruct me and my assistants in the use of high explosives. They responded very graciously and sent a man who, I believe, was on special duty in Florida. He remained with us many weeks, until we had mastered the work. So it was that the amazing, almost fantastic, idea of carving with dynamite came into use.

I ought to say here that we use high explosives in all proportions and in all quantities. I have two or three men—always more than one—who are not only experts in their knowledge of what an inch or six inches of dynamite will do, but who know what can be done with a percussion cap alone, even without the dynamite. Such a man must also know and be in constant touch with the drilling that is going on and with the general design; he knows the power of his explosive and the danger that may come to stone in place or to nearby work by using an overcharge. This empirical knowledge has proved of great value at Mount Rushmore, S. D.

WE have developed the drilling and blasting away of stone on Mount Rushmore to such a nicety that I can shape out a nose to within an inch or two of the finished surface, even down over the point of the nostrils, can shape out the lips, and grade the contours of the cheek and the brow and all curved surfaces. We can shape out even the eyeball as a whole, but the defining of the eyelids and pupils is done with a drill and the air tool, operated by hand.

Last year at Mount Rushmore, while working on the figure of Washington and blocking out the head of Jefferson and Lincoln, we removed over 12,000 yards of granite with less than 15 men. Not a foot of this stone was simply blown away; it was all carefully tagged or pointed, measured, blocked out, and marked. Then the dynamite charge was calculated to do the necessary work without injuring any stone left in place. Drilling and blasting followed and the carving went on. Following each shot, the remaining stone is carefully examined for any evidence of fault or injury. If found in perfect condition, it is marked for further work in blasting or air drilling and finishing.

In removing stone by this process, we first calculate the amount to be removed. For example, let us say there is 15 feet of granite down over the face to be carved. Then we locate the high points of the face, the end of the nose, the brows and chin. Next, for test purposes, we drill to a depth of three feet, to ascertain the nature of the rock and to discover whether there are any hidden cracks. If so, we note whether they are disappearing or increasing. The condition of the stone guides us constantly in drilling and loading holes. If the surface is imperfect, we move with great care, reducing not only the charge, but also the amount of stone to be removed by a single blast. This cautious procedure is maintained; we make each explosion lighter and lighter as we approach the face. In this way we are certain no injury can occur to the body of the rock.

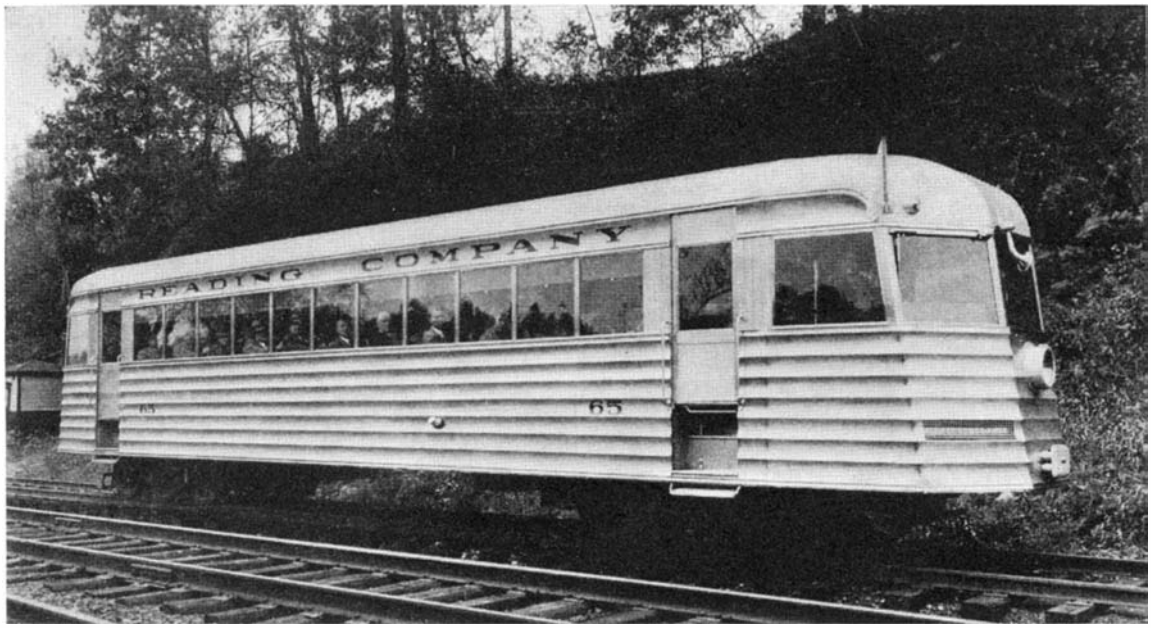
This year we expect to remove another 10,000 or 12,000 yards of granite before the Fourth of July, incidentally carving the entire front of Washington's coat and his left arm, including the finishing of these parts. Thus, in less than 60 working days we shall remove 10,000 to 12,000 yards of rough granite, and block and finish an area equal to an acre, representing the shoulders, waistcoat, and left arm of Washington. I doubt whether the ancient Egyptian craftsmen could handle such a volume of work even though they labored shoulder to shoulder over that entire surface; and I doubt too, whether the work we shall do in less than 60 days, with the aid of explosives, could be done in three years by old methods or at less than six times the cost.

●

The word "conservation," when applied to water resources, means "to develop and use"—not "to preserve." An article soon to be published shows this distinction and the importance of our water resources.—The Editor.

Photographs courtesy *The duPont Magazine*

The mouth and chin of the Washington head. This view shows clearly the manner in which numerous holes are drilled for removing small amounts of granite



The first pneumatic-tired car to go into regular service on an American railroad. It is built of stainless steel and is therefore much lighter than the present standard passenger cars. It is equipped with Diesel-electric drive

Fast Rail Car on Pneumatic Tires

SOME months ago a revolutionary change in railroad practice was forecast as the result of successful tests of the new Michelin rail tire in France. In itself representing a progressive idea, this new tire is pneumatic and has provisions for taking care of the weight of a rail car in the event that the tire goes flat. Experts saw in it a means of re-opening for service short lines of railroad which have practically ceased operation due to intense highway competition and for rendering fast and more frequent service on other lines. In short, here seemed to many to be an idea that could be worked out for the rehabilitation of the railroads in this country.

A RAIL car for using this new tire was immediately planned by the E. G. Budd Manufacturing Company, an American manufacturer, and the result is that the first of the Budd-Michelin, pneumatic-tired, Diesel-electric, rail cars is now in operation on the lines of the Reading Company. The new car will carry 47 passengers. It is of stainless hi-tensile steel construction throughout, practically all parts of which are "shot-welded." The outside of the car will have no paint as the lustrous stainless steel has a permanent finish.

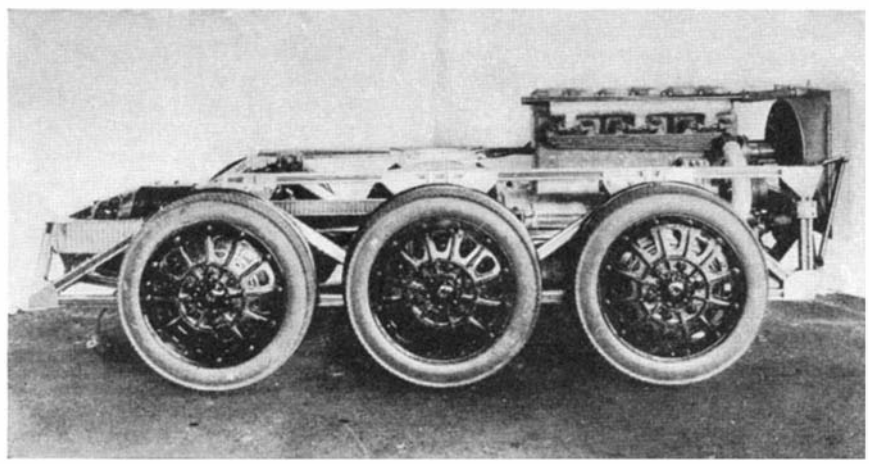
The front or power truck, shown at right, is equipped with a 125-horsepower Cummings Diesel engine directly connected to a Westinghouse 250-volt generator of special light-weight construction. In the power truck are mounted the batteries and control. The rear, or traction truck, has a single high-speed Westinghouse motor mounted under the bolster. The double extended shaft drives the front and rear axles of the truck through a 9.1 Timken differential worm.

The car weighs approximately 22,000 pounds and has a speed of from 50 to 55 miles per hour. The tires are 33 by 4½ inches, and carry a pressure of 95 pounds.

The fundamental development work of the Budd Company in handling and forming thin sheets of steel, and its research into welding methods have contributed to the fact that the car and truck construction is modern to the last degree. Relatively overnight, the weight of a self-propelled car of a given seating capacity has been reduced to 33 percent of that of a passenger coach having no power, as used on Class 1 roads.

Although the car is radically new in every point of construction, the riding qualities of the pneumatic-tired wheels, the exclusion of noise as well as dirt by the permanently closed windows, and good acceleration, all combine to give the passenger a reaction heretofore unattained in any self-propelled vehicle.

The Reading Company's car leads the way and is a permanent milestone in the design of self-propelled cars and trains that will operate at very high speeds and in deluxe service with an economy attractive to the railroad operator.



The front truck of the new car is equipped with a 125-horsepower Diesel engine and a 250-volt generator which supplies electricity to a motor on rear truck

OUR POINT OF VIEW

Rehabilitation Necessary

FOR several months we have seen on every side healthy signs of recovery from the despair that has beset many of us for long and dreary months. The consensus now is that business and industry are definitely on the up-grade and the increase in employment will continue in an ever-rising ratio. Thousands have gone back to work already; thousands more, millions even, will take up the tools of their trades in coming months.

Anticipation of this employment recovery is very encouraging, but—we are not yet out of the woods! There is a difficult winter to be passed, and jobless ones and their families will be cold and hungry. To ease the suffering of these unfortunate economic casualties, relief committees throughout the country will ask all who can to give "until it hurts" during the coming months. Give every cent you can possibly spare, for millions of dollars will be needed, and we must take care of our own. We must and will see it through!

There is still another angle to this problem that confronts us. Millions who have been unemployed for long periods have so far lost the "habit of work" that serious rehabilitation measures are now and will be necessary for perhaps years to come. Many of the unemployed ones have been rebuffed for so long that they have become introspective and afraid to face things squarely. It is therefore not enough that we give financial assistance and encouragement; it is up to us also to foster and promote educational schemes which will bring back to them confidence in themselves and, in fact, their self-respect. Personal contact with the unemployed shows us that this is vital.

Much has already been written concerning leisure-time opportunities for educating one's self for a better position during a period of unemployment, but with jobs opening up everywhere, it is useless to emphasize this fact now. Each person is going to spend most of his time trying to find a job. To reach these people, radio programs such as the "New Occupations During the Depression" program of the New York Y. M. C. A., and others of a purely educational character would do a great deal of good. Schools and colleges can accomplish much by keeping in close touch with and advising recent graduates who have had financial difficulties, to keep them from going on the rocks at an impressionable age. Lastly, the great mass of people everywhere can, by keeping up its own courage and fighting through to better times, by holding on to faith and hope and backing it up with hard work, by putting money in circulation and by making jobs wherever possible, stimulate and encourage those who need more than sympathy at the present time.

Planetary Vibrations?

EVANGELINE ADAMS is dead but astrology is not. In fact, this "science" (so-called by its votaries) must have gained impetus because Miss Adams so accurately predicted her own death—at sixty.

Perhaps Evangeline Adams did know when she would die. Not all men of science are yet ready to deny that some human beings have some kind of direct insight into future time—whatever time is. This question is one which the scientist is willing to leave open for future study. What he does deny is that the stars control our lives and that the motions of the planets serve as a guide to the future. Need the reasons for this rejection be argued and labored before our readers? We shall not thus insult their intelligence; while we do not flatter ourselves that we could in the least alter the views of the astrologers. In fact the astrologers do not read this magazine. If they did it is unlikely that they would be astrologers.

Evangeline Adams, whether she derived her findings from the stars or from some other source, or just "derived" them, was able to make remarkable predictions. She had an immense following, mainly among women, and to her disciples she was a great prophet. If astrology is childlike, still on the whole she did more good than harm; she helped many to find their life work. It is said that the annual income from her numerous forms of service was 50,000 dollars—largely wasted money, no doubt, but people pay that much every minute for other forms of amusement.

Miss Adams sincerely believed astrology was one of the sciences and felt aggrieved that astronomy, the legitimate offspring of astrology (which it surely was) is ashamed of its parent.

When one counts noses, not merely among the intelligentsia, but among all classes, and reckons up the number of persons who are subject to beliefs in superstition and are otherwise intellectually gullible, there is clear evidence that this is not after all the Age of Science, except among a relative few, but is still the Dark Ages.

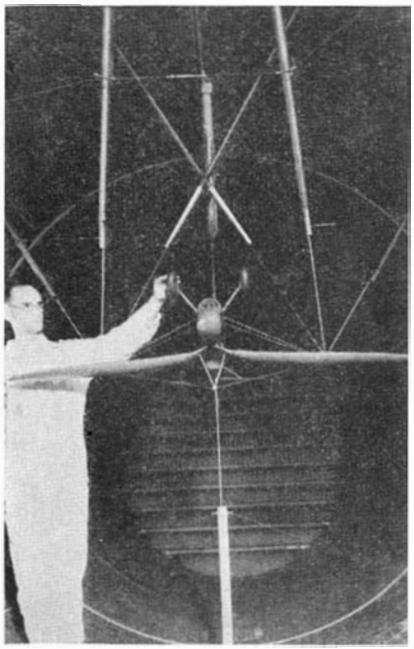
Is astrology a science or is astronomy a superstition; and when will the human race grow up?

Pioneering Progress

"WE are yet but on the frontiers of development of science and invention. I have only to remind you that discoveries in electricity, the internal combustion engine, the radio, . . . have in themselves represented the greatest advances in America. . . . Progress in that generation (the last) was not due to the opening up of new agricultural land; it was due to the scientific research, the opening of new invention, new flashes of light from the intelligence of our people. . . . There are a thousand inventions for comfort (and, the editor might add, for prosperity) in the lockers of science and invention which have not yet come to light; all are but on their frontiers." Thus spoke recently a noted and successful engineer, a man who envisions a far greater growth for America in the future than she has experienced at any time in the past; and in so speaking, President Hoover at once proclaims and encourages the genius of the American people.

The agricultural frontier of America is, indeed, gone forever, but the pioneering spirit which it engendered and stimulated has become rooted in the people; it is now part and parcel of the American system though the frontier toward which we strive at present is, as Mr. Hoover says, in science and invention. Appropriately, we may quote just here from President George Norlin, of the University of Colorado, who holds the Theodore Roosevelt Professorship in American History at the University of Berlin. In his recent inaugural address, he aptly stated that the old frontier has laid the foundation of American character "in self-reliance, self respect, neighborly co-operation, and the vision of a better and richer life, not for a privileged class, but for all."

Adversity may halt our steps for a little while, but only a little, for the world is young and there is much yet to be done; the stakes are high, the goal a glorious one, and nothing will daunt the pioneering spirit that is our birth-right.



An army observation plane ready to be "tamed." It is suspended in the rushing air-stream of the wind tunnel, upside down, and is connected by wires to the instruments

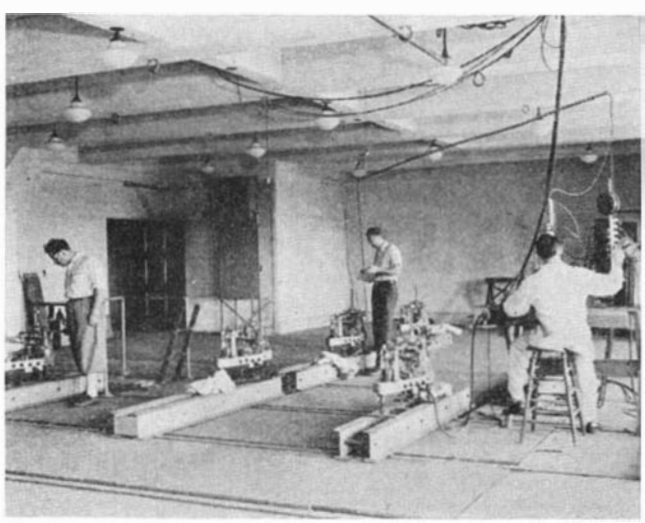
DELICATE INSTRUMENTS

AN army pilot, flying on a lone cross-country observation mission in southern Texas, runs into an unexpected storm. His high wing monoplane rocks and dips violently in the first gusts of "bumpy" air. Then it levels off, and with little more concern than one closes the door to shut off a draft, he proceeds on his journey, two miles above the earth, confident that his sturdy plane will carry him through.

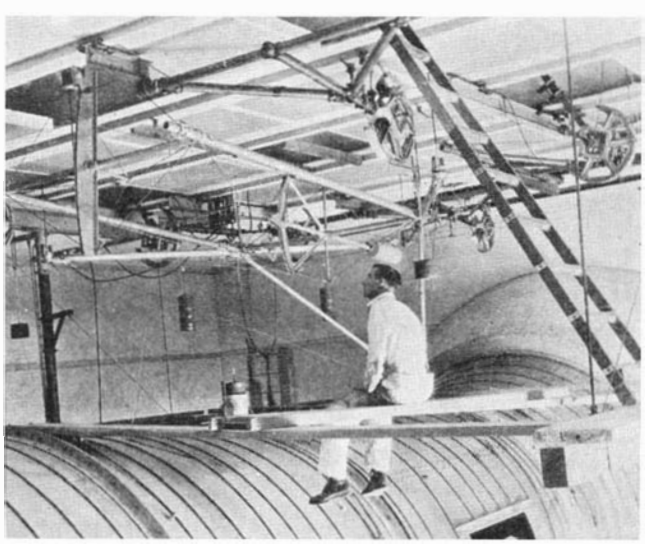
The pilot is confident not alone because he has learned well how to fly observation planes, but also because long before these ships reached army fliers a scientist and a wind tunnel had "tamed" them in gales that raged at speeds in excess of 200 miles an hour.

At the California Institute of Technology, Dr. Arthur L. Klein weighs wind pressures on models and actually determines the effects of winds up to 240 miles an hour—twice the speed of the observation planes—on 100-pound models the wings of which stretch no more than six feet across the 10-foot observation station. As the gale rages, he, with two assistants, reads these reactions in terms of pounds on five self-recording scales in a room 20 feet above the tunnel. From each of these delicate scales, capable of recording weights from one four-hundredths of a pound to 900 pounds, one point of the model is suspended by a long wire.

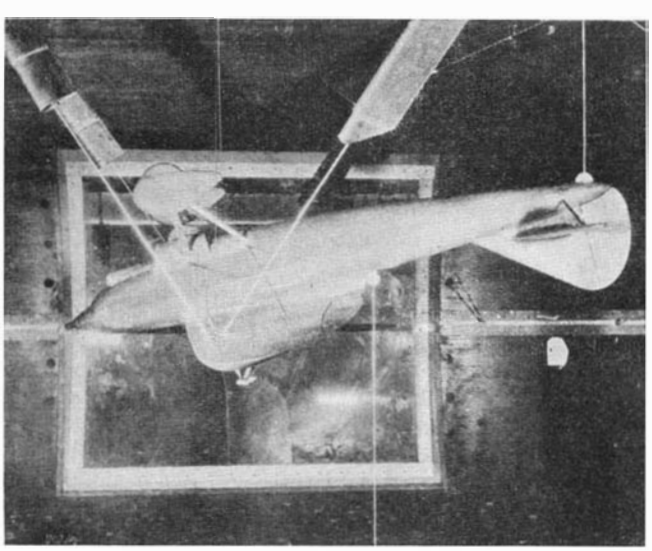
Thus Dr. Klein and his associates in the Guggenheim laboratory remove much of the hazard from flying by reducing the reaction of airplanes under unusual conditions to ounces and pounds. On these delicate balances, of his own design, he tested a 10-foot model of the *Akron*, world's largest dirigible, before she joined Uncle Sam's



Left: **In the instrument room above the wind tunnel are located five automatic scales which indicate the stresses exerted on the model under test in the terrific wind stream. The operator at the right in the photograph controls the position of the model as well as the speed of the man-made wind through the tunnel**



Above: **The space for rigging above the wind tunnel and below the instrument room, through which pass the wires connecting the model with the automatic scales. The top of the tunnel, and a part of the window in its side, may be seen near the bottom of this photograph**



Left: **View of a model monoplane as seen through the window in the side of the tunnel. Models are always set up in an inverted position so that stresses can be measured directly through the strong supporting wires**

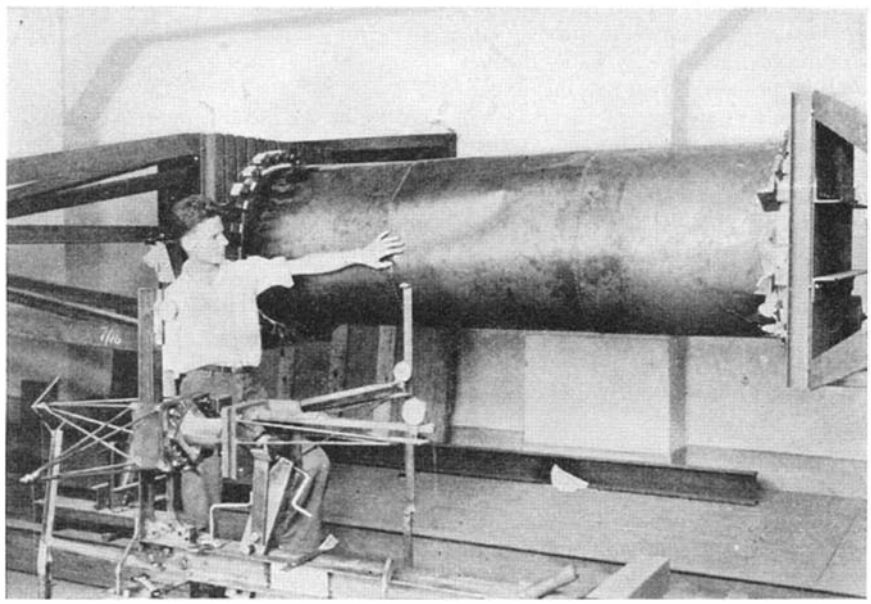
TAME WILD AIRPLANES

By ANDREW R. BOONE

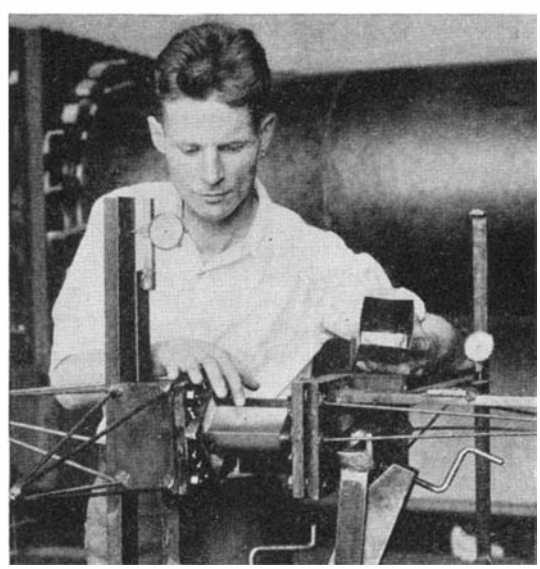
naval fleet, and more recently "tamed" the fast metal monoplane in which Bernt Balchen expects to dash 3000 miles across the South Pole this year. Connected to the five scales, Balchen's model plane was suspended in the tunnel upside down. All models are tested as though in inverted flight, for in that manner they are "lifted downward," as Dr. Klein explains. Thus can be measured the pulls and pressures directly through wires, rather than indirectly through supporting columns, as would be the case if models were installed right side up.

But trying out the complete models is only one part of the laboratory program to make flying safe. As the wind roars through the tunnel, technicians elsewhere in the building are pulling metal strips apart, twisting huge cylinders (with steel walls nearly as thin as paper), compressing smaller cylinders. All this is to learn the effects of twisting and pulling and pushing in the air. One large cylinder, approximately the size of a small airplane fuselage, reveals graphically the effect of a sudden twist, buckling under the strain. From these various studies Dr. Klein hopes to evolve formulas governing the extended use of metals in airplanes, metals of light weight that can withstand extraordinary strains in the air.

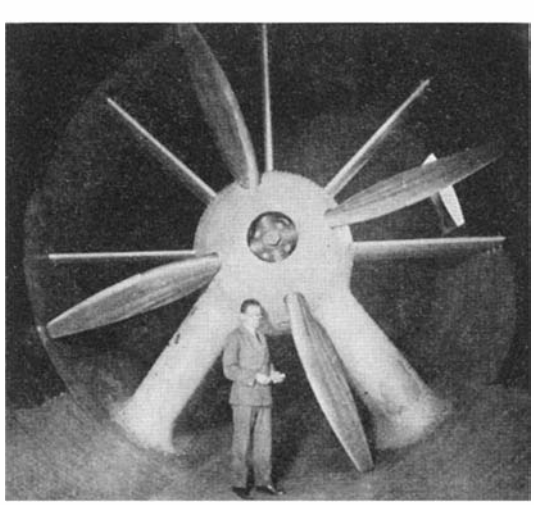
Dr. Klein conducts these experiments with various kinds of metals in the belief that in a short time airplanes will be all metal, mostly on the monoplane type, without fuselage or tail. The value of these investigations is considerable. Airplane manufacturers will not be surprised if these researches into the behavior of metals bring about a method of building "flying wings" with sealed cabins, yet lighter and stronger than any planes flying today.



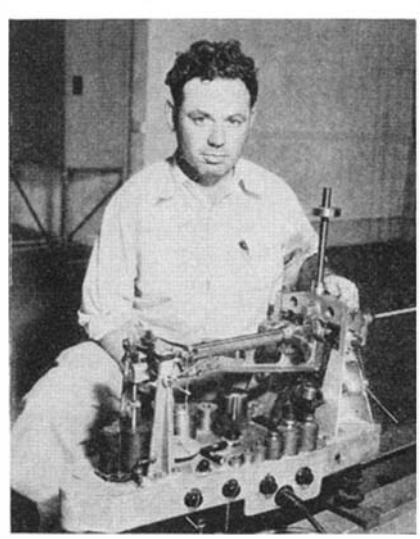
Above: **The large cylinder set up in this machine represents the fuselage of a plane. Note the "sheer wave" at which the operator is pointing. That is the way a metal plane fuselage might behave in the air!**



Right: **This machine tests models of metal shells, twisting and compressing them, in the course of the studies on the use of metal in planes. The results of such tests add to the sum total of knowledge regarding stresses in metals**



Left: **This fan, 15 feet in diameter and driven by a 750-horsepower motor, is capable of creating a gale of 240 miles per hour through the tunnel shown on the opposite page**



Right: **Dr. Klein with one of the balance scales which he designed for wind-tunnel work, and which are shown in use in the instrument room on the opposite page. Range of scale is from one four-hundredths of a pound to 900 pounds**

THE NEW WAVE ATOM, ELUSIVE

By C. J. PHILLIPS
Physicist, Corning Glass Works

IN innumerable cases two or more substances coalesce to form a new substance which may be so distinct in all its properties that nothing, apparently, remains to suggest the constituents from which it was formed. Oxygen and hydrogen, both gases under ordinary conditions, combine to form water. Sodium, an inflammable solid, and chlorine, an irritating gas, combine to form ordinary table salt. Conversely, even the most complicated compound may be divided by suitable means into its component elements and these usually differ widely from the parent substance.

Now it is the fundamental tenet of the atomic theory that these pure, elementary substances—sodium and chlorine in the above example—may still further be subdivided into minute particles called molecules; that each of these molecules in turn is composed of a limited number of still smaller bodies called atoms; and that each atom itself has a structure and is composed of protons and electrons. The structure of matter may in a sense be considered entirely electrical in nature since the protons and electrons are identified as equal positive and negative charges, respectively. Except in extraordinary cases, however, each atom is electrically neutral, due to the presence of an equal number of protons and electrons. With this brief explanation the family tree of Figure 1 should be sufficiently clear.

THE most startling property of electrons, atoms, and molecules is perhaps their minute size. Ten billion times a bird-shot is as big as the earth. Ten billion times the effective volume of an atom is less than a yard across. On the same scale 380 electrons would occupy but a pin-point.

This disparity of volume between atoms and electrons indicates that the atomic volume is mostly emptiness with much room for traveling. And all theories agree that travel the electrons do, often with a velocity approaching that of light, fastest mover of all. While the electrons rush furiously about within the atom, the atoms move about within the molecule, and the molecules themselves move within the mass of matter they constitute, freely when the matter is gaseous, less freely when liquid or solid. Everything—the earth, the paper upon which I write, the very air we breathe—consists of unimaginable millions of little worlds within worlds, rushing and revolving more rapidly than rifle bullets.

Despite the falsely apparent certainty of these facts it must be pointed out that no one has ever seen an atom, or an electron, or even a molecule. Given a microscope several hundred times more powerful than any we now possess we might be able to see some of the largest molecules, provided we could pin them

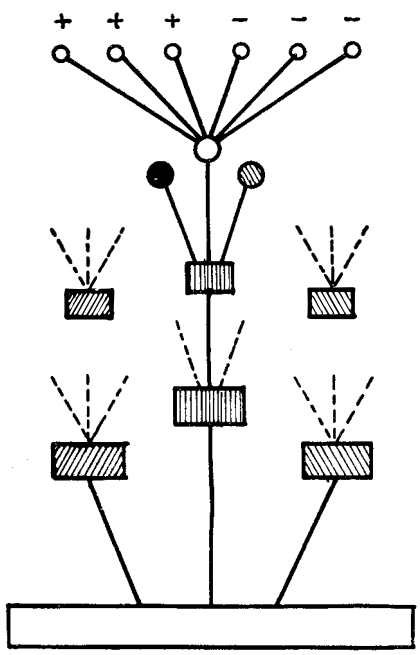


Figure 1: **The "family tree" of matter. At top are electrons and protons—equal numbers of each, from 1 to 240 per atom. Next are atoms, usually several different kinds for each molecule; then molecules, many kinds. Last come chemically pure substances and ordinary matter**

down and thus make them cease their perpetual dance. But we would still be hopelessly far from the sight of either atom or electron. The best we can now do with our most refined instruments is to view a tiny bit of matter which probably contains as many atoms as there are people on the earth. All our evidence is thus necessarily indirect, a process of deduction from various atomic and electronic performances under controlled and usually artificial conditions. It is the sort of evidence, as G. P. Thomson says, that a blind man would get of the workings of a fine watch by poking his finger into it. Nevertheless, some of this evidence is so striking, so conducive to results of great theoretical and practical importance, that we feel justified in attempting to build further upon this material as a foundation.

One of the most fruitful means of experimental investigation is spectral analysis. It is well known that if ordinary sunlight is passed through a glass prism it is split up into a series of colors: red, orange, yellow, green, blue, and violet, in just that order. It was discovered about 100 years ago that certain sources of light show, not a continuous color band, but one consisting of bright lines separated by dark intervals. It was then discovered that the number and position of these lines were characteristic of the substance emitting them. Common salt inserted in a gas flame shows a spectrum of two yellow lines close together. They are the fingerprints of NaCl and of NaCl alone. No other substance emits them. Sometimes the spectra are far more complex. But all this means simply that atoms and molecules possess energy, that part of this energy can be spent in the emission of light, and that the spectrum of this light is a characteristic of the kind and type of atom or molecule.

IN the case of hydrogen, the simplest substance with which we are familiar, an interesting peculiarity appeared, in that the spectrum was found to consist of groups of lines arranged in a manner apparently indicating a regularity of formation. Somewhat later empirical formulas were found which served to map out this hydrogen spectrum. The peculiarity continued to manifest itself in these formulas, by the fact that they all were proportional to the differences of the squares of simple numbers, such as one, two, or three. Here, certainly, was something worthy of further investigation. Ofttimes the knots and nodes and isolations in which such investigations result must seem to the layman like pure flights of fancy. But, boiled down, all the resultant trials, assumptions, and modifications are attempts at but one thing—to find a one-to-one correspondence between things known, but unexplained, and some sort of theory that will serve to make them plausible within the limited scope of our reasoning. So with this; the regularities apparently inherent within the hydrogen atom constituted the major facts to be explained by any good atomic theory.

The older atomic theories started with a model of the atom, guaranteeing as

AND MYSTERIOUS

THE real inwardness of the wave atom or wave mechanics cannot be explained without mathematics, any more than the Einstein theory can. Words do not suffice to reach it. Must the average "mere mortal" therefore be excluded for evermore from all knowledge of it? Perhaps not. Using all the word resources at his command, the author of the accompanying article has succeeded in giving a pleasing peep into a thing which admittedly only the mathematician can hope to bring into clear focus.

Even the mathematician and the physicist, however, have difficulty with the wave-atom concept. It is far from easy. Some high-grade scientists have confessed that they find juggling with it about as "simple" as carrying an armful of eels.

In the article the reader will pick up evidences of the perplexities of present-day science concerning the exact nature of the atom. The picture thus given may take the edge off some of the rather confident tone of settled assurance with which these matters are described in some popular books not written by physicists or other scientists. Certainly the scientists themselves do not believe they have "arrived" yet at ultimate truth concerning the atom.

—The Editor

far as possible simplicity from the very start, but tolerating all subsequent mathematical complexity merely because it came from that lovely model. Lord Kelvin thought the atom looked like a ring blown from a smoker's pipe. J. J. Thomson likened it unto a sphere of jelly or a plum pudding, each electron being represented by a plum. But the proof of the pudding was in the eating and the eating was not good.

The most successful picture of them all was that drawn by Niels Bohr, the great Danish physicist. Bohr proved that the regularities in the spectra of hydrogen could be reproduced by assuming three things: first, that the hydrogen atom consists of one electron and a nucleus, where in this case the nucleus was to be identified as a proton; second, that the electron revolves about the nucleus without radiating energy; and third, that among all the conceivable orbits which the electron might describe about the nucleus there are certain special ellipses which alone the particle is allowed to choose. In each permitted ellipse, according to Bohr, the electron possessed a definite amount of energy, which varied from ellipse to ellipse; but when, and only when, the electron actually jumped from one ellipse to another did it radiate energy and hence emit a spectral line. The solar system thus appeared to form a gigantic model of the interior of an atom, which was supposed to look somewhat like Figure 2 where the ellipses have been replaced by circles for the sake of simplicity. Though there was no good physical reason why it should be so, the electrons apparently were traveling on tickets permitting stop-overs only at New York, Pittsburgh, or Chicago, and nowhere between. Strangely enough it was in the countryside that the shootings occurred, for the atom could only, by postulate, emit energy enroute and never while visiting in any one orbit. Of course, innumerable connections were possible, since the electrons appeared to show no permanent liking for any one address, and this fact accounted for the complexity of the observed spectra. Moreover, the appearance of squares in the spectral formulas could be explained by assuming the energy of the electrons to vary as the squares of the radii—an assumption very prevalent elsewhere in physics.

Thus in many respects this theory and model were most successful and, indeed, the first of these postulates—that the hydrogen atom consists of one electron and one nucleus—has never since departed from the reasoning of physics, though in other respects, too numerous to detail here, it has definitely

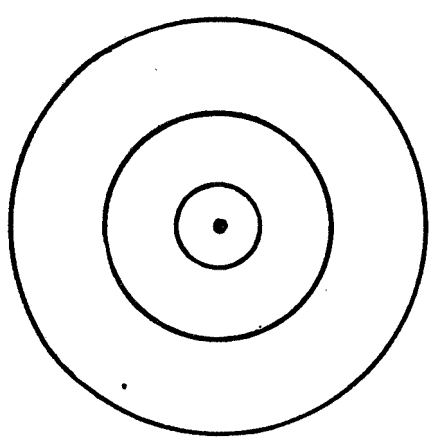


Figure 2: **The conventional picture of the Bohr planetary atom, with nucleus at the center and a number of possible orbits for the electron**

failed. As we now see things its greatest defect lay in the fact that the model as such—though a very pretty picture—was entirely superfluous in that its mechanism could never be traced to the point of making clear the thing which of all things it should do, namely, explain the very act itself of emitting spectral energy. Nothing in the atom appeared to vibrate, itself, in such a way as to emit the energy actually emitted; the proper energy arose in some most mysterious manner during the transition from one orbit to another.

