IS THERE AN ETHER?

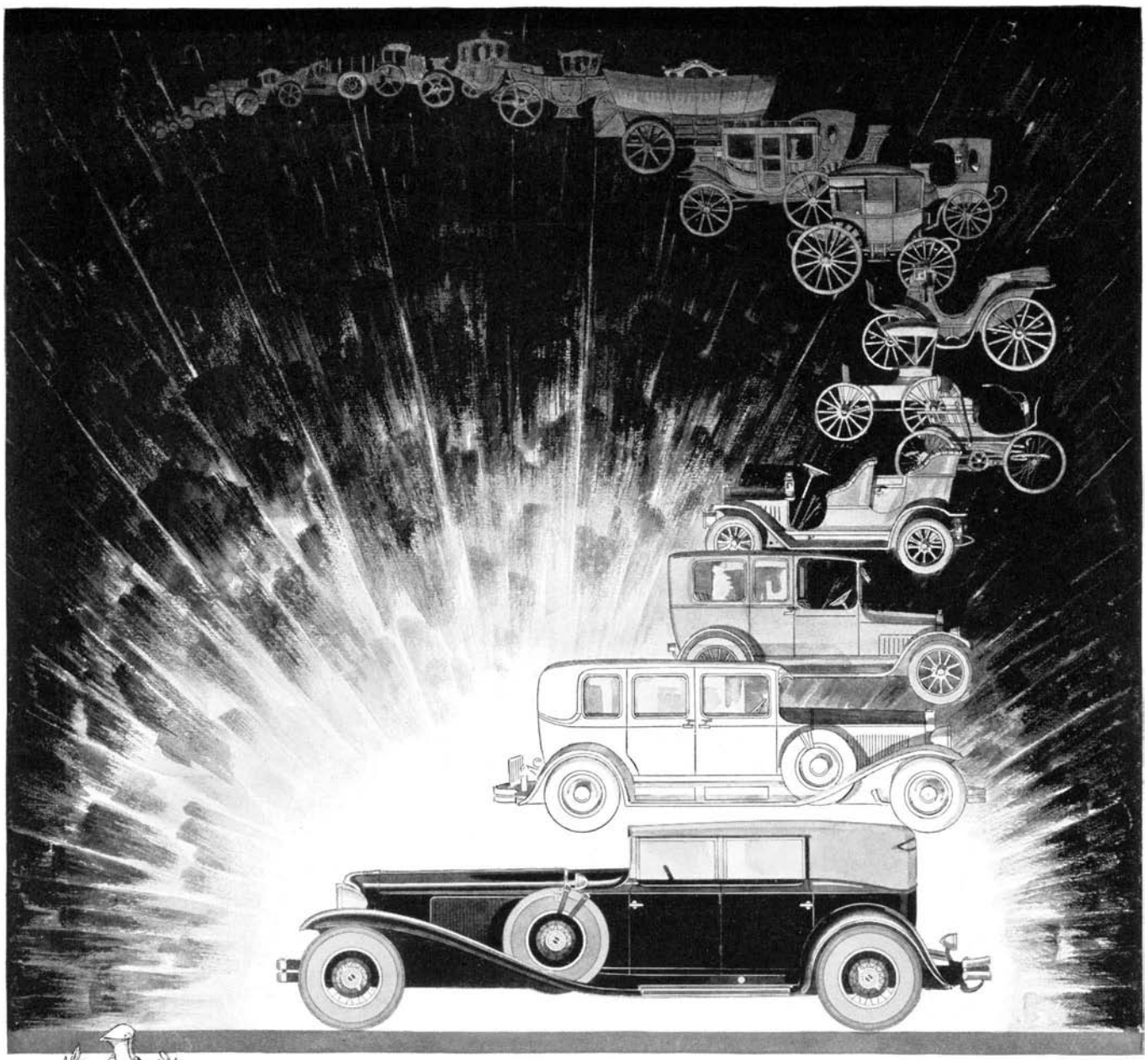
Super Magnetic Fields—The Pekin Man

SCIENTIFIC AMERICAN

June 1930

35¢ a Copy

Primitive Methods Used in Modern Copra Industry



Cord Phaeton

Just as we predicted five years ago that Straight Eights would sweep the market, which prediction has come true, we now predict that within five years Front Drive will be generally adopted by the industry—E. L. CORD

Some of the advantages of the Cord, which we claim actual driving convincingly demonstrates, are: It is the easiest car to handle because it steers easier and turns shorter. It is without equal in riding comfort due to the high ratio of sprung to unsprung weight. The absence of any tendency to tip or lean on turns is very noticeable. The inherent qualities of its design enable it to travel in a straight line better than other cars. There is no inclination to side sway on cobble stones and chuck holes. Its scientific seating comfort is unobtainable in any other car. And, you sense when driving it, a security found only in the Cord.

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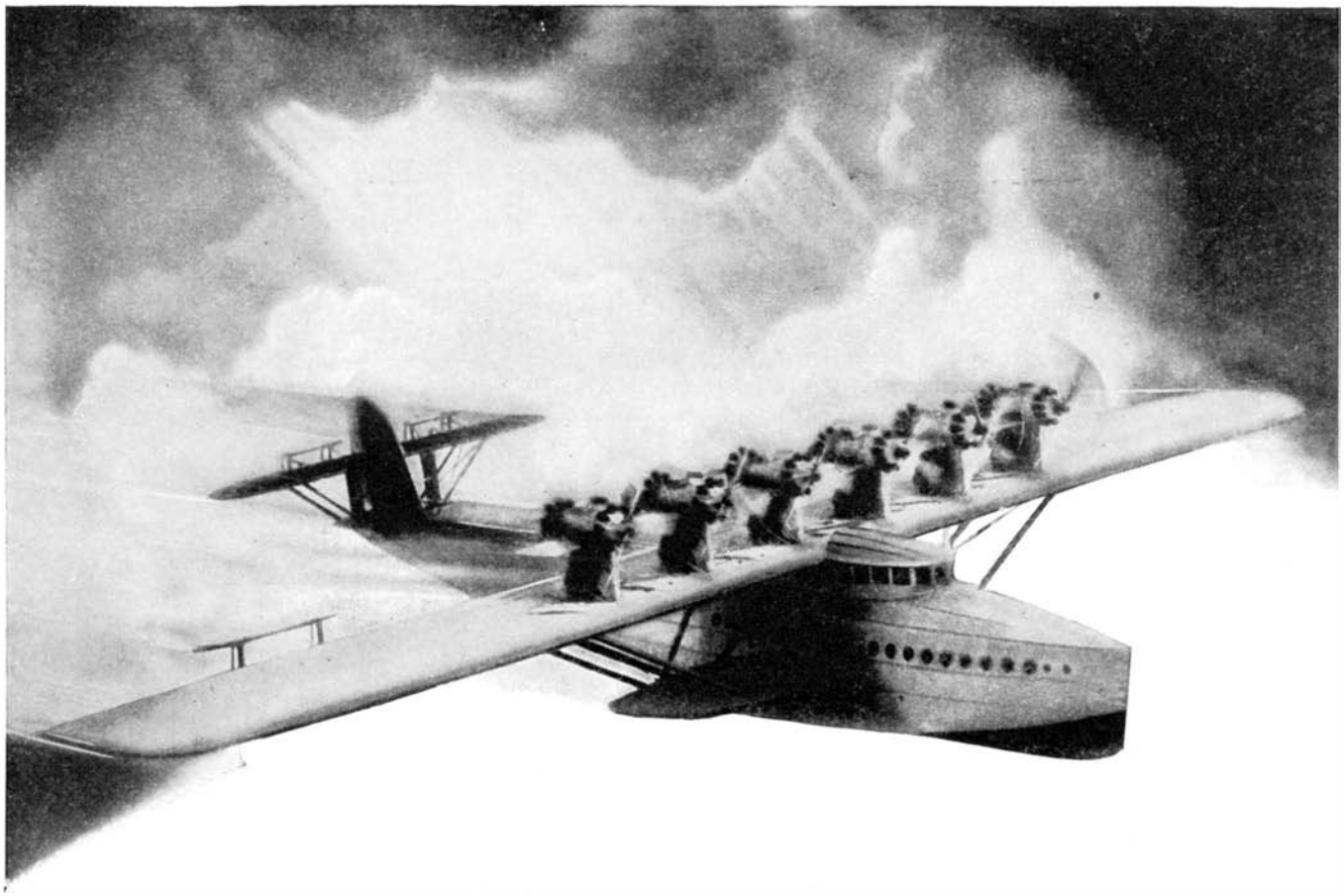

149 SKF BEARINGS

are on this, the Largest Airplane in the World

NO time to think about bearings ... not when the altimeter registers ten thousand feet ... not when a hundred trusting passengers are dozing in their seats behind.

No time to *wish* that the bearings had been purchased upon performance rather than upon price ... not when the twelve roaring motors on the wing will continue to roar *only* so long as the bearings stand up ... nor when the twenty-four engine generators are running on them, and lighting dynamo, radio installation and fuel pump depend upon them.

The DO-X

Germany's giant 100 passenger plane is powered with 12 SKF equipped Siemens Jupiter* engines. SKF Bearings take the propeller thrusts and are on the crankshafts, Farman type reduction gears, magnetos, lighting dynamo, radio and Lenz pump—a total of 149.

*NOTE: Recent press dispatches state that 12 SKF equipped Curtiss-Wright engines will be installed for the Trans-Atlantic flight of the DO-X.

And so in the DO-X, Germany's new giant one hundred passenger plane, as in practically every other well-known aircraft unit that was ever built, the bearings are SKF. Sixty-five prominent American manufacturers of aircraft and equipment alone use SKF Anti-Friction Bearings. SKF Industries, Inc., 40 East 34th St., New York, N.Y.

SKF

2479

THE HIGHEST PRICED BEARING IN THE WORLD

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SCIENTIFIC AMERICAN

June, 1930 — *ORSON D. MUNN, Editor* — *Eighty-sixth Year*

Owned and published by Scientific American Publishing Company; Orson D. Munn, President; Louis S. Treadwell, Vice-President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

IN THIS ISSUE

COVER

In the copra industry in the Philippine Islands, the primitive meets the modern. From the hinterland the natives bring their harvest of coconuts—by means of crude carts of the type illustrated by Howard V. Brown on our cover—to the modern extraction plants where the coconut meat is dried, and the resulting copra is pressed to remove the valuable coconut oil. The interesting story of this industry, which has a bearing on our everyday lives through soaps and many other familiar products, is told in the article starting on page 432.

ORSON D. MUNN, PRESIDENT
LOUIS S. TREADWELL, VICE-PRESIDENT
JOHN P. DAVIS, TREASURER
I. SHELDON TILNEY, SECRETARY

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LOS ANGELES

TO THE READERS OF THE SCIENTIFIC AMERICAN

The editors of the Scientific American have been serving you since 1845.

For eighty-five years they have been carefully culling and digesting reports upon the outstanding developments and advances in the scientific field, and giving them to you in authoritative form. You would probably be surprised at the responsibility and labor involved in sorting out the legitimate claims made to us from those made by the ultra-visionary.

You evidently have appreciated this fact, else you would not be reading the Scientific American.

This same care in the selection of editorial content is exercised in accepting advertising. We have refused to publish quite an amount of advertising that has been considered misrepresentative or questionable from one standpoint or another - pages representing considerable revenue - simply because we do not wish you to be imposed upon.

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When magazines request this it is not merely a matter of satisfying curiosity, but means much - probably more than the average reader stops to think - to all concerned:

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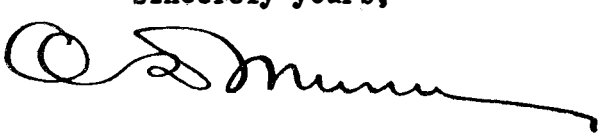
To the Magazine - because therefrom the business man will be convinced where to place his advertising;

To the READER - because the magazine, with increased revenue, can obtain better articles and more of them; use better paper and better illustrations, without increasing its price.

Sincerely yours,



Publisher

Looking Ahead *With the* Editor

Meydum Pyramid

WHETHER he knew it or not, Seneferu, first really great historic king of Egypt who died about 2900 B.C. was a past master of publicity. Fifteen hundred years before Christ, the mighty pharaohs used to boast of their exploits that "nothing like it has been done since Seneferu!" Father of Cheops, who built the Great Pyramid, Seneferu was also a great builder, as will be shown in a coming article on the excavations at Meydum.

Sleep

"IT is abnormal for a healthy sleeper to lie in any one position for a long time," is just one of the important findings of the sleep posture research conducted by the Mellon Institute to be reviewed at some length in these pages soon. A movie camera and elaborate mechanical and electrical devices were used in this research which discovered many new facts to replace old theories and suppositions concerning sleep.

Life and Death

IN structure, the living organism is identical with the non-living. What, then, is lost in death? No one knows—perhaps never will know. A widely known man of science, however, has worked out a sound theory on the nature of life and death which he has outlined in an article which we shall publish soon. In it, he includes a readable description of the many experiments which were conducted in working out his hypothesis.

Waves and Particles

BREAK a piece of chalk into two pieces. Break each piece again, and then again; continue the process. Is there any theoretical limit to our progress? This puzzle has been studied by science throughout the ages and science still theorizes. It is the question of the ultimate nature of matter—the structure of the atom. The evidence of experiment, according to an article ready for release, has forced a drastic revision of the concept of the nature of matter.

Tool-proof

COOK COUNTY JAIL, recently completed in Chicago, is said to be the largest and most up-to-date prison in this country. A description of it, which we will publish soon, will tell of some of its most important features including its "telephone pole" arrangement, its mechanical remote control of cell doors, its chisel- and saw-proof steel, and its connection with the Criminal Court Building, also a distinctive design.

Among Our Contributors

Edward S. Evans

STOREKEEPER, cowpuncher, farmer, assistant state librarian, real estate agent, and law student: Mr. Evans tried his hand at all of these before achieving his present prominent position in the business world. In addition to being president of the Detroit Aircraft Corporation, he is president of another large company, president and treasurer of another, honorary president of the National Glider Association, and holds other important positions. He achieved international prominence in 1927 when he made a record dash around the world in 28 days, 11,000 miles of his route being covered by airplane.

Paul R. Heyl

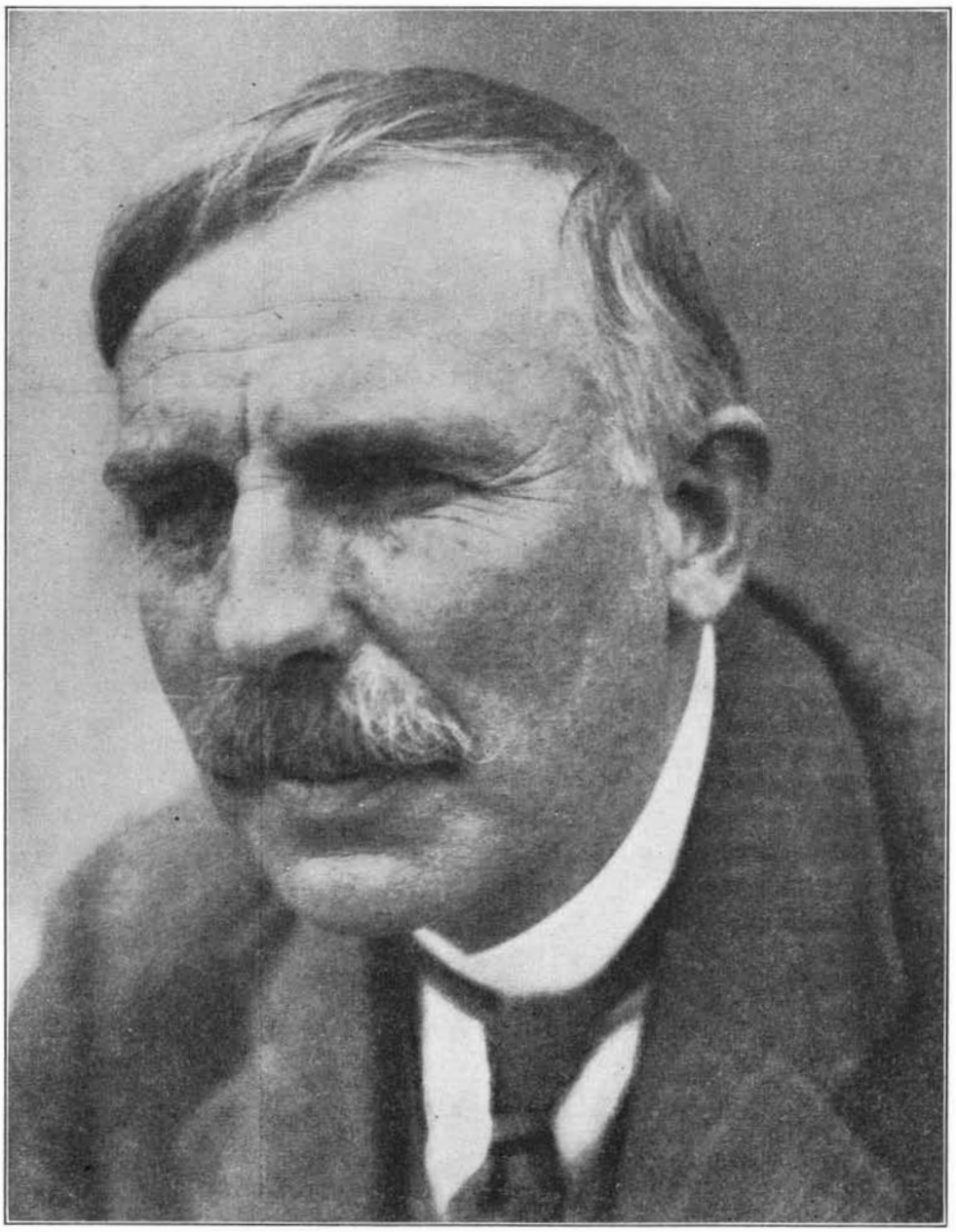
AGAIN in this issue we have one of the particularly clear and analytical articles by Dr. Heyl, who needs no further introduction to our readers. In "Is There An Ether?" he reviews a question which has puzzled man for ages and, in modern times, has caused considerable controversy.

J. G. Crowther

ANYONE who knows of the world-wide prestige of the *Manchester Guardian*, of Manchester, England, can realize the significance of the fact that Mr. Crowther is the scientific correspondent of that newspaper. Mr. Crowther's popular book, "Science for You," published in America by Brentano, was enthusiastically praised by an outstanding American man of science. He has just published a second: "Short Stories of Science."

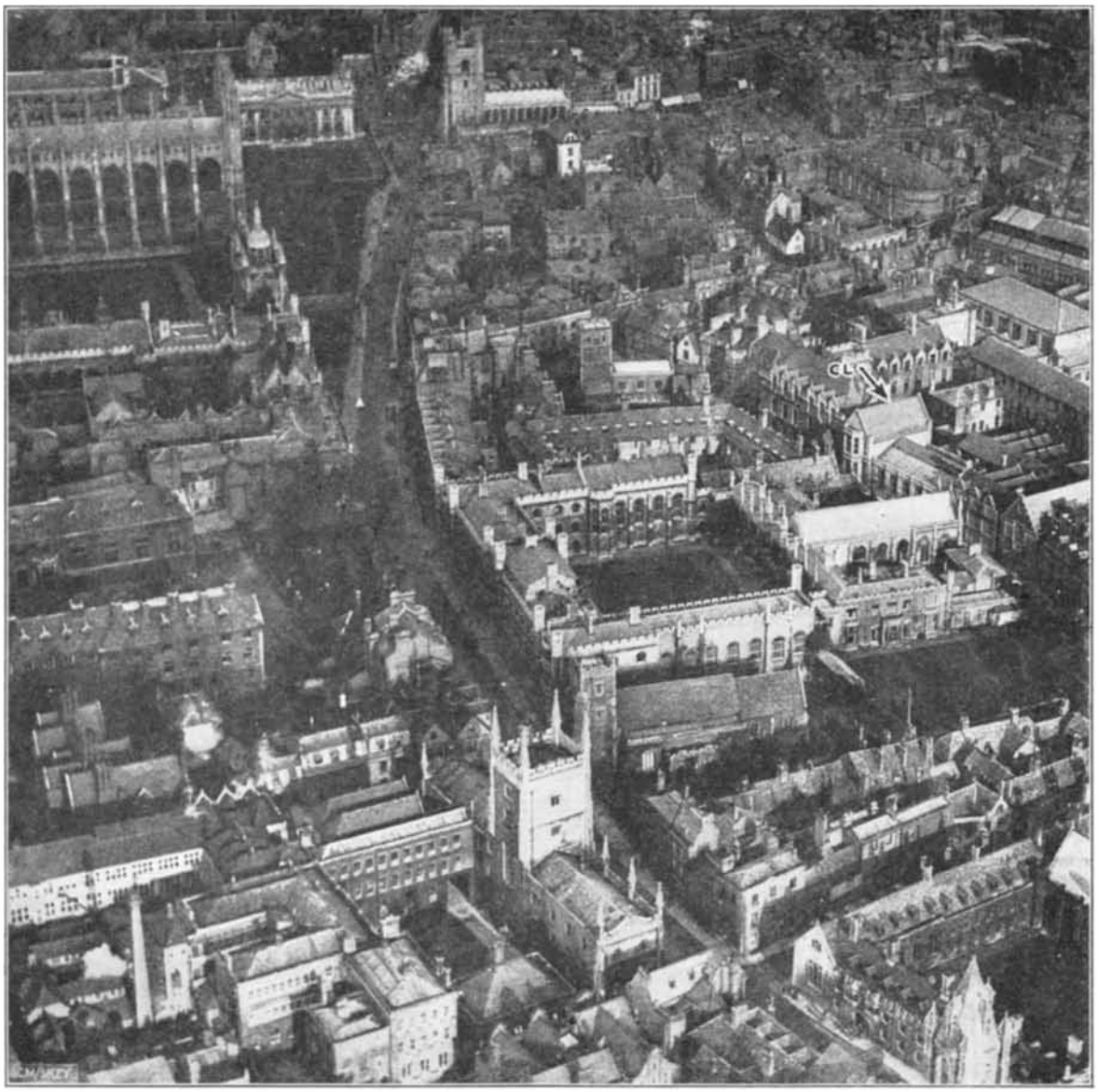
Thomas T. Read

DR. READ'S activities have taken in many phases of mining. Several times he has been a professor of mining and metallurgy at different institutions and is now professor of mining at Columbia University. He has been an associate editor of a publication on mining, chief of the service division of a large zinc company, with the United States Bureau of Mines in the Department of Educational Information and later as Director of Safety Service, and has written much on mining and metallurgy.



Sir Ernest Rutherford

SIR ERNEST RUTHERFORD was born and reared a New Zealander; he was professor of physics at McGill University in Canada for nine years; and in 1919 he succeeded Sir J. J. Thomson as Director of the Cavendish Physical Laboratory at Cambridge in England. His fame is founded mainly on his basic researches in radioactivity; the new student of that domain of physics may scarce turn a page without encountering his name, linked in many cases with those of Soddy, C. T. R. Wilson, and others who about two decades ago were pioneering in work which has since been seen to be of the utmost significance in physics. His is the discovery, for example, of the alpha rays or alpha particles. Honors too numerous to mention have been heaped upon him—degrees from European and American universities, and coveted medals, including the Franklin Medal of the Franklin Institute in Philadelphia. At present he is President of the Royal Society (properly The Royal Society of London for the Improvement of Natural Knowledge), the highest honor at the disposal of British science.



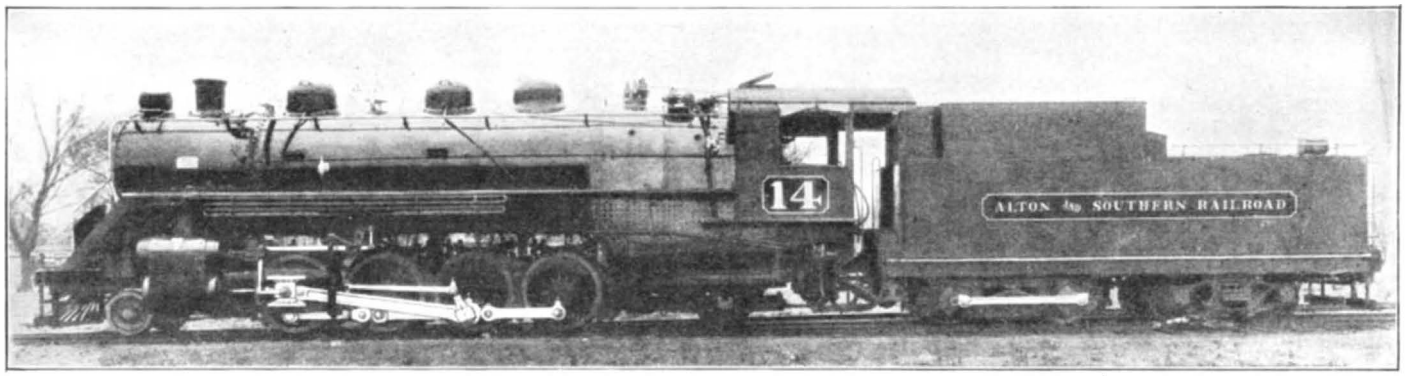
Great Britain's Foremost Physical Laboratory

IN the April number, on this page, we presented a photograph of Ryerson Laboratory at the University of Chicago, which was there characterized as "America's foremost physical laboratory." Now is shown a picture of a part of Cambridge University in England, including the famous Cavendish Laboratory of Physics (marked "CL" on the picture) which men of science regard as Great Britain's foremost physical laboratory.

Cambridge University as a whole is British headquarters for science, and has been so for centuries. It was here that Newton, profoundest intellect of the ages, performed his classic experiments on light and gravitation; and that Darwin, whose concepts of general evolution have had stronger impact on thought than those of any modern human being, obtained his education. Jeffreys the geophysicist, and Eddington the widely know astrophysicist, are Cambridge professors.

Cavendish Laboratory of Physics was organized by the great physicist Clerk Maxwell.

Just as, in Chicago, the Ryerson Laboratory's achievements have mainly been derived from Michelson's inspired leadership, so those made at Cavendish Laboratory have been the resultant largely of the personality of its former director and leading spirit, Sir J. J. Thomson, discoverer of the electron. Among Thomson's students now risen to eminence in physics are Sir Ernest Rutherford, the present Director of the Laboratory, Sir William Bragg, Charles G. Barkla, C. T. R. Wilson, F. W. Aston, and O. W. Richardson. "This," as Professor Arthur H. Compton, of Ryerson Laboratory, puts it, "is the largest group of Nobel Prize men that can be boasted by any laboratory. Under Sir Ernest Rutherford it continues to carry on with increasing vigor the work which Thomson started. To this laboratory can go the credit for having established the existence of both the electron and the proton, largely through the work of J. J. Thomson and Rutherford."