We can better understand this inherent defect if we start with a mathematical expression for the hydrogen atom, disregarding any model aspect connected with it other than that there is a nucleus and near it, somehow, an electron. We shall attempt to remove all physical significance from the expression other than that noted above, and consider it a mere combination of letters and numbers, a "name form," Swann calls it, peculiar to the hydrogen atom. It is not by any means an abstraction, however, but rather to be viewed as a dispassionate picture of the few things concerning the atom about which we are most certain, uncolored by any prettiments suggested by the Bohr model.

By certain permissible and well defined mathematical operations we can obtain from this set of letters and numbers another set which, by virtue of procedure and content, represent the vibrations inherent within the hydrogen name form. It turns out that in themselves these vibrations have nothing in common with those giving rise to the actually observed spectra. The latter can be secured only by making an assumption extraneous to the information contained in the original name form. This assumption, known to the trade as a quantum condition, entered in disguise, via the back door, in the Bohr model and is most easily unmasked by the procedure we have just followed.

SINCE, then, starting with a certain name form, which tells us all we really know about the atom, and going through certain manipulations of it, we arrive where we do not wish to be, we may well ask whether there is not some other way of manipulating the same set of letters and numbers and yet arriving where we do wish to be. One particular method of attaining this end is known as "wave mechanics."

The fundamental point of departure of the new wave mechanics is the desire to associate with every electron the idea of a wave propagation. The whole notion of waves has about it such a vague bonelessness that it is essential first to consider in some detail the exact meanings and ramifications of the term before proceeding further.

The word "wave" probably first recalls to mind the peculiar, though familiar, phenomena observed when a body

of water is disturbed, as by throwing a stone into a lake. The most astonishing thing about the resultant waves is that, though the water appears to diverge outward from the center of disturbance in alternate ridges and hollows—though this appears undoubtedly to be true—

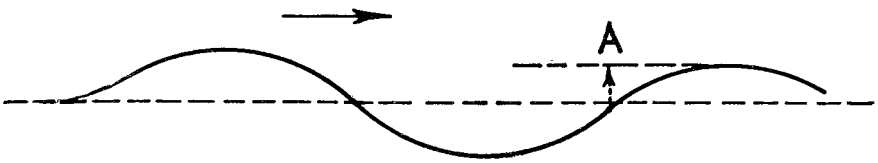


Figure 3: **A wave form of amplitude *A*, advancing from left to right**

it may nevertheless easily be made evident that the water, as a whole, does *not* move forward or outward, continuously. If it did, how explain the fact that a floating weed merely sways about its position while the wave shape, the ridges and hollows, rolls on? We know, too, that small pieces of cork resting on the surface ride forward on the crest of a wave for a short distance only, then fall back the same distance into the succeeding hollow, again to move upward and forward on the next succeeding crest. Since these pieces participate in the movement of the water on which they rest it is evident that the water itself does not move continuously forward—it merely oscillates back and forth—while the waves are a propagation of shape, not of matter. The speed with which the shape is propagated is known as the "phase velocity."

Now a rough sea seldom shows a regular train of waves like our conventional picture. Generally there are regions of intense disturbance followed by patches of comparative quiescence. These arise because the roughness of the sea endows some of the waves with a greater velocity than others. These differing waves interfere, adding and subtracting from one another, so that the resultant effect itself is a wave system quite different from any of those which comprise it. The effect is almost exactly analogous to that set up by a steamboat in calm water. A boat creates the well-known V-shaped set of bow waves and is followed near the stern by a broad swell of nearly straight waves at right angles to her course and stretching across the water. The two systems overlap, crest is piled on crest, trough deepens trough, and the V appears broken into short, sharp ridges, like the treads of a stairway, which themselves move in a wave form. Where crest falls into trough, or trough beheads crest, the surface is almost undisturbed. The speed with which the regions of disturbance move is quite different from that of any of the individual waves which have combined to form it. This speed is known as the "group velocity" and is the speed with which the waves carry forward energy, the energy which they can expend in beating against the shore-line or the hull of another boat. For our purposes, we can complete our brief description of waves by defining the amplitude as the measure of height or depth of the wave form, the distance A in Figure 3.

The motion of waves is not by any means confined to the phenomena we have just described. Wireless or radio waves are of identical general characteristics. Sound, heat, X rays, ultraviolet radiations, and what we call light, are all wave phenomena. In fact light is merely that small part of a vast range of radiations to which the eye happens to be sensitive.

We now propose to extend this already huge domain of waves to embrace even matter itself—atoms and electrons. Sporadic suggestions of this sort had been made many times, but it remained until 1924 for the French physicist, Louis de Broglie, to show that great advantages accrued by postulating that a wave—no matter "of what" as yet—accompanies the electron in its ceaseless motion. It must be emphasized that the whole theory rests upon this assumption. But it has turned out to be a very fruitful assumption indeed. Several methods of approach are open to us and common to the literature, but we shall temporarily disregard all of these and return here to the name form of the hydrogen atom discussed previously, and attempt to carry out our original intention of making it go where we want it to go.

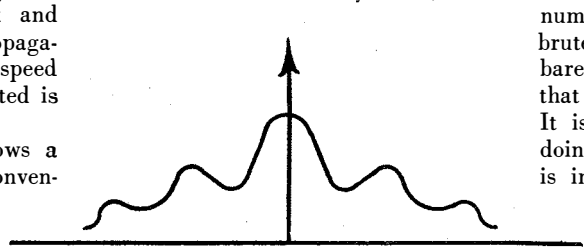


Figure 4: **The variation in wave amplitude as we progress outward from the center of the wave atom**

To do this we construct what the mathematician calls a differential equation, by replacing certain of the original letters and numbers by other letters and numbers, inserting by brute force an as yet undefined quantity Ψ, and equating the whole business to zero. There is to be no thought so far of having proved anything. We have merely exercised the physicist's right and penchant for trying and re-trying in the attempt to fit fact to theory. We have set down a certain process for obtaining a certain differential equation when given a particular set of letters and numbers peculiar to the hydrogen atom.

Continuing in this same fashion it appears that this differential equation is of such a form that its solutions are not in general always finite, single-valued, and continuous. In general, they become fuzzy, indeterminate, somewhere through space. There are certain values of a constant appearing in that equation, however, for which the solutions everywhere *are* real, finite, continuous, and very gentlemanly. Those values of the constant turn out to be just the values of the energy which the electron can possess in its various possible orbits—the very energy values and orbits which appeared in the old Bohr theory and would still have satisfied us had the remainder of the theory accorded with experimental fact and had the development been less artificial.

IT may be objected, and the objection is sound, that our own procedure to date has been fully as artificial as that of Bohr. We have ". . . replaced certain letters and numbers by other letters and numbers . . ." and ". . . inserted by brute force a quantity Ψ. . . ." On these bare bones it is accordingly imperative that we put some further rags of truth. It is unfortunate that the process of doing this is so mathematical that it is impossible to explain here. Nevertheless, if we could carry out the analysis we would see that the process of letter replacement we have just followed with regard to the hydrogen name form is simply that which is logically necessary to twist our original equation into a wave equation in line with the spirit of de Broglie's original assumption, and that the quantity Ψ then turns out to be the amplitude of the wave or waves governed by that equation. Since Ψ represents a physical quantity which, in principle at least, can be measured, it must be finite, single-valued and continuous for all those measurable values which appear in nature.

We have just seen that Ψ actually satisfies these conditions when a certain constant which we identified with the energy values of the hydrogen atom has the values actually appearing in nature in the hydrogen spectrum. Though we cannot prove it here, it may easily be shown that these various energy values are themselves analogous to the so-called "boundary" or limiting conditions which almost always appear in any case of wave motion. The fact that this is true replaces the older, more artificial assumptions in a most natural, indeed

almost a necessary, way—a way which arises from the characteristics of wave motion itself, rather than being pulled in through the back door by the scruff of its neck, as was the case with the Bohr quantum conditions. The further fact that the same results can be obtained in an entirely different manner, associated with the names of Dirac and Heisenberg, though also based on wave assumptions, lends further dignity to the whole procedure.

Without going into any great detail, the wave nature of the hydrogen atom, and of course of more complex atoms as well, may primarily be ascribed to that associated with the electrons which are part of the atom, each electron having a separate wave system of its own. When the electron is part of the atom its waves curl round, as it were, upon themselves. The atom itself thus consists of a whole group of waves whose relative complexity varies with the number of electrons present. The amplitude of this group diminishes rapidly as we pass outward in any direction from the nucleus, as shown schematically in Figure 4, but curiously enough never disappears completely, so that theoretically the atom has no boundary whatsoever. To all practical intents and purposes, however, the amplitude becomes so insignificant at such a small distance from the nucleus, due to mutual interference and cancellation amongst the several waves that form the atom group, that we may go on as before and consider the atom as a small unit whose size is reasonably definite. It is this meaning of size to which we had reference when we spoke of "effective" volume.

BUT when the electron gets free from the atom, as it does when shot off from the filament of a radio tube or in certain other situations, its waves are free to uncurl and expand indefinitely. As they do so some astonishing results of the new theory come to light. If we treat the electron just as we did on the old Bohr theory, as an actual bit of mass having restricted size, and put it through some experiment (of which there are several) to determine its velocity, it appears that the slower the electron moves the faster the waves associated with it move. It is apparent that the waves as such do not themselves carry the energy with which every electron is endowed. Fortunately this part of the theory, which at first glance looks so contradictory, can be readily explained by assuming that the waves themselves move with a phase velocity which, as we have seen with water waves, has nothing to do with the propagation of energy.

Even so, we have still left unanswered the question: "What *does* move with a velocity equal to that of the energy?" At first it was thought that we might still be able to retain some of our notions of the electron as an actual material particle by assuming that the waves were there, but merely guided it along, and thus also answer this question by replying that since the particle was still present it carried the energy itself. This view ran upon the rocks so many times that it was soon abandoned. It simply did not hold water. It was then

***Above:* Prof. Werner Heisenberg; a photograph taken last summer when he was lecturing at the University of Michigan. *Below:* Prof. Neils Bohr, the famous proponent of the old planetary atom concept**

discovered that, though we had used the phase velocity, we had found no use as yet for the group velocity. Since it was known with water waves, for example, that this *is* the velocity of propagation of the energy, it was gratifying and satisfying to find that for the electron Ψ waves this velocity came out to be just that of the electron on the old Bohr theory, and hence of the energy—no more and no less.

But with this advance the so-called native, common sense approach to physical problems completely broke down and matter came to be nothing but a synthesis of motions divorced from any conceptions of hardness or weight. Why? Simply because the group velocity must be considered as built up only from a peculiarity of the Ψ waves, just as in the case of our water waves —the speed of a group composed of them and of them alone. Thus ultimately our question can be answered only by saying that a group of Ψ waves moves with, and is, the particle, and that since the notation "Ψ" is thus interchangeable with the word "matter" we can push the explanation no further—we have reached the bed-rock of our conceptions.

It is easy to see that we have lost any possibility of a model. It may be shown that in most cases the waves are not even in the ordinary three-dimensional space of our conceptions but instead in the mathematician's n-dimensional space. We cannot put our finger down on the atom and say "Here it is." The orbital positions, though we can approximately locate them, have lost much of their definiteness. The electron seems full of go, but essentially bodiless.

IN some respects conditions are not quite so bad as they seem. It has been found that if Ψ is the amplitude of a particular group of these waves, then the square of the absolute numerical value of Ψ, that is $|\Psi|^2$, may be logically interpreted as the *probability* that the matter lies within the particular bit of space for which this Ψ was calculated. Applying this rule to the hydrogen atom it is found that $|\Psi|^2$ is very small outside the region which we should expect the atom to occupy according to Bohr's theory. This may be interpreted as meaning that, though the matter-waves themselves fade into multi-dimensional ghosts, and though we can never fix the electron or atom exactly, nevertheless the quantity $|\Psi|^2$ remains a sober reality in our own little world of three dimensions and enables us to locate the atom or electron with reasonably great precision.

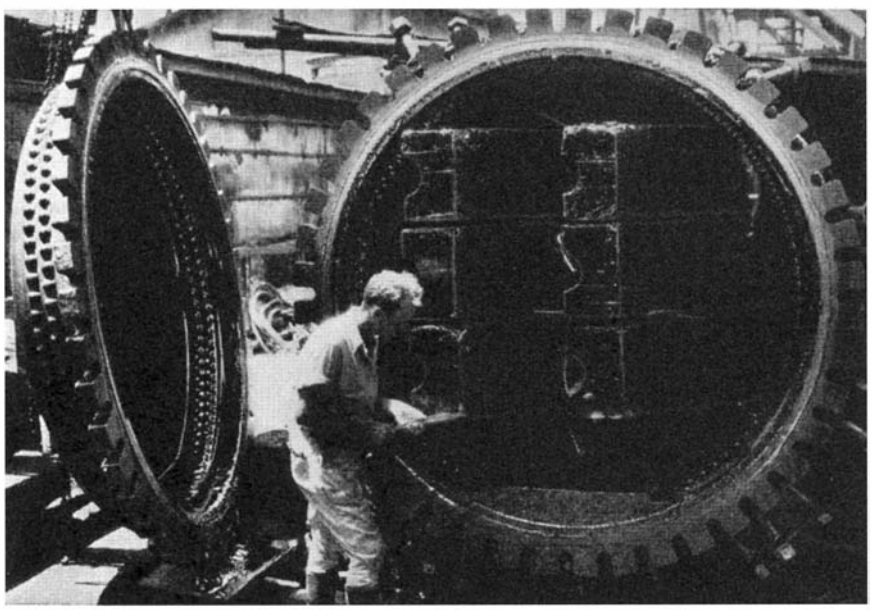
Moreover, the most recent atomic research offers a most heartening possibility of ultimately amalgamating the wave and particle concepts of matter. As a matter of fact, there are *no* experiments which prove that matter possesses *all* the properties of *either* a wave *or* a particle. Accordingly, Heisenberg has suggested that the two mental pictures which experiment conjures out of our imaginations—one of particles, the other of waves—are both to be viewed simply as incomplete analogies arising from our temporary inability to describe matter in everyday language.

Though we cannot draw a satisfactory picture of the atom as conceived by the wave mechanics, the mathematics of the theory enables us to do all the things which were possible with the Bohr model. In addition it appears that what were heretofore contradictions are removed, fundamental points are refined and made more precise, while the number of assumptions necessary to attain these ends are reduced to a minimum. From this point of view wave mechanics signifies not so much a radical change as a welcome and highly significant evolution of the existant atomic theory.

Concrete that Withstands the Sea

By HAMILTON M. WRIGHT

ALTHOUGH concrete has a myriad of important uses in this progressive age and, in fact, for some uses has no available substitute, it has the one limitation of being subject to the corrosive or chemical action of air, sea spray, and some liquids. This becomes a serious matter where concrete is used for piling, bulkheads, and similar structures in marine service, or in sewers, tanks, dams, and the like. Reputable engineers and engineering magazines have commented upon the destructive action of sea water upon concrete piling so frequently in recent years that it seems scarcely necessary to enter into an exhaustive elaboration of the subject here.



Concrete piles after impregnation with asphalt by the new vacuum-pressure process, on opening the retort. Note the great strength of the retort structure

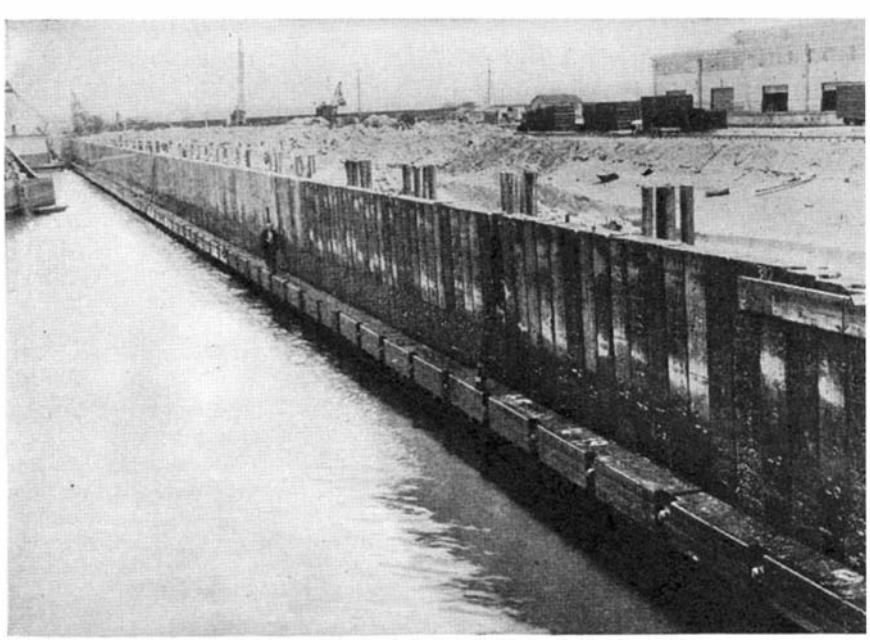
Briefly, it may be recalled that the destruction of concrete in sea water is due to both physical and chemical causes, and that this destructive action is progressive, since physical deterioration due to abrasion, or the formation of ice in the concrete, or to other causes, permits the sea water to reach farther within the concrete, while the chemical reactions also contribute to the physical destruction.

Ordinary reinforced concrete used in marine work is subject to attack by the action of sea water and sea air, caused, in part, by the chemical action of the sulfate in the sea water upon the lime in the cement. Among the products of this reaction is calcium sulfate which replaces a part of the calcium hydrate of the cement. As the calcium sulfate molecule is slightly larger than the calcium hydrate molecule, a swelling takes place during the reaction, adding a physical action to the chemical action already under way. On crystallizing, this compound takes up a large quantity of water, producing a great increase in volume and causing the concrete to crack so that the sea air reaches the steel, resulting in corrosion. The oxidation of the steel causes it to expand and it then spalls the concrete, exposing the steel.

Ordinary concrete aqueducts are particularly liable to deterioration when laid in alkaline soil. Cases are on record where aqueducts of varying lengths, some 100 miles long, conveying water to large cities, have cost thousands of dollars in repairs since their comparatively recent installation, because of the disintegrating effects of the soil alkali.

THE impregnation of cement concrete with asphalt under vacuum-pressure, however, secures the penetration of the asphalt into concrete to a depth of from one and one half to two inches and effectively insulates the concrete from the destructive action of sea water and of sea air. This process has now been adapted to a very wide variety of purposes.

Through the manufacture of pre-cast asphalt-impregnated concrete slabs, the insulation thus provided serves a multitude of purposes in facing concrete structures. These slabs can be adapted to construction of any shape or size, to fit tanks, pipes, breakwaters, concrete bridge floors exposed to sea spray, and the like. They are also adapted for use in insulating conduits, irrigation ditches, chemical tanks, and sewage disposal



Photographs courtesy Pan-Pacific Piling and Construction Company

Concrete sea wall pilings, impregnated with asphalt by Penocrete process, in place in Los Angeles Harbor. The wall has a neat appearance and is permanent

tanks where acids and alkalis would, otherwise, act injuriously on the concrete. Alkalis with a high content of sodium sulfate, for example, have been very destructive to such concrete structures, particularly in the middle west and in Canada.

In our varied industrial life it is the adaptation of any new method, discovery, or application to many uses that gives greatest service. But the widespread uses to which asphalt-impregnated concrete can be applied have really resulted from many years of work directed toward the creation of a cement concrete piling that will resist sea water.

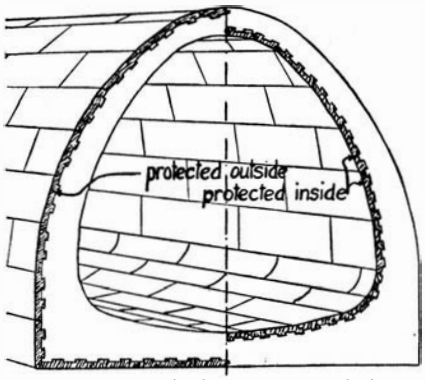
THAT such a result has actually been achieved will be news to many. In Los Angeles Harbor, however, concrete piling impregnated with asphalt, in the manner herein described, has given eight to ten years' service without showing any disintegrating effects of sea water. Mr. G. F. Nicholson, Harbor Engineer, Los Angeles Harbor Department, has stated officially: "It is conservatively estimated that a well-constructed impregnated pile is practically permanent, or at least will serve until the structure of which it is a part becomes obsolete—in any event, for 75 years or more."

This asphalt-impregnated piling, so deeply impregnated as to provide practically perfect insulation, was developed by the Harbor Department of Los Angeles Harbor and by engineers and

The exterior of a large concrete trunk sewer showing disintegration

chemists working in association therewith. The method of impregnation has been so perfected that asphalt-impregnated slabs are being produced commercially by the Pan-Pacific Piling and Construction Company, of California.

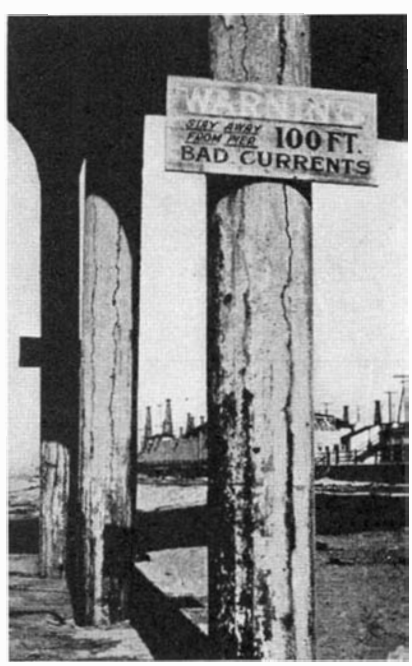
In the early experiments at Los Angeles Harbor, an attempt was made to impregnate concrete by immersion in a bath of asphalt heated to 450 to



Manner in which pre-cast, asphalt-impregnated slabs are used in sewers

500 degrees, Fahrenheit, for from 15 to 20 hours. The process was designed to release the free water contained in the concrete so that, as it cooled, the vacuum formed within the voids would serve to draw the liquid asphalt well into the mass. Adequate impregnation of the asphalt was usually secured, but the destructive high temperatures and the porous lean-mix concrete essential to the treatment, limited the success of the process. There then developed a method of treatment of concrete by a vacuum-pressure process similar to that used in creosoting lumber.

By this method, conveniently known as the Penocrete process (penetration of asphalt into concrete), the concrete slab, after thorough curing, is subjected to dry air treatment in a tempering chamber for 18 to 20 hours, the temperature being slowly and gradually raised to 240 degrees, Fahrenheit, at which it is maintained for from two to four hours. The slabs are then rapidly moved into the main treating cylinder which, previously, has been pre-heated and dehydrated under a 26- to 28-inch



Unprotected concrete piers cracking from chemical action of water

vacuum, to rid the slab of free water and produce a vacuum in the concrete pores. The temperatures are not high enough to release an appreciable quantity of the combined water of crystallization.

Thoroughly dehydrated grade D asphalt is turned into the treating chamber at approximately 250 degrees, Fahrenheit, the vacuum being maintained

Interlocking design of Penocrete wall showing penetration of asphalt

throughout its introduction. When the chamber has been filled with asphalt, the vacuum is replaced by air pressure running up to 175 pounds per square foot, the pressure being maintained for 12 to 14 hours. The temperature then is allowed to drop down to 200 degrees, Fahrenheit, at a rate not exceeding 11 degrees per hour. The slabs are then cooled gradually, the control in the cooling process being as carefully exercised as in the heating. A dry mix of concrete is used in the slabs or shell.

THIS process impregnates the concrete to a depth of one and one-half to two inches and so thoroughly as to seal the pores of the concrete and to secure the asphalt to its surface.

As large structures of concrete, such as sea walls, cannot be treated in a retort, as is done with piles or smaller pieces, the asphalt-impregnated slabs are now produced in various pre-cast sizes which can be used in practically every form of concrete construction.

The slabs are pre-cast to convenient size, then impregnated, and so laid that a mechanical bond is formed with the large concrete mass to be protected. So effective have they proved that they are now being introduced for sewers, as a protection against sewer gases on the inside, for pipes, disposal tanks, chemical tanks, telephone poles, culverts, irrigation conduits, and, in fact, in many applications where there is deterioration of concrete from acids, alkalis, or electrolysis.

The Amazing Process of Vision

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

IN scientific treatises for the past 50 or 75 years it has been said and repeated between ten and ten thousand times that any instrument-maker who delivered so crude an optical instrument as the eye would deserve rough treatment. Many doubtless believe this indictment of nature. In the accompanying article Professor Russell shows, on the contrary, what a truly wonderful optical instrument the eye is. Four years ago, Sir John Parsons came to the defense of the much-maligned eye. This is what he said:

"As Helmholtz long ago pointed out, the eye shows many defects as an optical instrument. The refracting surfaces are not accurately spherical; they are not accurately centered on the optic axis; they are not completely homogeneous and therefore give rise to irregular astigmatism, or completely transparent; the cornea and lens are not free from spherical or from chromatic aberration. Hence Helmholtz's oft-repeated dictum that if an optician delivered so faulty an instrument it would be justifiable to return it to the maker. Even Homer sometimes nods, and it is regrettable that Helmholtz should have uttered so unjust a sarcasm. For the true criterion of the eye as an organ of vision is its biological utility, *i.e.* its capacity to fulfil its manifold functions in the interests of the individual and ultimately of the race. An instrument approximately a sphere of 11 mm. radius, which combines the advantages of being a camera with automatic adjustment from infinity to a distance of three or four inches and unparalleled range of sensitivity, an efficient photometer, colorimeter, kaleidoscope, stereoscope, and range-finder, cannot be regarded as inefficient."

FROM the days of our youth we have heard and read of the photography of the invisible, the triumphs of the sensitive plate in revealing what no eye had seen or could see. These tales were true. The camera reveals ultra-violet light which makes no impression upon our vision and, with the aid of newly discovered sensitizers, our plates detect infra-red rays to which the human eye is equally insensitive.

More striking even than these is the way in which photographs of long exposure show objects such as nebulæ which are too faint to see. The outer spirals of the great nebula in Andromeda, for example, cover a region of the sky five times as long and twice as wide as the apparent disk of the moon. It is certainly not for lack of size that we cannot see them; their light is too feeble. Here the telescope is of little if any aid. It collects more light from the nebula but spreads it out more widely, so that the apparent brightness of the surface is not increased. No amount of patient gazing is of avail, but the camera reveals what would remain forever hidden from the eye.

THESE successes are so spectacular that we can believe, or at least feel, that here at least the machine wholly surpasses the man. Yet this is a notable error.

We go out on a clear night under a high winter moon and say, "It seems as bright as day." Every detail of the ground, the trees, the whole landscape, is revealed. Our eyes seem as efficient as ever (until we apply some severer test, such as reading a page of ordinary print). On such nights, thousands of enthusiastic amateur photographers must have tried their hand, if not at snapshots, at short time exposures, and all have drawn blanks. Good photographs of still life can be taken by moonlight. But the subject has to be quite decisively still, for the exposure must last half an hour when, with the same camera plates and stop, it could be made in daylight in a small fraction of a second.

A photograph of the moon, made by Harold A. Lower of San Diego, Calif., with his home-made reflector

No one would believe from the looks of them that sunlight is almost half a million times as bright as the best moonlight. The amazing adaptability of our eyes deceives us. But the sensitive plate is less adaptable and cannot be fooled. It demands a correspondingly long exposure.

Given time enough, the plate catches up with the eye and in the long run surpasses it. But in the short run the eye has the colossal advantage.

A large audience could watch a play, a dance, a pageant, by the light of a full moon. But woe betide the photographer who tried to take moving pictures of the performance, or even posed photographs with the few seconds of exposure which were customary when plates were slower.

This weakness of photography was evident in the case of the recent total eclipse. The approach of the shadow across a partly cloudy sky (as the writer saw it) was a spectacle of extreme magnificence. There was abundance of light to *see* it by, but if anyone secured a motion picture of the grand and rapid changes in landscape and cloud he must have had a marvelous lens. The few photographs which the writer has seen were under-exposed wraiths.

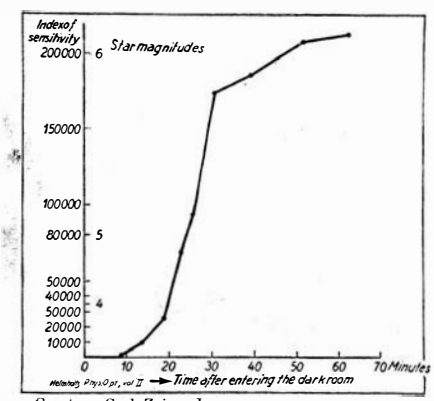
AGAIN, the student of meteors finds himself almost confined to visual observation. On any ordinary clear night a diligent watcher will see several meteors per hour. These are mostly of the third or fourth magnitude, like faintish stars, and they "go by so fearfully quick" that one might as well expect to catch a Bandersnatch upon one's negative. Only the exceptionally brilliant meteor which arrests the attention of anyone who is looking toward the sky will be recorded on photographs. Though a battery of wide-angle cameras is kept on the job night after night, the number of successful plates will be few.

It is worth while knowing just how great the advantage of the eye over the

photograph really is. A valuable set of measures has recently been made by Dr. Minnaert, a Dutch physicist, well known for his excellent work in photographic photometry. Working in his laboratory at Utrecht with a large spectroscope he measured the smallest intensity of light over which the lines of the solar spectrum remained visible; or, again, the bright lines of an arc spectrum. Then, using the same instrument and light of the same intensity, he found how long an exposure was needed to get a photograph on which the same lines just clearly appeared.

THE eye is most efficient in seeing bright lines on a dark background. In the violet, where the plate is at its best and the eye relatively insensitive, it requires an exposure of a minute to photograph a line which is visible at a glance. In the blue (λ4500) one can see light so much fainter that an exposure of 15 minutes is necessary. Toward the green, the eye gains still more, while the plates become less sensitive even though the best available brands are used. For green light (λ5200) it takes *thirty hours* to photograph a line which is visible in a fraction of a second after one looks at it. In the yellow and red the eye loses again while, by using suitable plates, photography suffers small loss. For the red hydrogen line, the exposure drops to 17 minutes and in the extreme red where the eye has almost struck work, it is down to a minute again and even below.

To see dark lines on a bright background takes more light. When the time necessary to get a photograph is reduced to one third of the values given above, the strongest lines of the solar spectrum become visible in all colors. The fainter lines are harder to detect and do not show up fully until the light is so much brighter that the exposure time is reduced to one tenth of the preceding value for red light. For green light a corresponding ratio is about 100, and for violet light about 2000!



Courtesy Carl Zeiss, Inc.

Increasing sensitivity of the human eye in total darkness. From Helmholtz' Physical Optics, Vol. 2

It is surprising that the increased illumination, which is necessary to make the fine details visible after the coarser ones are already perceptible, varies so greatly with the color. The obvious suggestion that the eye finds it hard to focus on violet light is negatived, since an eyepiece was used and carefully focused in all the observations.

Remarkable as these observations are, they were not designed to exhibit the maximum possible sensitiveness of the eye but rather to correspond to practical laboratory conditions. The room was kept pretty dark—"ziemlich dunkel"—and a black cloth was thrown over the observer's head to keep out stray light. But no attempt was made to rest the eyes in complete darkness for some time before observing. It is well known that this results in a great increase of sensitiveness. Ordinary light dazzles the eye—that is, it reduces the sensitiveness of the part of the retina upon which it falls. We are all conscious of this if we go from a brightly lighted room into a starlit night. Recovery of most of the "dark adapted" sensitiveness takes but a short time. But even starlight is bright enough to dazzle the eye.

MANY years ago the present writer studied what could be seen under very favorable conditions. Anyone can repeat the experiment if he lives far enough from city lights. Choose a room in which the windows can be closed light-tight by shades or blinds, except for a single hole a foot square or so. Sit in the pitch darkness with a clear starry night outside for a quarter of an hour. Then your eyes will be ready for a real test. You should have a large sheet of white paper. Set this up where the light of one of the brightest stars faces on it through the opening (10 feet or more away) and you should see distinctly the patch of starlight on the paper, though the light of a star like Vega is only a hundred thousandth part of full moonlight. If then you look back at the window illuminated by the "dark" night sky and then again to the paper, you may be able to see, as I have done, a dark after-image of the opening; appearing because the light of the sky, though itself faint, lowers the sensitiveness of the retina below its peak value.

The working range of the human eye is most amazing. It will perceive under best conditions the illumination of white paper by a star of the second magnitude and it can look steadily without permanent injury at the same paper illuminated by full sunlight which is 28.7 magnitudes, or three hundred thousand million times brighter!

How can any material thing, alive or dead, do this? A part of the range is provided by the automatic operation of the iris, that original diaphragm after which its mechanical imitations are named. But this takes care only of a factor of a hundred or so, leaving about a billion for the range of intrinsic sensitiveness of the retina.

At any one moment we use only a portion of the range, corresponding to a factor of a few thousands at most. A shadowed passage or cave looks black from the sunlit world outside. When one enters and his eyes adjust themselves there appears to be plenty of light. The explanation of this extraordinary adaptability and, at the same time, of the amazing sensitiveness of the eye at its best, is probably that the retina is continually manufacturing its own light-sensitive material. It is a living tissue with blood vessels which continually bring new supplies of all that is needful and carry away waste products. There may be compounds—and compounds capable of synthesis by laboratory methods—which are far more sensitive to light than silver bromide. But they would be of no use in photography unless they were stable. Commercial plates must last for months at least, without serious deterioration, and actually do better. Even for research purposes it is necessary to have sensitive film that keeps good for hours or days. But in the tissues of the eye the ultimate sensitive material may have a far shorter life, continually breaking down and continually renewed. Rest in the dark permits its accumulation to the maximum. Continuous stimulation may reduce it almost to a small fraction.

Courtesy Yerkes Observatory

A meteor trail accidentally photographed on a long-exposure plate. The meteor must have been large

There is probably far more than this behind the amazing process of vision. But enough may have been said to illustrate the hopelessness of attempting by mechanical means to compete with the superb delicacy of adjustment which is found within the living organism.—*Princeton University Observatory, October 4, 1932.*

Chief's crown, Tlingit. The eagle head-dress seems to be an imitation of the tall Imperial Russian crown

THE DISAPPEARANCE OF

By MARIUS BARBEAU
National Museum of Canada, Ottawa

NATIVE races once occupied North America from coast to coast. The Scandinavians discovered the Eskimos, nearly 1000 years ago, and lived close to them for three centuries, in their Greenland settlements. Several hundred years later—in 1534-35—the French navigator, Jacques Cartier, explored the east coast and ascended the Saint Lawrence to Hochelaga (now Montreal). He found the forests of the New World peopled with various tribes who somehow became known as "red" men, though their skin was tan or brown, much like that of the Asiatics. These were of two kinds: the nomadic hunters without a fixed abode, within ill-defined frontiers—the Algonkins; and the village-dwellers who cultivated the land and whose true name from the first was Canadian, since Kanada in their language meant "town." We now call them the Iroquois and the Wyandot nations.

Not long afterward—about 1660—the Russians landed on the Alaskan coast, where they found Mongolian-like Indians, and secured a foothold which they released comparatively recently to the United States. Other navigators of various nations at that date already had landed on the southwestern seaboards and encountered many semi-nomadic and village tribes.

A half-breed Pawnee girl, at a government agency school in Oklahoma. Not much "Indian" here

THE natives ever since those early years have come under the domination of the white man, bartering furs for commodities with him, resorting to his trading posts, and eagerly adapting themselves to his ways of living. There is little left now, after two or three centuries of incessant changes, of the wild tribes that once roamed naked in the virgin woodlands of the eastern watersheds, hunted the buffalo with bows and arrows on the prairies, or set salmon traps in the mountain streams of the northwest coast. Their numbers dwindled from the very first; whole nations were wiped out by warfare and disease. Their culture, with almost the single exception of their languages, is now a thing of the past.