LOCOMOTIVE PARTS OF STRONG ALUMINUM ALLOYS

Aluminum alloys are now being used on some railroads in place of steel for cross-head assemblies, valve motion parts, main rods, and side rods. Aluminum is used to improve the general balance, to increase the boiler power, and to obtain the required durability

Aluminum and Its 'Hard-Boiled' Alloys

How a Chemical Curiosity Became a 225,000,000-Pound Industry in Forty-Three Years

By ALBERT A. HOPKINS

INVENTIONS are not all made in woodsheds, although it seems rather a logical place for a shop. Given a shop and an inquisitive mind, who knows what may happen? There is, however, one woodshed which Mr. Ford will never have for his Dearborn collection, although he uses large quantities of the product that was born there. Unfortunately, this particular woodshed in Oberlin, Ohio, will also never be marked by a tablet, as it has been removed, but there is one on the house which adjoined it that reads: "In This House Charles Martin Hall Discovered the Electrolytic Process of Making Aluminum, February 23, 1886, the Year Following his Graduation from Oberlin College, Thus Making Available for Industry a Metal Long Known but Little Used." The tablet tersely describes the invention of a process vitally necessary for the commercial production of one of our most useful metals, particularly when alloyed.

ALUMINUM was separated from its chloride in 1825 by Oersted. Wöhler continued the Danish scientist's experiments but it remained for the French chemist, St. Claire Deville, to produce the first aluminum commercially. This was approximately 25 years after Oersted's discovery. In 1852 the metal was worth 545 dollars a pound but in five years the price had dropped to 27 dollars a pound. Thirty years later an Oberlin College student was destined to shake the metallurgical world with an epoch-making discovery and in a short time thereafter aluminum sold for two dollars a pound in 1000-pound lots, a remarkable decrease.

Professor Jewett, of Oberlin College, was lecturing one day and said that if anyone should invent a process by which aluminum could be made on a commercial scale that he would not only be a benefactor to the world but would amass a fortune as well. Charles Hall turned to a classmate and said, "I'm going for that metal." Six months later he came into Professor Jewett's office and said: "Professor, I've got it!" In his hand were little globules of aluminum. Inventor at the age of 23, this young man had carved his way to fame and fortune.

26 1/2 POUNDS

This is not a feather weight, but is certainly light, weighing 3 1/3 pounds a foot

A month or two later a French chemist, Heroult, of the same age, made the same discovery independently. On the occasion of the award of the "Perkin Medal" to Hall in 1911, Heroult crossed the Atlantic to congratulate him.

A COMMERCIAL plant was established in Pittsburgh in 1888 by a company called the Pittsburgh Reduction Company, which was the forerunner of the Aluminum Company of America. The first week's production was 100 pounds and it was kept in a safe, as aluminum was still a more or less semi-precious metal. But nobody wanted the product, so the company had to go out and make a market. They succeeded so well that the production of aluminum in the United States in 1928 as given by the American Metal Market was 198,414,000 pounds. In 1929 the production showed an increase but definite figures are not yet available. The average price of virgin aluminum has fallen to 24.3 cents per pound, a far cry from something that had to be kept in a safe and which nobody wanted.

It must not be supposed that Hall's invention did not thrive uncontested. The Cowles Electric Smelting and Refining Company, of Lockport, New York, reduced aluminum oxide with carbon in electric furnaces but only a copper-aluminum alloy was produced; it was a high-temperature reaction, and not electrolytic. The late Judge Taft who was destined to be President and Chief Justice of the Supreme Court, rendered a decision in the United States Circuit Court of Northern Ohio in which he said: "Hall was a pioneer, and is entitled to the advantages which that

ALUMINUM IN BUILDING

The pyramidal roof of the St. Louis, Missouri, Civil Court House was all fabricated from aluminum

fact gives him in the patent law." Other litigation followed, but finally all obstructions were swept away. With the cheap water power at Niagara and elsewhere we are able to obtain vast quantities of aluminum, which is gradually entering more and more into our daily life. It is used in our automobiles, airplanes, buildings, locomotives, and kitchens. It is used so much in everything to do with locomotion that it is interesting to note that its use in bicycles really brought aluminum into prominence. The war helped the aluminum industry; the light weight aluminum alloys dictated their use in aeronautical parts and today aluminum propellers, forged under huge air hammers, are standard on many of the finer planes. The dirigible depends largely upon aluminum alloys and aluminum sheet has even been used in place of a fabric as an outer shell for the ship.

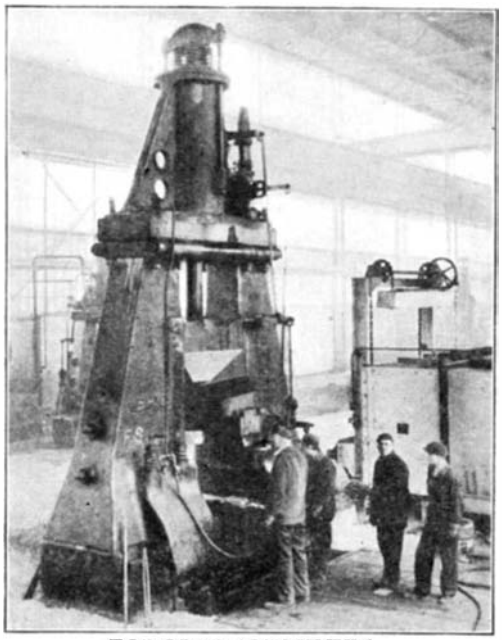
Because of the fact that manufacturers did not have uses for the new metal when it was first made commercially available, the Aluminum Company of America was really forced into designing and making all kinds of things such as bottle caps and seals, foil, and so forth, as well as plates, sheets, bars, castings, forgings and articles fabricated from them. The writer well remembers as a boy seeing the Cowles electric furnaces in "Lower Town" in Lockport, New York. These were under open sheds and it was a puny affair compared with the immense "pot room" at Niagara Falls, where the ingots are now produced.

The aluminum comes to the mills and shops in the form of "pigs" or ingots which weigh about 50 pounds. While large quantities of aluminum are used without alloying for consumption in foil, bottle caps, kitchen utensils, and hundreds of other uses, much of the aluminum of commerce is consumed in the form of alloys. The aluminum and the alloying metal, copper for example, are melted under the most precise pyrometric control, and cast into ingots weighing between one and 30 pounds. The alloys thus made are subsequently remelted and cast into rolling ingots or castings.

IN the case of sheet, tubing, and forgings, the ingots generally weigh between 50 and 300 pounds, but for structural shapes these ingots may weigh upward to 3000 pounds.

Aluminum and its alloys are cast in a number of ways—by gravity in sand molds; by gravity in accurately made fixed molds (permanent mold process) and by die casting under great pressure. The alloys can be forged under a steam or air hammer just as are iron and steel; airplane propellers are so forged. Remarkable effects are produced by heat-treating aluminum alloys. The end is to secure the best possible distribution of the alloying element and then to fix it. The heat treatment is conducted in electrical furnaces and steam pressure tanks. Aging of alloys, both natural and artificial, also enters the case, but here we are treading on a metallurgical morass so we had better retreat while there is time. Alloys have been developed which can be forged from one piece without reheating. Strong alloys are also made proof against corrosion. Pure, comparatively weak, aluminum is used as a protective coating over strong aluminum alloys. Indeed, the results obtained by heat treatment are so peculiar that it is sometimes called "voodoo" treatment by the scornful. The more you see of the processes of manufacture, the more respect you have for the magnificent laboratories which control it all.

Strong aluminum alloys have been developed to supply engineering materials, having mechanical properties comparable with those of steel, and,

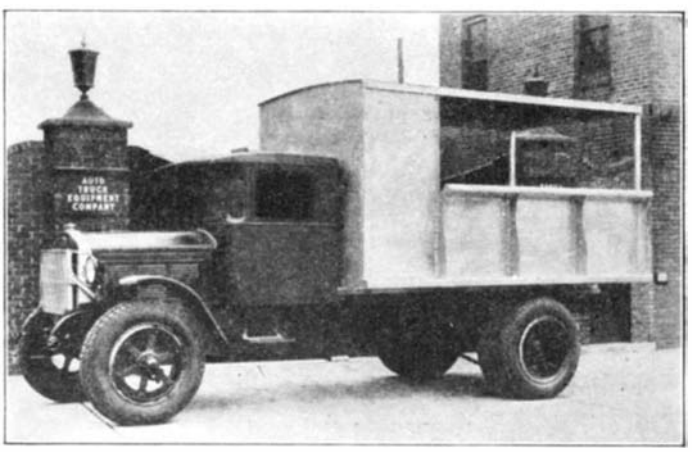


FORGING ALUMINUM

An 18,000-pound hammer is forging an airplane propeller. Some aluminum alloys can be forged

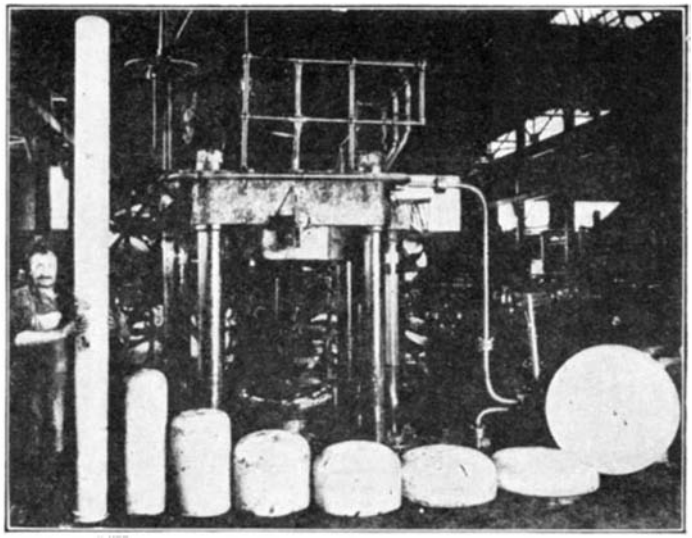
FOR ACETIC ACID

An all-aluminum tank of riveted construction is used for acetic acid, which does not affect aluminum. Capacity is 80,000 pounds



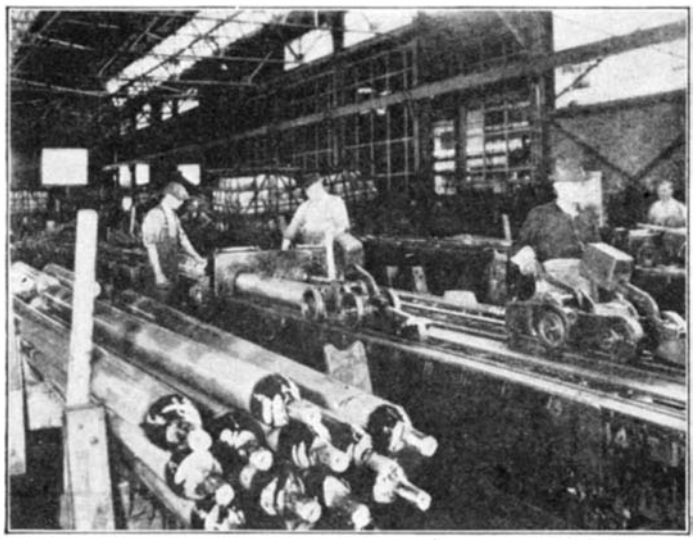
ALUMINUM TRUCK BODY

Every pound of weight that can be saved in the construction of the body of a heavy-duty truck is a pound added to the pay load



ALUMINUM TUBES BY CUPPING

An aluminum sheet is drawn on a cupping press into the form of a tube. Tubes thus produced may be further reduced by drawing



DRAWING TUBES

Round and square aluminum tubing has many uses. Tubes are also produced from the billet by means of an extrusion process

at the same time, retaining the well-known characteristic properties of the parent metal. Briefly summarized, these include low specific gravity, good resistance to corrosion, high thermal and electrical conductivities, and pleasing appearance. Pure aluminum has a tensile strength only about one sixth that of mild steel but "17ST" has a tensile strength of 55,000 to 63,000 pounds per square inch and a yield point of 30,000 to 40,000 pounds per square inch, fully comparable with low-carbon nickel and carbon steels.

These aluminum alloys are of rather recent development, but they have found immediate application in the aircraft and automotive industries, and their use has rapidly spread to other fields. From the truck and the bus, where the light alloys have already proved their worth, it is only a step to the electric and steam railway car, and this step has already been taken. Here the strong aluminum alloys have replaced steel. Such a substitution is not possible on the basis of first cost alone, even when it is considered that the low specific gravity of these alloys results in a very much lower metal requirement for any given part.

WHEN, however, the saving in power during the life of the assembly is considered, and also the lower maintenance cost resulting from the decreased inertia and vibrational stresses, as well as the increased resistance to corrosion, the advantage of the aluminum alloys becomes apparent. When, however, the strong aluminum alloys are substituted for other non-ferrous alloys, there is frequently an actual saving in metal cost.

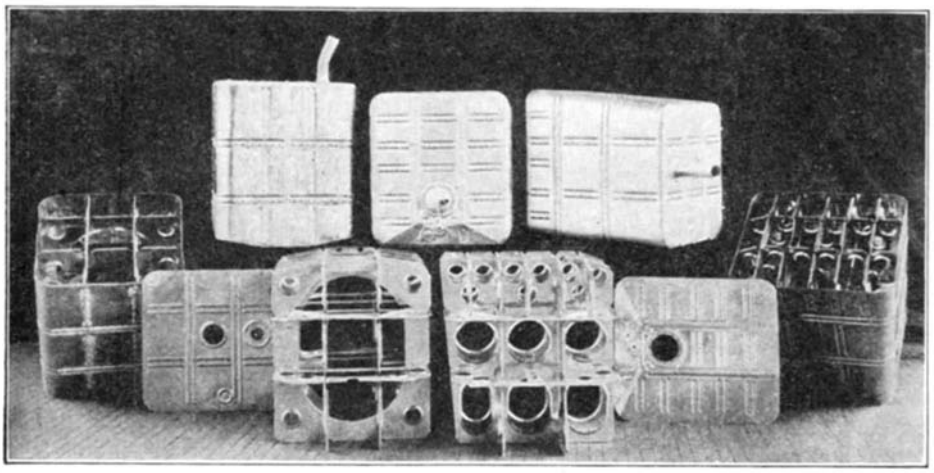
Almost at the birth of the automobile industry aluminum was recognized as an important material of construction and the automobile manufacturer is aluminum's largest customer. Aluminum is ideal for truck bodies in that it increases the pay-load or decreases the dead weight of the truck. Fuel consumption and wear and tear on the chassis are also lessened. Even if an aluminum body costs 600 dollars more, the revenue is increased some 800 dollars a year and the scrapped body can be sold for around 300 dollars. Trolley cars with aluminum bodies are giving excellent service and show the way to increased economies. The Navy's metal-clad dirigible *"ZMC-2"* not only has an aluminum framework but is enclosed in aluminum sheeting. The use of aluminum in airplanes is almost an old story now. Aluminum is ideal for many parts of the radial motors and forged aluminum propellers are largely used. Outboard marine motors afford a fine field for the use of aluminum. In washing machines, vacuum cleaners, and other household appliances aluminum enters the house as well as via the kitchen. Seals for bottles are made at New Kensington, Pennsylvania, by the hundreds of millions and are used on products packed in various places all over the globe. Aluminum foil is largely used in place of tin foil and can be obtained in all the colors of the rainbow. Aluminum tanks make good oil storage containers and aluminum tank cars carry acetic acid safely.

ALUMINUM HELPED

Over 100,000 pounds of aluminum sand-cast spandrels were used in the Koppers Building

ALUMINUM CHURCH SPIRE

Two hundred and twenty castings were used in the spire in this new church



AIRCRAFT TANKS

Here we have finished and semi-finished gasoline tanks for aircraft. Lightness is essential in such parts, and for this reason they are fabricated from aluminum sheet. Note the baffles

Aluminum furniture has come into its own. An average aluminum chair weighs only about seven pounds.

Aluminum is very successful in the building field. Over 900 aluminum spandrels were used in the Koppers Building in Pittsburgh, while in the new Chrysler Building in New York the spandrels, copings, and sills are of aluminum. Aluminum shingles and cast aluminum ornaments and crestings are being largely adopted.

Shingles made of aluminum have many points of excellence due to the inherent properties and qualities of the metal itself. They are wind, water, and weather tight. They are unbreakable and non-inflammable. They are frost proof; they cannot crack nor leak, because they are flexible. They are, of course, non-rusting and are light in weight, thus relieving the roof framing timbers of excess weight. These shingles are laid from the top downwards, so no scaffolding is laid over them and they are not injured by being walked on. Sheets of aluminum have been exposed to the ravages of the elements for over 25 years and at the end of that time they show no appreciable deterioration. This is worthy of note, when considering various shingle materials for building.

One of the most striking uses of aluminum for architectural purposes will be found in a church in Pittsburgh in the downtown section, surrounded by lofty office buildings. This church is the German Evangelical Protestant Church which is built in a modification of the French Gothic style. The spire is made up of aluminum castings. There are 221 castings used in this striking edifice which towers 259 feet above the level of the street. The spire is octagonal and is 80 feet in height. It rests on a concrete base 179 feet above the street. The crosses on both sides are also made of aluminum and are illuminated at night. The extreme tip of the spire is a single casting weighing 201 pounds. This spire will never have to be painted and it stands out brightly under Pittsburgh's rather trying climate. Aluminum also caps the Washington monument. The capstone weighs 3300 pounds and is finished off by a small pyramid of aluminum 5.6 inches at its base and 8.9 inches high. It weighed 100 ounces, being the "largest piece of this metal ever cast in any country." This was in 1884; recently a 3800-pound base for a Diesel engine was cast.

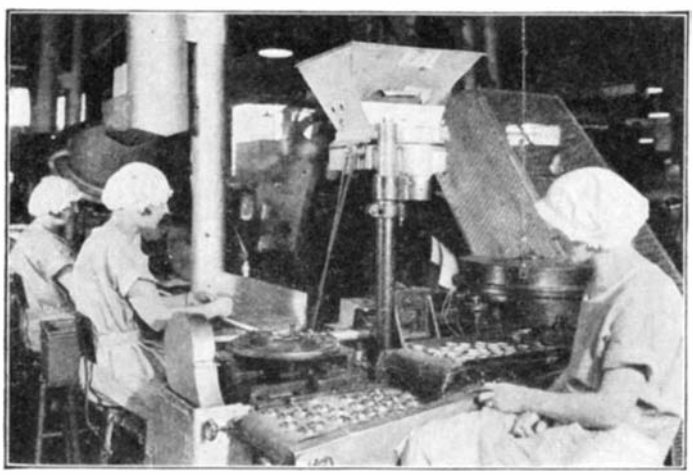
LOOKING FOR DEFECTS

X-raying a crankcase. Heat treatment and forgings necessitate such inspection

Aluminum paint is used in many industries. The pigment base is "albron," which is made by stamping pure aluminum into small, flat, and very thin *flakes*, which, when mixed with a suitable oil or varnish vehicle form aluminum paint. These tiny flat flakes overlap one another when applied. They arrange themselves layer on layer much like falling leaves. Thus there is formed a metallic sheath that can be readily washed. One coat will completely hide a black surface.

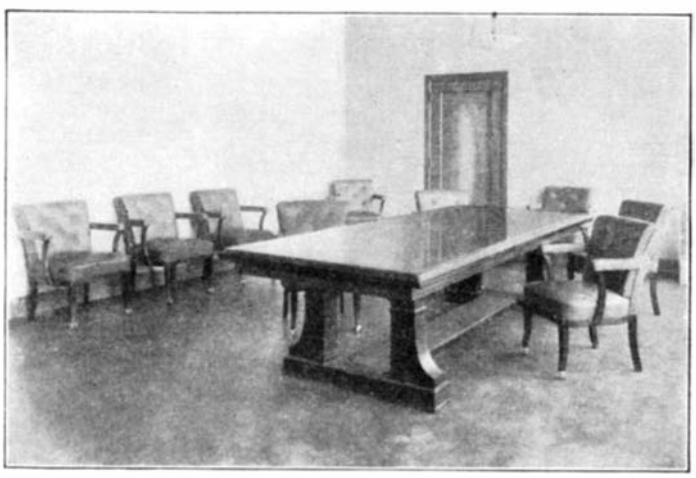
ONE more example of the application of strong aluminum alloys, in this case to locomotives, and we are through. It has been found advantageous to provide reciprocating parts of aluminum alloy. Any weight saving in the reciprocating or rotating parts can be put into boiler capacity without increasing the weight on the drivers. The saving in rail hammer is very great.

So here we must take leave of this very light and versatile metal and its useful "hard-boiled" alloys, to mill out new uses in our machine world.



BOTTLE SEALS

Girls place tin disks in the aluminum capsules as they pass by on a conveyor. A cork liner is dropped in and a groove secures it



ALUMINUM CHAIRS

Here is a director's room entirely equipped with aluminum chairs. Having no dowels they are especially valuable for dining cars

OUR POINT OF VIEW

The Rights of the Governed

PROBABLY no one will dispute the affirmation that the Constitution of the United States was promulgated with the inherent idea that, insofar as it is possible, the people shall have a direct voice in their own government.

As the years have passed, the practical operation of law-making and law enforcement has been more and more delegated to representatives, which though a proper procedure in itself, has resulted, in many cases, in the evolution of a situation where representatives do not always represent the opinions and beliefs of their constituents. This is evident in the agitations for the "referendum and recall"; by the pressure of public opinion which forced the passage of the XVII Amendment, the election of United States Senators by direct popular vote; by direct primary nomination in certain states, and so forth.

Even these reversions to older tradition of self-government have not entirely ameliorated the conditions, for we still find some of our representatives being governed by the opinions of a close coterie who are accessible and whose influence has weight with them, or by a part of their constituency who are most vociferous. It is true that when the situation becomes flagrant, the people will correct it by the removal of such misrepresentation, but in the ordinary run of events a representative can continue to misrepresent the majority of his constituents for long periods before retaliating wrath can be organized to overthrow and punish by elimination.

If popular vote can make, it surely has the same right to unmake. The aphorism that because a law is on the statute books it must remain and be enforced regardless of popular will, is as fallacious as that a man should continue to do something injurious to himself simply because it is a custom or a fad.

Criticism appears in some quarters of the nation-wide poll on the prohibition amendment now being taken by the *Literary Digest*. Yet, fundamentally, what is censurable in any honest effort to learn what the public really wants? Without a doubt this effort is an honest one, and to our mind it is representative, although as to the latter there is a basis for argument.

If the XVIII Amendment was put through as a war-time measure, at a time when we were ready to agree to anything that might help us to victory, and we now wish to reconsider that action in the light of present peace-time prosperity, who can gainsay us such a right?

It's Not the Cost

CRITICISMS of the increased rates for American naturalization papers seem partly justified by statistics. For the July-December, 1929, period as compared with the same period of 1928, the number of first-paper applications fell from 114,469 to 79,346, and second-paper applications fell from 106,028 to 65,887. Under the old rates, first papers cost one dollar and second papers four dollars; under the new, five and ten dollars respectively.

The drop in the number of applications has been laid to the increased cost, and the principal criticism of this increase seems to be that the tendency will be "to perpetuate an alien group." It is contended that the alien most often belongs to the low-income class and finds it exceedingly difficult to spare the money for naturalization papers while maintaining himself and his family, building a home, and educating his children. To some extent, then, the criticisms are justified, but—

The alien, as a rule, comes to this country because of his intolerable poverty in some other. If he belongs to this class, citizenship should be cheap at any price. There are some, of course, for whom the expenditure of the few extra dollars would work a hardship but the amount is so small even under the new rates that they can and will manage somehow if they seriously desire to share the benefits and prestige of American citizenship. As for those who can afford the price and will not because of indifference or lack of appreciation of what it means to them, and those who cannot because their earning power is too low, we do not want them. They are not the stuff of which good American citizens are made.

Unregenerate Criminals

IN a letter to *The New York Times*, Ranulph Kingsley, of New York, declares that we have become too good-natured and easy-going in our dealings with criminals. He believes that "Even if we have to pock-mark the state with prisons, we should put every confirmed criminal in one and keep him there." Mr. Kingsley states that since holding up the United States mail with gunplay was made punishable by life imprisonment some years ago, that kind of crime has noticeably decreased. He would have the states adopt laws as stringent as this federal law; and, further, he believes it inadvisable to take pistols away from honest people yet very necessary to teach the criminal that when he goes out at night with a pistol, "he goes to his own swift and inevitable imprisonment for life."

We heartily agree with Mr. Kingsley. Under the present lax system, too many politicians are working hand-in-glove with the underworld, too many murderers are brought in simply for questioning and then are let go with a smirk on their faces, too many foreign-born are conducting rackets that terrorize honest citizens. It is all very well to philosophize about the exploitation of human beings that leads them to become criminals, to prattle of reforming them, to pity them for their supposed lack of advantages, but that is not enough. All this is the fault of the system; therefore the system should be changed. Many years will elapse, however, before we have made a start in this direction and, in the meantime, confirmed criminals, with minds warped irreparably, continue their depredations on society. What we need right now is a Mussolini to round up our "Mafia" and a few jurors who are not too chicken-hearted to send the criminal up long enough to pay fully for his crime.

Questionable Success in London

A THREE-POWER Pact has been agreed upon by Great Britain, Japan, and the United States. For the present the differences between France and Italy have proved irreconciliable; but it is the intention of Great Britain, France, and Italy to continue negotiations in the hope of developing a formula that will enable the two Mediterranean powers to join the pact. We have a direct interest in the solution of the problem between Italy and France, because it may affect the number of cruisers considered necessary by Great Britain.

If the tentative agreement is carried out, the fleets of Great Britain, Japan, and the United States would be as follows:

	United States	Great Britain	Japan
Capital Ships	15	15	9
Cruisers (tons)	323,500	339,600	208,900
8" Cruisers	18	15	12
6" Cruisers	19 or 20	34 or 35	12 or 13
Destroyers (tons)	150,000	150,000	105,000
Submarines (tons)	52,000	52,000	52,000

(*Please turn to page* 485)

Super Magnetic Fields

Some Remarkable Experiments in England—"The Most Interesting in the World"—Promise New Revelations in Physics

By J. G. CROWTHER*

THE behavior of the compass needle is described by saying that a magnetic field of force exists on the earth's surface. The magnetic force turns the needle to the north. Clearly this field of force must have a definite strength at any particular place; it must be at least strong enough to deflect the compass needle. The strength of the earth's magnetic field is in fact about one half of the unit used for measuring such fields, that is, half a gauss. It is known that the sun has a surface field of about 50 gausses, and in sun-spots the field may rise to 5000 gausses. Very strong electro-magnets can generate fields of upwards of 100,000 gausses, though 30,000 or 40,000 is about their usual manageable limit.