Most white people never have seen a real Indian in their lives, if indeed such still exists. The half-breeds of the eastern states and the Saint Lawrence are not usually noticeable when they walk our streets, dressed as they are like others. Their complexion is not darker than that of most Italians. Their handicrafts have vanished, like their other traditions, except for basket-making, the manufacture of pottery and rugs in the southwest, moccasin and snowshoe-making elsewhere, the last two of which are now often improved with the help of modern machinery. If they cling to their reserves, it does not mean that reserve life was their own choice in the first place. The teachers in their government-subsidised schools are English-speaking graduates, nurses, and educated half-breeds. Their missionaries no longer bother as a rule to learn the native dialects, which are the last vestige of prehistory. The present-day Iroquois of New York and Canada are farmers and bridge-builders. Their Grand River council (in Ontario) is run in the style of a mock parliament. When they decided to claim their national independence before the League of Nations some years ago, their delegates donned feathered head-dresses and trailers which they had borrowed from the Blackfeet of Alberta. Otherwise they would have been mistaken for ordinary Americans from the middle west.

The Sioux, the Mandans, the Blackfeet, the Stonies, and other prairie tribes have preserved more of their individuality. But they are known mostly for their casual appearances in stampedes and parades for the benefit of western fairs. Their war paint and regalia belong to the circus. The tourists and sightseers alone are responsible for these survivals. After the disappearance of the buffalo, about 1880, they slowly deserted their medicine lodges, settled down around government agencies on reserves and learned to farm by up-to-date methods, but more frequently they starved to death.

Stony Indians (of Siouan extraction), at Banff, Alberta, in their modern prairie costumes such as are

What is left of the native bands of the northwest coast has also yielded itself to modern ways and contrivances. The 800 Haida half-breeds (out of 30,000 that lived a hundred years ago) are among the most progressive settlers and fisher folk of British Columbia. The Tlingit of Alaska are progressive people whose sons receive as good an education as

THE RED MAN'S CULTURE*

any white boys, and whose daughters graduate as nurses in Seattle. The other coast nations likewise have mostly given up their ancestral customs. They now resort to the salmon canneries for a living. They build gasoline yachts or work for the white people in lumber camps, in the mines, or on the railways.

The 4000 Eskimos who are still left on the arctic coast between Alaska and Greenland are likely soon to disappear —as they have already at the mouth of the Mackenzie—from the food depletion of their habitat and the rigor of the climate. They will pay the penalty for adopting new ways without acquiring the education and sense of providence which now safeguards their tribesmen under Dutch and American tutelage in Greenland and Alaska.

In other words, the Indian is now a creature of the past, who can be studied mostly in books and museums. But his history is indeed a fascinating one. We know as yet too little of his remote past, though he undoubtedly originated in other parts of the world, thousands of years ago.

used in summer parades for the benefit of the railways. Thus dressed they are said to feel strange

What is more familiar and spectacular is the colonial period of his evolution; that is, after the white man first smoked the peace calumet with him, bartered tools and weapons for furs with him, and challenged his supremacy over his vast domains. In this period of two or three hundred years, the natives underwent radical transformations, besides being decimated by disease and warfare with Indians and with whites.

Even ethnologists are apt to forget that our modern Indians bear little actual resemblance to their pre-Columbian ancestors. Only a vast critical knowledge will enable the scholar to unravel the ancient native elements from such as are secondary, or merely spurious and imitative. The majority of our ethnographers, not to speak of the ordinary laymen, have been sadly deficient in this respect. It must be granted that anthropology as a science is still in its infancy. Our museum collections abound with curios sentimentally gathered with little knowledge of their age and history. The museum monographs, bulky and sometimes pretentious, bewilder the reader. They are as a rule aimless and trivial. Much of these materials will ever remain of little use through the lack of necessary context, discrimination, and proper understanding. Current misconceptions and prejudices, besides, are allowed to interfere with the growth of analytical knowledge, or a much-needed readjustment of scientific standards both in museums and in the field.

Let me briefly outline some problems and indicate pitfalls of North American ethnology.

The racial characteristics of our aborigines—their features, their bodies, their aptitudes, their intelligence —have, in the last centuries, changed almost beyond recognition, when they are not wholly a thing of the past, as with the Beothuks of Newfoundland, and the Eries and the Neuters of Ontario, now extinct. If aboriginal features still prevail in many parts, it is due to a persistent reversion to racial type. Yet the type itself inevitably became modified through adulteration. No native at the present day can boast in all certitude of an unmixed ancestry. In the east he may without knowing it be part Indian, French, British, Scandinavian, Portuguese, Spanish, or Negro. In the extreme northwest he may be all of these plus Polynesian, Hindoo, Russian, Japanese, or Chinese.

The pre-Columbian races had also become mixed among themselves. An

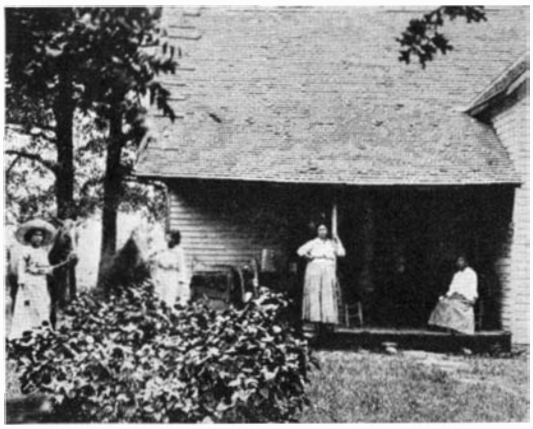
*Published with permission of the Director, National Museum of Canada.

Mask representing white man, made by Indians near Alaska

Algonkin strain characterizes the remains of the prehistoric Hurons of Ontario. The broad-faced stocky west coast people and the taller, long-headed Athapascans of the interior likewise had given rise to a mongrel race at the frontiers. There were already elderly half-breeds, and what were called "free-hunters," about 1810, when Thompson and Ross Cox first explored the Columbia River. Kanakas and Asiatics, along with the early mariners, often mingled with the Indians; Japanese junks, also, are known to have drifted to the coast as far as California, with survivors aboard, from time immemorial. The newcomers in most parts often cohabited with their hosts, whose code of sexual intercourse as a rule was by no means stringent.

The aboriginal arts and crafts could not withstand the impact of the trade

John A. Gibson, Canadian Iroqois, last prophet of the Handsome Lake religion, founded about 1802



Seneca Iroquois of Oklahoma, who live on farms and have houses like white peoples'

articles of the white man. They belonged to the stone age and had small chance to hold their own. Not many of the primitive artifacts survived long after the introduction of metal and woollen goods, even when they might have been preserved for the benefit of the community at large. The fur companies enlisted to their service all the Indians from coast to coast and provided them, at least bi-annually, with weapons, utensils, garments, and trinkets. The Eskimos were also affected, although not to the same extent as the other races, on account of their isolation and the rigors of the arctic winter. How overwhelming the transformation really was may be realized when we review the following aspects of pseudo-native technology and art:

THERE are barely a few traces left of the prehistoric costumes and body decorations, in either actual or derivative forms. They were everywhere most elementary, except among the Eskimos, and soon gave way to other fashions. This is borne out by the pictorial records of the Indians, such as we find in Champlain's "Travels" or in the early chronicles by Lafitau and his contemporaries. None of the garments which we now associate inseparably with our Indians were known to their forefathers in the beginning. The leggings, the uniform-like coat, the pointed hat of the Naskopi, the feather bonnet and trailer of the prairies, the shoulder band and attached leather or cloth bag, the blanket—all were introduced by the traders and the missionaries or through the imitative vanity of a people naturally fond of ornaments.

Their decorative embroidery, in the form of bead, silk, ribbon, moose hair, and porcupine quill, is a mere corollary of the introduction of the foreign garments with which they still retain their connection. The floral patterns of our northern tribes, which are abundantly represented in our museum collections, belong one and all to the French renaissance and peasant art, and were adapted at an early date by the Indians to suit their fancies.

The evolution of this spurious American art can easily be traced through all its stages. Sewing and embroidery, as well as other domestic arts, were taught systematically to Indian girls of Algonkin and Iroquois extraction by the nuns in the ancient colonial missions and schools. Besides, the school of art founded in 1672 by Mgr. de Laval at Cap Tourmente, New France, for the requirements of education and worship, so firmly established the renaissance architectural decoration in the colony that it has continued unimpaired almost to the present day in much of French America, from the Saint Lawrence to Louisiana. The floral art of the Indians, interesting in itself, is merely its collateral development. In such published compilations

Indian cradle board, as used among the Iroquois until 50 years ago. Floral designs are of French origin

as Speck's "Double-curve Motive," possibly not a single design can be traced back to prehistory. They were derived from the designs and ornaments of the Francis I period as transplanted to Canada.

The horse was first introduced in Mexico by the Spanish. So useful was it that it soon revolutionized native life, particularly in the desert and on the prairies. The nomads endeavored everywhere to acquire it by every means at their disposal, fair or foul. They became professed horse raiders and thieves. Herds of horses soon traveled northward. When the overland explorers reached the prairies and the foothills, before the conquest, the Indians already owned "cayuses," used the *travoy*, and their culture as a result had been radically transformed. The Hispano-Mexican decorative patterns, angular or geometric, with diamonds, swasticas, and hour-glasses, had followed in the trail. The altars and *katchinas* of the Pueblos bear such a striking resemblance to similar Spanish features that they are not likely to have originated independently.

ELM splint basketry is one of the outstanding manual arts of our Indian reserves throughout the eastern woodlands. The white people have for a long time bought their baskets from their nearest Indian neighbors. Yet, experts are coming to the conclusion that it is a pseudo-American art, derived particularly from the French settlers. The Iroquois *hominee* sieve is the only exception still held in doubt.

Modern devices likewise displaced archaic contrivances or enlarged them almost beyond recognition, under the impetus given by the white man. For example, the pack straps, sashes, and garters braided or woven on small portable looms and existing almost everywhere on the continent; the pipe-tomahawk, an accessory to treaty-making; the *wampum* belt as it became known in colonial diplomacy—the *wampum* here differing materially from the archeological conch bead; the *voyageur* type of birch-bark canoe that spread from the Algonkins to the far northwest; the silverwork, and the wood carving with gouge and the crooked knife.

The totem poles of the northwest coast have usually been mistaken for an unadulterated form of native symbolism and decoration. While the local inception of this art cannot be questioned, one may be surprised to learn that as late as the year 1800 there may not as yet have been any real totem poles.

A real American farmer. This is an Indian, but who would know it?

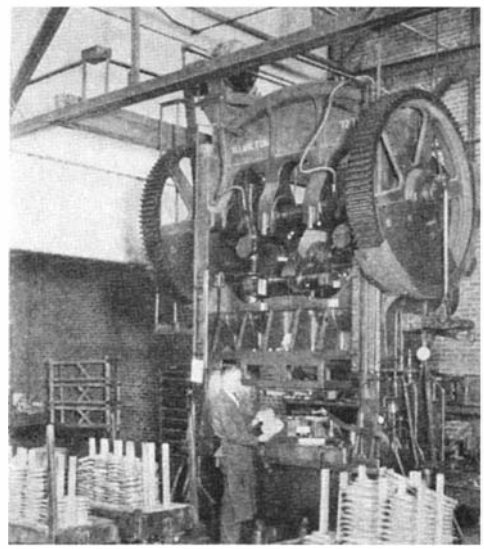
Fiddling on Aluminum

THE sweet, poignant, at times almost human voice of the violin has earned for it a unique place in the music world. It carries the lead rôle in the symphony, yet it is perfectly at home in the pulsating rhythm of the modern dance orchestra. It is heard in all lands. It stirs the blood of black-eyed señoritas, quickens the jigs of red-headed sons of Erin, enraptures the hearts of stalwart youths of "das Vaterland."

From the beginning, wood has been the accepted material for violin manufacture, but the possibility of using aluminum for stringed instruments was suggested a number of years ago. The metal seemed well adapted to the manufacture of instruments of this nature because of its lightness and strength, its smoothness of texture, and its unusual working qualities.

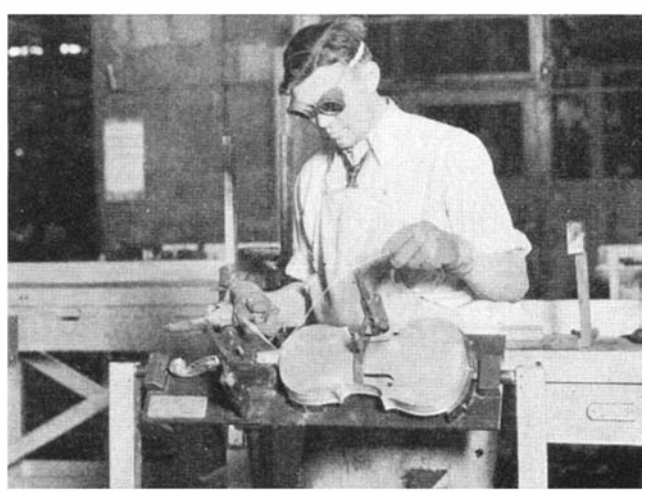
Prominent musicians became interested in the subject, among them Joseph Maddy, nationally known music supervisor and director of the National High School orchestra. It was decided to put the idea into practice and a trial order of aluminum bass viols was fabricated under the supervision of technical experts of the Aluminum Company of America. Light alloys were utilized for every part except the fingerboard, bridge, and a few minor accessories.

These early efforts seemed promising and plans were made for carrying the idea a step further, to the creation of an aluminum violin. Noted acousticians were called in; artists and artificers were summoned. They met and talked it over. "An aluminum violin? Shades of Stradivari! What next?"



The aluminum violin is made up chiefly of stampings. The press beads panels

Filing and otherwise smoothing the panels in order to remove dead metal accumulated during welding process



Jointing by welding insures great strength and gives improved tone as well. Special clamps hold the parts together

Final assembly of the parts including the fingerboard and bridge

A trial violin was fashioned and examined by experts. Good? Yes, but not quite good enough. Changes were suggested; other models were made, patterned after the instruments of the old masters. Finally a violin was produced which was deemed fit for a final test. More musicians were summoned, artists accustomed to wood violins through years of experience. They handled the aluminum violin, played on it, and were amazed. Indeed, it was a sensation and worthy of the musician's consideration.

The process of making an aluminum violin is an interesting one. The instrument is constructed rigidly, welded at the joints so that the entire ensemble is a single unit. The back and front panels are stamped from light, strong aluminum alloy sheet, as are the neck and key sections. The scroll is composed of two thin die castings of aluminum, welded to an extension of the stamped key section. Every part is finished to extremely accurate tolerances, as the slightest misadjustment might easily result in a serious impairment of tone.

The finishing of a violin is an important step. Aluminum violins are grained to resemble wood instruments, with a base protection of successive layers of enamel sprayed on and baked in ovens at high temperatures. These are followed by three coats of varnish which are baked also to secure the necessary hardness. The graining, just before the varnishing, is accomplished, for the top, by means of transfer from a spruce board. The bottom panel and sides are hand grained. A rub with pumice, followed by an oil polish, constitutes the final step.

The snow-surveyor with his instruments in their housings on the summit of Mt. Rose, in Nevada

THE SNOW-SURVEYOR OF THE SIERRAS*

By SWIFT PAINE

DR. J. E. Church, Jr., professor of Latin and Greek at the University of Nevada, surveys and samples mountain snow. Why? To determine the relation between snow and water supply for irrigation and power, and especially the relation between forests and conservation of this snow supply.

He developed his accurate method of snow surveying as a hobby, but its development has almost crowded out his vocation. Short, perpetually brown, with mild eyes and a manner unfailingly benign, he is an utterly indefatigable mountaineer. When he went in midwinter on an expedition to Greenland, he maintained his meteorological observations on an ice-cap at three-hour intervals day and night. But that is another story.

He began his work in the Sierra Nevada Mountains near Reno, measuring great typical stretches of snow, particularly on the slopes of Mount Rose, northeast of Lake Tahoe. Many times each winter he measured the depth of these snow stretches at fixed points, a hundred feet apart. He developed a hollow steel cylinder with which he was able to obtain samples of the snow. These he carefully weighed to determine its density and water content. Over and over he did this, in dense forests, beside windbreaks of twisted Alpine white pines, on rough masses of broken rocks. People called him fussy, but he knew what he wanted. He wanted to know how much snow the mountains contain in any given winter.

Now his method is supported by the legislatures of Nevada and California, and by the producers of electric power on the Pacific Coast. It has also been adopted in other places, notably in Utah and in Alberta, Canada. Each spring he and those using his method can accurately forecast how much water will be available in the rivers during the summer.

In all of his snow surveying Dr. Church keeps a careful record, and his data on the conservation of snow by the forests are especially interesting.

Last stages of pitted snow, as Dr. Church, the snow-surveyor, measured it

MUCH timber in the region about Mount Rose was ruthlessly cut down about 65 years ago for the great silver mines of Virginia City and Gold Hill. On these semi-arid slopes the snow surveyor made some interesting discoveries. At an elevation of 5500 feet he found that a reforested area thickly covered with young pines had in March of one year 13 inches of snow. This he determined as equivalent to five inches of water. A deforested area dotted with manzanita and snow bush at the same altitude had five inches of snow, which would mean two inches of water. At the same elevation a typical sagebrush area had only one and one half inches of snow, which would mean only one half inch of water.

Thus the reforested area conserved more than twice as much snow and water as that which had been deforested, and nine times as much as that covered with sagebrush.

His measurements in April at an elevation of from 9000 to 10,000 feet were just as striking. He also found that in the month of March a forested slope, though it gained little in actual depth of snow, kept its increase so packed down that the gain in water content was

*Courtesy of *American Forests*

nearly 50 percent greater than that on a slope without trees.

Dr. Church has made innumerable measurements of snow in different kinds of forests. An open forest of pine and cedar, he found, which had in January 47 inches of snow, had by the end of April only one half inch. A dense fir forest had 40 inches on the earlier date and two inches on the later. A fir forest, dense, but full of glades, had 50 inches on the earlier date and eight inches on the later. Thus glades greatly increase the snow-gathering capacity of a forest.

In one sense, Dr. Church found that dense forests are wasters of snow; but even they conserve far more than they waste, in comparison with areas barren of forests. A sturdy growth of new trees can conserve almost as much snow as virgin forest without glades. The best types of trees for the conservation of snow, said Dr. Church, are those which are sufficiently separated to let the snow reach the ground and yet protect it from the sun and wind. A line of trees which forms a break against the wind can conserve a good deal of snow that lies in the open, he found.

Dr. Church surveying snow in Greenland in mid-winter

A MAN so gentle and yet so persistent as Dr. Church has naturally made enemies. What could a professor of Greek know about water? Seasoned ranchers and woodsmen laughed at him at first. On the very top of Mount Rose he built a shelter tight as a ship's cabin and filled and surrounded it with an extraordinary collection of apparatus, much of which he later discarded. At one high windy mountain pass he put up a shelter like a sentry box, to stand in while he recorded his data in books and on papers which otherwise might have blown away. It was a hard day's work to get that sentry box up to the 9000-foot pass.

Gradually Dr. Church interested many in his snow-surveying—a rancher at a foot of a mountain, a caretaker at a summer resort on Lake Tahoe, a dam-keeper at the Blue Lakes. Bob Watson, one of the most famous guides in the Sierras, has become his staunch friend. In some he aroused enough enthusiasm so they would take measurements for him.

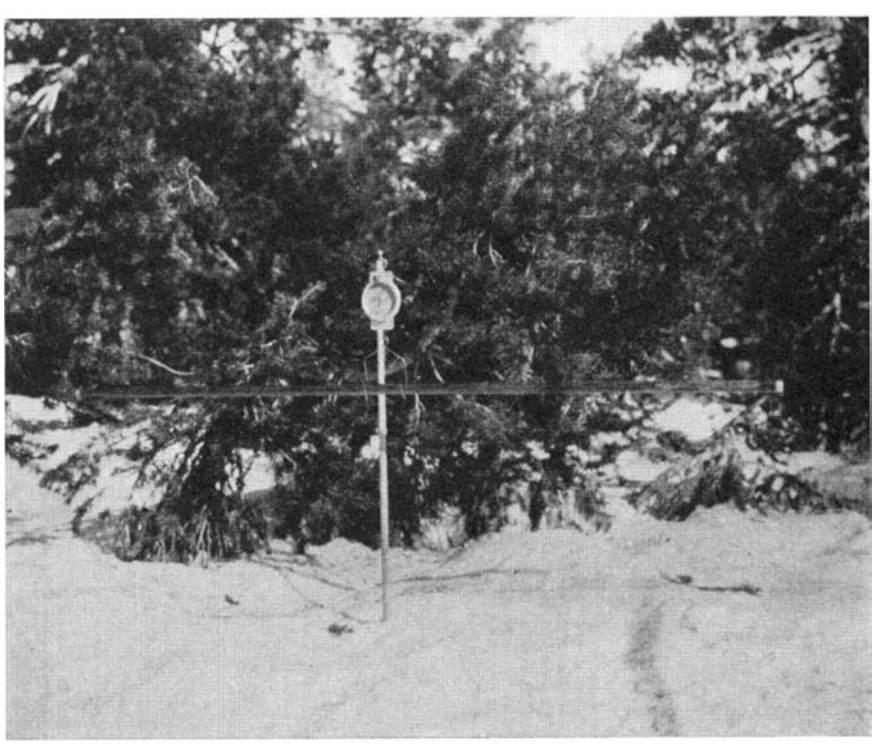
At first the money available for his work was pitifully small. He was forced to spend much of his own salary as professor of Greek. But every winter he is found dashing off to Mount Rose, Webber Lake, Ward Creek, Bridgeport, anywhere in the Sierras within a hundred miles of Reno. Botanists use his cabins in summer as centers from which to collect specimens. Geologists use them for the study of rocks.

Always he is generous in sharing his experience. Time after time I have gone to him for equipment and advice for pleasure excursions into the Sierras. With the utmost thoroughness he tells me everything necessary for me to know, gives me the keys to his huts, urges me to make free use of his provisions.

In the last few years, as a result of his Sierra Nevada success, he has been asked by the University of Michigan to go on two expeditions to Greenland. Naturally he has come back with more knowledge of winds and snow and ice than ever. Yet the region that is especially his is that around Lake Tahoe in both California and Nevada.

●

Molecules smooth out steep hills for your motor car. How and why will be told in an article scheduled for publication in our next number.



Weighing snow to determine its density and water content

INVENTION as a profession —practiced by a small group —is not new. The idea of teaching it in colleges and universities, however, has never been more than a hazy idea in the minds of a few. Therefore there may be some differences of opinion regarding the points brought out in the accompanying article, especially in view of the tremendous growth in recent years of industrial and engineering research laboratories. We offer the article, however, for the original thought it contains; it rests on its own merits. We should like to make one suggestion: where the author uses the expression "basic invention," the term "pioneer invention" might be more appropriate since there can be no hard and fast definition of the former.—*The Editor.*

INVENTION— A COMING PROFESSION

By H. OLKEN

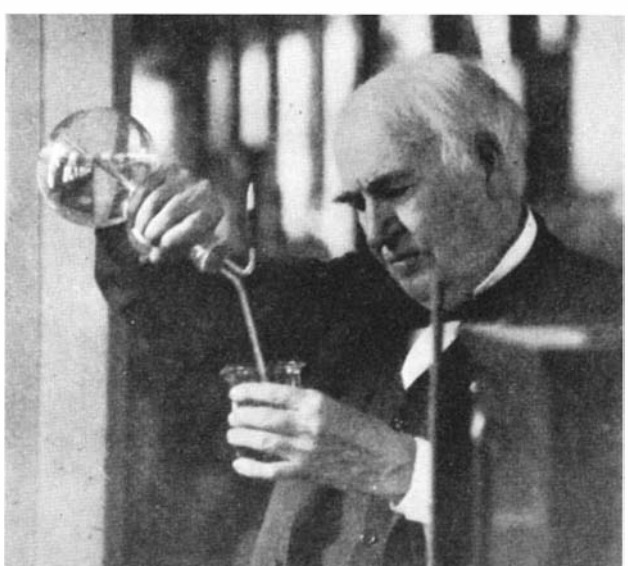
INVENTION is regarded the world over as a matter of genius—a rare, mysterious ability to create. Such is not the case; invention is not a rare and mysterious faculty present only in geniuses, but a faculty which all intelligent persons possess. In most people this faculty is so weak that it cannot excite itself into activity, and without activity it undergoes no development. Even if most of us have a faculty for invention, it is left in such an apathetic state that we are entirely unconscious of its presence. By mental priming, however, many an inert inventive faculty can be stirred into action and, once started under way, can readily develop, with exercise, into a very considerable talent. Such mental priming to awaken inventive faculties might occur by accident, but it can be provided by proper education.

There is an urgent need in modern industry for an abundant, constant, and dependable supply of inventions. In other words, modern industry demands the services of an inventing profession. Engineers are equipped with technical abilities, and their services being a glut on the market at present, engineers are the most logical "raw material" out of which to create this new profession of inventing.

What is signified by the terms "engineering" and "invention"? Suppose, for example, a conventional airplane is to be designed to meet a specified rating for speed, rate of climb, ceiling, and so forth. The engineer will analyze the group of physical principles which, in combination, make flight in heavier-than-air craft possible. Each principle is taken apart by itself (angle of lift, angle of incidence, and so forth), proportioned to suit the specification requirements, and then all the different elements, each properly proportioned, are grouped together to comprise the complete design. This is engineering.

But suppose that only the conventional type of airplane is known to the designing engineer and he is required to design a new type of airplane—a type which rises vertically. The known combination of physical principles which produces the conventional soaring flight will not do. His problem now is to provide a new combination of the principles of physics which will effect vertical flight. This is a problem of invention.

The first problem is solved by a mental process of analysis, of taking a combination of principles apart. But the latter problem must be solved by a process of mental synthesis. Engineering is a mental function in which the mind operates to break down a combination of scientific principles into its elements, whereas, in invention, the mind functions to combine elementary principles of science into a desired combination. They are opposite processes of the mind.



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The late dean of all professional inventors, Thomas A. Edison, perfected many extremely important inventions

Most scientific education, particularly in engineering, is today almost entirely a matter of training in analysis. In fact, emphasis on mental capacity for analysis has grown almost to be an obsession in scientific and engineering circles—so much so that, in the selection of technically trained employees, "power of analysis" stands almost as the all-important criterion on many an employment application blank.

This view—that engineering involves mainly a mental process of analysis whereas invention calls for the opposite mental process of synthesis—is a very simple one. But when one follows it out to its logical implications, the conclusions reached show a surprisingly great need for teaching invention to engineers.

CONSIDER, for example, the most fertile field for invention of all branches of engineering—the electrical. There the basic inventions—induction motor, two-phase to three-phase transformer, polyphase power generation and utilization schemes, the three-wire distribution system, and many others—were produced by the pioneers in the field, Edison, Tesla, Elihu Thomson, and their contemporaries of a generation and more ago. Since then, one of the most challenging problems confronting electrical engineers has been that of creating a switch which could interrupt currents of high power at high voltage. There were hundreds of patents granted on this subject for a generation, but not until a few years ago was a basic invention produced, which provided a high-power current breaker really adequate to power needs. The first of these was the "Deion" breaker.

An even more striking example exists in the field of illumination. Patents galore have been granted to electrical engineers for detail improvements in the two basic inventions for lighting purposes—the incandescent lamp and the arc light, both of which were invented more than 50 years ago. Since

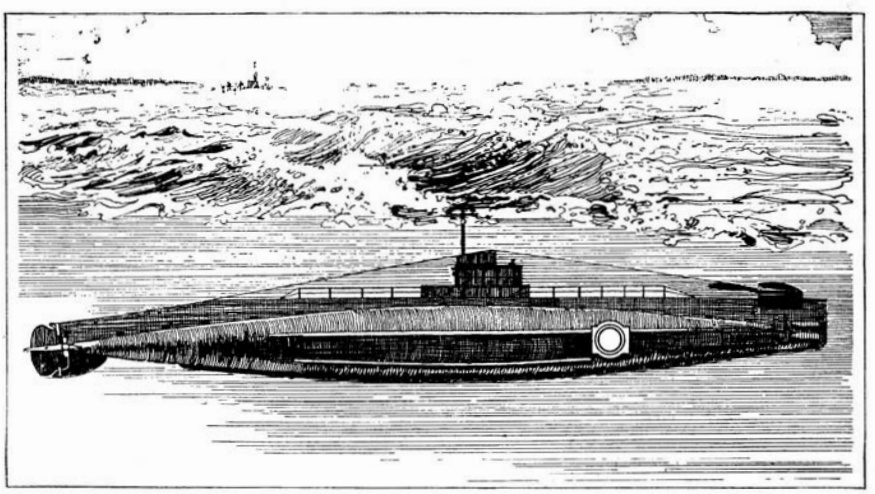
then there has been an urgent need for a light with all the colorfulness of the arc, the simplicity of the incandescent lamp, and of vastly greater efficiency than either the arc or the bulb. For years, hosts of engineers have been working on this problem. True, they have brought out a great number of special and novel types of light sources, but the universal electric illuminant is only now being approached, in the form of a recent sodium lamp. Yet even this lamp, which is all that the many great engineering staffs can show for years of work and fortunes spent in "research," though five times more efficient than the incandescent lamp, is still a far cry from the basic invention called for.

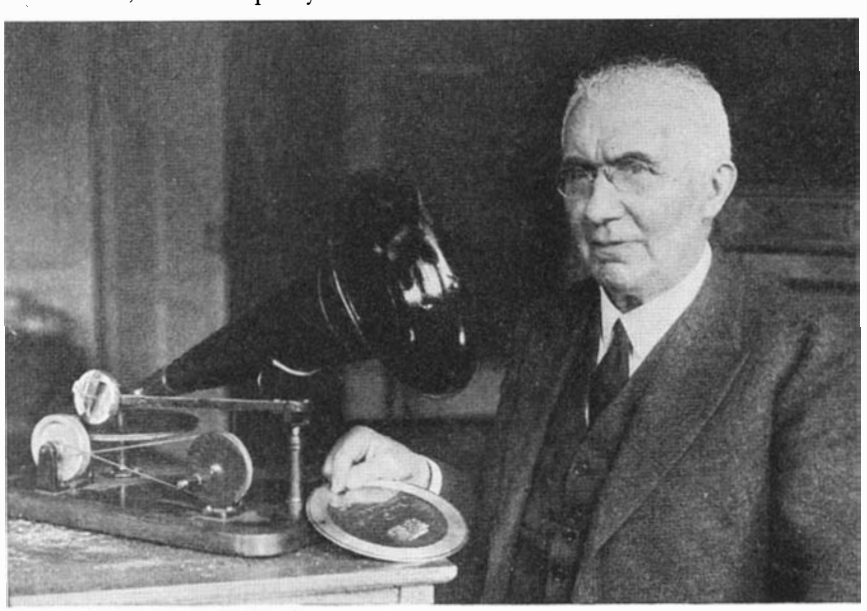
Reginald A. Fessenden, deceased, who was noted for many important inventions utilizing electricity, sound waves, and radio phenomena. Below is shown a submarine using his oscillator, perfected during the war, which indicates nearness of ships which might send it to the bottom

We come then to the realization that the engineering education of today tends to stifle what little inventive faculty the engineer would ordinarily develop. And this realization comes from the simple view of engineering and invention as the two opposite mental functions of analysis and synthesis. But this view leads also to another broad and equally disturbing realization:

IF one considers the course of industrial development in the three decades preceding 1930, it is surprising how lop-sided this development has been, from the point of technological progress. Units of machinery, processing units, and plant units have grown bigger, faster, more powerful, by leaps and bounds. Electrical generators, for example, grew from units of a few kva output to immense turbo-generators of around 150,000 kva capacity. Processing equipment for oil refining developed into colossal units, and plants to turn out automobiles and similar machinery grew to tremendous size. This was progress in engineering—the design, in ever greater units, of inventions already known. But progress in invention was negligible in comparison; only a few basic inventions that created new industries were produced, principally the talkie, the vacuum tube, and the photo-electric cell. Technical progress was enormous, but mostly on one side, the side of engineering.

"Well," one might say, "what of it?" Progress in industry is a beneficial trend for the human race even if it be lop-sided progress. A little close scrutiny, however, shows that lop-sided progress in industry is like lop-sided travel in a vehicle—very likely to be upsetting and quite disastrous.





Copyright Underwood and Underwood

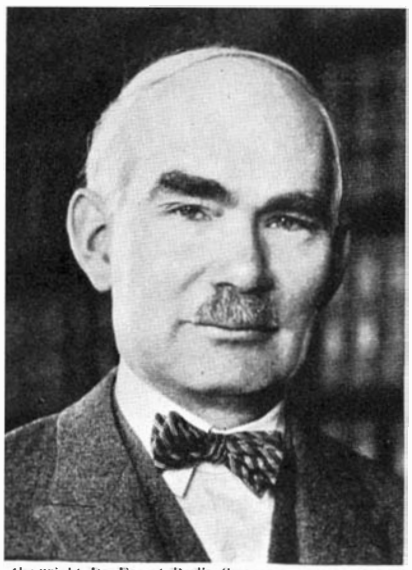
Another professional inventor: the late Emile Berliner, whose inventive genius produced important developments in "talking machines" and the telephone

Less figuratively speaking, industry has recently advanced by pushing to the limit development and exploitation of existing inventions. But had there been a good deal more of invention; had engineers been as good designers of new products and new processes as they were good computers of larger and larger units, then small production of new products would have offered just as profitable industrial opportunities as mass production of standard items. Then would the progress of industry have been more balanced and the depression less severe.[1] Excessive

[1]There may be an objection here that the population cannot adapt itself to inventions coming too rapidly, one upon another. This arises from a common notion of what inventions are in prospect. Television, for instance, has been prophesied to the public for a long time, and, of course, television would affect prevalent modes of living appreciably and directly. But there are vast fields for industrial invention that but faintly touch on the average man's life, and these fields are just opening up. Practically all the industrial processes used today are refined hang-overs of a pre-scientific age. Cloth, for example, goes through practically

cultivation of analytical faculties by the modern process of technical education, with its consequent withering of inventive faculties, is therefore as much as anything else the cause of the present "upset" condition of industry.

The prevailing process of technical education should be changed so that inherent inventive faculties will be permitted to grow. Invention, therefore, is a vital subject in the curriculum.



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Dr. Lee De Forest who is often termed creator of radio broadcasting

Nor does the matter rest here. Besides putting invention on the engineering curriculum to insure stable progress of industry in the future, it is most important that new products, new processes, be created now. Overbuilt plant capacities, idle engineers, must be productively employed as soon as possible. It is most urgent that a body of engineers be transformed into capable practitioners of invention—the nucleus of a new profession.

In general, a line of occupation grows into a subject of professional-school instruction somewhat like this: First some outstanding geniuses establish, through their achievements, a background of practice in an art. Working from there on, with capacities cultivated by the influence or example of these greater men, lesser geniuses contribute to the art and advance it beyond where the greater ones left off. This process continues until sufficient background in the art is established, and a sufficient number of persons are engaged in the practice of it to make it a profession.

ELECTRICAL engineering affords a very good example of this course of development. Outstanding pioneers such as Edison, Sprague, Thomson, Kennelly, Lamme, and Steinmetz established a body of practice which was broadened and deepened by later practitioners of the art.

In the art of invention, we are fairly well over the stage of basic achievements attained by men of outstanding inventive ability such as Edison, Tesla, Fessenden, Sprague, Elihu Thomson, De Forest, and others. There are now a considerable number of their successors, men most often recognized by their large number of patents, who make a regular practice of invention. And working practically in apprenticeship to these practitioners of invention are groups of young men who may be termed, in the not too distant future, "the first members of the inventing profession." It may therefore now be safely presumed that the time has come when a sufficiently large body of practice in invention has been established, and there are a large enough number of practitioners in the art so that, by close study of the art under guidance of one skilled in it, students of technology can become quite capable at invention—even those endowed with only average inventive faculties.

"CLOSE study of the art" boils down to these two things: First it means cultivating "invention consciousness," a habit of regarding critically each product, each process, and questioning it thusly: This method or device is a combination of scientific principles but is it the best combination for the purpose? Will a changed or a different combination be better? Secondly, it means practice in digging up an element to suit a required combination of principles, also training in working out a method of combination when a group of principles is given.