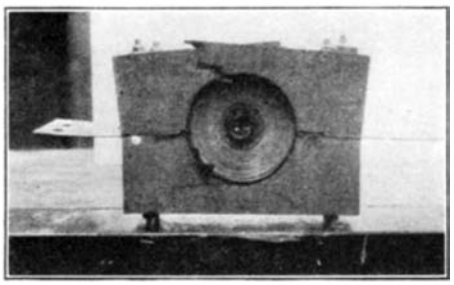
One wonders what will happen in more intense magnetic fields. Superficially, it looks quite easy to discover. You take a bar of iron and wind copper wire around it. You run current through the wire. This produces a magnetic field within the coil and in the iron. The iron concentrates the field around its ends, called the pole-pieces. Put more current through the coil, and the field in the interior becomes stronger.

But this phenomenon occurs only up to a certain point. Iron has only a limited appetite for magnetic fields; it can not absorb them beyond a certain strength. So very strong fields must be made without the assistance of concentrating iron poles. This means that still higher currents must be put through the coil, since the iron will not be there to assist in the concentration.

BUT copper wires heat when currents are passed through them. When the currents are above a certain volume, the wire is heated above its melting point. Thus, seemingly, there is a limit beyond which the field inside a copper wire coil can not be raised—the limit determined by the melting point of the coil.

Dr. Kapitza, working at the Cavendish Laboratory at Cambridge University, has shown how this limitation can be evaded. Suppose an enormous current is sent through the coil, but only for a tiny fraction of a second. Even the most powerful current takes some time to heat up the wire. May it not be possible to get the enormous current through the coil and cut it off again before it has had time to melt the copper wire? This is Dr. Kapitza's method. He sends the current through the coil for not more than 1/100th of a second.

Although this sounds simple, the execution of the method bristles with difficulties. Obviously, everything has to be done in less than 1/100th of a second. Even after the apparatus itself is successfully designed, all the experiments have to be carried out and measurements made within periods of



AN EXPLODED COIL

The magnetic field, 600,000 times as strong as the earth's, is produced at the center

1/100th of a second. The fields exist for a period of 1/100th of a second. If their duration has to be accurately defined, they must be started and stopped almost instantaneously. Dr. Kapitza's switch for making and breaking the circuit can operate in 1/10,000th of a second.

The powerful currents are obtained by short-circuiting a dynamo. The machine Dr. Kapitza uses is of a special design. It is wound so that the current alternates its direction during a revolution, that is, it has a single phase winding. At the beginning of a revolution the current is zero. It rises to a maximum at the quarter revolution and then declines to zero again at the half revolution. The current then changes its direction, rising to a maximum in the new direction at the three quarter revolution, and declining to zero again at the full turn. With such a machine, the current will be zero at the beginning, the middle and the end of a revolution. The volume of the current at the maxima will depend on the size of the machine. In Dr. Kapitza's machine the maxima are about 30,000 amperes. By special winding the maxima can be reduced but spread out a little. In this way, he obtains a steady 30,000 amperes for 1/100th of a second, instead of, say, 72,000 amperes for a far shorter fraction of a second.

We now come to one of the many highly ingenious features of this machine. Dr. Kapitza has his source of 30,000-ampere current; how can he tap it?

We all know that when a current is broken, sparks occur; for instance, when a street car trolley jumps off the wire. Will we not get a tremendous spark if we try to break a current of 30,000 amperes? And will not a big spark at each end of the 1/100th of a second period rather blur the definition of the interval? We can avoid all that, says Dr. Kapitza, by seeing that the current is tapped from the machine when it is at one of its zeros.

So the coil for producing the magnetic field is switched on to the dynamo in 1/10,000th of a second when it is producing zero current. As there are limits to mechanical accuracy, the current may not be quite zero, but perhaps a mere 3000 amperes. So the switch must be capable anyway of breaking a current of a few thousand amperes in 1/10,000th of a second. That is why it has to be so large and complicated. Dr. Kapitza considers that the switch was the hardest to design of all the parts of his apparatus.

THE coil has now been switched into the current when the current was comparatively feeble. In a small fraction of a second it rises to 30,000 amperes and remains at that strength for the next 100th of a second. All the experimenting has to be done in this short interval.

For the small fraction of a second when it is short-circuited, the dynamo develops about 50,000 horsepower, and the energy discharged into the coil is about equal to that discharged when a field gun is fired.

The machine was made to Dr. Kapitza's design, in consultation with Professor Miles Walker, of the College of Technology at Manchester, by Metropolitan Vickers at Old Trafford, in England.

The magnetic coil for producing the magnetic field consists of layers of square copper wire, or copper-cadmium alloy. When a current is sent through the wire the opposite sides of the coil repel each other. If the current is small the repulsion is not great but if the current is large the force on the coil tending to make it expand can amount to several tons per square inch of copper.

In his earlier designs, Dr. Kapitza

*See "Among Our Contributors," page 421.

found that the metal of the coil spread like putty under these repulsive forces. But it is possible to design the coil so that these forces cancel out, except directly outward. So this was done, and a strong steel strap was clamped around the coil to bear the resultant outward thrust. By using copper-cadmium alloy, the coil itself can be made four times as strong as when copper is used, and yet retain 90 percent of the conductivity of copper.

Then a worse snag arose. The repulsive forces tending to make the coil expand made the coil unwind itself a little. Its ends were torn away from their terminals. Coil after coil burst in this way, and the experimenter had the unnerving experience of seeing his experiments failing after all the labor and expense on the dynamo and other apparatus.

After some months of disappointment, the experimenter devised a solution of the bursting coil trouble, and it was possible to proceed with these epic experiments. He designed coils which "breathed," that is, expanded automatically. The central winding in the coil was made out of a piece of copper-cadmium tubing with a helical saw cut. A ring was made to slide around this tube, and then the end of the wire was brazed to the ring. When the coil expanded, the wire just slid the ring around the tube. After being used once, the coil settled into a permanent position cramped against the outer steel strap and the trouble was overcome.

Another difficulty was caused by earthquakes. When a dynamo about to produce 50,000 horsepower is short circuited, it suffers a severe shock which it communicates to its foundations. A small earthquake travels through the laboratory at the rate of about two miles a second. Measuring apparatus, spectrographs, and so on, are thrown out of adjustment. Now these magnetic field experiments last one 1/100th of a second. So, if the coil is placed some distance away from the dynamo, the whole experiment will be over before the earthquake shock has had time to reach the measuring instruments, and so Dr. Kapitza has arranged it. All the photographs and observations are taken before the shock arrives, even though it is traveling at two miles a second.

The unleashing of energy at the rate of 50,000 horsepower for a fraction of a second, has been calculated to produce an exceedingly high momentary temperature inside the coil, possibly the highest temperature the earth has known since it condensed out of solar material. This calculation, and Professor Rutherford's disintegration of atoms at Cambridge, prompted Professor Eddington to remark humorously that, though the interior of a star may be at a temperature of millions of degrees, centigrade, it is quite a mild place compared with the Cavendish Laboratory.

Dr. Kapitza has already made two discoveries of great interest, besides extending magnetic field technique ten times beyond its previous limit. The late Kamerlingh Onnes, the Dutch scientist, discovered that when certain metals were reduced to a very low temperature their electrical resistance decreased almost to zero. Other metals decreased steadily until a low temperature was reached, after which there was a sudden drop in resistance. Still other metals were always left with a certain residual amount.

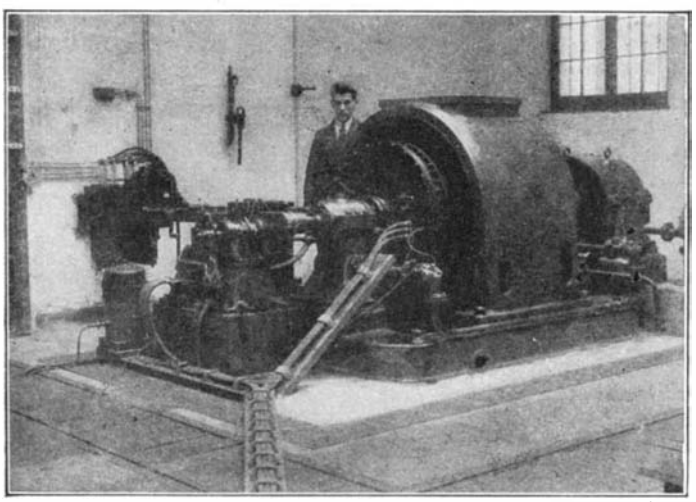
NOW the resistance of metals increases in strong magnetic fields. With the range of field strength at his command, Dr. Kapitza has shown that the residual resistance is due to internal disturbances in the metals. If the temperature could be lowered sufficiently, these disturbances would disappear. Thus he has shown that the same laws of variation of resistance control all metals under undisturbed conditions; the exceptions are due only to disturbances which can be removed by adequate technique. A jumble of varied data has been reduced to order.

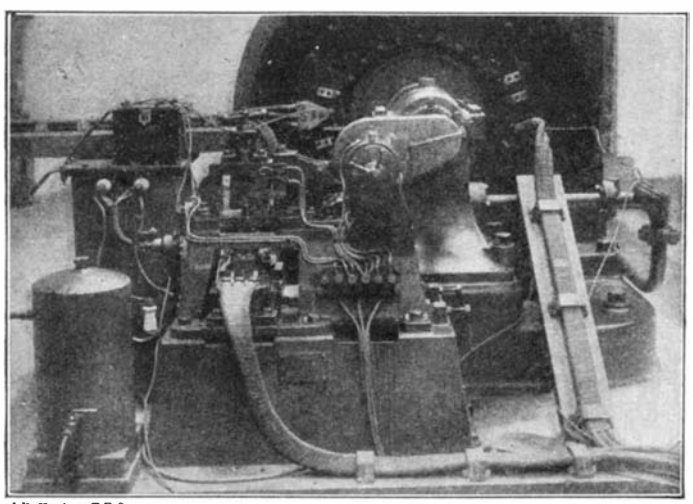
His next remarkable result was published recently. He has discovered the phenomenon of atomic magnetostriction; that is, the stretching in a magnetic field of the bonds between atoms. It has long been known that metal rods change their length when placed in magnetic fields. This old phenomenon is completely describable in terms of the elasticity of the metal and what is known as its magnetic susceptibility. It is due to slipping or rearrangement of the polar crystal units of which the rod is built up.

Kapitza's phenomenon is quite different. The crystal units themselves are distorted under the enormous stresses of his intense magnetic fields. He finds that the strong fields tend to increase the strength of strong short bonds between close atoms, and to weaken the weaker bonds between atoms farther apart. Thus Kapitza has started a completely new line of attack on the nature of certain of the forces acting between the atoms of magnetic solids.

The greatest achievement in science consists in the invention of new methods. Once a new method is devised, it can be applied to hosts of objects, and must almost necessarily reveal new facts, many of which must be important. Dr. Kapitza has devised a new method. It is not at all unlikely that the next great advance will be the outcome of applications of this method.

For many years the study of magnetism has been in a jumble. Straightening the jumble will almost certainly reveal an atomic design of the profoundest significance. It looks as if Dr. Kapitza is in a fair way to do this straightening. At the moment, no one in the world is making more interesting experiments in physics.





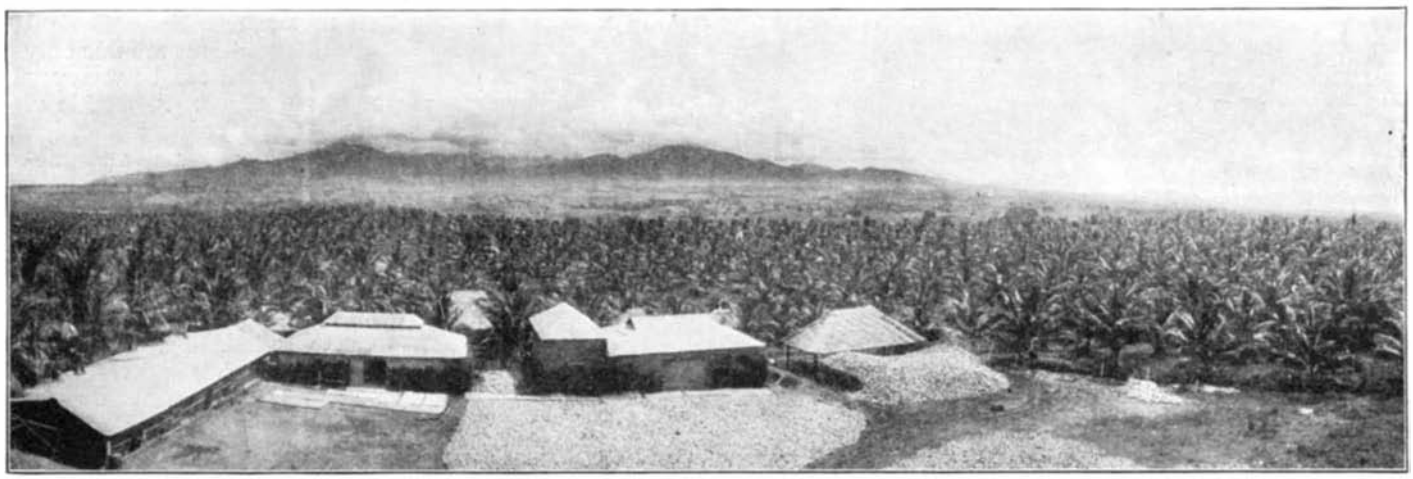
All photographs by courtesy of P. Kapitza, F.R.S.