An attempt at teaching invention along these lines has been made by the author in an informal course of lectures to a small group of graduate engineers. This led to realization that the following are the two cardinal factors in teaching invention:

In the first place, to confront the student with an actual problem of industry is the most exciting possible stimulus to his inventive faculties. Consequently, the course should be based on co-operation with industry wherever possible. A very good arrangement to effect this would be to give the course on a regular graduate basis, as a co-operative course in a research institute supported by industrial fellowships, but under supervision of the graduate department of the engineering school or university. At least one such research institute has already been established. It was the aim of Dr. Duncan, in founding the Mellon Institute, to develop in chemists "creative mental powers" or, as it is called here, "the mental faculty of synthesis," by graduate work in co-operation with industry. More similar research institutes in the other branches of technology, in mechanical and electrical engineering, radio, and particularly for the general field of physics, are urgently needed and their creation would promote education in invention.

The second cardinal factor in teaching invention, and the one most worth keeping in mind, is this: The bulk of work in studying as in practicing invention is library work, rather than laboratory work. To be adept at forming combinations of scientific principles calls for ability to dig through the world's technical literature and find just the principle required to effect a desired combination, or to find just the combination that will fit together an available group of principles. This means long practice in hunting ideas, or methods of using ideas, where both are stored abundantly—in libraries. This fact should facilitate the teaching of invention. Library facilities are generally very good throughout the country so there is not so much difficulty in providing facilities for instruction as when laboratories are a primary consideration.

The entire discussion might well be concluded with this brief summary:

C. Francis Jenkins, a pioneer in the development of the motion picture

Invention is not a rare and mysterious power, but the converse process to mental analysis; hence it is a faculty common to all, and can be developed, by education, to considerable power. Consequently, it is but a matter of time before training in the art of invention becomes general. And the day is therefore near when the new profession of inventing will arise to join engineering in making science an even greater boon to industry than ever.

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the same process in manufacture as it did 200 years ago; steel-making has not changed since Bessemer's day; and so on all through industry there are myriad needs for new products and new processes which will advance industry without even slightly disturbing the present ways of life. Cellophane, for example, created a new industry and changed many others—yet it has not disturbed, but helped, the average man's daily life!

THE KUKULOGRAPH

By THE REV. M. J. HOFERER, S. J.

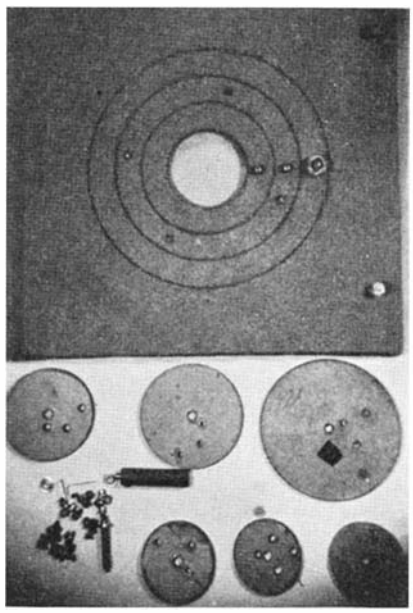
COMPOUND-harmonic-motion figures and designs of innumerable forms and varieties suitable for paint and crayon work, or to serve as patterns for fancy needle work, may be simply produced by means of the Kukulograph designed by the writer. The device also has possibilities as a children's toy.

The name means "circle-circle-writer," and is appropriate because it is by means of disks moved around and around within circular guides that a great variety of figures and designs are produced. Short leads of different colors, inserted on the under sides of the disks do the writing.

The origin of the Kukulograph dates back more than 30 years to the time when the writer constructed his quadruplex-compound-harmonic-motion pendulum which was described in SCIENTIFIC AMERICAN for April 1, 1899. This device consisted of four heavy pendulums suspended from the four sides of a table, two of them moving a blackened glass plate, and the other two a needle that traced the resultant of the four motions upon the plate. The whole performance was, at the same time, projected upon a large screen.

A YEAR later, the Rev. Marc Deschevrens, in France, invented the Camphylograph, an apparatus producing the same figures by means of a series of cog-wheels. In this device, a fifth motion was added by having a revolving plate that multiplied and beautified the resultant figures indefinitely. A description appeared in the *Scientific American Supplement* for December 15, 1900.

Another, and far more complicated machine, was devised by the Rev. W. F. Riggs, at Creighton University, Omaha, and was described in the *Supplement* for February 9 and 16, 1918. In this formidable machine was a multitude of cog-wheels, pulleys, belts, and cylinders, all set in motion by an electric motor. Of course, the figures which could be produced by this device runs into thousands and even millions.



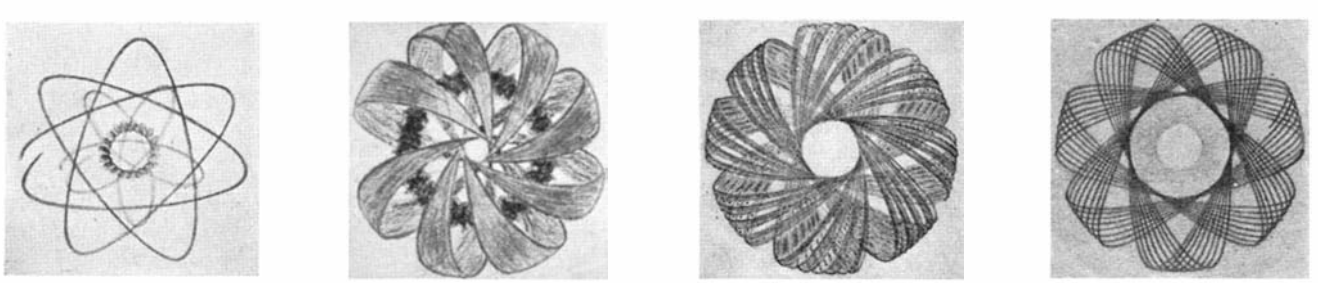
The parts of a Kukulograph, showing one of the large boards with three guide rings inserted. Below are the disks, spindle, and leads

Contrasted with these complicated instruments is the simplicity of the Kukulograph. A circular hole is cut in the center of a piece of half-inch fiber board about a foot square, and two or more concentric rings of the same material are cut to fit exactly within this hole. The inner edges of the rings, or the hole in the board, serve as guides within which is to be run the drawing disks. These disks may be of various diameters, but all sizes are provided with center holes which serve as bearings to hold the handle by which the disks are moved. In the under sides of the drawing disks are other holes, spaced at different distances from the center, in which are to be inserted one or more leads. These leads trace the figures, and upon the placement of them depends the final result.

The number and variety of figures that may be drawn is almost beyond reckoning, depending on the ratio between the diameters of the disk and guide, and also on the distance of the lead or leads from the center. If the lead is inserted in the exact center of the disk, the figure will always be a circle. If the diameters are in the ratio of 1:2, the resultant will be a straight line, when the lead is near the circumference of the disk. Ellipses of different shapes will be produced for different positions of the lead nearer the center. When the ratios are 1:3 or 2:3, the figures will be triangles of different shapes. Ratios of 1:4 and 3:4 will produce squares; 1:5 and 4:5, pentagons; 2:5 and 3:5, five-pointed stars; and so on.

THE operation of the Kukulograph is as follows: The drawing disk is selected and the desired leads are inserted. The large board, with or without one or more of the rings, is held with one hand on a sheet of paper or cardboard. The disk, with spindle inserted, is placed within the guide. Then the operator, pressing inward and downward with the spindle, forces the disk to follow the inner edge of the guide and at the same time rotate around the spindle. The simple rotary motions are continued until the desired design is completed.

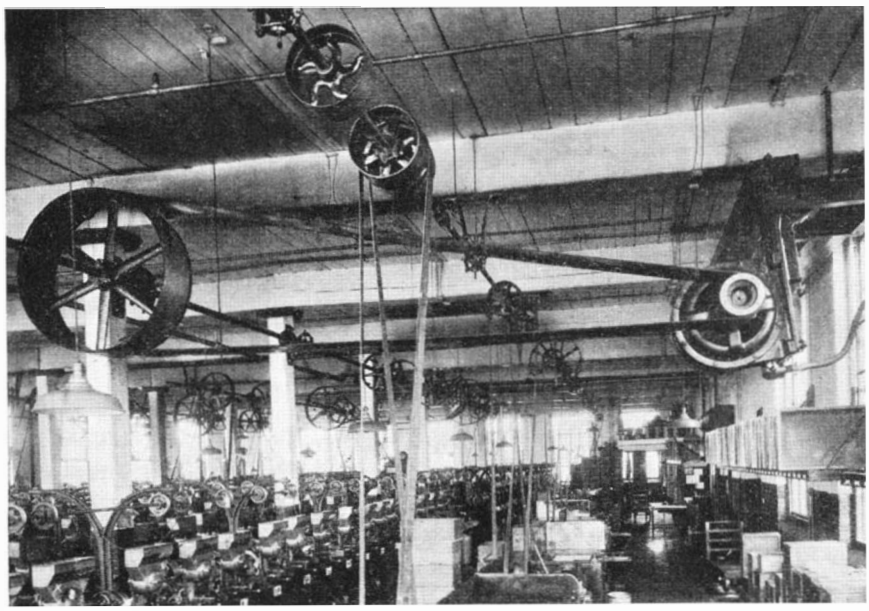
Aside from applications in art and industry where designs are an essential part of the work, the Kukulograph has possible applications in schools. The teacher of a drawing class, with a Kukulograph available, might easily prepare a set of papers containing the same design, and distribute them among the pupils for a competitive test in the artistic combination of colors. The figures reproduced on this page give some faint idea of the work that can be done with this simple device.



Examples of designs produced with the aid of the simple device illustrated and described above

LEATHER POWER-BELTS REGAIN FAVOR

By J. R. HOPKINS

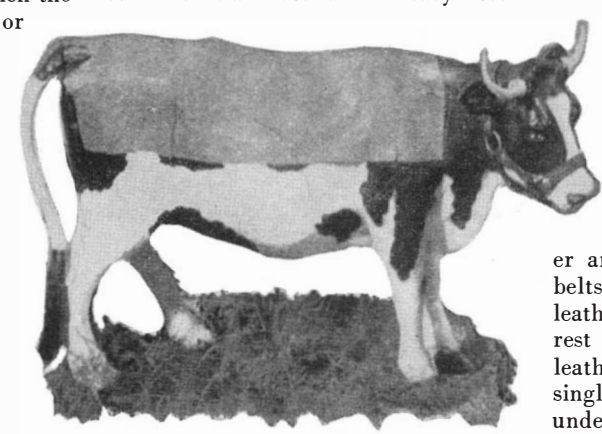


A typical modern application of motorized group drive with leather belting. The motor is mounted on a pivoted base, insuring uniform tension on the belt

TRANSMISSION of power by line shafts and leather belting was the usual method of driving machinery before the advent of electricity on a commercial scale made the electric motor practicable. Then, for a time, the power belt was somewhat eclipsed by the individual motor drive in which the electric motor was built into, or placed beside, the machine to be driven. This method of driving machinery to some extent replaced the line shaft and belt, but it was soon found that comparatively large electric motors, driving line shafts as did the steam plants of earlier times, have strong claims for being the most economical method of motorizing machinery. Thus, a single large motor may be employed to drive a group of machines through a modern ball- or roller-bearing line shaft, using a leather belt to transmit the power from the motor to the shaft, and also from the shaft to the individual machines. A new pivoted motor base makes an installation of this type still more efficient.

The longevity of belts is an interesting subject. In 1876 there were exhibited at the Centennial Exposition three belts 60 inches wide, 176 feet long, and weighing 1130 pounds each. In 1925 these belts were still running, having been in continuous use for 50 years in a paper mill at Wilmington, Delaware. Many a leather belt has outlasted the machine it drove. The average life of a leather belt is estimated to be not less than eleven years.

Today's manufacture of leather belting is standardized and highly developed. The raw material is heavy steer hides. Over 90 percent of all steer hides are tanned and used for sole leather but the finest hides, free from blemishes, are used for leather belting, for the strongest and toughest leather is required. The tanning has the same end in view. Only about 26 percent of the entire hide is used in the manufacture of belting. After the hide is tanned it is called a belting butt. Great care is taken during the tanning process to maintain the surface of the leather, as the grain or hair side has the ability to grip a pulley as will no other material.



Upper part of steer hide is used for belting; remainder is destined for shoe leather and leather specialties

WHEN the actual manufacture begins, the shoulder is cut off and the belting butt now becomes a "butt bend." The piece of leather is thoroughly washed and scoured to remove tanning materials or foreign substances, for if dirt or foreign matter should remain in the leather it would cut the fibers of the belt and shorten its life. Next the wet leather is wrung through great wringers and while still damp it goes to the fleshing machine where all fats and fleshy particles are removed. The surface of the hide is then rubbed with cod oil, and the hide is sent to a drying room. While still warm and dry, with the pores of the leather all open, the currying or lubricating materials are rubbed into the leather. This currying mixture is hot and penetrates through the leather, thus lubricating the individual fibers. After the currying, the butt bends are stretched in frames and the temporary and permanent stretch of the leather is tested. This stretching is very important because, not only are no two hides alike as to stretch, but not all parts of any one hide are alike before stretching.

The leather now comes to the belt shop where it is made into single, double, and three-ply belts. The leather is graded and cut into strips of usable widths. The center part of each butt furnishes the finest leather and becomes material for the best belts. The best half of the "side stock" leather is also used for belting, and the rest is destined for use in making leather specialties. Under light loads a single belt gives sufficient adhesion but under heavy loads a double belt has proved to be more satisfactory. A belt of single thickness will withstand a stress of 700 pounds per inch of width, while double and triple belts give corresponding values of 1400 and 2100 pounds respectively.

In the manufacture of belts, the ends of each strip are scarfed to a pointed edge, then feather-edged and the laps roughed by a rapidly revolving wire brush. This lifts up the ends of the fibers in the parts to be joined with cement so that they are firmly embedded

in the cement. Belt men then match up the leather into rolls of finished belting, without actually gluing it together.

We now come to a radical change made recently. In the old method, the scarfed leather was given to belt men who took it to their belt press, matched their leather, fitted it together to uniform thickness, and each belt was actually built separately. In the new process, as carried on in the plant of the Chicago Belting Company, Chicago, Illinois, the single belts are kept by themselves, the leather for each roll is laid out and matched to make an even, uniform roll, and the pointed ends are touched up by hand. The different pieces are then numbered consecutively and go to the belt pressman.

IN the old method the hand cementing was of two kinds, one cement being called hot cement, made of animal materials; the other a celluloid, waterproof cement cut with acetone. This was applied cold and in two coats, the first left to dry a half hour or less and then the second applied. Sometimes this celluloid came in sheets which were dipped in solvent and laid on the parts to be cemented.

In the new process, roll cement replaces the sheet celluloid cement. All of the roll cement is of the same calipered thickness, a few thousands of an inch thick. It is dipped into its solvent by automatic machines which keep it there an exact number of seconds, and is then placed on the single belt laps. These laps go into an automatically controlled belt press so that the number of seconds each lap is in the press is always exactly the same. These new belt presses are hydraulic and they are equipped with a device for automatically rolling up the belting as it is made. After the belts come from the press the laps are inspected; then the belt is trimmed and stamped with an arrow showing the purchaser in which direction he must run the belt.

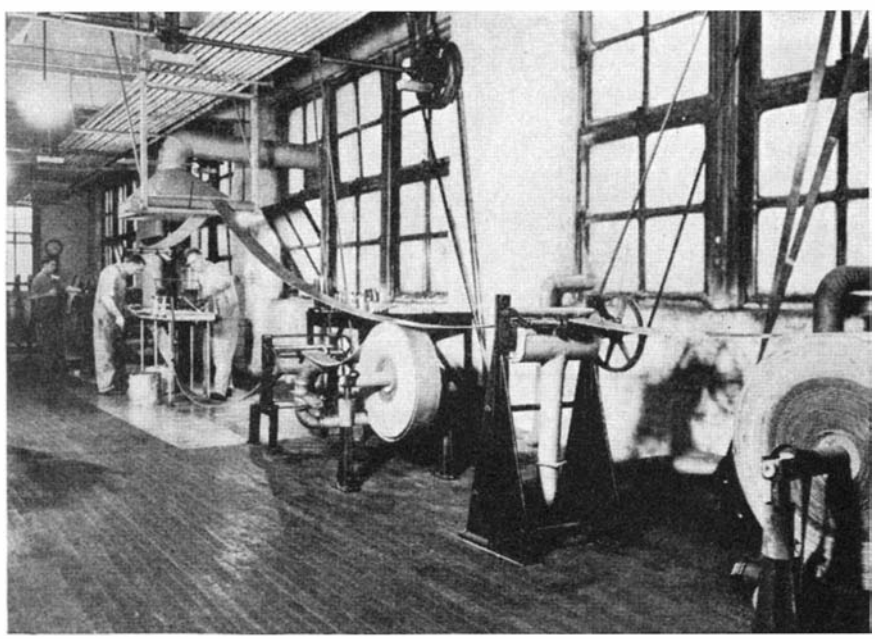
IN making double belting by the new process the double belts are first carefully matched up without cementing, a complete roll of belt is laid out and the pieces of leather numbered. This belting is then made into two rolls of single belting by the process described. It then goes to an intricate set of new machines which prepare the leather for the new tension cementing machine. This cements the two rolls of single belting into one double belt while the leather is under tension.

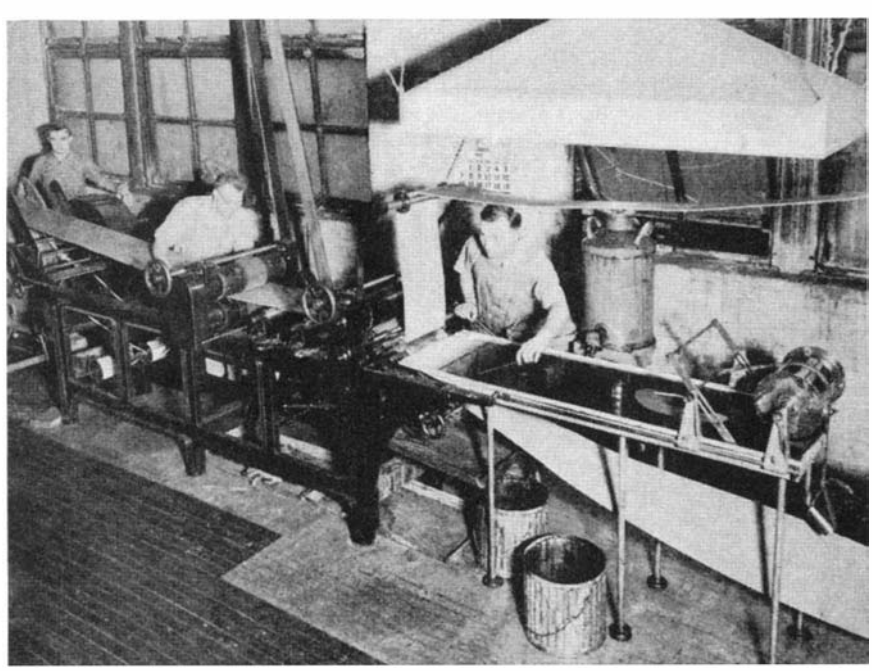
Before the two rolls of single material are cemented together into one roll of double belting, the leather in each single roll is roughed up by machinery, carefully matched together and the upper ply alone is brought to a standard, uniform thickness. In the old method the leather for double belting was scraped by hand and then roughed with a roughing tool. In the new process this single hand operation is replaced by 13 machines that do the same job with a degree of uniformity not possible by the old method. About 10 percent more of the strength of the leather is also retained that used to be scraped away by hand.

The cement on the tension cementing machine is the new type of roll cement and passes through its solvent at a uniform speed, entering between the two plies of leather under tension. The finished double belt is then rolled up under tension and dried and seasoned, still under tension, being held in place by about 60 feet of old belting which is wrapped around the new roll.

The new cement is waterproof, resists the action of mineral oil, causes the belt to have less stretch and is more pliable. In both methods the trimming and finishing are the same and the finished rolls then go to the stockroom to await shipment to the ultimate consumer.

One of the objections to leather belt transmission on any type of drive, either between long centers or short centers, has been that, together with its desirable elasticity, there has been some permanent stretch which has required inconvenient "take-ups" involving considerable loss of time. With this new process of producing belts, however, the percentage of permanent stretch has been greatly reduced.





Above: **In the new process three operators do the work of 20 men. The two rolls of single belting are in foreground, the tension cementing machine in background.** ***Below:*** **The two single belts being cemented together under tension. This eliminates from 50 to 75 percent of permanent stretch and retains native strength**

SCIENCE AIDS THE CANNERS*

By E. F. KOHMAN

THE story of Lavoisier's discovery of the rôle of oxygen in life was recently heard over the radio. We were told how Lavoisier found that if the oxygen supply of mice was cut off, they would rapidly succumb. However, if oxygen was promptly readmitted into the oxygen-free chamber, the mice revived and resumed their normal frisky manner of activity. From this was deduced a glowing picture of a certain tooth paste, which, on being used in the customary manner, liberated life-giving oxygen.

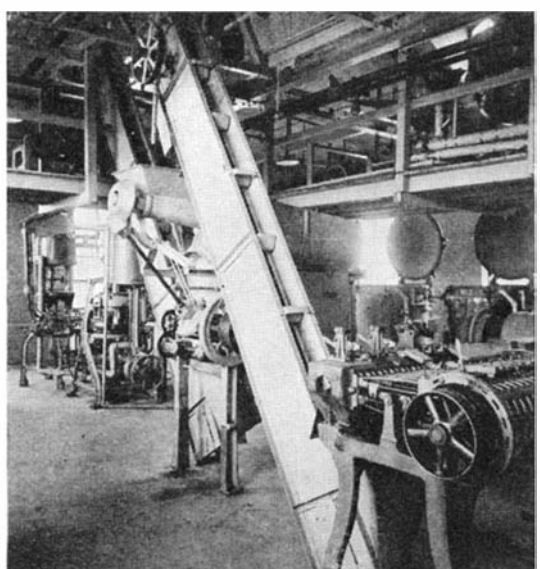
A benumbed conscience would be necessary to develop such a glowing picture of the rôle of oxygen in foods. Yet every raw vegetable and fruit consumes oxygen just as did Lavoisier's mice. Their avidity for oxygen is even greater than that of mice. Without oxygen, mice promptly succumb to a point at which they can no longer utilize it. Not so with raw vegetables and fruits. They continue to evolve carbon dioxide in not greatly diminished amounts long after their oxygen supply is cut off.

OXYGEN is, strictly speaking, not life giving. Oxygen is corrosive and destructive. Oxygen in Lavoisier's experiments was not the life-giving principle. The oxygen destroyed that the mice might live. Oxygen is admittedly essential in every life process, but in every life process the direct rôle of oxygen is to rob the energy from some substance and this energy, thus liberated, is the real life-giving principle. Oxygen is, in practically every instance, inimical to preservation. With few exceptions, this is true in every phase of the food industry and it is particularly true in the preservation of foods by canning. The purpose of foods is to maintain life, and the purpose of the preservation of foods is to stabilize the life-giving principles. The energy supplied by food is one of its life-giving principles.

Considerable losses in energy value may occur under ordinary conditions of handling vegetables as the result of oxidation. Benoy held raw vegetables for twenty-six hours at 30 degrees Centigrade (86 degrees Fahrenheit). Under these conditions carbon dioxide was evolved equivalent to 13.6 percent of the energy value in asparagus, 6.4 in lettuce, 6.3 in green beans, 5.2 in okra, 4.5 in green onions, 3.1 in carrots, 2.6 in tomatoes, and 2.0 in beets.

This characteristic of all vegetables and fruits is of such profound significance that it deserves more attention. Such activity is generally designated as the respiratory process. Every vegetable and fruit, while in the raw state, is endowed with enzymes that cause oxidation of some of the food materials in them as well as bring about other chemical reactions. These enzymes are so active and their demand for oxygen so great that if oxygen cannot be obtained from the air, it will be obtained from some of the food issues. When sugar is present, it is most likely that the oxygen will be derived from the sugar and a process simulating the anaerobic activity of micro-organisms results, similar to fermentation by yeast in the absence of air. When oxygen is extracted from sugar for oxidation purposes under such anaerobic conditions, a residue relatively poor in oxygen is left behind. Thus, undesirable by-products result. Among these, alcohol and aldehyde are usually present.

This enzymic activity in raw vegetables and fruits may under certain conditions have adverse effects. For example, when an apple or a potato is peeled, darkening of the ruptured cells on the surface promptly occurs. If an apple is bruised as by dropping on the floor, this bruised area undergoes increased enzymic activity, as a result of which its flavor changes in a few minutes; in time the bruised portion becomes brown in color, tough and dry in texture, and a large part of its food value is lost. When orange juice is expressed from the best container that so far has been found for orange juice—that is, from the healthy skin of an orange—this juice promptly becomes "untasty."



Photographs courtesy *Canning Age*

Machinery for cutting and mixing corn to be canned. As the author points out, the corn will lose flavor unless handled expeditiously

When corn is cut off the cob as for canning and the kernels are more or less macerated, it readily develops off-flavors. Its acidity changes measurably. If the canner did not handle this product with great expedition, there would result an abnormal flavor in the canned corn. By the continuous process that he has developed, the canner can observe expedition that would be impossible for the housewife to simulate with her limited equipment, and without which the canning of cream style corn would be out of the question.

ANY bruising that ruptures a vegetable cell induces accelerated enzymic activity and brings about abnormal conditions. Freezing to the point of congealing is disastrous to vegetable cells, hence the rapid deterioration of frozen vegetables and fruits upon thawing. In the harvesting, handling, shipping, and storage of raw vegetables and fruits, these matters have a significance far out of proportion to the attention that has been given them. The effect on vitamins is even more pronounced in some instances than on energy value or flavor.

Raw potatoes were known to have antiscorbutic properties before the discovery of vitamins, as evidenced by their use on early sea voyages. Some years ago Bezssonoff became curious to know whether the juice of potatoes possessed this property. He ground potatoes and pressed out the juice by means of a hydraulic press and fed the juice and the residue, or pulp, separately. Although they were fed within two and one half hours after the process was begun, he found neither the juice nor the pulp to have appreciable antiscorbutic value; on combining the two in their original proportion, the combined mixture no longer had antiscorbutic properties at all comparable to the orig-

*By courtesy of *Hygeia*

inal raw potatoes. In a study of shredded carrots, it has been found that the vitamin C content may be lowered by approximately 25 percent if the shredded carrots are held from one to three hours before they are fed.

Fortunately the same enzymes whose activity may be so disastrous can frequently be directed into channels of great usefulness. Canners have worked out a unique process for the canning of apples. In this the respiratory process is employed to free the apples of oxygen. Thereafter they may be canned and practically their full vitamin C value retained, whereas, without such treatment, it is largely destroyed.

The manufacture of sauerkraut presents an interesting illustration of the rôle that oxygen may play in the destruction of vitamin C and how this may be avoided. Cabbage stored in the head gradually loses its vitamin C content. The shredding of the cabbage, as is evidenced by the experiments cited with shredded carrots and potato juice, might entail an undesirable set of consequences were it not for the conditions prevailing in the vat in the manufacture of sauerkraut. It is known that the activity of micro-organisms in the fermentation process in the manufacture of kraut promptly creates anaerobic or air-free conditions. The fermentation process would quickly consume the oxygen present, since this makes such a strong demand for oxygen that it is taken from the sugar in the cabbage and as a result a certain amount of alcohol is produced.

IN the commercial manufacture of kraut, the huge volume of the vat results in the kraut being effectively protected from the air. Thus the kraut, months after shredding of the cabbage employed in its manufacture, is still potent in vitamin C. Moreover, this may be retained in the canned products as shown by Clow, Parsons, and Stevenson. But, as also shown by these investigators, not all canned kraut retains this vitamin C to the maximum extent. The canner of kraut, when he has the data available to show him the procedure to follow during the canning process, will have the facilities to take steps in this connection that will be impossible for the retail distributor or the housewife to take. The canning of kraut, therefore, should be a means of distributing kraut of a higher vitamin content than is possible in any other way, as distribution through other channels must necessarily entail more or less exposure to the atmosphere.

I recently defined canning as "the art of preserving seasonal products, and others susceptible to rapid spoilage, as far as possible in their natural state with all their nutrient qualities intact and in a form that renders such products more or less stable and capable of being distributed at all times to all places." This is a big bill to fulfil. It virtually means the elimination of the word "season" from the food lexicon. Although great achievements have been made, the fact that the canning industry is young is sufficient evidence that its ultimate goal has not yet been attained.

In a long series of co-operative studies by Teachers College of Columbia University, under the direction of Prof. W. H. Eddy and the National Canners Association, represented by myself, it has been demonstrated that each of the known vitamins commonly found in vegetables and fruits can be supplied in adequate amounts by some canned food over the usual test period. By taking cognizance of fundamental principles, such as are described above, as well as others that cannot be described in such limited space, the foregoing definition is fulfilled to a remarkable degree by the canning industry.

Tester for determining freshness of liquid foods, used in Birdseye laboratory. Electrical resistance of the liquid indicates its freshness

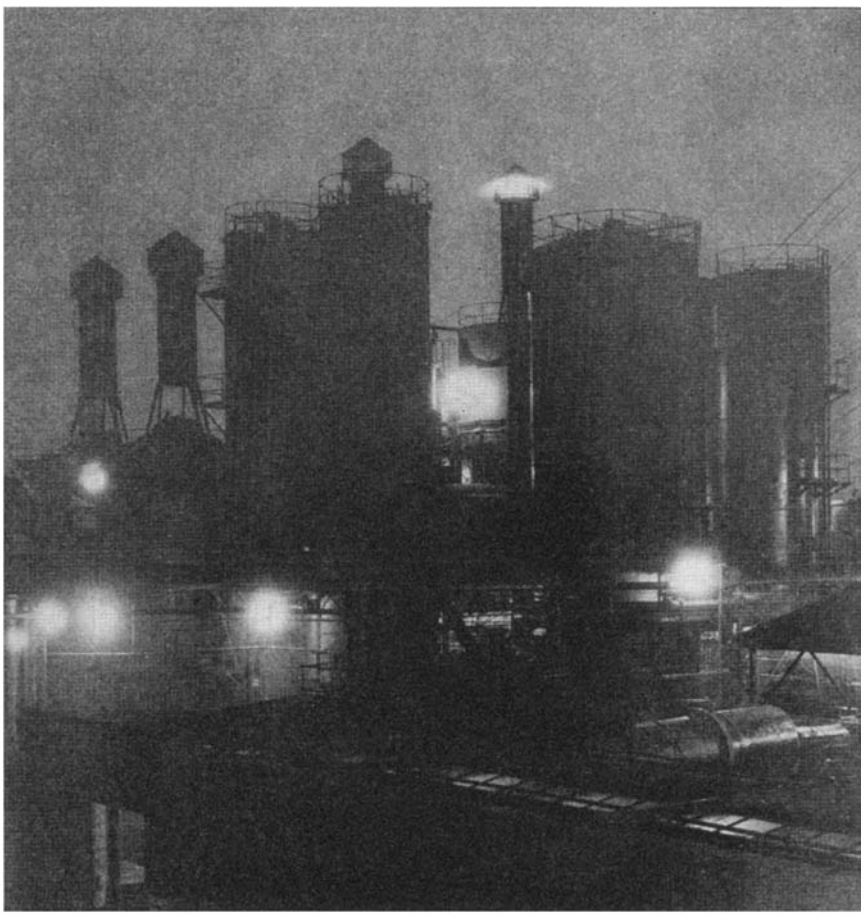
But have all the vitamins or other dietary essentials been discovered? Is the usual test period adequate to demonstrate conclusively dietary sufficiency? Even to these questions we are now arriving at answers in the co-operative studies mentioned above. Our results were recently reported before the American Chemical Society. For more than a year both rats and guinea-pigs have been fed and reared on a diet made up completely of canned foods sterilized by heat. They have reached the sixth generation. Growth has been as rapid, reproduction as prolific, litters as large, and lactation as abundant as can be expected from these species of animals. No dietary difficulty of any kind has been encountered. Every period of five days the animals are given five different canned foods so selected as to constitute a balanced ration. The different foods are not mixed, but each animal is permitted to eat according to its likes and dislikes. At the expiration of each fifth day, a new combination is set before the animals. So far 49 canned foods have been fed in 74 combinations. This variety probably accounts for the animals surpassing those on the usual laboratory stock diet.

OF equal moment are other studies reported by us at the same meeting of the American Chemical Society. It is an interesting fact that although we are told to eat raw vegetables and fruits to secure an adequate supply of vitamin C, there is no record of head lettuce and celery, the two vegetables eaten raw in greatest abundance, ever having been tested in this country for their vitamin C content. Consequently, over a period from May to October these vegetables were purchased daily in prime condition from New York markets to have their vitamin C potency determined. We must admit surprise at the values found. Canned turnip greens were being studied at the same time. Four grams of the latter were superior as antiscorbutics to 10 grams of celery or 15 grams of head lettuce. No explanation is afforded by available data for the low vitamin C value of these raw vegetables. However, attention is called to the fact that the turnip greens—as is usual in the canning of vegetables—were canned a few hours after harvesting in a region in which they grow to the best advantage. In contrast to this, head lettuce and celery are shipped from afar and frequently stored for long periods, thus permitting enzymic activity full play. It is well recognized that green vegetables are also far superior to bleached vegetables in vitamin A; that is, they have a far larger content of that vitamin.

The canner, by recognizing facts disclosed by fundamental research, by turning to his advantage certain properties of vegetables and fruits that in other directions may have deleterious consequences, by employing processes made possible only by the machinery of industry, can in many ways accomplish what is impossible in any other way. We are told to eat salads twice a day for an adequate supply of vitamin C. It now appears that if head lettuce or celery is the basis of the salad, we may secure more vitamin C by serving canned peas, tomatoes, spinach, peaches, or pineapple. All the facts about all the available foods are as yet by no means known. What is known may well be taken to assure us that, with reasonable discretion and intelligence in choosing our foods, our every dietary need may be amply supplied from a variety of abundant products.

Natural Gas Greets a Substitute

Newly Developed Gas Manufactured From Diesel Oil May be Used to Replace Natural Gas When an Emergency Arises



Night view of gas manufacturing plant at San Diego where gas is made on a "10-10" cycle. This means that for 10 minutes the honeycomb of brick in the generators is heated from the blast of the furnace; then this is shut off while the fuel oil is injected and gas is generated for 10 minutes. When the next charge from the blast furnace is admitted, the gas remaining in the generator causes an explosion that blows a flame out through the stack. Such a flame is seen emerging from the central generator stack in this illustration

By NORMAN V. DAVIDSON

NATURAL gas was early recognized as a fuel for commercial and industrial purposes and was adopted and used when the source of supply was near at hand. With the coming of new manufacturing methods for pipe, natural gas suddenly donned seven league boots and brought itself within the reach of far greater fields by stepping hundreds and even into the thousands of miles.

The difficulties of spanning rivers with the pipe line and troubles arising from corrosion and electrolysis suddenly loomed up. The problems of spanning the rivers fell naturally into the hands of the bridge engineers and those of corrosion and electrolysis were relegated to the chemical laboratories. The progress with which new lines are spreading over the country lend substance to the conclusion that these problems are rapidly being solved. There has been a lag, however, not in the solution of the pipe line problems but on the receiving end of the line. This has been due to the suddenness with which natural gas has forced itself upon the cities. The problem has been, not in the natural gas itself or the change-over to natural gas, which is a problem of considerable magnitude, but in the manufacture of a substitute for natural gas in the event that the elements temporarily win an upper hand and sever the long pipe line.

This problem takes on considerable importance because of the fact that during the season in which the elements occasionally play havoc with the pipe line, the line pressure is increased to meet the mounting demand. The natural forces thus make a double threat against delivery in this period of need. If a break does occur it is most apt to occur when the internal pressure and the external abuse from the elements are at their greatest. This is a peak load period and to meet the demands of a break in the pipe line would mean either that a tremendous amount of manufactured or natural gas must be kept on hand, or that the local manufacturing plant is suddenly called upon to supply its capacity load. Even with a supply of gas in storage, the manufacturing plant would soon be called upon to assume the entire load and would have to continue to carry it until the natural gas service was restored.