MACHINERY FOR PRODUCING THE FIELDS

The dynamo gives electrical energy at the rate of 50,000 horsepower during a period of about 1/100th of a second. It has a special single phase winding, which is described in the text

THE SWITCH, AN UNUSUAL PIECE OF DESIGN

This must be capable of cutting off a current of about 5000 amperes in 1/10,000th of a second; the maximum is 30,000 amperes, which flows through the circuit for 1/100th of a second



A COCONUT PLANTATION IN THE PHILIPPINE ISLANDS

Piled against the side of the thatched hut to the right of the center of this photograph are thousands of coconuts. In the center foreground is a large area covered with coconuts that have been broken open and exposed to the sun to dry. The resulting dried meat is called copra

From Coco Palms to Coconut Oil

The Coconut Has Exerted a Tremendous Influence in the Industrial Life of the Philippine Islands

By CHARLES W. GEIGER and RUTH SABICHI

COPRA, the dried meat of the coconut, has figured in the romance of world trade since the days of Magellan. The story of the coconut is the story of the economic progress of the Philippine Islands, to which it has contributed more than any other product, with the possible exception of hemp. Few plants, if any, are as serviceable to primitive man as is the coconut. The nut meat is eaten as food; the oil is useful in making edible fats and soap, and is also used for illumination; the tree roots provide a dye, and the trunks, building material; the leaves are employed for thatching roofs; the midrib of the leaf is used for making baskets, brooms, and brushes; the fiber from the nut husk is woven into ropes and mats; and the nut shells, in addition to providing fuel, are shaped into cups, ladles, spoons, and other utensils.

UNDER primitive conditions, the production of coconuts, copra, and coconut oil was confined to the groves of wild palms that skirted tropical shores. These wild or uncultivated trees still constitute a considerable source of supply when the market price is sufficiently attractive to the natives. The coco palm, however, is now cultivated like any other staple agricultural product. Large plantations are to be found throughout the tropics, for supplying the international trade in copra and coconut oil.

In domestic cultivation, it is customary to set out trees in rows, about 30 feet apart, giving room for about 48 to the acre. Crops of abaca, or Manila hemp, and other quickly growing plants, are usually grown between the rows. During the fifth or sixth year, the trees begin to bear, and after the seventh year the planter can reap an annual harvest of 15 or more nuts from each tree. The trees reach maturity at the age of 10 years, when about 70 nuts per tree are collected annually. In rare instances, as many as 500 nuts have been harvested in a year from a single tree, and trees have been known to continue to produce after reaching an age of 150 years.

IN THE JUNGLE

At the right is a coco palm. In the left background is a primitive cart for hauling nuts

The natives pick or shake the nuts from the trees and crack them open with a machete. The broken nut meats are then placed in the sun to dry. Sometimes the broken pieces are placed on drying racks under which coconut husks are burned to speed the drying process. The resulting smoke-colored copra is called "smoke-dried" to distinguish it from that which has been sun-dried. The fire-drying method is used in regions where excessive rain makes natural drying impossible. Mechanical driers are employed on some of the larger plantations, but the practice has not become prevalent.

MATURE nuts yield copra of the best quality, but it is customary for the natives to harvest the nuts before they are ripe and depend upon a month's curing on the ground. Copra made from immature "meat" has a tendency to re-absorb moisture after drying, as well as to become moldy and sour, but dry-curing before removing the husk that surrounds the shell overcomes this objectionable tendency.

In some parts of the islands, where sunshine during the harvesting season is very uncertain, the copra is dried by the use of a *tapajan*. This device is a bamboo

grate, about 20 feet square, under which a rough earthen oven has been prepared. Over the grate, a roof or watershed is erected, composed of coconut fronds. The nuts are husked and the shells split, and the broken coconuts are placed on the bamboo grate. A fire is built under the grate, and the meat shrinks from the shell as it dries. The shells, when removed from the meats, are used as additional fuel for the fire. The total drying time by this method is from five to 12 hours.

THE natives have various ways of disposing of their crop. In some districts, they sell their copra direct to the dealers at trading stations operated by the exporters. Chinese merchants in the small towns also acquire much of the local copra stocks, usually giving merchandise in exchange. The merchant, in turn, settles his accounts in the form of copra shipments. The coconuts are frequently made into "rafts," and are floated down the rivers to market.

Some years ago it was the practice to ship almost all of the copra overseas for crushing and conversion into coconut oil, but a few mills have been established in the Philippines, in India, and in the Dutch East Indies. These local oil mills have become important factors in the copra market, exerting a balancing influence on the market price of copra and oil. However, the proximity of raw material, and the cheap native labor available for operation of the mills is offset by lower power costs, more efficient labor and machinery, and more convenient marketing conditions in the United States.

Copra first became an important item in world commerce in 1886, although a French sailing vessel had carried a load of coconuts to Marseilles as early as 1750. Marseilles soon became a manufacturing center for copra products, and is still one of the most important copra importing ports of the world. It was in France that the first butter substitute, consisting of coconut oil and peanut oil, was produced.

Traders, operating sailing vessels in the South Seas about the year 1890, brought copra and other native products to the United States. Coconut oil mills were established at San Francisco and Berkeley. The phenomenal growth of the copra industry in the United States is shown by the fact that imports in 1920 amounted to 218,521,916 pounds, of which only 7 percent came from the Philippine Islands. By 1927, our copra imports had increased to 450,994,519 pounds, of which 72 percent came from the Philippines. Of the 238,471 tons of copra exported in 1928 from the Philippines, 181,111 tons came to the United States, and 57,360 tons to Europe. About two thirds of the American copra imports were consigned to the major Pacific Coast ports — San Francisco, Los Angeles, Portland, and Seattle.

REMOVING HUSKS

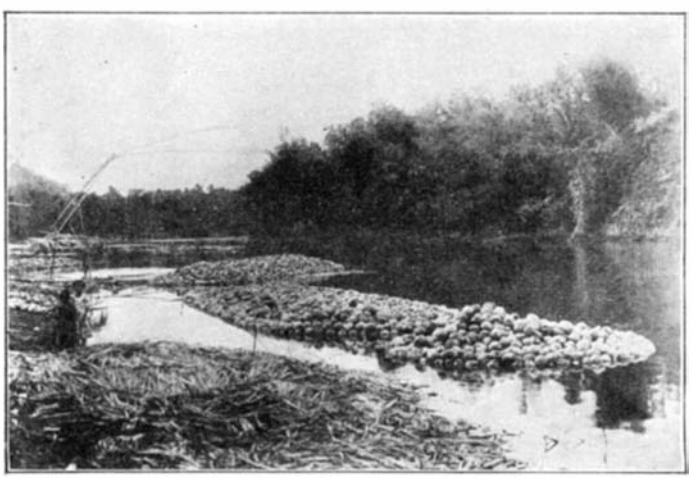
Before the nuts are broken and meats extracted, the thick, fibrous, outside husk must be removed

Originally coconut oil extracted from copra at the source was shipped to San Francisco and other ports in five-gallon cases, barrels, and drums.

THEN a system was perfected whereby the oil was shipped in tank steamers and in deep tanks on passenger and cargo vessels operating between America and the Orient. This practice immediately revolutionized the transportation situation; for years the great ocean steamers had been carrying petroleum from this country to the Orient and returning in ballast, until someone thought out a practical scheme of carrying the coconut oil on the return voyage. A number of tank steamers are now engaged in transporting petroleum from Pacific Coast points to the Orient, returning with a capacity cargo of coconut oil in the same tanks.

Of course it was necessary to devise a very effective system of cleaning the tanks of the ships before filling them with edible oil. After the petroleum cargo has been removed, a charge of live steam is forced into the tanks. This is continued for a period of 12 to 24 hours. After pumping out the bilges, and waiting a sufficient length of time for the interiors to cool, men are sent down into the tanks to clean them as thoroughly as possible. Later, upon arrival at the port where the coconut oil is to be taken on, the tanks are given a final cleaning.

A fleet of specially designed coconut oil barges, with two large pumps, transfer the oil from the copra crushing plants in Manila to the oil tankers or



COCONUT RAFTS

When a river is near enough to a coconut plantation, the nuts are bound together in rafts and floated down stream to the market

ON A SMALL SCALE

Scene outside a typical native habitation, with a small quantity of coconuts broken open and exposed to the drying action of the sun

OIL TRANSPORTATION

Above: Specially designed coconut-oil barges are used to transfer the oil from the crushing plants to huge tankers. *Right:* A pump barge alongside a tanker. The machinery pumps the oil from the barges to the tanks on the ocean steamer

passenger vessels equipped for transporting oil. Each barge has a capacity of 250 tons of coconut oil. Pump barges are equipped with two duplex pumps, each of which can pump 100 tons an hour. There are always a number of loaded barges on hand, so that there will be no delay in transferring the hose when one barge has been emptied. A loaded barge is pushed into place while an empty one is being removed, and the pumps seldom stop running until the tanker has been filled to capacity or the supply of coconut oil available at the time has been exhausted.

The most important factor in handling coconut oil is temperature, for in order to keep the oil in a liquid state, the temperature must be more than 70 degrees, Fahrenheit. Under cooler conditions, it hardens into a dense material resembling butter or lard. Consequently it is necessary to provide heating pipes in the tanks of the steamers, in storage tanks, and in the tank cars used for distributing the oil in the United States. In many cases, the delivery pipes or hoses have a small heating tube running down the center, carrying steam or hot water. Compressed air is sometimes used to force the oil out of tankers and the loading pipe, in order to expedite the transferring operation.

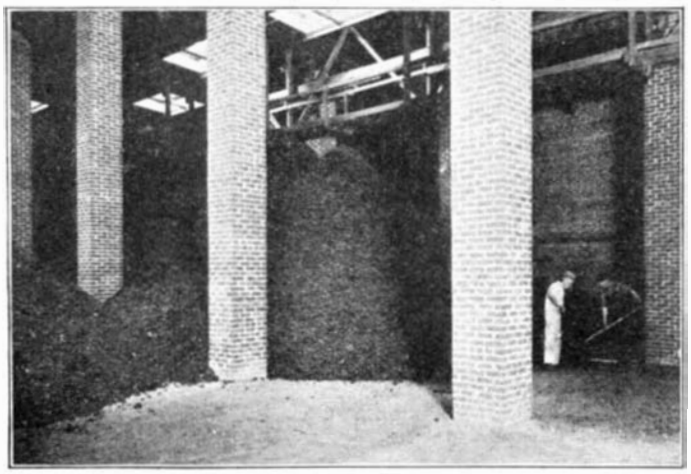
When the copra is not to be pressed at its source, it is transported in much the same way as other bulky materials are handled. One of the most familiar sights in San Francisco Bay is the process of transferring copra from the holds of ocean-going ships to the dock. By means of large metal tubs operated by the ship's tackle, overhead hoppers on the dock are filled. Dump wagons and trucks back up under the hoppers, where they are loaded and then proceed to the warehouse or crushing plant. Copra is also transferred directly from the ship's hold to railway cars. On the Oakland waterfront there are several pneumatic boat unloaders which "suck" the copra from the hold, loading it into a railroad car or warehouse.

In making coconut oil, the copra is first put through expellers which force out about 25 percent of the oil content. The residue is then ground into meal, and the remaining oil content is squeezed out by hydraulic presses. Most of the oil is then filtered, and used for the manufacture of soap, shaving cream, shampoo solutions, and a long list of cosmetics. Some of the coconut oil is used for edible products, and must be refined several times to remove free fatty acids, color, and odor.

Besides being used in making margarine, the oil is employed in manufacturing thin sugar wafers, cookies, candies, and for shortening in cakes and pies. About 63 percent of the copra is converted into coconut oil, and the remaining 37 percent is used as coconut meal, which has high food value and is used as a feed for stock and poultry. About three fifths of the coconut oil consumed in this country is used in the soap industry; one fifth is used in the production of margarine, and practically all of the remainder is consumed in the manufacture of candy and biscuits.

IN AN EXTRACTION PLANT

This copra crushing plant is located in Berkeley, California. In the left background are three hydraulic presses for pressing oil



COPRA STORAGE

Part of the dried copra is shipped direct to this country, where the extraction of oil takes place. This pile of copra awaits pressing

Birds of a Bleak Arctic Island

A Bit of the Far North Is Borrowed for a Museum Habitat Group

IN Bering Strait, a few miles south of the Arctic Circle, lie two granite islands. The larger, Big Diomede, seven miles long, is Russian; Little Diomede, much smaller, is American. Here where the East and the West are but little over two miles apart, the East is to the West, and the West is to the East! The International Date Line, here a line of convenience, swings east of the 180th meridian and passes between the two islands. The days are born on Big Diomede, follow the sun around the earth and end 48 hours later on Little Diomede.

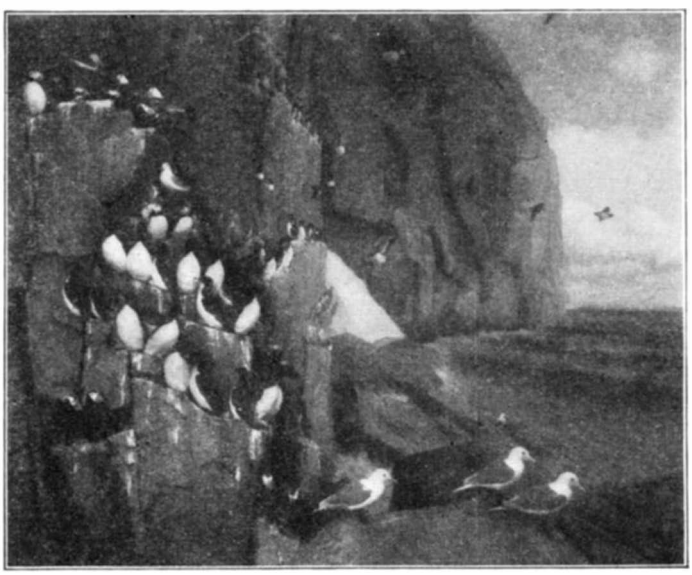
AT Little Diomede was collected the material for the Bering Strait Bird Group which completes the series of habitat groups of North American Birds at the American Museum of Natural History, under direction of Dr. Frank M. Chapman. Mr. Francis L. Jacques, Assistant in Preparation, says in *Natural History* that his problem was to suggest to the museum visitor, through sight alone, some sense of the flying gray clouds, the wind-whipped sea, the cool salt air, the towering cliffs with their teeming bird life, and the savage loneliness of the scene. The group space is 20 feet in width, 7 feet from front to back, and 12 feet high.