The older form of manufactured gas, that in many instances has been replaced with natural gas, has a heat value of about 550 B.t.u. per cubic foot. Natural gas has a heat value of about 1100 B.t.u. per cubic foot, or double that of the manufactured gas. The manufactured gas has what might be termed a quick flame while that of natural gas is sluggish. In making the change-over it is necessary to restrict the natural gas by adjusting or altering each orifice of all gas burners to take care of the slow burning characteristic of the natural gas. Once the burners have been adapted to the natural gas it becomes an impossibility to revert back to 550 B.t.u. gas because of the effect upon the flame.

If a burner is adjusted for a flame ½-inch high with 550 B.t.u. gas and natural gas is turned through this burner, the flame will, because the natural gas is richer and burns more slowly, be approximately five or six inches high.

It will also have a tendency to pull away from the burner orifices. A flame of this size has more heat than is needed, so the amount of natural gas allowed to escape is restricted so that a soft flame approximating the height of the former 550 B.t.u. flame is obtained. If an attempt is now made to revert back to the old manufactured gas, the flame would be scarcely a sixteenth of an inch in height and would be practically useless.

To overcome this difficulty in localities where both natural and manufactured gas are available, it has been necessary to enrich the manufactured gas to about the heat content of natural gas. Various petroleum products have been used for this purpose. Butane, propane, pentane, and other vapors (collectively known as butane or as butane-propane) have been employed because their natural volatility suggested an easy way to secure the end desired. Their vapors were simply added to the manufactured gas in sufficient quantity to supply the B.t.u's. required. The fact that they have such high vapor pressures, however, makes it necessary to store them under pressure to keep them liquid. Tanks for storing them must necessarily be strong, and strong tanks sufficient to hold the quantities needed become quite costly. The handling of the vapors in transporting them is also an item that adds to their cost.

TO overcome these particular disadvantages of butane, other less expensive petroleum products have been attacked with the intent of cracking them and securing the desired rich qualities. They have been tried in the old manufacturing equipment and with changes of more or less costly appliances added to the equipment. Methods employing a catalyst such as nickel wire have been used with some degree of success.

On the Pacific coast, because of the comparative nearness of the supply, it was fairly well concluded that the use of the volatile butanes was the most logical way to combat emergency situations. Thus the city of San Diego, when preparing for natural gas, was found to require the storage of 225,000 gallons of butane and the necessity of keeping that amount on hand at all times. In an effort to avoid the expenditure necessary for such storage, J. A. Harritt, Superintendent of Gas Production, San Diego Consolidated Gas and Electric Company, and Leon J. Willien, Operating Gas Engineer, Byllesby Engineering and Management Corp., undertook a series of laboratory cracking tests on four petroleum products. These were fuel oil, which is essentially crude oil minus gasoline; Diesel oil; kerosene; and gasoline. As an outcome of the tests, a promising gas from Diesel oil was discovered.

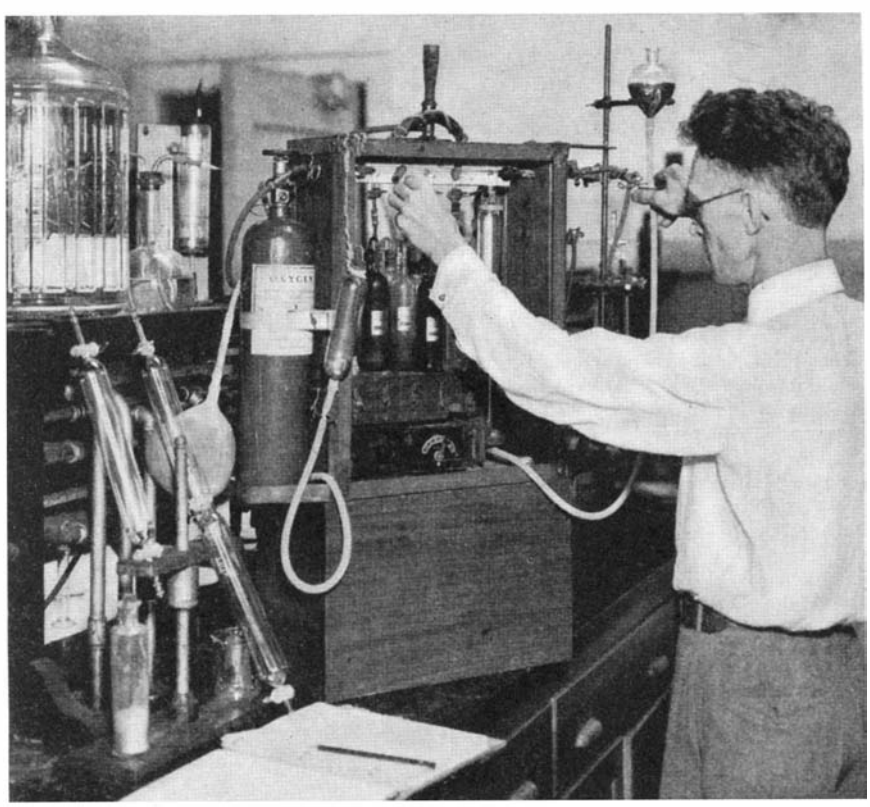
Because the city of San Diego was still using manufactured gas and hence not ready for rich gas experiments under full-scale conditions, the Pacific Gas and Electric Company co-operated in turning over the plant of the city of San Rafael, where natural gas was being used, for the continuation of experiments. Various percentages up to 100 percent of the new gas were introduced into the mains, and the effects from the consumer's standpoint carefully checked. It was found that the new gas was a little more sensitive to adjustment but that it would serve satisfactorily in 98 percent of the appliances. It was, during the course of the full scale experiments, varied between 950 and 1100 B.t.u. per cubic foot.

Diesel oil was used both for "heating" and "making" the gas, and the generators were of the usual type used for the production of 550 B.t.u. manufactured gas. Lampblack, the usual offender in the manufacture of an oil gas, was found to be eliminated if the temperature was held below 1600 degrees, Fahrenheit. The tar formed was of such quality that it could be utilized for fuel or sold commercially.

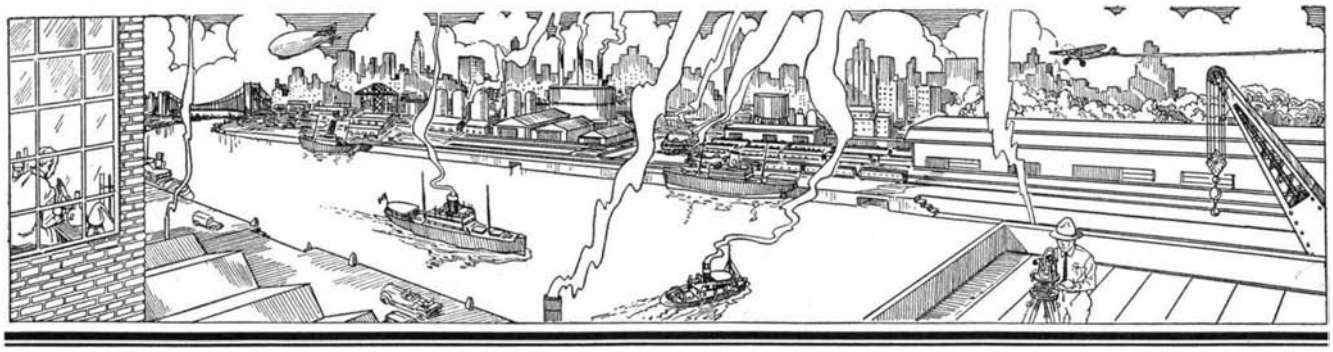
The progress that has been made in this discovery of a natural gas substitute is partially in the lessening of the storage tank costs, since Diesel oil is readily stored in the usual tanks, and partially in the elimination of one troublesome by-product which previously made frequent cleaning necessary. The primary advance lies in the fact that existing generators for 550 B.t.u. oil gas may be converted to manufacture the Diesel oil gas with but slight changes. This discovery makes the change to natural gas safer and less expensive.

CONTRARY to the publicity that accompanied the first introduction of natural gas, it is actually less dangerous than the manufactured gases. Natural gas contains far less, if any, carbon monoxide gas, than do the present manufactured gases. There is, of course, the possibility that carbon monoxide can be formed if the natural gas is incompletely burned, as with the gasoline in an automobile, but if vented properly this is taken care of. Since an explosive mixture of either manufactured or natural gas is dependent upon the oxygen content of the air and this is a more or less fixed quantity, the claim that natural gas is more explosive is not well founded.

Natural gas is not toxic in effect but since it can completely displace the air of a room, suffocation can take place. This was erroneously reported as poisoning when natural gas was first introduced. Natural gas has no odor and for this reason it was rather sinister until the plan of adding an odorant was inaugurated to make its presence detectable. It is proving a beneficial aid to man wherever it is properly provided for and controlled.



The gas analysis laboratory in which a number of oils were tested in order to discover a substitute gas. It was here that the new Diesel-oil gas was developed



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

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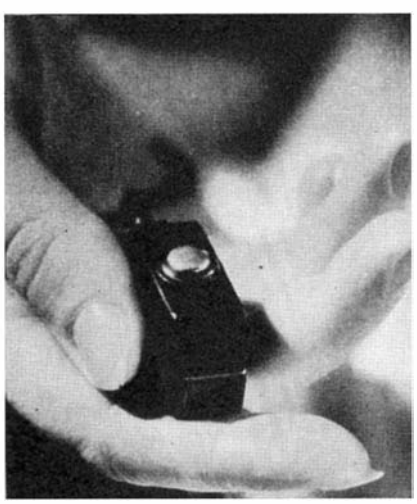
Bone-Conduction Hearing Aid

A METHOD of hearing by the conduction of sound through the bone structure of the head instead of through the outer ear, was successfully demonstrated recently at the Engineers Club, New York, to a group of prominent men and women, many of whom are deafened, when Dr. Hugo Lieber announced the perfection of a new device, known as the bone conduction oscillator. The demonstration was held under the auspices of the Sanzoray Club, an organization of prominent society women who are hard of hearing.



The tiny gold button oscillator is the heart of the new hearing device

The principle of bone conduction of sound vibrations, Dr. Lieber explained, has been known to science for decades. Most hearing aids, up to the present time, he said, have been based on forcing intensified sound waves through the impaired outer ear, usually resulting in distortion of sound and imposing a strain on the hearer. The bone conduction oscillator, on the contrary, when held firmly behind the ear, detours the sound around the outer ear directly to the internal hearing organs. Sound heard through bone conduction, he said, is without distortion, is clear and distinct, and causes no strain. About 20 percent of the deafened, Dr. Lieber was careful to explain, have poor bone conductivity and will not be aided by the device.

The equipment consists of a small transmitter, concealed in a pocket or inside the dress, a battery, and the tiny oscillator, which can be carried like a lorgnette, or worn on a head band. Sound waves are converted in the transmitter into electro-mechanical vibrations, which also bring about variations of electrical current drawn from the battery, and these varying electrical currents are conveyed to the oscillator, where they create greatly varying mechanical vibrations. The oscillator does not reconvert these mechanical vibrations into sound waves, as does a hearing aid which works through the outer ear, but on the contrary conveys mechanical vibrations to the bones of the head and from there directly to the internal auditory organs.

Fake Stomach-Ulcer Medicines

PERSONS suffering from stomach ulcers, gallstones, cholecystitis, (inflammation of the gall bladder), and diseases of the liver, often deny themselves relief by resorting to fake medicines advertised as having remedial value for these serious diseases, according to Dr. F. J. Cullen, Federal Food and Drug Administration. The nostrums advertised commonly contain alkalies, such as sodium bicarbonate, bismuth subcarbonate, calcium carbonate, and milk of magnesia, which are falsely claimed as treatments or remedies in these disorders.

"No drug or combination of drugs is recognized by present-day medical science as being a cure for diseases of the liver, or for stomach ulcers, nor will any of them remove gallstones," says Cullen. "There is no medical nor dietary treatment for gallstones nor for cholecystitis. The buyer may be sure that any drug sold to dissolve gallstones or to cure inflammation of the gall bladder is a fraud.

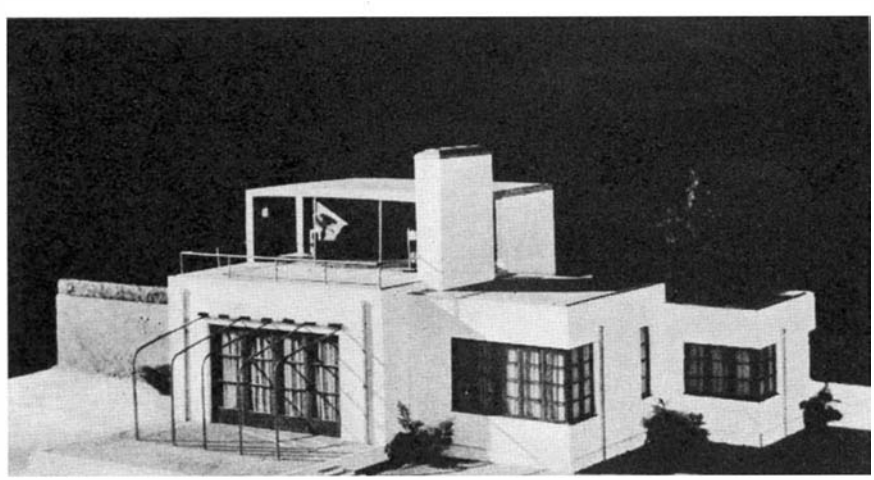
"Some of the minor symptoms of these diseases may be alleviated and the patient made more comfortable through the use of medicines, a correct diet, and proper care."

A House Built of "Presdwood"

WITH a group of prominent Chicago business men and labor leaders in attendance, W. H. Mason, vice-president of the Masonite Corporation, recently broke ground for the prize award Masonite house being erected in the Century of Progress Exposition to typify the last century's advances in home construction. This house, a four-room bungalow designed by Frazier and Raftery, architects, of Chicago, is of the more conservative modern trend, obtaining its modern appearance more from its unusual plainness than from any ornamentation or striking colors.

The exterior will be one-fourth-inch Presdwood over a sheathing of wood fiber structural insulation. A portion of the walls will be painted white and the remainder will be varnished to retain the natural color of the Presdwood; Tempered Presdwood of a darker color, will be used for trim.

The flat roof, a portion of which will be



The architect's model of the house to be built of "reconstructed" wood

TOOTHPASTE FACTS AND FANCIES

Merits Lie in Advertiser's Imaginations, Say Chemists

IN spite of what the advertisements say, it's the toothbrush that cleans your teeth; the toothpaste is of negligible importance, according to S. M. Gordon and E. W. Shand of the American Dental Association Bureau of Chemistry. The merits of the different brands of toothpaste are mostly confined to the imaginations of the men who write the ads, say these two chemists, for all toothpastes are mostly calcium carbonate or phosfate, soap, and flavoring.

Recent work of the Bureau, reported in *Industrial and Engineering Chemistry* was undertaken to check up on the claims of one toothpaste advertiser to the effect that his product has a low surface tension—the inference being that thorough brushing of the teeth is unnecessary; just work up a lather in the mouth and the penetrating foam with its low surface tension will penetrate into the crevices between the teeth and remove every particle of debris lodged there! The investigators found that there isn't enough difference in the surface tension of various toothpastes to distinguish one from another, and they intimate that even if there were, it wouldn't mean anything as far as the actual cleaning of teeth is concerned.

The compositions of several well-known toothpastes are revealed in the above-mentioned paper as follows:

Colgate's Ribbon Dental Cream. Each 100 grams of this paste (made by Colgate-Palmolive-Peet Company, Chicago) contains 28.0 grams glycerol, 5.0 grams soap (vegetable), 35.7 grams calcium carbonate, 7.6 grams precipitated chalk, 2.1 grams sodium benzoate, 0.9 gram aromatics, 6.5 grams corn starch, and 14.2 grams water.

Ipana Tooth Paste. Preliminary unpublished investigations indicate that Ipana (made by Bristol-Myers Company, New York) contains 18.8 percent glycerol, 38.5 percent calcium carbonate, 29.1 percent water, approximately 6 percent soap, β-naphthol, and a plant material which has not yet been fully investigated.

Forhan's. This toothpaste (made by the Forhan Company, New York) was found to contain approximately 0.2 percent of zinc chloride (2), 5 percent soap, and 46.0 percent calcium carbonate. The manufacturers refused to divulge the formula.

Iodent Toothpaste No. 1. This paste (made by Iodent Chemical Company, Detroit) is composed of 55 grams precipitated calcium carbonate, 6 grams soap, 34 grams glycerol, 1.25 grams petrolatum, 0.25 gram saccharin, 1.0 gram oil of peppermint, 2.26 grams water, and 0.24 gram iodides (as potassium and calcium)—in 100 grams.

Iodent Toothpaste No. 2. The composition is 30.14 grams precipitated calcium carbonate, 30.14 grams prepared calcium carbonate, 7.23 grams soap, 28.9 grams glycerol, 1.51 grams petrolatum, 0.30 gram saccharin, 1.20 grams oil of peppermint, 0.30 gram water, and 0.24 gram iodides (as potassium and calcium)—in 100 grams.

Pebeco Tooth Paste. Each 100 grams of this paste (made by Lehn & Fink, Bloomfield, N. J.) contains 19.98 grams precipitated chalk, 41.62 grams potassium chlorate, 2.15 grams stearic acid, 14.87 grams sugar and glycerol, 19.13 grams water, 0.72 gram binder, and 1.53 grams flavoring.

Pepsodent. This tooth paste (made by Pepsodent Company, Chicago) has an avowedly changing formula. It is now advertised as having the following composition: Special calcium phosfate 54.40 percent, Benzoic acid 0.1 percent, tragacanth gum 0.6 percent, Karaya gum 1.2 percent, calcium chloride 0.237 percent, and glycerol, water, flavor, etc., 43.463 percent.

Listerine Tooth Paste. This paste (made by Lambert Pharmacal Company, St. Louis) is admittedly secret in composition. Qualitative tests indicate the abrasive portion to consist of calcium sulfate and tricalcium phosfate. Soap was not found.

Kolynos Dental Cream. This paste (made by the Kolynos Company, New Haven, Conn.) was stated by the manufacturers to have the following composition: 18.87 percent alcohol, 0.21 percent thymol, 0.35 percent saccharin, 1.30 percent oil of eucalyptus, 1.42 percent oil of peppermint, 0.22 percent benzoic acid, 28.63 percent glycerol, 20.00 percent soap, 29.00 percent chalk.

Dr. West's Tooth Paste. This paste (made by The Western Company, Chicago) has the following formula, according to the manufacturer: 39.71 percent calcium carbonate (Sturge), 0.76 percent carbonate of magnesia, 1.51 percent soap (imported castile), 17.80 percent milk of magnesia, 2.50 percent silica, 2.50 percent simple syrup, 30.54 percent glycerite of starch, 3.75 percent mineral oil, 0.06 percent gum tragacanth, 0.07 percent saccharin, 0.78 percent flavoring oils, 0.02 percent color solution.—*A. E. B.*

closed in to provide a sort of covered terrace, will consist of wood sheathing applied over structural insulation for strength, with a layer of one-eighth-inch Presdwood over the sheathing and a covering of waterproofed canvas over this. This construction will permit walking and the use of furniture on any portion of the roof, even in the hottest weather, without injury to the roof.

Interior walls will be of structural insulation covered with wallpaper, plaster, canvas, paint, or decorated Presdwood, the finish being different in each room. Bathroom and kitchen walls will be covered with Temprtile decorated in harmony with the room fixtures. Floors will be of Masonite cushioned flooring with the exception of the bathroom in which a ceramic tile will be used. Doors will be veneered with Presdwood, which will be left natural or will be enameled according to the finish of the room.

French Superliner Has World's Largest Motors

THE four largest motors ever built for any purpose will propel the new French superliner *Normandie* which was launched at St. Nazaire on October 29. These motors are rated at 40,000 horsepower each, giving the new ship a total horsepower rating of 160,000, according to officials of the General Electric Company, which is acting as consultant in the work. The four synchronous propulsion motors and all auxiliary electrical equipment for the *Normandie* were built by Als-Thom, French associate company of the General Electric Company.

The previous record for motors was held by the two airplane carriers, U. S. S. *Saratoga* and *Lexington.* Eight motors, each rated at 22,500 horsepower and connected two to each propelling shaft, are used to drive these vessels, with 45,000 horsepower for each propeller. The propulsion and other electrical equipment on these ships were supplied by the General Electric Company. The airplane carriers, with 180,000 horsepower, still rank as the world's most powerful ships.

Courtesy Erwin, Wasey and Company, Inc.

This complicated electrical device, built into a bridge table (shown with the top removed) thoroughly shuffles a pack of cards and deals four bridge hands with great speed

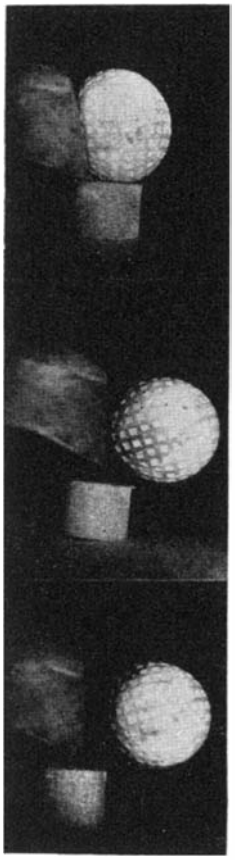
Lead Poisoning from Discarded Batteries

DISCARDED casings of storage batteries now appear as a new source of lead poisoning. Thirty-six cases of poisoning from this cause were reported to the City Health Department of Baltimore, Maryland. The casings had been given away by junk dealers of the city after the lead plates had been salvaged from them. The casings were used as fuel. A certain amount of lead which is deposited on the casings in the form, usually, of lead sulfate, vaporized into the poisonous fumes when the casings were burned.—*Science Service.*

Auto Finish Protected by Special Lacquer

INTERESTING facts concerning the absorption of light by films of cellulose acetate, disclosed recently by the Eastman Kodak Company, promise to have application in both the cellulose (nitrate) lacquer and the rayon industries.

Practically all cellulose finishes on motor-car bodies consist of a film of cellulose nitrate—usually a nitrate of low viscosity. Such a finish loses its luster and brilliancy



Splash! Here is what happens when a drop of milk falls into a glass of milk, *at left,* as photographed by the new method developed at M. I. T. From the bottom upward, each picture represents 1/480th of a second. The golf ball, *above,* was photographed at exposures of 1/50,000th of a second each. The top picture of this series shows the ball flattened by impact of a club. In reacting from this stroke, (middle picture) the ball is elongated horizontally. The ball starts on its flight (bottom picture), and the bulge on right side shows that it still oscillates as a result of the impact. *At bottom of page:* Photographic set-up

when exposed to sunlight, since it is particularly sensitive to the action of ultra-violet light. Its life could, therefore, be extended if it could be coated with another film of a substance which would cut off the ultra-violet light. Cellulose acetate itself is not suitable, since this substance has less absorptive power than cellulose nitrate, but the absorptive power of the acetate can be increased by the addition of aromatic compounds, thus making it suitable for use as a protective medium.

A suitable dope for coating over the cellulose lacquer of a motor car is prepared by incorporating 0.25 to 5.0 percent of phenanthrene or other aromatic compound in cellulose acetate together with 50 percent of a plasticiser, and then dissolving this in a mixture of solvents consisting of 15 percent ethyl acetate, 50 percent acetone, 20 percent ethyl lactate, and 15 percent denatured alcohol.—*A. E. B.*

New High-Speed Photographic Method

PHOTOGRAPHS at the rate of 4000 a second with exposures ranging from 1/100,000 to 1/500,000 of a second have been made at the Massachusetts Institute of Technology by means of a unique electrical circuit which produces light of great actinic intensity. The instantaneous flash of this light is many times more brilliant than sunlight.

This new circuit, which employs either mercury arc tubes or spark gaps, was developed by Professor Harold E. Edgerton and Kenneth J. Germeshausen of the department of electrical engineering. By means of this device it is possible to make both still and motion pictures. For the latter special cameras are necessary.

The light produced by the new circuit occurs in pulses or flashes, and the intensity of each flash is equal to the concentrated light of approximately 40,000 ordinary 50-watt bulbs such as are used in household lighting. The scientific importance of the method lies in the fact that the frequency of the flashes or the moment of starting may be accurately controlled. In making motion pictures the pulse of light is synchronized with the speed of the films, which moves past the lens aperture at velocities up to 200 miles an hour.

As a tool for research, this device opens new prospects for study. It is compact and portable, and is expected to be of great value in the photography of transient motion, types of motion which occur only once. To the scientist it offers unusual opportunities for the study of motion in liquids and gases. Laboratory studies of the wing motions of birds and insects are also expected to be possible by this method.

The device has already been used to make striking photographs in which familiar things are shown in astonishing new forms. The splash of a drop of milk falling into milk is revealed in the shape of a miniature crown tipped with infinitesimal pearl-like drops. The photographic image recorded at the instant of impact between a golf club and ball shows clearly the momentary flattening of the latter at the point of contact.

The chief feature of the electrical circuit which makes this type of photography possible consists of mercury arc tubes or spark gaps which are made to produce intense, extremely short flashes of a bluish-white light. Electrical energy from an ordinary house lighting circuit is "stepped up" in voltage and stored in condensers. The light is produced when this electrical energy is discharged into the mercury tubes or spark gaps.

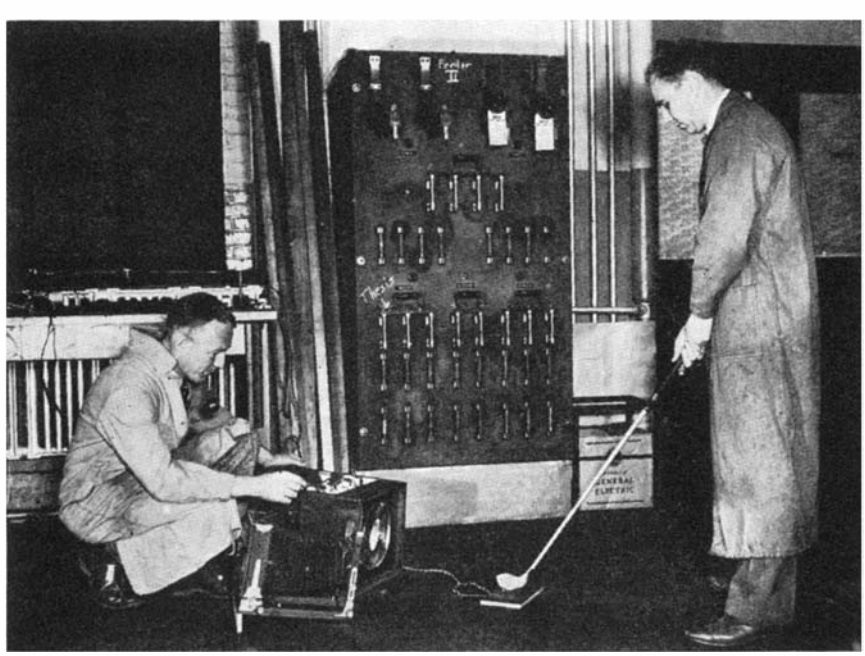
When this device is used, for example, in making motion pictures, a commutator on the sprocket which drives the film through the camera comes in contact with a small brush, which in effect is a switch. One of the striking features of the circuit is that a current of a few thousandths of an ampere in the brush is sufficient to operate the thyratron tube, which in turn causes a current of several thousand amperes to flow instantaneously through the mercury tube, thus producing the flash.

The device is a further development of Professor Edgerton's research which two years ago led to his design of a new type of stroboscope. By the use of extremely brief flashes of intense actinic light, this "whirling watcher" made possible stop-motion photography of machinery moving at high speeds.

Storing Potatoes

POTATOES keep better in storage if they are kept comparatively warm for the first few days, according to recent findings of the Cornell University Experiment Station. Three years of tests have shown that nearly half the losses by rots and much of the water losses are obviated by keeping the temperature at about 65 degrees, Fahrenheit, for the first 10 days in storage, but the customary practice is to hold the temperature at 40 degrees, Fahrenheit.

The reason for the reduction in losses at the higher initial temperature lies in the



fact that the thickening and toughening of the skin is hastened. As the greatest losses in weight of stored potatoes are due to losses of water, the thickened skin reduces this loss early in the season. After the first few days of warm temperatures, the usual cool temperatures should be maintained.—*A. E. B.*

Glass in a Man's Body

THAT a man could possibly live while two pieces of plate glass—one four inches long, one inch wide, and half an inch thick; and the other of the same width and thickness but one and a half inches long—were imbedded in his chest, would seem impossible. Such, however, was the case with a Brooklyn man who died recently. After his death, officials of a Brooklyn hospital found the glass and then learned that 12 years before, when he was 18, the man had been in an accident in which he was thrown through a plate glass window.

Adhesive for Wax Paper Needed

A NEED of today is an adhesive which will stick cartons that are wax-coated and wrappers that are printed with oil-bearing inks. According to *Food Industries*, production is often delayed—even stopped—by cartons whose sealing flaps had been waxed where they should have been waxless, and by labels where oil in the ink gave the same effect.

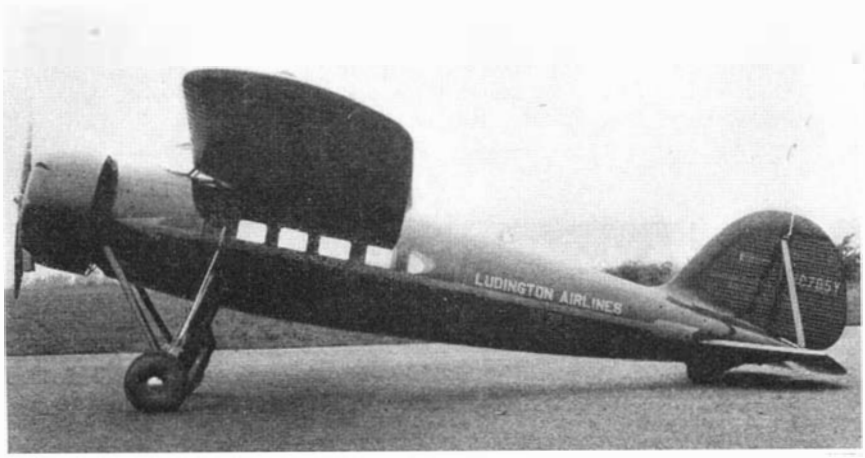
To produce such an adhesive is not easy. Benzol or other solvents possessing odors or flavors, toxic or otherwise, are ruled out right from the start. It is cheaper to dump the offending cartons and labels than to ruin the product. Food manufacturers would welcome some kind of "stikum" that would stick.—*A. E. B.*

High-Speed Passenger Transport

THE recent transcontinental record flights of little more than 10 hours duration have led to the prediction that a night's run from New York to Los Angeles will be a regular feature of the transportation system of the United States in a few years' time. The whole trend of airplane design tends to bear out this prediction.

For example, we have now an 80-minute service between New York and Washington conducted by the Ludington Airlines, employing the Consolidated Fleetster Model 17-A shown in our photograph.

This fast ship is powered with either a Wright Cyclone or a Pratt & Whitney Hornet. It weighs, fully loaded, only 6500 pounds although it carries nine passengers and baggage. Thus it weighs, with some 600 horsepower in its engine, little more than 10 pounds per horsepower. Compared with all other methods of transportation, aviation has found it possible to employ a far greater concentration of power.



A high-speed, high-wing passenger transport plane

Remarkable refinement in design has kept step with the concentration of power made possible by the engines now available. If we examine the photograph, we see that the resistance of the engine cylinders is decreased because they are completely cowled in by the Venturi or N.A.C.A. cowl; the internally braced wings merge into the fuselage; the fuselage, of metal monocoque construction, is of almost perfect streamline form; the vertical tail surfaces merge gracefully into the fuselage; and the passengers are seated in three tiers of three seats each so that no space is lost and the dimensions of the fuselage are kept down to a minimum. It is no wonder that the cruising speed (which is at least 20 miles an hour less than the maximum speed) is 160 miles per hour. And the cruising speed is that speed which the airplane can maintain indefinitely without strain.

In the interior, the front row of passengers looks back toward the tail; the two rear rows look toward the pilot who, in turn, is placed well ahead and above the fuselage so that his vision is perfect. The passengers are comfortable in such a cabin, with well upholstered seats and comfortable arm rests. These arm rests can be folded into the seat when less than three passengers occupy any one tier of seats. The right hand seat of the middle row can be folded against the side to permit ingress to the rear three seats.

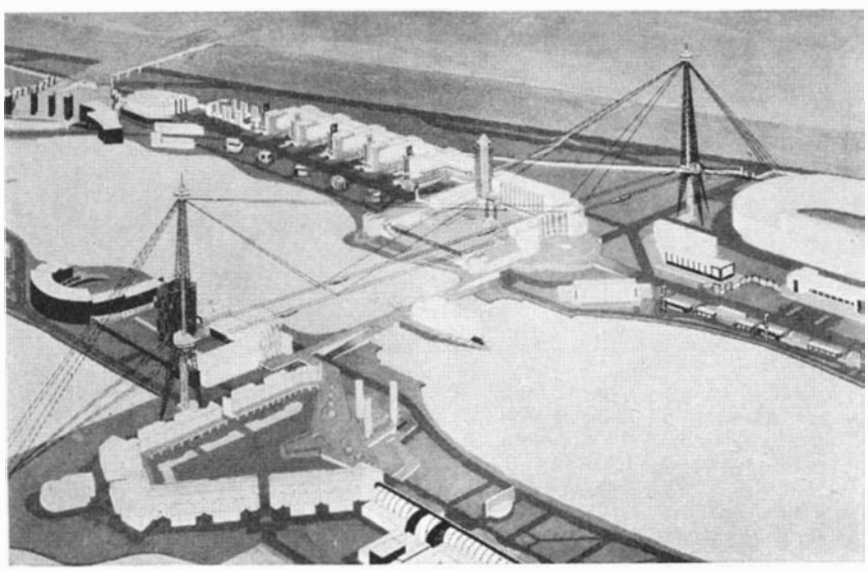
The whole fuselage is covered with a duralumin alloy sheet only 30 thousandths of an inch thick. This sheet is reinforced at intervals with bulkheads or rings, and with 24 stiffeners, or long angles, running the whole length of the fuselage. The monocoque construction is not unlike the construction of a ship, with skin, bulkheads, and longitudinal members all riveted together to form a remarkably strong, light, and durable structure.—*A. K.*

Chicago's Sky-Ride

IN the Paris Exposition of 1900, the most striking feature was the Eiffel Tower which has been famous ever since. In the Chicago World Fair of 1933, there will be an even more striking attraction for visitors in the "Sky Ride."

Two gigantic towers, 600 feet high and spaced 2000 feet apart will be connected by two four-cable tracks, at the 200 foot level. The cables will propel eight streamlined cars which will each be 33 feet long, constructed of glass and aluminum, and double decked with seats arranged lengthwise, so that the passengers may look outward. Colored steam will be emitted in the wake of the cars so as to give them the appearance of rockets rushing through space.

The towers will be triangular in section, gayly ornamented and brightly illuminated at night. Flood lights will be attached to the bottoms of the elevators (which will run to the very top of the towers) transforming them into rising and falling pillars of colored light. The project is expected to cost 1,000,000 dollars and involves many difficult engineering problems. Two thousand tons of steel are required for the towers. Another thousand tons of steel will go into the 16 cables—eight for the two aerial tracks and eight for bracing the



Artist's drawing of the unique thrill-ride to be built at Chicago

towers against great operating stresses.

Rocket propulsion as a means of aerial navigation is still some distance off, but the Sky Ride should certainly provide many of the sensations of the rocket travel of the future.—*A. K.*

Establishing a Federal Airway

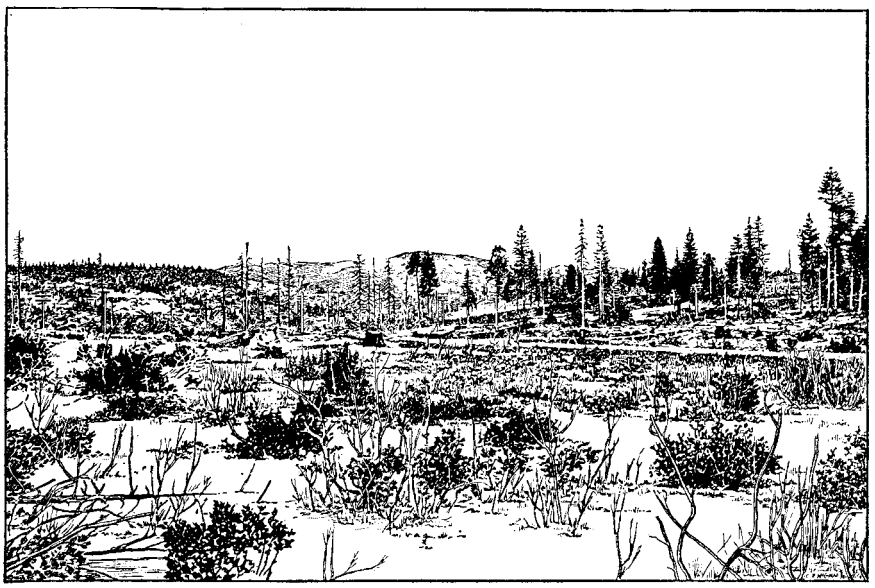
A COMMON complaint is that America has found its last frontier, that romance has vanished from our lives. Some of the engineers of the Aeronautics Branch of the Department of Commerce will not agree, particularly those who have to plan and supervise the establishment of our Federal airways.

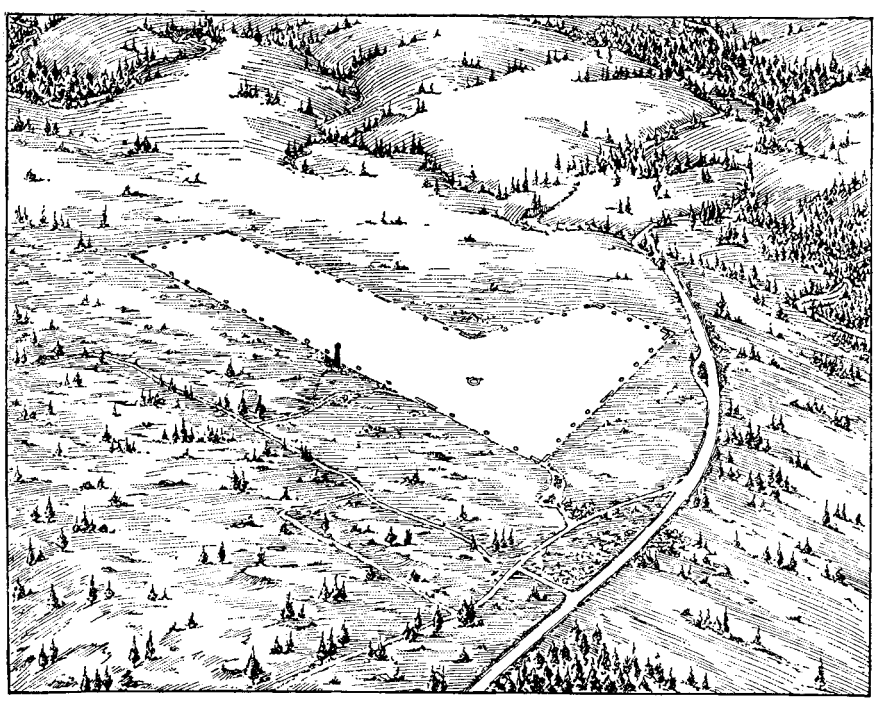
The Airways Extension Superintendent first of all has to make a preliminary survey of the area through which the airway has to be extended. This survey is made by air. The Superintendent flies back and forth over the route, examining a strip approximately 25 miles wide throughout its whole length in order to determine the location of the best flying country. He looks for suitable intermediate landing sites, notes the general type of terrain, the natural features of the ground, power lines, roads, centers of habitation, and the like. In rough country it may be necessary to fly the route four or five times. In mountainous regions the Superintendent may have to fly over country in which landings are practically impossible, and a forced landing is sure to spell disaster. So there is plenty of adventure for the airways men.

The Superintendent also has to turn to real estate, getting his knowledge as best he can from local real estate offices, banks, and agricultural agents. He learns such rough rules that if land is worth 100 dollars an acre, the lease of the field should be eight dollars a year; or else he estimates what profit the use of the land gives the owner per annum. The lease must cover such items as the right to establish beacon lights, the erection of new structures by the owner, and so on.

Surveys for beacon-light sites frequently reveal the fact that a light should be located on a hill top; this gives the Superintendent a lot of hard climbing.

The engineering report turned in is quite a comprehensive document. The task of converting virgin land into a landing field may be one quite worthy of a pioneer. The two drawings show a contrast between the rough field and the completed intermediate landing field.—*A. K.*





Above: **Typical site for an intermediate landing field.** ***Below:*** **The same rugged site after completion of field**

Reducing Propeller Noise

THE exact cause of propeller noise is still somewhat of a mystery. All we know definitely is that the noise is reduced by avoiding too high a tip speed; that is, by gearing down the engines, and running the propellers at lower speed. James H. McKee, Chief Engineer of the Pittsburgh Screw and Bolt Company, announces an entirely new method of reducing propeller noise, which is apparently successful. At first exhaust gases were taken from the engine into the propeller hub, and then led inside the hollow steel blade. The exhaust gas escaped through slots near the leading edges of the backs of the blades. The noise was reduced by 50 percent!

The mechanical difficulties resulting from the hot gases were, however, very acute. So the exhaust gas method has been abandoned in favor of passage of air from a scoop in the front of the propeller hub, with passage to the slots as before. The result is the same as far as the noise is concerned.

It is all very well to talk of boundary layer control. The phenomenon is really unexplained to date. We would welcome a truly scientific explanation.—*A. K.*

The Aviation Industry Today

IN authoritative circles there is little hope of many private planes being sold within the next year or two. One reason, of course, is the depression. The cost of private flying is still high. Planes for the private owner have not been radically improved.

The air transport side of the industry is contrastingly brilliant. In air transport operations in the first six months of this year, the mileage flown increased only 22.2 percent, but passenger-miles increased 30 percent, and the number of passengers carried increased 30.5 percent. The public is becoming accustomed to air travel. It no longer regards air travel as a thrill, but as a serious and dependable method of transportation. On the other hand, mail flown has decreased and the government is always watching for a chance to decrease mail-carrying rates to the operator.

Passengers pay an average of seven cents a mile, which is not expensive when compared with the best Pullman travel, and considering the saving of general expense in rapid travel, and in business time saved. It is significant that the transport companies have *not* cut their winter schedules.

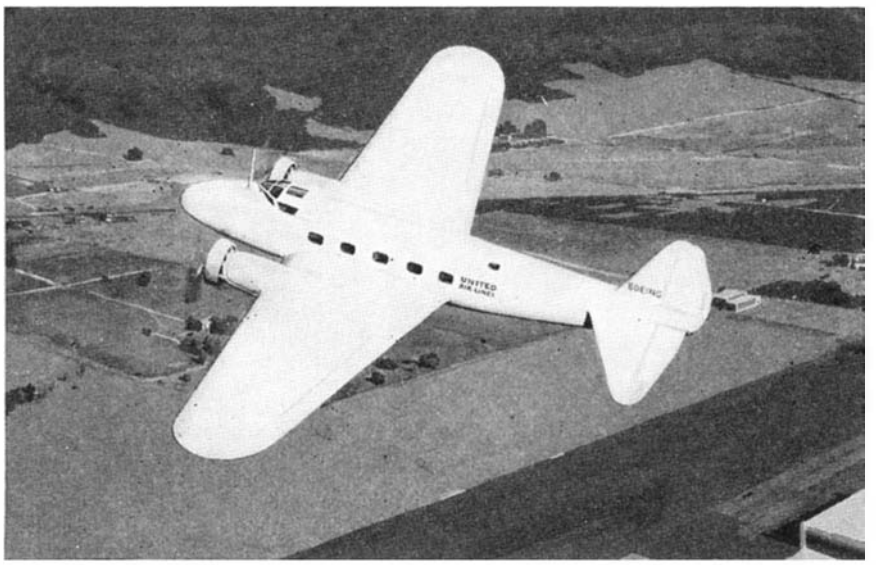
If mail is not taken into consideration, seven cents a mile is not a profit-making rate. The planes are expensive, insurance is high, depreciation and obsolescences are high, the pilot earns 400 dollars a month, and a complicated and expensive ground organization has to be maintained. The seven cents dwindles away rapidly when divided into its component parts. Yet faster

and faster speeds are demanded by the public, and forced by competition.

The problem is one of engineering. Speeds must be increased, yet horsepower kept to the old limits. Payload must not suffer because of the higher speeds.

Manufacturers are apparently concentrating on remarkably improved equipment to meet the above requirements. Planes cruising at 175 miles per hour are being constructed, with no decrease in payload, to be sold at two thirds the 1929 and 1930 prices. The Ford Motor Car Company has suspended airplane construction, but General Aviation (a subsidiary of General Motors), Douglas Aircraft, Curtiss-Wright, and Boeing, are all hard at work. The tendency seems to be that airlines shall either control manufacturing facilities, or be closely connected with manufacturers.

Our wash drawing gives a splendid illustration of what is being built. The artist has given a perspective view of an all-metal, low-wing, twin-engine, Boeing monoplane, a fleet of which is being built for United Air Lines transcontinental and Pacific coast routes by the Boeing Airplane Company of Seattle. The new machine will have a top speed of 175 miles per hour, and a cruising speed of 155 miles per hour. The 27-hour transcontinental schedule of United will be reduced to 23 hours. The transport plane will carry 10 passengers, two pilots, and 400 pounds of mail and express. It will have two-way radio equipment, special night-flying equipment, and very complete navigating instruments. The retractible landing gear adds 20 miles an hour to its speed. Fully loaded, the craft will be able to climb to three and a half miles above sea level. It will be powered with two 550-horsepower Wasp motors. It is announced as the world's fastest multi-motored passenger plane.—*A. K.*



The Boeing monoplane discussed in the column at left

Life Saving By Air

THE purposes for which airplanes have been used are many. Wherever speed is the primary object, airplanes may be built to suit the particular need. Certainly when miles and minutes become a matter of life and death, an ambulance plane meets the emergency.

All too few planes are fitted to serve as ambulances, yet with only slight alterations, the standard cabin plane can carry an ambulance litter.

The Waco Aircraft Company has outfitted their standard cabin Model C airplane for ambulance purposes without sacrificing its normal utility.

The litter is suspended from the roof immediately behind the pilot's seat. It is brought into the cabin through a special panel on the side of the fuselage. This arrangement permits handling the litter with the least trouble and annoyance to the patient as would be the case if the litter were brought through the main door.

When not in use, the litter is placed in the rear storage compartment which is closed off by a "zipper" panel.—*A. K.*

Heating and Ventilation Aloft

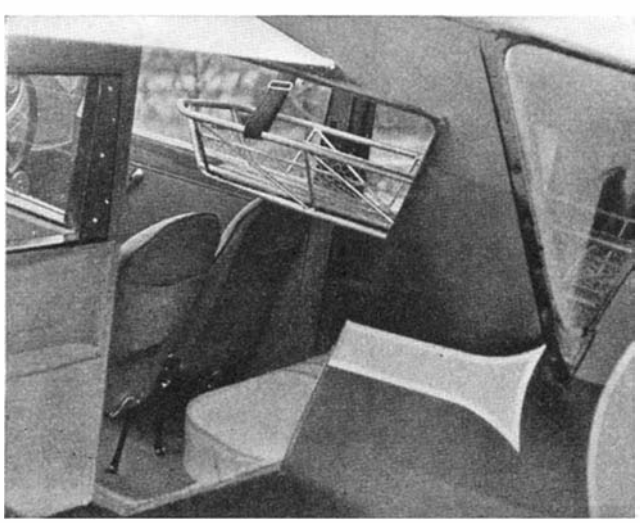
RECENTLY there appeared in the press a brief story of four passengers in an airliner overcome by exhaust gas fumes and landing unconscious at the airport, although fortunately they revived soon thereafter.

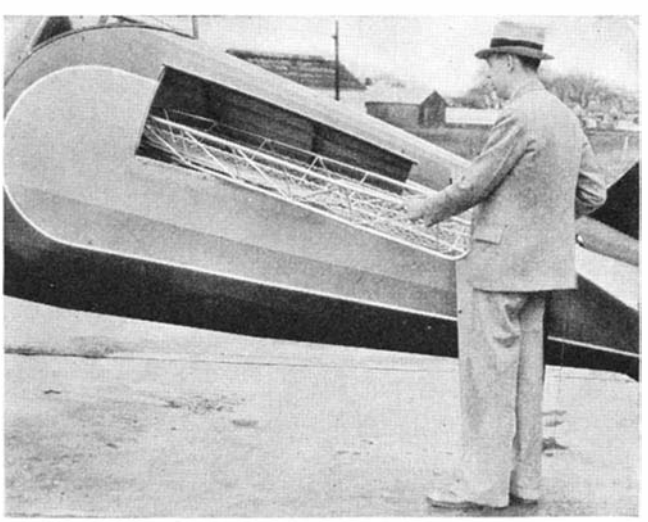
The first reaction is one of incredulity. Surely there is plenty of fresh air when one is up several thousand feet. In practice, however, it is just as difficult to ventilate a passenger plane cabin as to heat it.

Windows in an airplane cabin should never be opened. They allow the noise of engine and propeller to enter—thus nullifying the effect of sound proofing in the walls—and cause unpleasant drafts. The better plan is to keep all windows closed and to employ some system of semi-natural, semi-artificial ventilation.

The passengers are seated in a relatively small space, and the air must be frequently renewed, not so much because the lungs need so much air, but because fresh air is needed to remove body heat, odors, et cetera. On the ground, 30 cubic feet of fresh air per minute per person is the absolute minimum; in schools the generous allowance of 200 cubic feet per minute is sometimes required. It is only in the old fashioned theater that the minimum of 30 cubic feet is probable. In airplane practice, the average is about 50 cubic feet per minute.

If a cabin has a cubic content of say 400 feet and carries 10 passengers, then the entire air volume of the cabin has to be renewed nearly once a minute. If this were done with a single inlet, then one unfortunate passenger would experience a terrible draft of air; others would complain of the stuffiness. The best practice is, therefore, somewhat as follows: A duct is placed on the under, or pressure, side of the wing stub. This duct may be several square inches in area, and is placed far enough away from the fuselage to be clear of the engine fumes or exhaust, yet in the propeller slip stream so that the cabin is ventilated even on the ground, provided the

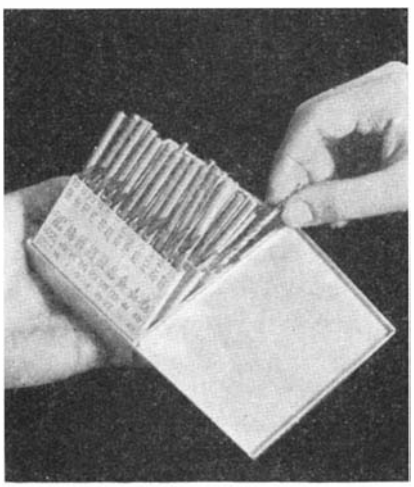




The litter in place in the cabin of, and the method of loading it into, a life-saving Waco plane

engine is turning over. The duct is connected by very light aluminum tubing to openings in the side of the fuselage, which end in a nozzle. The nozzle may have its direction of opening changed, or be shut off altogether. For each passenger, there is available an individual nozzle, which he can manipulate to suit himself. The outlet is carefully placed at a point where the fuselage is under suction, so that the outflow may be unobstructed.

The control of temperature must be carefully studied as the range of flying temperature in the United States is very wide. In the west and southwest, the average summer temperature in the day may be as high as 90 degrees. When the airplane flies a few minutes directly in the sun's rays, the temperature in the cabin may become several degrees above the outside temperature. In the pilot's compartment when directly behind the engine, the temperature may rise to 110 degrees or more, which is uncomfortable if not dangerous. Since artificial refrigeration is out of the question, ventilation is of paramount importance from even the temperature point of view.



Courtesy Huot Mfg. Company

Like a card index, this compact little steel box eliminates the search for the right size drill. In it drills are filed by number and decimal size

In the United States in winter, we must provide for 20 degrees below zero, Fahrenheit, at times, and in Canada, 40 degrees below zero is not out of the question. Ordinary fabric covering or metal covering loses heat very quickly. Hence the advisability of using heat insulation such as balsa wool, Cabot's quilt, or something similar. Fortunately the good heat insulators are also sound insulators as a rule.

Even with the heat insulators, the loss of heat to the cold atmosphere is rapid, and maintaining a cabin temperature of 70 degrees, Fahrenheit, is quite a problem. Steam, vapor and air heaters have been employed. The lightest, and generally considered to be the most practical system is that of hot air, with the incoming air led through an exhaust gas heater. Of course if the exhaust air heater is not carefully designed and maintained, carbon monoxide may seep into the incoming air with disastrous results. If the hot air system is right, if the incoming warm air is led into the walls of the cabin a few inches above the floor (but not from the floor since dust would then mingle with the air), then the passenger's feet are kept nicely warm. Also the hot air rises to the top of the cabin and helps the circulation of air of the general ventilating system.

There is quite a variety of combinations of heating and ventilating systems possible, and the art is growing in knowledge and complexity. Next time our readers fly on an airliner perhaps they will give this part of the craft some interested attention.—*A. K.*

Hostesses of the Air

AN enterprising reporter of the *New York Evening Post* has been interviewing a hostess employed by Eastern Air Transport. The qualifications for this new profession are quite severe. The young lady has to be single, under 25, a college graduate, and weigh not more than 125 pounds. Apparently the hostess has to move about, and must be light enough not to unbalance the ship! A three-hour flight test for air-sickness, and two weeks' observation by pilots are other hurdles.

The duties are: to attend to passengers, entertain them, and divert their minds from the imaginary dangers of a first flight. It is significant of the enterprise and business ability of our transport operators that they do provide such service.—*A. K.*

A Giant Flying Boat

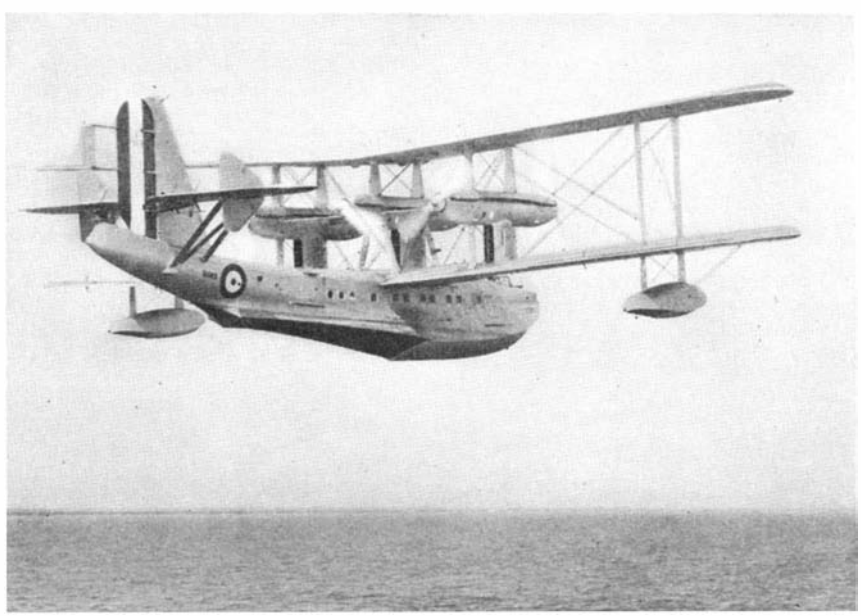
THE question is often asked: Why is not a transatlantic seaplane service as yet available? The answer is that we have not as yet a seaplane with enough range and payload, which is also large enough to be sufficiently seaworthy. The *Do-X*, although of excellent design, fell short of meeting the range and payload requirements. The British, a seafaring people, build excellent flying boats and are of the opinion that conventional biplane construction, with external bracing, is a better path to follow for very large machines than the cantilever, internally braced construction of the *Do-X*. Since the *Do-X* wings weighed more than three pounds for every square foot of their area (a real handicap) it is possible that the conservative British may be right. At any rate, their latest flying boat, the Short Reconnaissance, second only to the Dornier *Do-X* in size, is proving highly satisfactory.

The Short Reconnaissance carries a crew of 10, consisting of two pilots, and navigators, bombers, and gunners. One gunner is carried at the extreme tail of the boat, behind the tail surfaces, where he can protect the seaplane from attacks in the rear. Two gunner's cockpits are placed amidships, and another cockpit is disposed at the forward end of the boat. It is perfectly true that a single seater or even a two-seater fighter can out-maneuver and outspeed one of these giants of the air, but with armament arranged in this fashion, the large machine can give a good fighting account of itself.

Another point, besides seaworthiness, in favor of large flying boats for transoceanic service is the roominess and comfort which become possible in a very large craft. In the new British craft, a number of portholes are disposed along the side of the hull which make the interior of the cabins particularly bright. These cabins are roomy and high enough to accommodate the tallest of men. It is claimed that in the Short Reconnaissance the comfort of a battleship will be available for the crew even on the longest cruises. The British have always aimed at making their naval flying boats independent operating units.

The machine has a wing span of 120 feet, over-all length of 89 feet 6 inches, and an over-all height of about 30 feet. Fully loaded the speed is estimated as being in excess of 150 miles per hour.

The boat is powered with six Rolls-Royce Buzzard engines of 825 horsepower each. If there is one advantage that English designers have over their American competitors, it is in the availability of really powerful water-cooled engines of proved merit and reliability. The Rolls-Royce Buzzard is based on a long series of water-cooled engine designs, and on the strenuous experience of the Schneider Cup Races. In designing engines for this classic race, British builders learned many useful



The Short Reconnaissance, the second-largest flying boat. A gunner's cockpit is seen at the extreme end of the tail. The rudder is particularly easy because of the auxiliary, or "servo," surface which is placed some distance behind it

INCREASE YOUR OPPORTUNITIES WITH ANOTHER LANGUAGE —IN 3 MONTHS

THE TREMENDOUS changes taking place to-day in commerce, industry, science and international affairs are affecting the entire world—with America as the center. The new line up of international business is creating a wealth of new opportunities for men who are not shut in by national borders. The call will come for men who know the markets, the peoples and the *languages* of other lands for the expansion of American business.

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lessons. In the air-cooled engine field, the United States is supreme, and it is to be hoped that the Navy will foster the development of large water-cooled types. Admiral Moffett, Chief of the Navy Bureau of Aeronautics has often expressed the opinion that such development was a vital necessity for American aviation.

There is another useful practice employed in the Short craft. On very large machines, working the rudder becomes quite a

The painter's job is made easy by this new color match slide rule

strain even for the most powerful pilot. If the reader will examine closely the end of the hull, he will note that the rudder is placed on hinges back of its leading edge. This helps to balance it. In addition, an auxiliary rudder surface is carried well back of the main rudder. It is this surface which the pilot moves; the small surface in turn actuates the main rudder. Accordingly, the rudder is exceedingly easy to work.

The Short flying boat carries collapsible dinghies, mooring equipment, provision for attaching a beaching chassis, wireless, and so on. A short-wave transmitter has been provided for use when the machine is on the water.

With all the difficulties which the British taxpayer has to meet (he pays at least 25 cents of every dollar to the government in income tax), something like a hundred thousand pounds have been spent on the construction of this machine. The boat is intended for service in the Mediterranean. Modifications of the design may be useful in transatlantic services. At least that is the gossip.—*A. K.*

Slide Rule for Color Matching

WHEN a car is damaged, the repairs almost always involve a refinishing of some part of the body and the owner is always exacting in expecting that the car look "as good as new." There must be no evidence of patching. The re-painted parts must match the rest of the car perfectly.

Color matching is an art which calls for both a good color eye and a great deal of judgment and experience in matching the color of a car that has been in service a year or so. Although the layman is not aware of it, the color of his car may have taken on a tone that is noticeably different from what it was when new. In repainting such a car, the color must be modified to compensate for the action of sunlight and ultra-violet rays upon the surface finish.

A practical and simple method for exact matching and mixing of colors is just being brought to the finishing trade—a color matching principle that enables a novice or a garage mechanic, after a little practice, to match and mix colors with exactness. It is the slide rule method of color matching developed by Dr. N. E. Van Stone, Director of Chemical Operations for the Sherwin-Williams Company and internationally known chemist.

Three hundred color matches are possible with the slide rule. The device carries the complete range of shades from light to dark in each color family. If the original finish on a car is gray the painter selects one of the gray cards which contains all the shades and variations of gray, and which are inserted in a book in loose-leaf fashion on a ring binder. He then slips a celluloid mask over the card and places it against the color to be matched and slides the celluloid mask up and down until he finds a chip on the card that matches exactly the color of the car. Each one of the 300 color chips are numbered.

After finding the correct color, the painter's problem is practically solved. What colors and how much of each must he mix to obtain the matched shade? That question too is automatically answered by simply turning the card over to the reverse side without moving the celluloid mask. Here he finds the formula for the particular color in question. With the directions for mixing the color, the painter is also given two suggested trim colors to choose from, as well as an appropriate striping color.

"Cannon Ball" Corrosion

IN a recent issue of *Chemical and Metallurgical Engineering*, Dr. H. M. Weir, of the Atlantic Refining Company, described a peculiar type of corrosion which, for want of a better name, might be termed "cannon ball" corrosion. Specimens of metal taken from pipe-stills that had been running mid-continent and West Texas crudes over a period of three or four years showed that the corrosion had taken the form of almost perfect hemispherical pits which were as much as ¼ to ⅜ of an inch deep in most cases. Lacking other explanation, Dr. Weir stated that "we ascribed the type of corrosion shown by these samples to sulfur compounds, but we are quite at a loss to explain why such a large proportion of the corroded spots on the straight pieces were hollowed out in the form of portions of spheres."

The specimens shown in the accompanying photograph were taken from a section of a petroleum still where the temperature of the liquid and vapor averaged around 775 degrees, Fahrenheit.—*A. E. B.*

"Human Pin Cushion"

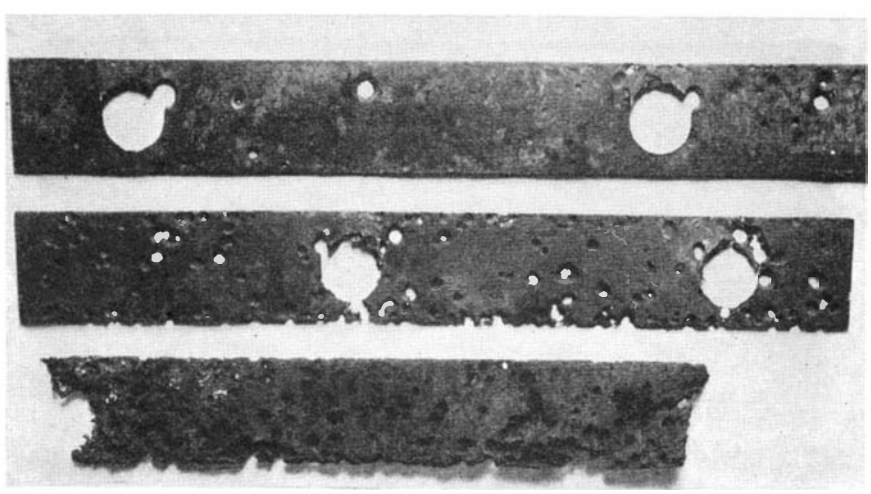
A HUMAN pin-cushion, a New York resident who feels no pain when sharp pins, needles or instruments are thrust into his body, provides medicine's latest enigma.

He is a theater ticket-taker, musician, ex-vaudeville artist, and chauffeur, who has been studied by Dr. George Van Ness Dearborn, psychiatrist and psychologist at the United States Veterans Hospital in the Bronx. His identity has been withheld by Dr. Dearborn because of professional ethics.

Dr. Dearborn admits that he is unable to understand the unusual circumstances that cause this man to be free from pain. The patient does not remember ever feeling any pain except headache, though he has a good memory. He does remember that his parents and physicians complimented him on his "grit" on various occasions of boyhood accidents, such as breaking his leg and shooting himself and, at another time, burning a finger. But he claims he felt no pain to cry over. For a year and a half he made use of his peculiar faculty in a vaudeville act in which he allowed some man in the audience to come up on the stage and push pins into him. As many as 50 or 60 would be stuck into him as far as their heads at one performance.

Careful psychological and neurological examinations failed to give any scientific explanation for this unusual lack of sensation of pain. The patient himself explains it by saying he concentrates on something else. However, this does not satisfy Dr. Dearborn, who says that the man shows no one of the physical signs of attention concentration.

Dr. Dearborn suggests that it is due to a complicated structural defect, present at birth, in the central cerebral pain-mechanism. It is not due to hysteria or similar nervous condition, Dr. Dearborn and other neurologists are convinced, and Freudism cannot explain it. More definite explanation cannot be made until after the man's death, when his brain and nerve cells can be ex-



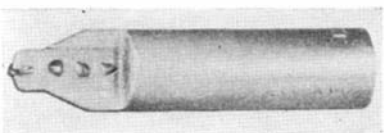
The peculiar "cannon-ball" corrosion discussed above

amined. Meanwhile, Dr. Dearborn has asked fellow-physicians if they can suggest any explanation for this unusual condition or if they have studied any similar cases. —*Science Service.*

Multi-Diamond Dressing Tool

THE discovery and development of a new metal which has the same co-efficient of expansion as the diamond, now permits the setting of a number of smaller diamonds in line in a single tool with the same rigidity and permanence as a single large diamond. A diamond dressing tool of this unique construction is produced by the Koebel Diamond Tool Company, of Detroit.

It is a well-known fact, recently verified



Cut-away section of diamond tool showing several inset diamonds

by careful experiments, that a far greater proportion of perfect industrial diamonds are found among the smaller sizes ranging from ¼ to ½ carat. The difficulty in the past has been to set the smaller stones so that they could be entirely used up in one setting. This difficulty has been overcome in the Koebel tool. In this tool, a number of small diamonds are imbedded in a standard shank, in tandem as it were, so that when one has been completely used up, the metal may be cut away to expose the next in line.

The Koebel process has several advantages. It eliminates all re-setting cost; it permits selection and purchase of diamond tools with no more difficulty than that with which one buys an ordinary drill; it is simple, positive, and adaptable to all kinds of grinding machines; the first cost is low.

Oyster Shoe for Oystermen

AND now oyster shoes have been designed to guard the lovely Olympia oyster in the state of Washington. Because of the small size of the Olympia oyster, it was found that fishermen in collecting them trampled large numbers deep into the beds, says the magazine *Inco.*

Modeled after "bearpaw" snow shoes, the oyster shoes are made of monel metal channels and wire set in frames of wood with a device for fastening to the rubber boots of the fishermen. Just as snow shoes prevent the feet from sinking into snow drifts, these shoes keep them from sinking into the oyster beds.

In selecting the metal for them, it was necessary to choose one that would not be affected by the salt water and that would resist the abrasive action of the sand and shells.

Franklin's Medium-Priced Car

THE automobile world was treated to a surprise recently with the announcement by the Franklin company of the first air-cooled car in the medium-price field. The sedan in this group, the "Olympic," is listed at 1385 dollars. This new line will be a companion to the "Airman" series and the 12-cylinder models.

As reported in *The New York Times*, in addition to a supercharged engine of 100 horsepower, the "Olympic" models are characterized by streamlined bodies, X-frame of the double-drop type, and free-wheeling, syncro-mesh transmission and "Startix" automatic starter.

Economy as well as agility in performance are claimed for the "Olympic" models as the result of weight saving of more than 800 pounds from current Franklin types. The engine, it is stated, produces one horsepower for every 35 pounds of car weight.

The new cars make use of the supercharger employed on the company's other lines.

The "Olympic" models' transmission incorporates helical gears for silent operation. The free-wheeling unit has an automatic lock-out which gives immediate effect to free-wheeling after the transmission is shifted out of reverse, without further resort to the control.

The frame has X-bracing in the center and other cross members front and rear. Springs, semi-elliptic, have a total suspension of 15 feet 8 inches, and their action is regulated through Delco hydraulic shock absorbers. Brakes are of the Lockheed hydraulic type.

Low-Priced 1933 Cars

ACCORDING to a reputable observer in the automobile field, the general guess is that the lowest price tag on any standard passenger automobile this year will be marked "350 dollars." In view of the large number of manufacturers who are claiming for their own product the lowest price, it is believed that this price is very nearly correct. There will be sufficient competition among builders of cars in this class to push the price down.

Light-Weight Aircraft Radio

AN aircraft radio system generally accredited as being the most modern in use today has been completed along the eastern seaboard of the United States. This network, the property of Eastern Air Transport, consists of 11 ground stations and more than 40 aircraft stations. The ground stations are strategically located along the 2435-mile airway, and operate on frequency bands ranging from 2380 to 5840 kilocycles for aircraft communication, and from 2922 to 6600 kilocycles for point-to-point communication.

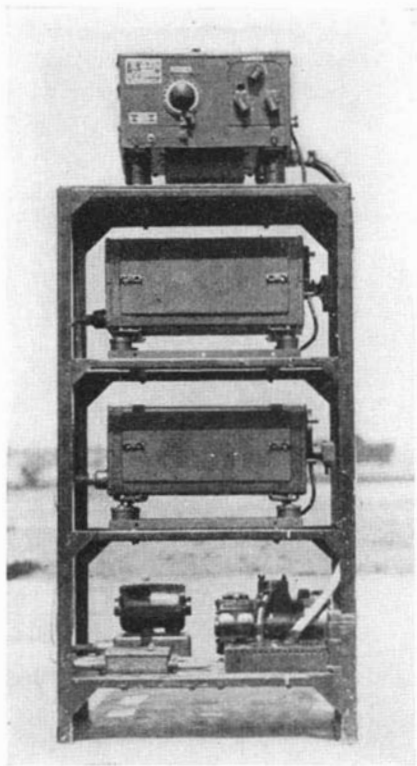
A feature of the service is that radio telephony and telegraphy are combined. Telephony has certain disadvantages at long distances from the ground stations, when it often fades or becomes badly garbled by static crashes. Telegraphy, on the other hand, can be received through almost any interference. The piping signals of the telegraph key can be picked out of static crashes without difficulty, and have a much longer range than voice with the same power output.

The engineers who designed the equipment did so with the plan of making it practically impossible to silence a station. The result is that many things can go wrong, any one of which would instantly silence other sets, without putting this network's units off the air. The entire telephone transmitter can break down and the telegraph unit may still be used, or vice versa. The sets are so wired that any tube may burn out in either the modulator or the transmitter, or in both, and the set still be used. The entire modulator may go out without stopping telegraphic communication, and every tube except one may burn out in this latter unit without putting the station into silence. The combination sets weigh only 85 pounds.

Auxiliary power plants are installed at each of the 11 ground stations. If the city power supply should fail, the operator simply snaps a switch on the control board. His Kohler plant begins generating power then, and he is back on the air with a delay of less than 30 seconds.

All the equipment for an airplane station has been concentrated into one framework, so that it can be installed in the pilot's compartment and be readily available to him. This allows all equipment to be removed as a unit and another set installed within five minutes. All repairs except minor adjustments are therefore made in the shops with no delay to the operation of the plane. This also saves 20 percent of the total weight of the equipment by eliminating many interconnecting cables and junction boxes.

The entire system was developed under the supervision of F. E. Gray, in collaboration with engineers of the Aircraft Radio Corp. and the Radio Marine Corporation of America.