The birds having been collected, and the skins properly prepared, the artist faced the problem of how to use the material obtained. The first step in making a museum group is the construction of a scale model. The model made for this group was about 30 inches long, or one and one half inches to the foot. About 65 mounted birds are used in the group. Each bird is mounted to fill a certain place according to the scale model.

The American Museum has a large staff of preparators and artists under the direction of Mr. James L. Clark, and a number of habitat groups are now being prepared, each with problems of its own as difficult, or more so, than those of the group described. Museum standards are being raised so that we may expect even more perfect groups.

BEHIND THE SCENES

Trained taxidermists mounting the birds in the Department of Preparation and making the plaster rocks which will support them. Realism is the result of careful attention



ARCTIC BIRD GROUP

Here the artist has transferred his impressions of a remote arctic island through the medium of paint, plaster, and mounted birds

SEA, ROCKS, AND BIRDS

The Bering Strait bird group shows almost inaccessible places where the birds gather. There are 65 mounted birds in the group

Fragmentary Molecules of the Sun

On the Sun Most of the Elements Are in Isolated Atoms, Because of the Heat. Unfamiliar Compounds Are Being Discovered

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

NOT long since (February and March) it was told how an analysis had been made of the sun's atmosphere, giving not only a list of the elements present there but the approximate quantities in which they appear. The upshot of this work was that the solar atmosphere consists mainly of hydrogen mixed with a much smaller proportion of the other prominent gases (perhaps one part in 12) and a still smaller quantity of metallic vapors.

The question then arises, are the other bodies known to astronomy of similar composition? How about the stars—and the earth and the other planets?

The answer comes easily for the stars, far off as they are. Thousands of them have spectra almost exactly like the sun's, and therefore must have atmospheres of very similar composition. For the rest, which are hotter or cooler than the sun, the spectra often appear at first sight very different, but when allowance is made for the different manner in which atoms are set up in the business of absorbing light or put out of business at different temperatures it is found that the stars too do not differ greatly in composition. Indeed, Miss Payne, whose work at Harvard has given us most of our information in this matter, concludes that the stars are "remarkably similar in composition."

FOR the earth the resemblance is apparently much less close. We know with certainty only the composition of the outer crust of our planet down to a depth of perhaps a few dozen miles, though the general nature of the denser material in the deeper interior is fairly well assured. This is composed mainly of *rocks*—compounds of the metals with silicon and oxygen. Hydrogen, instead of being predominant, is present only in a small percentage, mainly in the ocean water.

It is important, however, to notice that the relative proportions of the various metals in the terrestrial rocks are not very different from those of the same substances in the sun. Just those metals which are the main constituents of the rocks—aluminum, iron, calcium, sodium, potassium and magnesium—are the most abundant in the solar atmosphere; and silicon and oxygen, still more abundant in the rocks, are also present in great quantities in the sun. The detailed proportions are different; there are more aluminum and silicon on earth and less magnesium. But it is probable that if we could get at the dense deep-lying rocks which form the main bulk of the earth the discrepancy would be smaller.

The earth, then, is very similar in composition to what we would get out of the sun's outer layers if we let a great mass of them cool down and preserved the portion that liquefied or solidified, throwing away about all the excess of uncondensed gases. But this is exactly what might be expected to have happened if the earth was produced by the ejection of incandescent matter from the sun—as all present theories of its origin assume. Hydrogen would escape most easily of all and it is no wonder that there is relatively little of it left on earth.

FOR the other planets we have no chemical data to go on, but only general information about density and the like. The smaller bodies, Venus, Mars, Mercury, and the moon, are probably much like the earth in composition, for similar reasons. The great planets, from Jupiter to Neptune, are so much less dense that it is certain that they contain a much greater proportion of substances of low density than does the earth. Chamberlin and Moulton years ago suggested that this indicated that these larger masses had retained a greater proportion of the light constituents which were originally present in the matter ejected from the sun, and this view is now generally accepted.

In all these respects, then, the composition of the sun, the stars, and the planets appears to be very much the same. But some exceptions are still to be found. There are several important elements and many less familiar ones, the lines of which do not appear at all in the solar spectrum. We know precisely where to look for them, and they are not there. Among the list of missing we find fluorine, phosphorus, and chlorine, which are all present in abundance on the earth; as well as less abundant but familiar ones like neon, argon, bromine, and iodine. Are these substances really absent from the sun?

Modern spectroscopy gives a definite answer. The lines which these substances give in the laboratory (within the range of the spectrum which we can get at in the sun) are all produced and absorbed only by very highly excited atoms heavily loaded with internal energy. Even at the high temperature of the sun only an exceedingly small fraction of all the atoms of fluorine (for example) would be in a state to absorb the lines in question (which in this case lie in the red). Calculation shows that unless fluorine was more abundant than any other metals, or even than oxygen, its lines would not be strong enough to detect. The same is the case for all the other "missing" elements which are at all abundant on earth or even moderately rare there. The more striking cases of apparent absence are thus fully explained.

Some of the heavy metals such as bismuth, have the strongest line in the accessible region and if there was much of them in the sun we would surely detect them. But all the heavy metals, even those whose lines appear, are present in but small proportions and a moderate decrease in abundance would put them beyond detection. So even in this last instance there is no evidence of any real difference of importance between the composition of the earth and sun, beyond those which may be reasonably explained by the circumstances surrounding the origin of our planet.

IN another respect, however, the difference in composition between the earth and the sun is very great. The earth is made up almost entirely of chemical compounds. Metals in the free state are rarely met with, though platinum and a few others are sometimes found "native." Among the non-metals only the oxygen and nitrogen of the air are counted "free" and these are not composed of isolated atoms but of molecules in which a pair of atoms are tied very tightly to one another. Only the inert gases—neon, argon, and the others—which can not enter into combination are found on the earth in the atomic state.

But upon the sun isolated atoms are in the overwhelming majority. All the spectral lines of which we have so far spoken are produced by free atoms and many atoms which have not only been released from combination, but themselves partially decomposed by the loss of an electron.

This, of course, is a result of the sun's high temperature and so obvious a result that it has been understood and generally accepted since Lockyer pointed it out in the very dawn of astrophysics.

It was not until the last 20 years indeed that any definite evidence of the presence of chemical compounds in the sun's atmosphere was forthcoming. About this time it became clear that the molecules of such compounds, if they stood up at all without decomposition under the rough treatment required to get them to emit light, gave spectra of a very complex sort, consisting of thousands of lines closely packed together in certain regions to form conspicuous "bands." A few such bands appear in the solar spectrum, the most prominent being in the violet (Fraunhofer's G group) and in the ultra-violet (the well known "cyanogen" bands).

WITH the rise of spectroscopic theory it was shown that the complexity of these spectra arose from the fact that a molecule can do many things which an atom can not. The separate atoms within it (or at least their heavy nuclei) can oscillate, changing their distance apart, while at the same time the molecule as a whole rotates about an axis. We have now in many cases a good idea just what processes correspond to each of the multitude of lines in the band spectrum. Molecules of three or more atoms are too complicated to tackle as yet, but when there are only two it is possible to find the distance of the two nuclei, and various other things. Spectra due to a number of different molecules have thus been definitely identified in the sun, the list including CN (cyanogen), C_2 giving bands in the yellow and green, CH (the G band), and OH and NH (bands in the ultra-violet).

Very little knowledge of chemistry is required to make the reader exclaim at these formulae. CH_4, H_2O, NH_3—these represent very familiar molecules; but what are these other queer things? Exactly what the formulae indicate. They are not familiar molecules of methane, water vapor or ammonia, but *fragments* of these molecules already partially though not completely decomposed. The CN molecule, too, is recognizable not as that of the well known cyanogen gas, C_2N_2, but as one half of it.

Clearly, then, at the temperature of the sun the dissociation of such molecules as are familiar to us has already advanced far, though it is not complete.

The amounts of these various molecules in the sun's atmosphere can be found by the same methods which are used in the atoms. They come out small. Cyanogen, the most abundant of them, is present in smaller quantities than even the rare element scandium, and for every such molecule there are thousands of atoms of uncombined carbon or nitrogen. This is in harmony with the fact that for stars only a little hotter than the sun the bands disappear, showing that all the molecules are dissociated into atoms. In the sunspots, which are well known to be cooler than the rest of the sun, new kinds of molecules are recognizable but show no bands in the solar spectrum—hydrides of magnesium and calcium, MgH and CaH, and oxides of titanium and boron, TiO and BO. These molecules are evidently decomposed at normal solar temperature. Like the others they are chemically incomplete or "unsaturated"—the familiar stable compounds being MgH_2, CaH_2, TiO_2, and B_2O_3.

It seems curious that only these fragmentary molecules should reveal themselves, but there is a good reason. The spectra of molecules consist partly of bands which are absorbed by the molecule in its normal state, and partly of those which are absorbed only by excited molecules loaded with energy like the excited atoms discussed above. The number of excited molecules, too, would be a very small fraction of the whole, so that only the bands absorbed by molecules in the normal state should be expected to appear unless the compound in question was present in great quantity.

NOW the analysis of laboratory spectra shows that for all the saturated stable gaseous compounds with which the chemist ordinarily works the strong absorption bands due to the unexcited molecules lie far out in the ultra-violet, while for the unsaturated, fragmentary molecules they are usually to be found in the visible spectrum or just outside it. This probably means that ordinary saturated molecules are, so to speak, so well satisfied with themselves that it takes a powerful disturbance such as is given by light of short wavelength to stir them up, while the half molecules are much more easily irritated. Anyway it explains why the latter have been depicted in the solar and sunspot spectra and not the former. There might be, however, a very considerable quantity of molecules of the stable sort in the solar atmosphere without our knowing it, since the lines which would reveal their presence are in the inaccessible part of the ultra-violet. Proof that this is actually true in the case of hydrogen has very recently been given by a brilliant young Italian physycist, Professor Piccardi of the University of Florence.

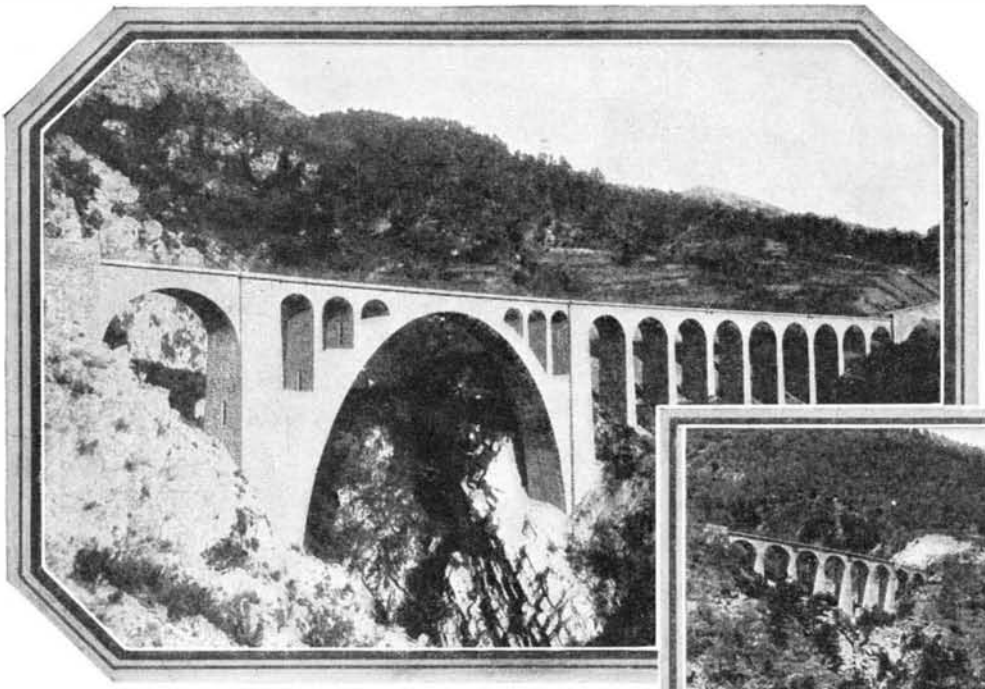
Besides the familiar line spectrum, which appears so strongly in the stars, hydrogen in the vacuum tube shows a second, and much more complicated, "secondary" spectrum which is now known to arise from the hydrogen molecule H_2. The lines of this spectrum, at least in the visible region, are not visibly grouped into bands but the spectrum has been worked out and found to be similar in nature to other molecular spectra. The bands absorbed by the unexcited molecule lie very far in the ultra-violet and the visible lines are produced only by highly excited molecules.

THE energy which is required to dissociate a hydrogen molecule into its two atoms is not accurately known and Piccardi, calculating from this, showed that at the ordinary temperature of the sun's atmosphere and the pressure prevailing there practically all the molecules should be dissociated, but that at the lower temperature of the spots one percent or even more of the hydrogen atoms might be combined into the molecules.