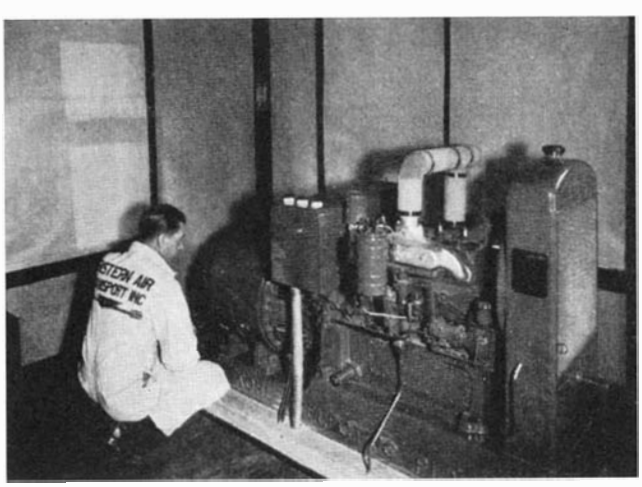
Above: **A complete light-weight aircraft radio transmitter and receiver ready for installation.** ***Below, left:*** **Auxiliary power plant at ground station.** ***Below, right:*** **Interior of an Eastern Air operating room, equipped for both telegraph and telephone sending and receiving**

New Marmon Cars

WITH the introduction recently of the new Marmon Sixteen, the Marmon Motor Car Company will go into the production of the "ultra fine" cars exclusively, according to an announcement by G. M. Williams, the company's president. No basic changes have been made in this line of cars. The 200-horsepower, all-aluminum engine, which won for its designer, Howard C. Marmon, the medal of the Metropolitan Section of the Society of Automotive Engineers, is retained without change in the new models.

Pyranol—A New Liquid Insulator

A NEW synthetic liquid insulator which has been announced by the General Electric Company not only has the advantages of mineral oil as an insulating and cooling medium for electric equipment but in addition is non-inflammable and non-explosive. Designated by the trade

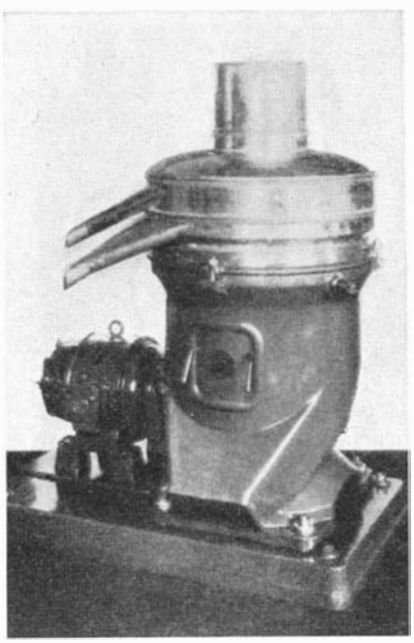


name "Pyranol," the material is produced in different forms for different purposes, all being synthetic organic dielectrics of varying physical and electrical properties and all having a high dielectric constant.

The liquid is chemically stable and it resists oxidation, so that there is no sludging after continued exposure to heat or air. It demulsifies, or separates from water, more than twice as rapidly as does mineral oil; and the moisture rises to the surface, from which it may be evaporated. Viscosity and freezing point can be varied to suit conditions without affecting other qualities of the liquid.—*A. E. B.*

New Centrifugal Separator

IN the application of high centrifugal force to clarification and separation problems, there has long been a demand for a centrifugal capable of continuous operation on liquids containing a relatively high percentage of solid material. Up to the present time two distinct types have been available: the bulk centrifugal type, developing low



Rotojector centrifugal, showing the five-horsepower driving motor

centrifugal force but capable of handling large quantities of solid material; and the high centrifugal force machine, developing very high centrifugal force but having a comparatively low solid-holding capacity.

To these can be added a third type, the Sharples Rotojector centrifugal, a machine employing very high centrifugal force, combined with the ability to remove relatively high percentages of solid content from liquids, economically. As a clarifier, the Rotojector is designed for the removal of sludges, slimes, amorphous precipitates, and so on, from liquids of the difficultly filterable type.

As a separator the Rotojector economically handles emulsions and mixtures containing percentages of solids that would require a prohibitive amount of bowl-cleaning with the ordinary types of centrifugal separators. In many cases emulsions or mixtures are stabilized by the solids contained and can neither be filtered nor separated until such solids have been removed. As a

(*Please turn to page* 52)

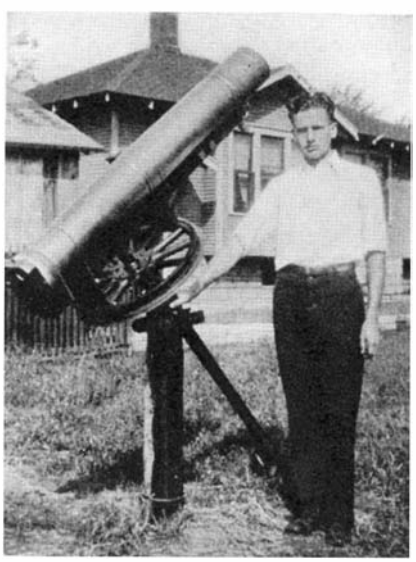
THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THE new (third) edition of "Amateur Telescope Making" is out!

Well, is it?

We can't ourselves answer this question and this is why: We are writing this screed on November 4th, many weeks ahead of publication, and at a time when A. T. M. is only in galley proof form. This is one of the delightful uncertainties of the editorial game—you are always forced to project yourself two months ahead and make wise guesses. And then, only after your guesses have gone into type and plates have been cast from that type and the magazine has been "run off" and is being sent in 32 directions of the compass, you may learn that your guess was bad. A month ago we made a bad guess—that A. T. M. was ready. Something happened. Something always happens. And something may happen again, but on November 4th we go on record as believing that A. T. M. will be ready when you read this. If not it can't be long and you may hang a curse on us for every solitary day's delay thereafter.

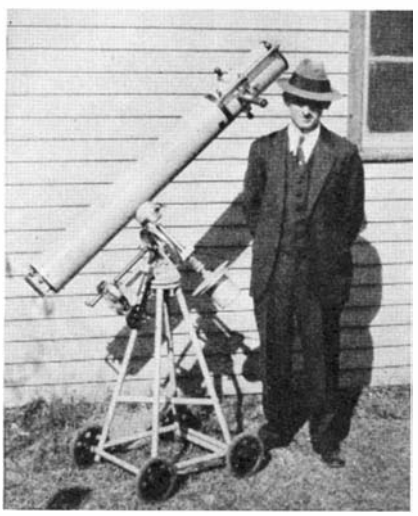


Myron A. Elliott

We have labored on this edition, with its addition of about 200 pages, ever since last spring. One feature, with nine chapters, is a part entitled "Contributions by Advanced Amateurs." This means that the hobby has gone a long way since 1926 when we amateur workers were all glad to get hold of anything at all that would help us to make telescopes. The pupils are now the teachers. Ellison's statement that "the amateur has shown the way to the professional, and forced the pace for him, ever since Herschel's time," is beginning to apply in the present development.

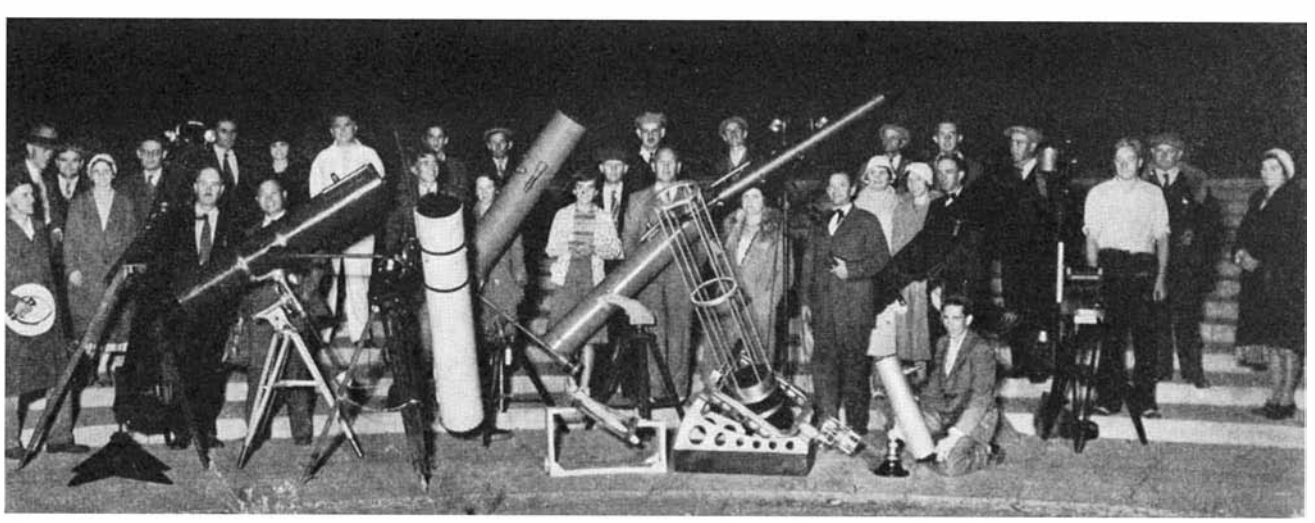
Silvering has proved to be such a bugbear to the beginner that we have made an effort to round up all the pertinent details on the process we could, and the result is a general symposium and digest on silvering which will run to about 20 pages in the book "Amateur Telescope Making." Most of the previously published instructions for silvering mirrors have left much to the worker's judgment, a commodity which only the born genius may be said to possess previous to gaining actual experience. We have also told how to make a lap—almost in disgusting detail, since so many have written about their trials and tribulations in connection with that cantankerous job. Other material prepared makes it look at present writing as if A. T. M. would run to nearer 500 pages than 400, with many illustrations added.

A club of amateur astronomers and telescope makers is being organized in northern New Jersey, by R. B. Butler, 963 Kenyon Avenue, Plainfield, N. J., and others. Other amateur astronomical activities are shown in the photograph at the bottom of the page, taken on the occasion of a joint meeting of the Amateur Telescope Makers of Los Angeles and the Citrus Belt Astronomers, held at Pomona, California. Mr. M. Nagata of Brawley, California, discoverer of "Nagata's Comet" a year or so ago, appears in this group (front, third from left); also Dr. H. Page Bailey of Riverside (extreme left) who seems to be a general all-around genius and inspirer of telescope activities in that part of the world. A neat, compact split-ring equatorial telescope of the Porter type (A. T. M., Figure 26, page 27), made by him for astronomer Nagata, appears near the middle of the picture. Amateur telescope making in California appears to have gone co-ed; look the picture over! Incidentally there are 10 telescopes in it. Can you find them all? (No prize awards—it isn't a come-on.)



Frank Cornil

Whew! How the telescope pictures are coming in! Scads of 'em. We don't know how many telescopes have been made to date—probably over two thousand, especially since many individuals have made from two to a dozen—and no two have been alike. This is perhaps the most gratifying thing about the whole development. Some months ago we mentioned the question of standardization. Both in numerous letters and by spoken words we have been urged not to promote that idea. However, there need be no occasion to worry. We

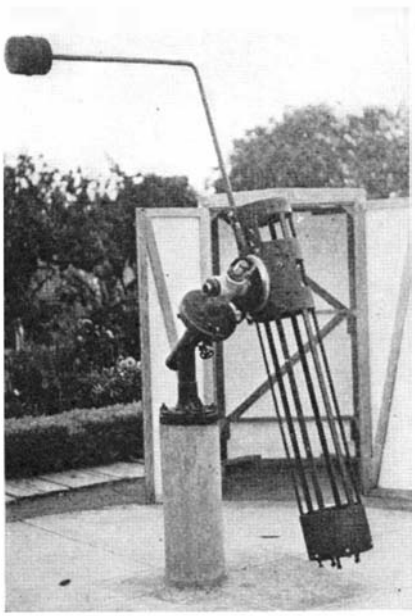


Ten telescopes, twenty-three men and eight women, hobnobbing about amateur astronomy at Pomona, California

don't like standardization—it spoils all the fun—and we shan't come within a light-year's distance of flirting with the idea.

Recently we made a call at the Corning, New York, main factory of the Corning Glass Works, where Pyrex is made, and saw some very interesting things. Among others were some Pyrex disks for telescope mirrors. For the past few years Corning has been besieged by innumerable amateurs to make up some real Pyrex disks, instead of the makeshift kind hitherto available, and now they have done it.

"The total cost of my mounting was under two dollars," according to Myron A. Elliott, 1120 West Prairie Street, Taylorville, Illinois, who is rather resourceful in the adaptation of this-and-thats to his needs. He used a Ford front wheel and axle as the basis for his mounting, made the tube of stove pipe, used a linen tester



William E. Mueller's telescope

lens for an eyepiece, and gets a magnification of 160 diameters, though the distortion is bad at the edge. He made a finder from an old flashlight tube, a 10-cent reading glass and a small one-inch focus lens, and is satisfied with his telescope until he can build a larger one.

To render his telescope portable, Frank Cornil, 2305 West 17 Street, Little Rock, Arkansas, mounted it on wheels. He uses two spirit levels, a peep sight and four elevating screws, to make possible quick setting in the meridian. It has slow motions and is a rather complex, interesting piece of design.

A Springfield type of mounting of rather elaborate nature carries a 6-inch mirror at the observatory of William E. Mueller of Sutter, California. Slow motions and brakes are provided for both axes. The second prism can be removed and the eyepiece inserted in its place. Except for the tube and a pipe cross, the mounting is all made of Ford parts. "One of the planetary transmission drums makes a neat cell—it seems to have been specifically made for a 6-inch mirror," Mr. Mueller writes. "I put this cell in a brake drum. The tube is of ½- by ⅜-inch channel iron. The telescope has a 9-foot concrete base and when not in use has a portable pick-up-and-carry-out-of-the-way canvas housing."

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 49)

solid-recovery machine the new centrifuge can concentrate high percentages of solids from liquids without the labor of bowl-cleaning that has previously limited such applications.

The Rotojector principle incorporates a special construction of the bowl, which consists of an inner bowl sliding in a casing to uncover an annular discharge slot for the discharge of the solids while the bowl is running at full speed. The opening of the bowl is accomplished by the hydrostatic pressure in a layer of water charged into a special space in the bowl. The hydrostatic pressure is generated by the rotation of the bowl and works against eight springs which tend to close the bowl. The pressure amounts to about nine tons, but is so quickly generated and released that the opening and closing of the bowl are accomplished within 10 seconds.

There is no possibility of contaminating the liquor that is being treated with the water used to unload the bowl, since no passage exists between the bowl and the pressure chamber. The machine weighs 930 pounds and is fitted with a five-horsepower driving motor. Liquids can be fed at rates up to 700 gallons per hour, the rate of feed varying with the nature of the liquid and the solid content.

Platinum Plating

PLATINUM knives and forks and platinum handles on automobile doors are ready to make their appearance when the next boom arrives. A new process of platinum plating is making headway, not only for deposition on silver ware, thereby avoiding trouble from tarnishing and cost of periodic cleaning and polishing, but also for scientific, optical, and surgical instruments, and for the highest class of automobile fittings and door furniture in the home.

The cost is about three dollars per square foot for parts subject to rough usage, and about one dollar per square foot for such articles as photograph frames, this being the actual value of the platinum. The cost of plating, which is not included in this figure, is about the same as for depositing silver.

The technique of using the new platinum plating salt has been carefully worked out, and the current density used is between six and eight amperes per square foot, with a voltage of between two and ten according to the size of the article being plated. Three ounces of plating salt costing about 70 dollars are required for each imperial gallon of plating solution.—*A. E. B.*

Odor Makes Sight Keener

A WHIFF of the odor of oil of citronella will make you see better, it is indicated by experiments reported to the American Psychological Association by Dr. George W. Hartmann, of Pennsylvania State College. Stimulation of other senses has a similar effect on vision, he found.

"Apparently lights, sounds, smells, pressures, and pains do have some property or properties in common, for how otherwise would one account for their similar influence on visual acuity?" he said. The results suggest that one sense might serve in place of another, he concluded.—*Science Service.*

Courtesy of Aluminum Company of America

An aluminum ladder made for use in an armory, for reaching the lights to clean them. The strong, rigid, yet light-weight structure is moved on the wheels at lower end

Better Thermostatic Metals

THERMOSTATIC process control is rapidly extending into industry with the result that precise thermostatic metals are demanded, according to Howard Scott of Westinghouse Research Laboratories. Perhaps the most versatile of the thermostats available are those using bimetal actuating elements. Industrial application of this material, however, began only after the low-expansion alloy, Invar, became available. The first widely used bimetal was brass combined with Invar by brazing together plates of equal thickness. These metals differ so widely in expansivity—18 parts per million per degree, Centigrade—that a small temperature change will cause a strip of the bimetal to bend considerably. This bending is employed to actuate thermostats and other temperature responsive devices.

In operating mechanisms, bimetal is required to apply mechanical forces. Its ability to do that, expressed as "activity," is measured by the force required to annul unit bending. Accordingly, the strength of the bimetal is as important as its sensitivity; that is, degree of bending for unit temperature change. The strength of a bimetal is determined by that of its weaker member. Brass is a comparatively weak metal, particularly at elevated temperatures. By substituting certain of the new austenitic nickel-chromium steels for brass as high-expansion members, bimetals of markedly superior strength were obtained.

Such bimetals, after being properly conditioned, can be heated nearly to a red heat without loss of their reversible bending characteristics.

Bimetals in which the nickel-chromium steels are used lack the sensitivity of brass-Invar. Recently, however, an austenite nickel-manganese steel has been combined with Invar to produce a bimetal having the high sensitivity of brass-Invar with the superior strength of austenitic steel. The high-expansion member contains 8 to 25 percent nickel and 3 to 12 percent manganese.—*A. E. B.*

Blood Spots in Eggs

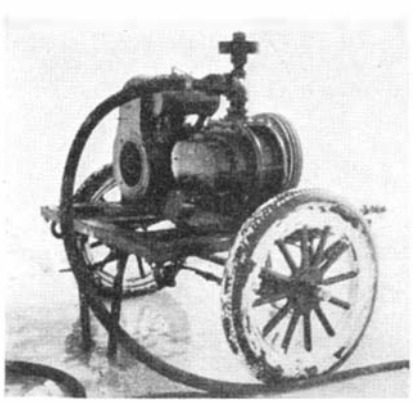
A SMALL blood spot in an egg does not indicate that the egg is stale or bad, says the United States Department of Agriculture, in response to frequent inquiries. Blood spots are found occasionally in fresh eggs although this imperfection seldom occurs in the best grades of eggs that are candled and sold on the markets. Eggs from farm flocks are not so likely to contain blood spots as those from commercial flocks that are fed for maximum production.

The seasons when blood spots are most likely to occur are late spring when the hens are laying heavily and in the fall when the pullets begin to lay. Poultrymen who desire to remove all questionable eggs from those marketed should candle their entire production and use such eggs at home. Less forcing for egg production and liberal feeding of green feed will tend to reduce the formation of blood spots in eggs.

The Poor Fish Get the Air

DUE to the past three or four dry seasons, the lakes used in connection with the Iowa fish hatcheries reached a very low stage last year and a new method of aeration had to be developed to supply the young fish with a sufficient amount of oxygen in the water.

According to Mr. S. P. Baur, State Fish Culturist, two years ago several of his men



A portable air compressor used to aerate the water in a fish hatchery

were sent to the State Board of Health to learn how to make dissolved oxygen tests, and air compressors mounted on trucks were purchased to aerate the ponds.

During the winter months all of the lakes with a depth of less than seven feet were tested twice a week and as soon as a lake showed a low amount of dissolved oxygen, one of the compressors was put to work.

Following the extremely hot, dry summer of 1931, it was necessary to improve this method and in conjunction with the Engineering Department of Roots-Connersville-Wilbraham, Connersville, Indiana, the portable blower outfit shown in the illustration was developed.

This unit has proved to be quite successful and the method of operation is as follows: A 50-foot section of hose attached to the blower is threaded under the ice and supported by two by six inch timbers spliced together so that the hose is suspended at least three feet above the bottom of the lake. The blower is then started and as soon as a hole is blown in the ice, the hose is swung around in a circle so that the air does not escape. After several holes are blown in the circle, the hose is withdrawn and the unit is moved to another part of the lake where the operation is repeated.

Sodium Metal as a High Current Conductor

A RATHER startling announcement was made at the recent meeting of the Electrochemical Society by R. H. Boundy, of the Dow Chemical Company, who said that his company had for years been using a 4000-ampere conductor 850 feet long consisting of iron piping filled with metallic sodium. The weight per unit conductivity is decidedly less than for copper and the cost per running foot of conductor is approximately the same.

Metallic sodium is white in color and very soft. Its most striking property is its strong affinity for oxygen, which causes it to burst into flame when it touches water. While chemists have known the metal to have high electrical conductivity, it has not previously been thought of as a practical conductor.—*A. E. B.*

Something May Come of This Grape Fruit Mutant

A GRAPE fruit plant which, it appears, will well bear watching for it may turn out to be the accidentally discovered parent of a new strain of fruit, is growing in England and an account of it, written by its owner, Mr. J. Livingstone Sands, of Trent Vale, Stoke-on-Trent, England, is quoted below:

"An article in the September, 1932 issue of SCIENTIFIC AMERICAN, entitled 'Youthful Maturity' deals with experiments on grape fruit seeds and the results. It is stated that normally these seeds take five years or more to grow and flower. I know nothing about these things, but thought that you would be interested in the following:

"In June last we had grape fruit for tea, and on cutting through one of them I found that one of the seeds inside was just cracking, similar to a brood bean seed. The fruit itself was in the pink of condition. Just for the fun of the thing we planted this seed in a pot which stands in the bath room window upstairs. There is no heating in the room except what is carried from the hot water pipes. The soil was ordinary leaf mold and loam mixed.

"The grape fruit seed grew quickly and by the end of July had reached a height of 21 inches and bore a flower. In color

and shape this was similar to a small dandelion. This flower has now died off and left a hard center; but there are five more flowers in various stages of growth. The plant and leaves are of a pale green.

"I do not know whether the above is unusual or not; but as your article deals with specially X-rayed seeds which flowered in five weeks, I thought you would be interested in this seed which has had no special attention."

Mr. Sands' letter was submitted to the scientists of the General Electric Research laboratories, who experimented with X-rayed grape fruit as described in the September number, and from one of them, Mr. C. P. Haskins, came the following comment:

"I was very much interested to receive the English communication of Mr. J. Livingston Sands concerning his premature flowering grapefruit, and surely thank you for it. This is the only case of which I have heard of this type of abnormality, and it would appear to me that Mr. Sands has a very unusual specimen.

"Reasoning from my experience with American types, it would appear to me that Mr. Sands' mutant is a naturally occurring variation not dissimilar from those which we obtained from X-rayed seeds, and even more interesting.

"Evidence is accumulating to indicate that natural mutation, a foundation-stone of evolutionary processes, is primarily due (laying aside secondary chromosome rearrangements incident to natural or artificial hybridization) to the action of natural ionizing radiation produced from such sources as radioactive potassium, uranium, radium, and thorium, and perhaps cosmic radiation, acting in small concentrations over enormous periods of time. The exposure of seeds to X rays is then in effect the repetition of a very old experiment under more favorable conditions. The time of the experiment is enormously reduced, but the X-ray dosage is multiplied tremendously. Effects, therefore, should be represented by mutations of the same type as those normally occurring. We should, however, be able to improve on Nature in at least three ways: by increasing the percentage of occurrence of variations already existent; by emphasizing and carrying to extremes modifications already known in less positive form; and by repeating mutations beneficial to man but detrimental to the plant carrying them—mutations which may have occurred at some time in the phylogenetic history of the plant but which disappeared before man became interested in it, perhaps before man's advent. We have also the very slender chance of producing something really entirely new.

"In Mr. Sands' plant we have a natural mutant, apparently, which quite equals ours in precocity in point of time and which possesses several other interesting features: the remarkable growth, virescence, odd flower, and habit of sprouting in the fruit.

"Mr. Sands should certainly attempt to breed this plant. I would expect that selfed seed would be very largely type-true and might yield a very interesting strain. I would be more than interested to follow his progress."

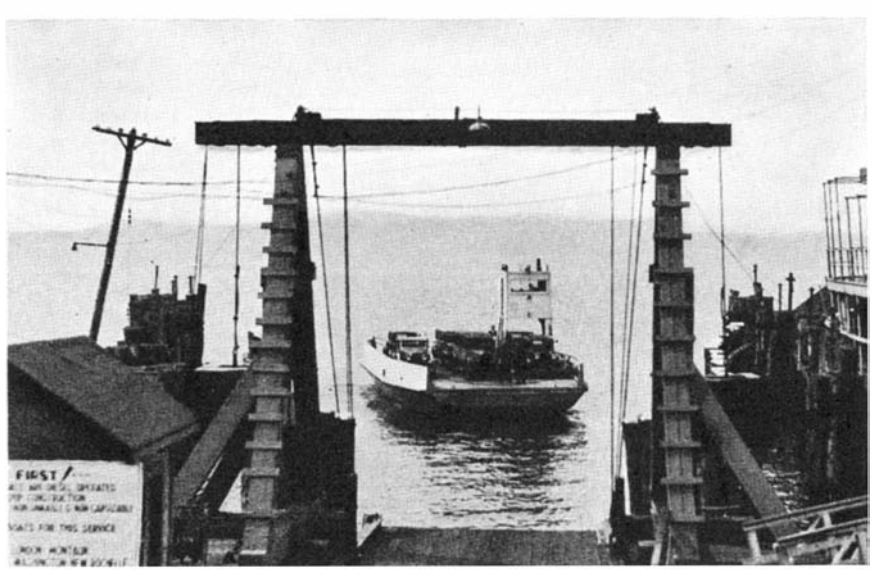
Mr. Haskins' letter has been forwarded to Mr. Sands.

One-Man Ferry of Radical Design

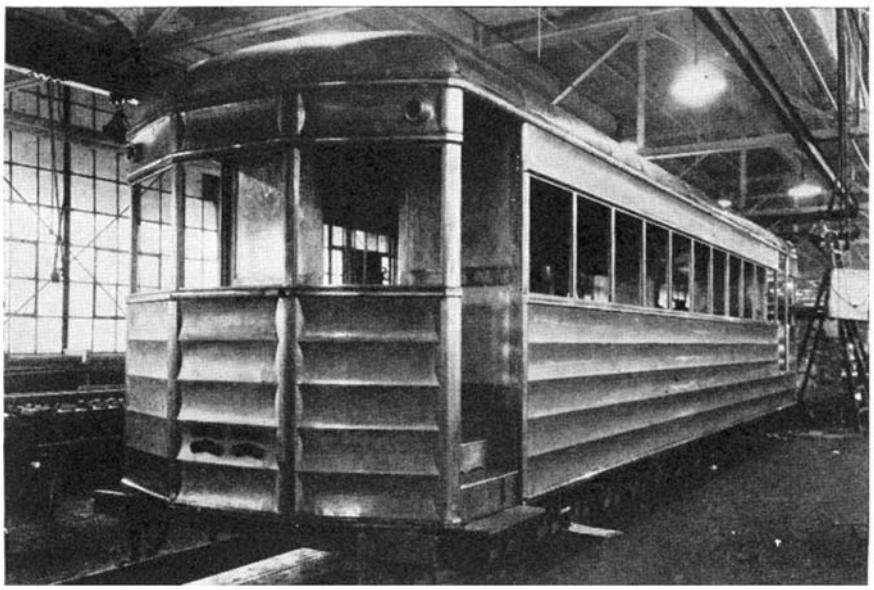
BUILT with the square lines of a barge, braced like a bridge, powered with a Diesel engine, and designed for complete operation by a single man, a strange little ferryboat recently slid from the Staten Island ways of the United Dry Docks. It was the first of the two vehicular ferryboats which have since shown such surprising service in their runs across the wide breadth of Hudson River between Irvington and Piermont.

From the time Eads Johnson designed them until they were actually put into operation, marine architects referred to these tradition-breaking vessels as "Johnson's folly." The square bow would offer wasteful resistance; the square stern would prevent the water from properly meeting the propellers. Even Johnson was worried when the officials of the ferry company insisted that these hundred-ton boats be propelled by engines of only 70 horsepower.

Several months' use, however, has proved these vessels to be quite capable. Without fancy lines and trimmings, elaborate superstructure, and comparatively large crew and operating expense, these little bottle-tight "boxes" of welded steel have been giving far more effective service than the



A novel one-man ferry driven by a 70 horsepower Diesel engine



Above: **A shot-welded car under construction.** *Below:* **An operator working with one of the new shot-welding machines. At right is the timing and recording unit**

large conventional steam ferryboats which they replaced.

Besides the square lines, and the pilot house mounted on angle-iron stilts, the most unusual feature of these new boats is the truss-welded interior bracing of the hulls. Instead of heavy internal bracing members, such as keels, ribs, beams, and frames, the entire interior of the hulls, except for the engine compartment, is filled with a cell-work of two-inch steel angle members, spaced on two-foot centers. The angles—running longitudinally, transversely, and vertically—are welded together at every intersection and welded at their ends to the steel skin of the hulls, securing great strength and rigidity with least weight.

Devised about four years ago by J. Kjekstad, electric welding authority, the truss weld system has been used with marked success in many types of hull construction, including oil carriers, deck barges, marine filling stations, derrick and even pile-driving barges. In no instance has there been a sign of failure. This is the first time the system has been used in the building of ferryboats.

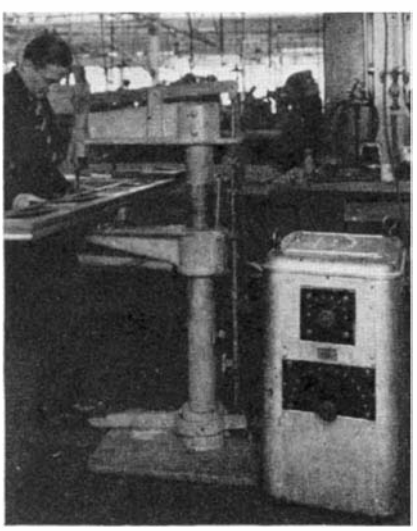
Divided into compartments by watertight steel bulkheads, weighted with thirteen tons of concrete, their hulls welded and braced by welded trusses, the vessels are practically unsinkable and non-capsizable.

Driven by small Diesel engines of the originally proposed horsepower, and carrying a load of a dozen motor cars, they make the surprising speed of eight miles an hour.

Shot Welding Stainless Steel

THE recent announcement of a new method of electric welding known as "shot welding" has provoked numerous inquiries about this interesting development which marks another stride in the art of welding.

Briefly, shot welding is resistance welding employing high current values within a short time range. It is performed by a machine which records every weld on a tape, thus permitting the operator to check back and see that each weld has been



properly made. Moreover, the shot-welding machine permits rapid operation. One man can make as many shot welds in a minute as he can place and head up rivets in an hour.

Colonel E. J. W. Ragsdale, research engineer for the Edward G. Budd Manufacturing Company, of Philadelphia, is responsible for the development of this ingenious and interesting method of welding. Colonel Ragsdale has long appreciated the value of stainless steel, which is unaffected by the majority of corrosive agents and which in its cold rolled state is so much stronger than ordinary steel that it may be used in very light gages. High tensile stainless steel, however, can not be riveted satisfactorily and it will not stand up under ordinary welding. Heat it to 2000 degrees and quench it and it becomes soft and ductile, with an elongation akin to rubber. Therefore, it was necessary to hit upon a satisfactory method of fabricating this metal before its widespread use was possible. Shot welding is the answer.

Shot-welded stainless steel retains its noncorrosive properties.

Colonel Ragsdale's experiments showed him that since the strength of welds in stainless steel vary radically with slight changes in current, manual time control, as used in welding low carbon steels, was

not feasible. He developed a timing device so arranged that when once set for a given condition, a constant time was assured for each consecutive weld. This was followed by the development of an annunciating recorder. Heretofore, welds could not be accurately tested except by outward appearance. This recorder provides a highly desirable check. It works on the principle that for a given total metal thickness a given amount of heat energy is needed for a perfect weld. Consequently, the recorder measures and records on a moving tape, similar to a ticker tape, the amount of electrical energy put into each weld. An inspection of the tape determines whether or not the welds are up to the desired standard.

But this machine does even more. So long as the welds are perfect the machine is silent. Let an imperfect weld be made, however, and a bell rings. Thus, improper welds, resulting from poor contacts, loose cables, improper adjustments, and other variables formerly left to the skill of the workman to detect, are now automatically discovered and a warning of their existence is immediately sounded.

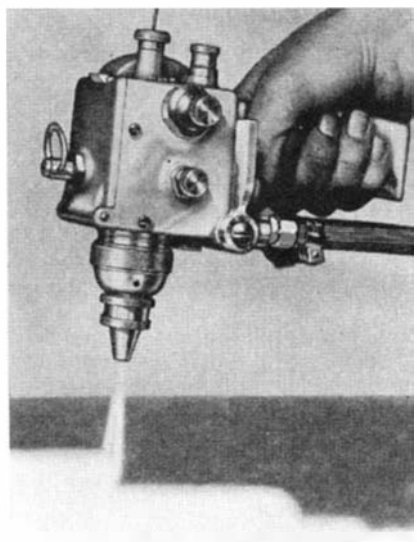
Shot welding makes possible a widespread use of stainless steel which may revolutionize not only aircraft structures, but railway vehicles, buses, trolley cars, elevators, and even water craft of various kinds. This metal has so many favorable characteristics and structural advantages that its use in a number of different fields is possible and probable now that a means of satisfactorily fabricating it has been developed.

Gun Coats Anything With Metal

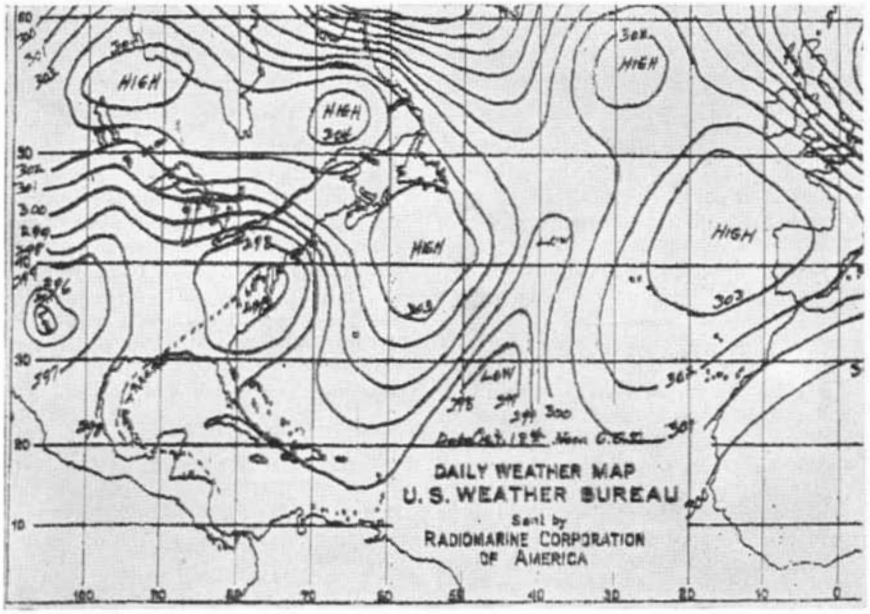
THERE seems to be no limit either to the kinds of materials that may be coated with metal or to the kinds of metals that may be used for the coating, with a new metal spraying gun, the Metallizer, which has been produced by the Metallizer Company of America, Ltd. This new gun is sold outright to the user.

Any surface—wood, plaster, concrete, paper, cloth, glass, or metal—can be metallized, and the coatings built up to any desired thickness. The natural surface of such a coating is dull but can be burnished to a bright finish. Water tanks, smoke stacks, underground pipes, and any other equipment subject to corrosion can be coated with any kind of metal. Prevention of corrosion is, in fact, perhaps the most important field of use for such coatings but they can also be used on architectural decorations where striking effects may be obtained. Store fronts, lamp pedestals, ceilings, columns, and the like can be built of any cheap and easily worked material such as wood, plaster, concrete, or cast iron, and made to simulate solid bronze or other solid metal by use of the new gun.

The Metallizer consists of a gun somewhat similar to an ordinary oxy-acetylene cutting torch. Through this gun a wire of the coating metal to be used—and practically every metal is now available in wire form—is fed automatically to the nozzle



Above: **Close-up of the gun that coats anything with metal.** ***Below:*** **Demonstrating the fact that the sprayed metal, a short distance from the spray gun, does not burn**



Above: **A facsimile of a weather map, as received on board the S. S. *President Harding*. *Below:* The facsimile receiver on board ship. Reproducer is at right**

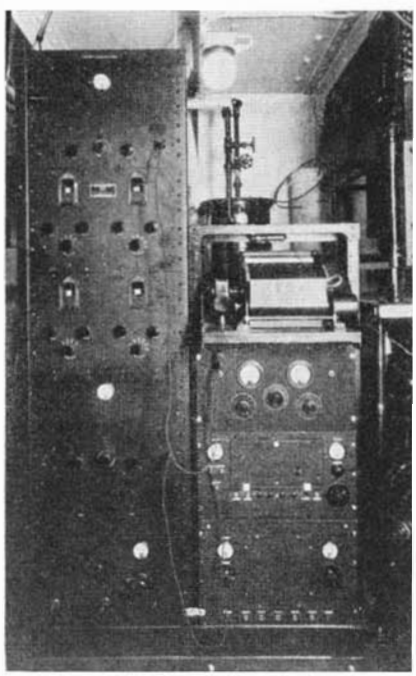
where an oxy-acetylene flame melts it. A high pressure stream of air, supplied also to the nozzle through a feed hose from an air compressor, breaks up the molten metal into millions of tiny particles and sprays them at high speed against the material being coated.

Facsimile Transmission to Ships At Sea

ON a recent trip of the S.S. *President Harding* from New York to English and continental ports, a successful test was made of equipment for reception on ship-board of facsimile weather maps and other data and information that may best be transmitted in original form. It is expected that extension of this service will be of great value to steamship operators, as it will open to them the possibility of a weather reporting service that will be far superior to that now generally available.

In order to test the facsimile system of weather map transmission, which will make the entire map of the Weather Bureau available on board ship, the United States Lines, the Radiomarine Corporation, and the Weather Bureau co-operated in the recent tests. Experimental work had been conducted along similar lines by the RCA a year or so ago, and good results had been obtained over distances of 3000 miles. However, it was apparent at that time that further development would be necessary before the facsimile transmission could be considered as reliable as the radio-telegraph system which it would supplement. Since that time the equipment has been improved to a point where it was considered efficient enough for a test under actual working conditions.

The so-called diversity method of reception was used on board the *President Harding*. In this system, two separate antennas, fore and aft, act as impulse collectors for two separate superheterodyne receivers. The out-put circuits of the receivers are fed to a common amplifier. This system, credited to RCA engineers, has been used heretofore in transoceanic work with remarkable results in reduction



of fading. Since fading would be disastrous to successful facsimile reception, every effort has been made to reduce it to a minimum. It has been found that when a short-wave signal is weak at one point, it will almost invariably be strong at another point only a few hundred feet away. Thus the two antenna systems, with their subsequent common circuit, take advantage of this peculiarity of short waves, and deliver to the facsimile recorder a modulated current almost unmarred by fading.

At the recorder, a metal stylus, actuated by the received impulses, moves over the surface of a sheet of carbon paper, and so makes instantly visible the received image as it is recorded. The equipment is fed from a continuous roll of carbon tissue, which permits the quickest possible preparation for the reception of an image.

The routine followed in this work is as follows: The RCA supplies to the Weather Bureau outline maps of the north Atlantic, of the correct size—8½ by 11½ inches—

for use in the facsimile transmitter. From the individual reports received from ships at sea, the Bureau plots isobars and special symbols on one of these outline maps, and turns it over to the RCA for transmission.

The present experimental work is being carried on through a 20-kilowatt transmitter at Rocky Point, Long Island. It is expected that the combination of this high power with the diversity method of reception will provide a steady, strong signal in all parts of the north Atlantic.

Colored Copper

BRASS and copper may be colored various shades of brown or dark green by pickling the metals in baths containing certain chemicals, according to the *Journal of the Institute of Metals*. A dark brown oxidized bronze effect is produced in a bath containing copper sulfate and nickel sulfate crystals together with other chemicals, while a dark green effect is produced in a bath containing small percentages of copper and nickel sulfate and potassium permanganate.

Hazards of "Ages of Man"

FROM babyhood to three-score-years-and-ten, each age of man has its big, outstanding hazard, so far as accidents in the home are concerned. Lining up these hazards, in a talk before the Annual Congress of the National Safety Council, Dr. Marjorie D. Batchelor of Palmerton, Pennsylvania, said that in children from one to five years of age, pneumonia holds first place as the cause of death. Many of these child fatalities, she declared, are accidental deaths in a very real sense, since they might have been prevented if more care or intelligence had been shown in the home.

Gastro-intestinal disorders take second place in causing death among young children, Dr. Batchelor said. Accidents, such as burns and falls, rank third.

Among children of five to nine years, accidents take the heaviest toll and diphtheria takes second place.

At 10 to 14 years, accidental deaths lead in mortality tables. Fatalities from heart disease have a high showing, however, many of the cases resulting from an infection.

"I want to make a plea to give school children a chance to recover completely from minor sickness before we rush them back to the heavy schedule of school work," said Dr. Batchelor.

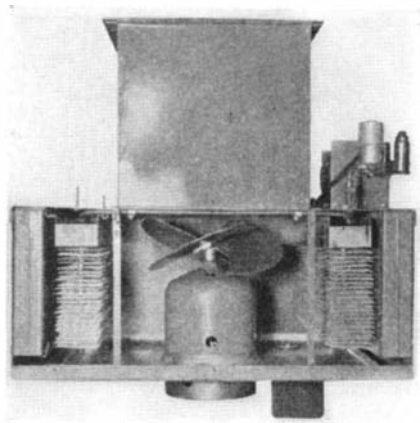
From 15 to 19, tuberculosis heads the list of death reports. The strenuous physical and emotional life of young people was blamed partially for this condition by the speaker, who said that even a vigorous body may be sapped of its strength by the pace of youth. Poor eating hygiene, especially by girls who are trying to keep thin or reduce, is another contributing factor. A third is the unwillingness of young people to take reasonable care of themselves in the convalescent stage of an illness.

Among people over 65 years of age, accidents do not lead in the death toll, but falls do stand out as a cause of much misery. Three-fourths of the accidents at this age are falls, Dr. Batchelor stated, and as the bones of old people are brittle, they break easily and mend slowly. To make the home safe for the old, she advocated anchoring small rugs, providing good lights at hazardous places, hand rails on stairs, floors kept non-slippery.—*Science Service.*

Absolute Alcohol

REMOVING water from alcohol to produce "absolute alcohol" has been a tedious process and many attempts have been made to dehydrate alcohol more cheaply and easily. In Germany, this has been achieved by the use of an azeotropic distillation process in which benzol or gasoline is added to form a ternary system with alcohol and water.

In the upper part of the rectifying column a ternary mixture of alcohol, benzol



Home humidifier described and illustrated opposite—cover removed

and water, boiling lower than alcohol, is distilled off, whereas in the column itself, absolute alcohol remains. The ternary mixture is then allowed to settle off into layers, which in turn are used in the process again. This process, which has already found considerable use, has been improved by the use of trichlorethylene instead of the benzol or gasoline. The German state monopoly is using the process in six of its plants and obtaining a daily yield of 340,000 liters of absolute alcohol.—*A. E. B.*

Vibrating Tube Concrete Tamper

A NOVEL method of tamping concrete placed in forms of walls and other structural units is coming into use. It is a tube within which an eccentric weight is revolved in such a manner as to cause it to vibrate 5000 times per minute. This tube is inserted into the plastic concrete being placed, and the vibration aids the concrete to flow around reinforcing rods and into the narrow parts of the form-work. It is claimed that one such electric tamper will do the work of five to 15 hand tampers.—*Science Service.*

Electrocuted Milk

PASTEURIZATION of milk by electricity is a practical process, according to Dr. C. G. King of the University of Pittsburgh, who recently described the new process before the Electrochemical Society. Alternating current is passed through the milk and the entire mass of fluid is easily and evenly heated with a minimum of exposure to either air or metals. Water-cooled carbon-plate electrodes are used and the temperature is brought up in two stages—

first, to 120 degrees, Fahrenheit, and then to 162 degrees, Fahrenheit. The pasteurized milk produced has been given repeated and thorough tests as to efficiency in destroying pathogenic organisms. The reports of these tests have been most satisfactory.

Commenting on Dr. King's results, Dr. Lowy added that there are 17 plants already in operation utilizing the electrical heating method.—*A. E. B.*

Air Humidifier and Filter

THE "humifilter," a device which will circulate, filter, and properly humidify air in a home without the use of a duct system, using electric power at the same rate as a single incandescent lamp, has been announced by engineers of the General Electric Company who have for some time been engaged in the study of air conditioning problems. The device is capable of producing a complete change of air in the lower part of a house in 40 minutes.

Because the human body is comparatively imperceptive to changes in the moisture content of the air, over a wide range, a way was sought by the engineers to make the control of the humidity automatic. The solution to this problem was found in a humidistat which measures the relative humidity of the air and automatically controls the amount of moisture evaporated in the "humifilter".

The "humifilter" has been shown through tests to be very effective in humidifying the entire home, since the diffusion and distribution of moisture in the air in a closed space is not dependent upon the movement of the air within the space. The device has an evaporating capacity which will supply an adequate amount of moisture to homes with a volume not exceeding 50,000 cubic feet. It has a filtering capacity which will take care of a volume of about 15,000 cubic feet—or a home with six to eight rooms on the lower floor.

The "humifilter" is installed in the first floor of a home and discharges a gentle flow of air through the floor grill. This air is taken from the basement and passed through a filter which removes dust suspended in the air. It then passes through a humidifier which makes use of hot water to facilitate evaporation. The water is heated by a small amount of steam supplied by the existing boiler. Cleaned and humidified, the air then passes through the discharge grill. The circulation is produced by a quiet, elastically-mounted fan driven by a small motor. The air is brought back to the basement through a return grill.

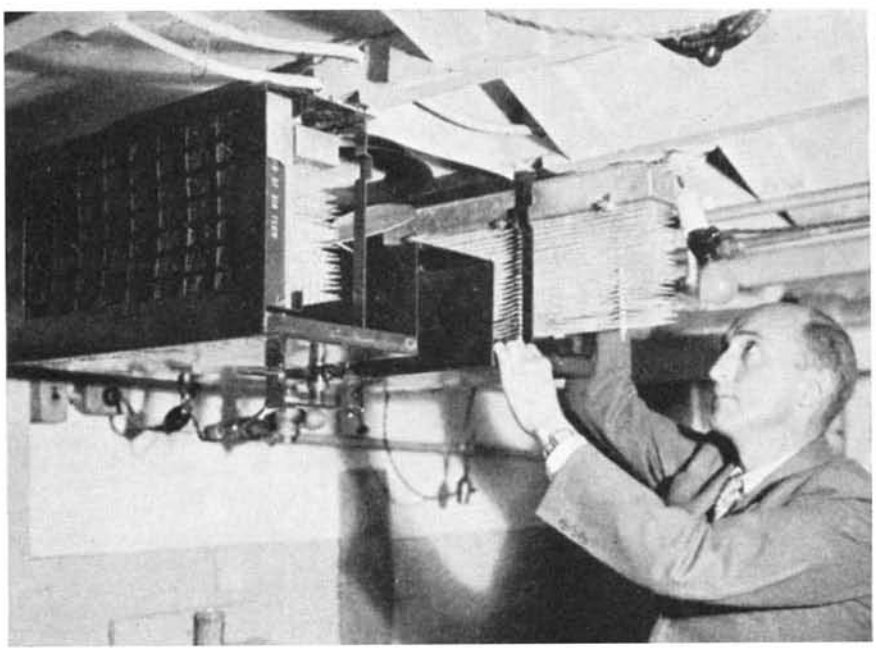
Smoking Cools Fingers and Toes

WHEN you smoke you cool your fingers and toes from one to nine degrees while at the same time your blood pressure and pulse rate increase.

This seemingly paradoxical finding showed very definitely in experiments aimed to determine the effects of tobacco on the circulation of the blood in the extremities and the advisability of permitting patients with the mysterious Buerger's disease to smoke. The tests just concluded on young adults were carried on over six months by Dr. W. G. Maddock and Dr. Frederick A. Coller of the University of Michigan Hospital.

The cause of the cooling of the extremities was found to be the effect of tobacco on the sympathetic nervous system, which among other functions ordinarily expands or contracts the walls of the small blood vessels of the skin to regulate circulation and so temperature.

"Buerger's disease," or thrombo-angiitis obliterans, is a not uncommon condition of young adults in which a blocked circulation may so affect the extremities as to lead to gangrene. The exact cause of this disease is still a medical mystery. For many years physicians have been convinced that the disease becomes worse if the patient continues to smoke. The experimental result of Drs. Maddock and Coller demonstrates just how this occurs; smoking further reduces the temperature and circulation of the already deficient blood supply in the extremities of these patients. Therefore patients with Buerger's disease are strongly urged to stop smoking.



An air humidifier and filter being installed in a private home

CURRENT BULLETIN BRIEFS

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

HOUSEHOLD MANAGEMENT AND KITCHENS (a publication of the President's Conference on Home Building and Home Ownership) gives reports on household management and kitchens as well as other work centers. It gives most comprehensive studies of the subjects. It is a bound book of 228 pages and is sold at a very low price. *James Ford, Care of President's Conference on Home Building and Home Ownership, New Commerce Building, Washington, D. C.—$1.15.*

NATIONAL PAVING BRICK ASSOCIATION, PROCEEDINGS 1931, contains a series of valuable technical papers presented at the Twenty-fifth (Silver Anniversary) Annual Meeting held at Pittsburgh. *National Paving Brick Association, National Press Building, Washington, D. C.—Gratis.*

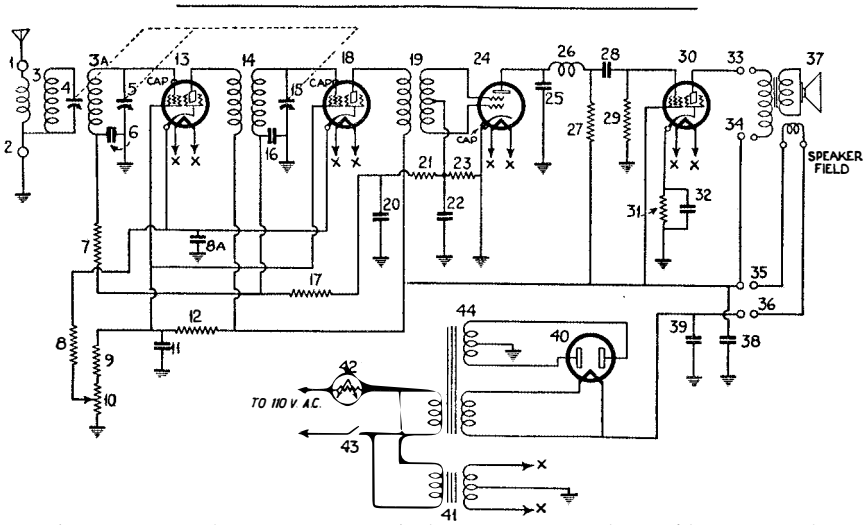
THE PRESENT ECONOMIC STATE OF GERMANY (International Conciliation, April, 1932, No. 279) gives six objective and scientific studies on the subject of economic conditions in Germany from the points of view of agriculture, industry, transportation, communication, public finances, and banking and credit. The several authors are eminent professors of economics at six important German universities. *Carnegie Endowment for International Peace, 44 Portland Street, Worcester, Mass.—5 cents.*

STANDARD SPECIFICATIONS FOR VITRIFIED BRICK PAVEMENTS (Series A-29 American Society for Municipal Improvements) gives approved engineering practices in connection with the design and construction of pavement that has been in use in this country for over a half century. Well illustrated. *National Paving Brick Manufacturers Association, National Press Building, Washington, D. C.—25 cents.*

AIRPORT MANAGEMENT (Aeronautics Bulletin No. 17) gives considerable out of the way information; for example, storage charges at representative airports. In Los Angeles an airplane having a wing span of 30 feet costs $1.10 a day for storage but if the wing span is from 85 to 100 feet the tariff is $6.25 daily or 1600 dollars a year. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

WHERE PROFITS ARE MADE IN THE COAL BUSINESS (Bulletin No. 122) gives many approved methods of handling and storing coal. *Gifford-Wood Company, Hudson, N. Y.—Gratis.*

MOLYBDENUM (Bureau of Mines, Economic paper 15), by Alice V. Petar, describes the economic uses of a relatively rare element. The price is dropping steadily as the uses increase. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*



This triple pentode circuit employs the latest super-control, variable mu pentodes —44 type tubes—in the radio-frequency stages. There are two tuned radio-frequency stages preceded by a band-pass filter arrangement. Through the use of the new variable-mu tubes, cross-talk, hum, distortion, and receiver hiss are virtually eliminated. The detector stage is untuned. The Wunderlich detector tube, in addition to acting as perfected detector, gives the effect of an extra audio stage. It is coupled to the 42 type power output tube by resistance coupling. The tone quality is superior to that possible where an output pentode is coupled to an ordinary detector being operated at high input levels. The automatic line voltage control amperite is another feature of the circuit. This receiver is efficient and compact, being built up on a chassis only 8½ inches by 11 inches by 2½ inches high. Top and bottom views, and complete list of parts may be obtained from the *Allied Engineering Institute, Suite 541, 98 Park Place, New York, N. Y.—15c.*

CALORIMETRY describes an apparatus for the determination of the heating value of a gas. This brochure describes not only the apparatus itself but also its operation. *American Meter Company, Inc., Albany, N. Y.—Gratis.*

NICKEL ALLOY STEEL CASTINGS (Nickel Steel Data and Applications 8-A) describes the applications of these alloys, their melting, casting, and heat treatment. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

CIVIL AIRCRAFT ACCIDENTS AND CASUALTIES (Aeronautics Branch Bulletin No. 13) makes public the causes of accidents in civil air navigation in the United States. The fatal accidents and the miles flown per fatal accident in all services were comparatively small in the period considered. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

ZONING, by Edward M. Bassett, Counsel, Zoning Committee of New York, is a compact but complete handbook of zoning covering the story of the spread of this movement, the reasons for zoning, the experiences of the various zoned cities, the correct principles and best practice, the legal pitfalls and a selected list of references. *National Municipal League, 309 East 34th Street, New York City.—25 cents.*

MARINE BIOLOGICAL LABORATORY SUPPLY DEPARTMENT furnishes preserved and living material for courses in zoology, botany, and related subjects. Strange to say, such material is rather hard to secure and a steam yacht is part of the equipment of the Laboratory. *Marine Biological Laboratory, Inc., Wood's Hole, Mass.—Gratis.*

HUGGENBERGER TENSOMETERS are used to evaluate stresses in the most complex structures under the most complicated conditions of loading. Relatively little technical training is necessary to those using the method. The pamphlet describes the highly interesting device and the methods of using it. *Baldwin-Southwark Corporation, Philadelphia, Pa.—Gratis.*

GOLD IN CANADA (No. 730 Mines Branch), by A. H. A. Robinson, gives in brief form a picture and description of the gold mining industry in Canada as carried on at present. *Mines Branch, Department of Mines, Ottawa, Canada.—20 cents.*

SCHEDULED AIR TRANSPORTATION (Aeronautics Bulletin No. 23) gives full information as to the service rendered to the public in air transport. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

Books SELECTED BY THE EDITORS

MARVELS OF MODERN CHEMISTRY

By Beverly L. Clarke, Ph.D.

BASED on "Every Man's Chemistry" by Ellwood Hendrick, which was the first comprehensive book written for the layman, this goes a bit further and brings this branch of science up to the present day. Natural divisions of Theoretical, Inorganic and Organic Chemistry are again divided into constituent parts and developed according to the interest and value of each in industry. Thirty photos "bleed" the pages, thus giving larger illustrations than the size normally allows. It would be difficult to imagine a more intriguing and substantial presentation than is here to be found. Lucky are the classes that will have this as a text or reference book and it should with equal propriety be available in all general libraries.—$3.20 postpaid.

THE METALS

By A. Frederick Collins

THE alloys, amalgams, and compounds which are so rapidly being developed in a wide variety of applications are here explained for the non-technical reader: common metals, noble metals, uncommon metals, rare-earth metals, radio-active metals, and so on—also the discovery of each, how and when first found, what use is being or probably will be made of each. There is an interesting chapter on hypothetical metals—metals once believed to exist but later proved to be non-existent. A handy compact reference.—$2.15 postpaid.

THRILLS OF A NATURALIST'S QUEST

By Raymond L. Ditmars

THIS is a different sort of book about animals, for while it tells for the first time some newly observed habits of certain species, it is a most interesting account of the specimen hunting travels of the author—internationally known as an authority and collector. Many of the descriptions and scenes are set forth in most vivid and realistic fashion, in a style altogether entrancing. One would like to read straight on through, yet the chapters are so arranged one can—and should in order to properly digest the mass of information—read the record of what is known of a single species only at a sitting. Forty-six illustrations enhance a text of 268 pages in a format altogether pleasing.—$3.70 postpaid.

CHINA TO-DAY: ECONOMIC

By J. B. Condliffe, Prof. Economics, Michigan

AS Research Secretary of the Institute of Pacific Relations and then Secretary of the League of Nations "World Economic Survey," Dr. Condliffe has had ample opportunity to study all phases of the situation, the research already done, and by friendly association with Chinese intellectuals to assess the basic economic realities of present-day China. Thus this concise analysis becomes not the work or opinion of one man but the collated evidence from every available source molded into a constructive outline of the formidable obstacles that face the Chinese people. —$2.65 postpaid.

FORTY YEARS FOR LABRADOR

By Sir Wilfred Grenfell

IT is impossible in any short review to do this book justice, for of all the stories of heroism and adventure that we have read this one must be placed first. There is inherent in it not only a profound impulse to serve mankind, but also the urge to divine compassion bolstered by physical courage second to none. To the lonely fisherfolk Sir Wilfred brought not only the necessary medical treatment, often going tremendous distances for a call, but also that human appreciation of their evident want both physically and spiritually which sprang from an understanding of love and sympathy. A rugged, wonderful biography, strongly written because of its simplicity.—$4.25 postpaid.

THE SAGA OF FRIDTJOF NANSEN

By Jon Sorensen

BELOVED by children as he loved them and held in deep affection and honor by his country to which he reflected so much honor, the sturdy adventurer in frozen continents spent the last years of his life in assuaging the hunger and misery that followed the war. Winner of the Nobel Peace Prize, he was the official ambassador of the League of Nations in repatriating war prisoners, in charge of Russian refugee relief, and ending his work, still in harness, by caring for the little Armenians as part of his larger plan for Near East relief. Since his death much new data has become available from his diaries and family records to form this saga of his life and influence in many fields.—$4.75 postpaid.

YOUR HEARING

By W. C. Phillips and H. G. Rowell

HOW to preserve and aid hearing by facts from the experience of two outstanding authorities. The mechanism of hearing, the varieties and causes of hearing trouble, with a careful statement on the possibilities of remedial medical treatments, is all carefully explained, as well as lip reading, mechanical aids, and systematic hygiene for the conservation of hearing. This is a constructive attempt to supply the lack of knowledge which results in making a disaster out of a mishap.—$2.15 postpaid.

HEROES OF THE AIR

By Chelsea Fraser

REPEATED printings of this book attest its appeal because of the accuracy and conclusiveness of the chronology, the variety of its illustrations, including as it does clear maps of all important flights and the general comprehensive details given throughout. Six hundred and forty-eight pages, forty-three maps drawn by the author, and forty-two photographs. A splendid non-technical reference.—$2.65 postpaid.

MODERN MERCURIES

By Lloyd George and James Gilman

FROM the beginning of communication—traditionally the fleet-footed Mercury, messenger of the Gods—down to the latest expansion of the airmail, the story runs with exceeding interest through pony express, pioneer railroad, and modern mechanized post-office, till today we can talk across oceans quite as readily as within our own city. Well told and full of interest.—$3.15 postpaid.

COMMERCIAL PROPERTY NEWS

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

The New Trend of Invention

RECORDS of the Patent Office indicate that new trends are being followed by the inventive minds of America. This fact seems evident as the applications for patents on certain types of devices increased noticeably during a period when total applications are declining at the rate of about 12 percent.

In the past year, according to Thomas E. Robertson, Commissioner of Patents, there has been an influx of applications for patents in connection with air conditioning, refrigeration, oil burners, dewaxed oils for automobile lubrication, alloys, electric clocks, the automobile industry, and devices for rendering railroad travel more comfortable, safer, and less expensive.

Many of the applications which have been received in increased volume represent the engineering talent of already established companies that wish to improve their products, Commissioner Robertson stated. At the same time, other applications reveal the ideas of American consumers. Of the 20,000,000 automobile owners in the United States, for example, many have ideas for improving the efficiency or comfort of this form of travel, he said.

"They are stimulated by their own experience to work out all sorts of devices," said Commissioner Robertson. "These include inventions for opening and closing the doors of the cars by the driver without leaving his seat. Plans for various varieties of free-wheeling refinements are coming to the desks of our patent examiners in notable numbers. The same thing applies to patents relating to railroads."

Commissioner Robertson pointed out that at the same time many of the patent applications on devices relating to railroads come from experienced, technical railroad men. These include such things as improvements for unseen but vital parts of rolling stock such as journals, ball and roller bearings and means of lubrication, as well as air conditioning for cars and signaling systems for dispatching trains.

But also there are applications springing from the brains of those whose only railroad experience has been as passengers. Such ideas sometimes lead the way to far-reaching changes, he said.—(*Department of Commerce.*)

Plant Patents

THE plant patent law passed a little more than two years ago has resulted to date in the granting of 39 patents on flowers, fruits, and other plant life.

The patents protect horticulturists in their possession of a new variety of plant which may be distinguished from others by the color of the flower petals, the shape of leaves or, in fact, any distinguishing characteristic.

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.

Although no far-reaching importance is attached to any such patents already granted, this protection may be invaluable to further developments, such as the reported experiments under which it is hoped that pulp-wood trees may be coaxed to grow twice as quickly as they do now.

The new patents involve the use of color plates in registering those which are distinguished solely by a new combination of colors.

The majority of the plant patents have been granted for new varieties of flowers. Sixteen patents were issued for roses and nine for other miscellaneous flowers such as carnations, freesias, and dahlias. The rose appears to be the most popular flower, if the number of patents issued so far can be taken as an index of the trends and tastes of plant breeders. Red seems to be the favorite color as eleven of the patented roses are red and four are yellow.

Luther Burbank, the famous plant breeder, although dead, has received six plant patents through his executrix, Elizabeth Burbank of Santa Rosa, Cal. Burbank has to his credit today more plant patents than any other plant breeder. On April 5 of this year four patents were issued to him covering, respectively, a new red freestone plum, a pure golden freestone plum, a large beautifully colored variety of deep carmine plum, and a yellow freestone peach. On May 10, 1932, he received another patent for a red-skinned, golden-fleshed plum, very large in size. His sixth patent, issued last July 19, was for a chrome yellow, apricot-like flavored plum.

Thirteen patents have been granted for new varieties of fruits, including peaches, cherries, strawberries, and dewberries.

Majority of Canadian Patentees Are Americans

OF the total number of 11,262 Canadian patents issued in 1931, 7298 were applied for by residents of the United States. This is nearly 65 percent of the whole issue and is an increase of 2 percent over the preceding year. Of the remaining, 1705 patents or over 15 percent came from residents in 31 other countries.—(*Journal of the Patent Office.*)

No Silver in "Silvercraft"

HOLLOW ware which resembles silver but contains no silver and is not silver plated, is not to be labeled or advertised as "Silvercraft," according to an order of the Federal Trade Commission to a New York firm. Likewise, clocks having frames, stands, or backs which resemble silver but neither contain silver nor are silver plated are not to be designated by the term "Silvercraft."

Exception is made in each of the foregoing instances as follows: "Unless the word 'Silvercraft' is accompanied by a word or words equally conspicuous in type and position, stating the metal or material of which the said hollow ware or clock frames, stands or backs are composed."

Trade Mark Registration in China

NEW regulations of the Chinese Trade Mark Bureau prohibit the use of the words "registered trademark" on goods offered for sale in China unless the mark is registered in China, according to a radiogram from Acting Commercial Attache A. B. Calder, Shanghai.

It is not believed that this particular portion of the regulations will decrease the fraudulent use of American trademarks on goods manufactured elsewhere.—(*Department of Commerce.*)

Exporters Warned to Pay Patent Tax

MANUFACTURERS exporting abroad who have obtained patent grants of inventions and industrial processes should be especially careful to see that their patent taxes are paid when they become due. Failure to pay may result in the patent becoming invalidated or a penalty of additional levy. Moreover, in those countries where taxes are payable on trademarks, care should be exercised to see that these are paid within the prescribed period in order to avoid complications.—(*Department of Commerce.*)

International Patent Exchange

INTERNATIONAL exchange of patents and manufacturing processes on a new basis is planned by Amerika-Interessen, Inc., according to an announcement by B. Lilienthal, president of the Aktiengesellschaft fuer Amerika-Interessen, which was organized in Berlin to further German-American trade relations.

"International trade cannot possibly recover until the present tariff restrictions are readjusted," Mr. Lilienthal said. "In the meantime, some remedy must be found for industrial paralysis due to these insurmountable barriers to normal international exchange of manufactured goods. Manufacturers in Germany, and in England, France and other industrial nations have reacted favorably to the proposal of Amerika-Interessen, Inc., that at least part of the income lost through decline of ex-

port markets for finished goods should be recaptured through license of patents or through other arrangements whereby new products, devices, and manufacturing methods can be made available in countries other than those of origin.

"It will be the purpose of Amerika-Interessen, Inc. to do everything possible to establish contacts and further negotiations not only for European industries and firms having proposals of interest to American manufacturing corporations; but also to conduct negotiations for American manufacturers who wish to exploit the foreign rights of their patents in Europe."

"Snaplite" Patent Upheld

A DECISION handed down by Judge D. J. Knox of the U. S. District Court, Southern District of New York, in an infringement suit brought against U. S. Electric Manufacturing Corporation of New York by Burgess Battery Company on the Burgess "Snaplite" flashlight patent, upheld the charge of infringement and furthermore confirmed the validity of the claims of Burgess United States Patent Number 1701093. The court ordered that the defendant stop infringing.

Although the defendant endeavored to invalidate the claims of the Burgess patent by citing earlier United States and foreign patents the court pointed out the novelty of the Burgess "Snaplite" construction and ruled that the earlier constructions do not anticipate the Burgess construction.

Hazeltine Patent Review Denied

PETITION to the Supreme Court of the United States for review of a case involving a controversy over alleged infringement of Hazeltine Patent No. 1553858, relating to radio high vacuum tubes and control of undesired regenerative effects, by means of neutralizing circuits, was denied recently by the highest court in Radio Corporation of America v. Hazeltine Corporation.

Respondent sued for the alleged infringement and the United States Circuit Court of Appeals for the Second Circuit held the patent was valid on authority of its prior decision in Hazeltine Corp. v. Wildermuth, and Hazeltine Corp. v. National Carbon Co.

The patent of respondent covers, particularly, so-called plate circuit neutralization in which a neutralizing coil is associated with plate of output side of tube, neutralization being effected wholly within the plate circuit.

Radio Patent Decision Upheld

THE Supreme Court of the United States refused recently to review the determination of the Circuit Court of Appeals for the Third Circuit that three claims of the Dunmore and the Lowell and Dunmore patents relating to the use of residence alternating electrical current in radio receiving sets are invalid. [See page 380, June, 1932, SCIENTIFIC AMERICAN.]

The court denied the petition for review filed by the Dubilier Condenser Corporation, present owner of the patents, of the decision holding the claims in issue invalid and not infringed by the Radio Corporation of America.

In case No. 396, the high tribunal denied a review on the ground that petitioners failed to file their petition within the time prescribed by the statute. In this case the condenser corporation had alleged infringement of Lowell and Dunmore Patent No. 1455141, which covers radio receiving apparatus and claims the means for use of alternating current from standard residence light power, in lieu of direct current from batteries, in sets consisting of radio frequency amplifiers, a detector, and audio frequency amplifiers.

The court also refused to review case No. 397, involving alleged infringement of Lowell and Dunmore on Patent No. 1635117. This patent covers a signal receiving system and claims the means for operating circuits of a low-frequency amplifier tube from alternating current.

The trial court held that claims 3 and 14 of No. 1455141 and claim No. 9 of No. 1635117 were valid and infringed. The petitioners appealed to the Supreme Court from a decision of the Circuit Court of the United States for the Third Circuit which reversed the trial court's decision on the ground that both patents were invalid for want of invention.

The Supreme Court had previously granted review of cases Nos. 316-18, brought before it by the Department of Justice to determine whether assignments of the patents involved in this case and one other patent by Mr. Lowell and Mr. Dunmore, formerly Bureau of Standard scientists, to the Dubilier Condenser Corporation are valid. The Government contends that the inventions were perfected by the scientists as part of their research in the field of radio art for the Government, on Government time, and therefore the inventions are the property of the Government. These cases have not yet been heard by the court.

Government Wins Case Decision

THE Curtiss Aeroplane and Motor Corporation has been denied by the Supreme Court of the United States review of its suit against the Federal Government to recover compensation for the use or manufacture by the Government of an improved lubricating system for aeronautical motors which the Curtiss company alleged was an infringement of its patent No. 1329038.

In its appeal to the Supreme Court, petitioners complained against alleged infringement by the Government in its manufacture and use from 1917 to 1923 of Liberty motors, and also Wright and Packard motors. The invention in suit covers an improved lubricating system by which operating parts may be lubricated uniformly and without flooding at all angles of inclination.

Petitioners sought in the Supreme Court to overturn a Court of Claims decision that the Curtiss invention was not patentable in view of the prior art, particularly Patent No. 843084 to Grieser and Yates, Patent No. 925258 to Winton, and British Patent No. 15866 to Austin, relating to motor vehicles and boats. It held that the patentee merely adapted existing and old elements to a new condition of use without alteration of their functioning capacity.

In its petition to the highest court for a writ of certiorari, the Curtiss company alleged that the Court of Claims failed to give any effect to the presumption of validity arising from the grant of the patent, and to the presumption of novelty arising from the issuance of a secrecy order during the pendency of the patent application.

In its opposition brief, the Government stated that although the Court of Claims did not specifically refer to the presumption of validity arising from the issuance of the patent, there was nothing in its opinion to indicate that it failed to consider this presumption in determining the weight to be given to evidence as to prior developments in the art.

Patent Disclaimers

IN discussing certain questions relating to disclaimers in the patent infringement suit of Fruehauf Trailer Co. v. Highway Trailer Co., Judge Tuttle, sitting in the United States District Court for the Eastern District of Michigan, used the following illustration:

"Another thing these disclaimers do in nearly every case is to define the claim in a most unusual way. The wording is so unusual and so difficult to comprehend that you just cannot take the original claim and the disclaimer and shape a claim that reads in the way that any good solicitor draws claims. Speaking by way of illustration and with some exaggeration perhaps, the usual disclaimer claim is very much like a solid block of marble. The dealer in marble delivers the solid block and tells his purchaser that it is a Madonna. When the purchaser complains, the dealer says: 'All you have to do is to knock off all of that block except what represents a beautiful Madonna.' There is so much difference between the block of marble and the Madonna which the sculptor produces that the two can hardly be considered as the same. There is so much difference between the original claim of the patent and the claim as worded by this type of disclaimer that the same analogy applies. They are substantially as far apart as the block of marble and the Madonna. * * *

"Nearly every one of these cases of disclaimers that has come before me has been of the type of the block of marble out of which the Madonna was carved by discarding the part they did not care to use for the statue, or attempting to recarve the statue to make a sculpture wholly different. This thing is done, not by defining the lines that shape the piece of sculpture, as would seem required by the patent statutes concerning definite claims, but by discarding everything that is not wanted, and using a process of elimination and remainder purely. * * *

"Under present conditions, it is necessary for business men and their patent lawyers not only to read the claims of patents, but to search the drawings and specifications to see whether or not there is something else shown, a picture of a Madonna somewhere in the background, that somebody with glasses will say is plainly disclosed. If it gets down to a question of whether it is plain or not plain, we are liable to inject something into the patent that is going to be weighed differently by different sets of glasses, and seen in different lights."

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