Working with a copy of the great Mount Wilson map of the sunspot spectrum he found faint lines in the position of most of the strongest lines of the "secondary" hydrogen spectrum—except for some which were obviously "masked" by strong lines of the ordinary solar spectrum that happen to fall close by. These lines appear only in the spots, as they should do if they really belong to H_2. Moreover they show no trace of the Zeeman effect due to the magnetic field in the spots (as lines belonging to atoms practically always do but those of molecular spectra practically never). Some of the strong lines observed in the vacuum tube failed to appear in the spots but this supports rather than weakens the argument.

This mass of cumulative evidence justifies most thoroughly Piccardi's conclusion that hydrogen molecules are present in the sunspots. The number of excited molecules which absorb the observed lines is very small compared with most other constituents of the atmosphere. But the unexcited molecules must be enormously more numerous and they may outnumber even the atoms of abundant metals like iron. Since only a small percentage of all the hydrogen atoms are combined in the molecules we have here another proof, perhaps the most convincing of all, of the overwhelming preponderance of hydrogen at the sun's surface.

It is probable that molecules as well as atoms of some of the other familiar elements such as oxygen and especially nitrogen are to be found in the sun's atmosphere. We may soon be able to calculate what proportion of such molecules there may be, but there is no hope of detecting them spectroscopically.—*On the Nile, Jan. 7, 1930.*

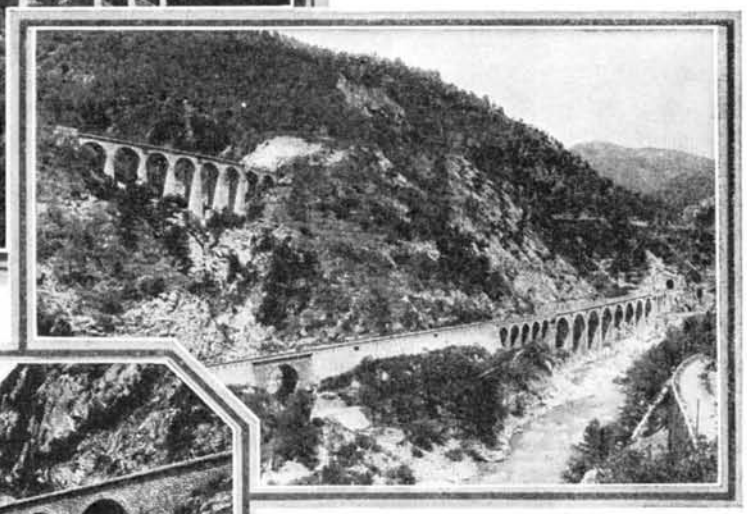


ERBOSSIERA

The Erbossiera viaduct which perches on the side of a hill. It consists of a main arch span of 118 feet, one side arch of 32.8 feet, and nine approach arches of 26.3 feet

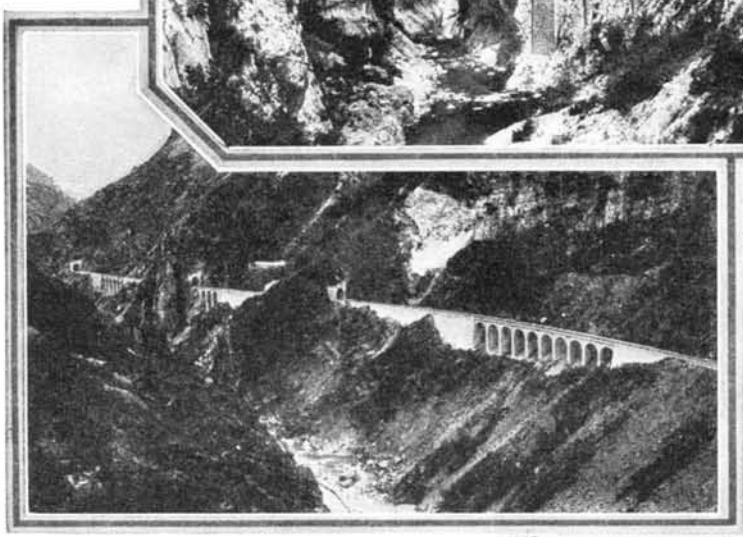
DE BIANCAO

Of the two beautiful viaducts at this point, the upper one is on the main line to Nice and the lower one is on the branch to Ventimiglia. Note the lower tunnel



BEVERA

The unique transverse arch which supports two 148-foot truss spans of the bridge proper. The skew is of masonry, has a span of 82 feet, and is at right angles to the bridge. The stream is small



FONTAN

Solid and arched viaduct construction on the ascent to Fontan. This was necessary because of the unstable rock formation of the mountain-side. Three tunnels are visible in this picture

L'ESCARENE

From Nice, the line ascends the valley of the Paillon River as far as the village of L'Escarene, over which it passes on this beautiful masonry viaduct of 11 arches, each having a span of 49 feet

Beautiful Bridges On New Rail Line*

Exceptional Engineering Problems Involved in Construction of European Railway

BRIDGES of remarkable beauty, and several long tunnels, are the outstanding features of a railway extending from Nice, France, to Coni, Italy, with a branch to Ventimiglia, Italy, which was opened a little over a year ago. The new railway is approximately 63 miles in length, of which total about 39 miles are situated on French territory. Its construction presented a large number of serious engineering problems, owing to the fact that the line extends through extremely mountainous territory.

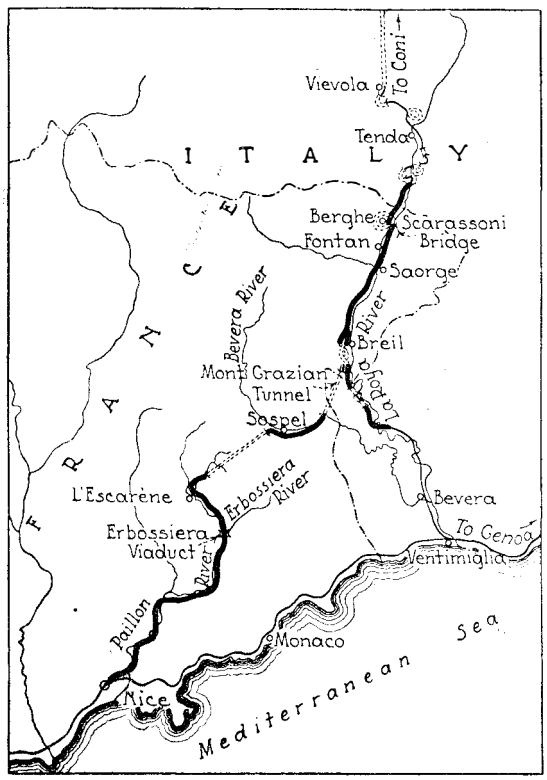
Prior to the construction of the new line there was no direct rail connection between southern France and northern Italy with the exception of the northern line from Lyons to Turin and the coast line from Marseilles to Genoa, via the Mediterranean coast. Neither of these existing lines provides a direct line from Turin, Milan, and the important towns in the plains of Lombardy to the south coast of France and the western section of the Italian Riviera, the only route to these places being a long detour via Savona.

THE need for such a direct link led to an investigation by the Italian government into the possibility of the extension of the existing line from Coni to Col de Tenda, as far as Ventimiglia on the Mediterranean. It was soon discovered that the only feasible and economically practicable route for this extension would be through the communes of Fontan, Saorge, and Breil, in the French Department of the Alpes-Maritimes.

As a result of an international conference, an agreement was signed between France and Italy in 1904, under which both governments agreed to construct, each in its own territory, a railway line linking up Nice and Coni via Sospel, while another line, leaving the main line at Breil, would prolong the railway to Ventimiglia. It is these lines which have now been completed, 24 years after their construction was authorized.

Owing to the rugged character of the mountains in the Alpes-Maritimes, it was necessary to construct no less than 45 tunnels, with a total length of 14¾ miles, nearly a quarter of the whole mileage. Of these, the longest is that under the Col de Braus—3¾ miles. In addition, the numerous ravines and deep valleys which abound throughout the traversed territory called for a large number of bridges and viaducts, many of which are of unusual interest, as they involved exceptional forms of construction.

Among the most remarkable of the bridges is that over the narrow gorge of the Bevera River. Since the location was unfavorable for the construction of a span of 300 feet, an intermediate pier was desirable, but such a pier would have almost completely blocked the waterway. The problem was solved by constructing an arch rib, approximately parabolic, spanning between the walls of the gorge at right angles to the center line of the bridge. The skew arch has a span of 82 feet, a height of 49 feet, and is 10½ feet thick at the base. It is surmounted by a bridge seat which supports two lattice steel trusses 147 feet 8 inches long. (See February, 1929, issue, SCIENTIFIC AMERICAN.) The solution of this problem consists of a variation of that employed in the "hanging bridge" on the Denver & Rio Grande Western.



SERVING A TOURIST SECTION

Map of the Nice-Coni Railway, with its branch line to Ventimiglia, showing bridges and tunnels

Another interesting structure is the Saorge Bridge which spans La Roya River at a height of 197 feet and has an arch with an opening of 131 feet 3 inches, while another remarkable crossing of the same river is the Scarassoni Bridge near the frontier. This consists of a main span comprising an open-spandrel arch of 160-foot span with its crown 148 feet above the stream. It is flanked by approaches embodying arches of 42½-foot span.

Many of the difficulties which confronted the engineers in the construction of the Nice-Coni line must be ascribed to the unstable rock formation of the Alpes-Maritimes. This is largely of a chalky nature in distorted and faulted stratification. In some cases the strata stand almost vertical or lean toward the valley so that loss of support through excavation could easily have resulted in great slides. As a result, large expenditures were made for retaining walls, while on some mountain slopes where ordinary practice would call for side hill cuts, it was deemed unsafe to disturb the slope by excavation and the line was supported on solid or arched masonry viaducts.

IN addition, it was found that the water from many underground water pockets caused the rapid disintegration of the mortar used in the masonry of tunnels and retaining walls, and special steps had to be taken to prevent this water from reaching the mortar. The large amount of special construction which was thus necessary throughout the length of the line naturally had a marked effect on the cost of construction, which amounted to nearly 450,000 dollars per mile.

Apart from the value of the new line from an economic standpoint, it will also tend to foster a very considerable tourist traffic. Hitherto there has been little opportunity for the visitor to the Mediterranean coast to penetrate into the interior of the Alpes-Maritimes and the adjoining provinces of Italy except by the comparatively slow motor coach service. With the coming of the new railway, however, a more rapid route has been opened, which abounds in picturesque scenery and new playgrounds.

* Abstracted by permission from article by F. C. Livingston in *Railway Age*. Illustrations courtesy *Railway Age*.

Sinanthropus, the Peking Man

As Evidence Accumulates, the Million-Year-Old Fossils Found in China Are Assuming Increasing Importance

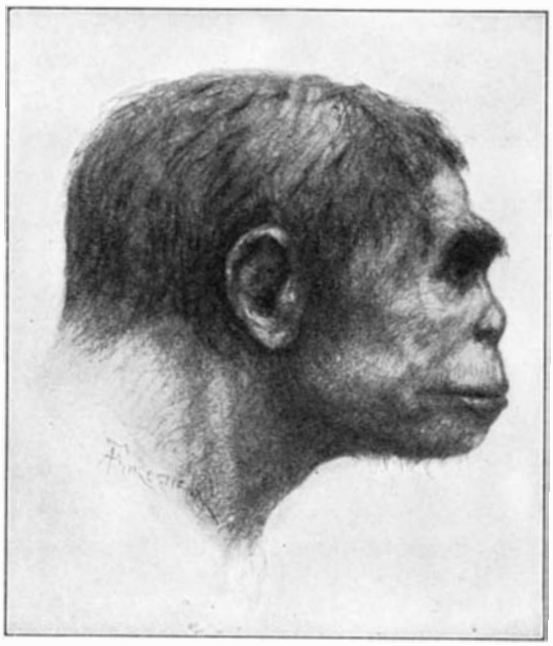
ANTHROPOLOGISTS are attaching vast significance to the fossil finds that have been reported from time to time from the vicinity of Peking, or Peiping. As the possible significance of these fossils gradually emerges, men of science are filled with eagerness to see the excavations completed; likewise to know the full evolutionary meaning of the finds already made. It is manifestly impossible to make more than a preliminary determination short of painstaking, detailed study at present. No discovery of fossil man since that of *Eoanthropus*, the "Dawn Man" of Piltdown, England, has aroused interest to such a fever pitch among anthropologists.

Owing to the accident of geographical location the belief appears to have become widespread that the fossils of *Sinanthropus* were those of an ancestral Chinese. No such asumption is justified by the facts, for the antiquity of *Sinanthropus* is doubtless a million years. The existence, even 10,000 years ago, of a race in a part of the world which the original owner of the bones in question inhabited 100 times as far back in the remote past is doubtless little if any more than a coincidence.

SCIENCE has but small knowledge of the origin of the human races, with regard to time, place, cause, or manner. In 1,000,000 years, or even 100,000 years, a race would have ample time to have passed through many vicissitudes, wandering far afield from its point of origin. Therefore the search for the "cradle of the human species" is likely to prove elusive. The human species evolved from some earlier animal, and this process doubtless took place gradually, covering a vast period of time. When, then, and where in its possible wanderings, can the human species be said to have been cradled? Had we a perfect rather than a fragmentary collection of ancestral fossils the impossibility of attempting to choose the "beginning" of humanness in what would then be seen to be a long, gradual transition doubtless would become more patent.

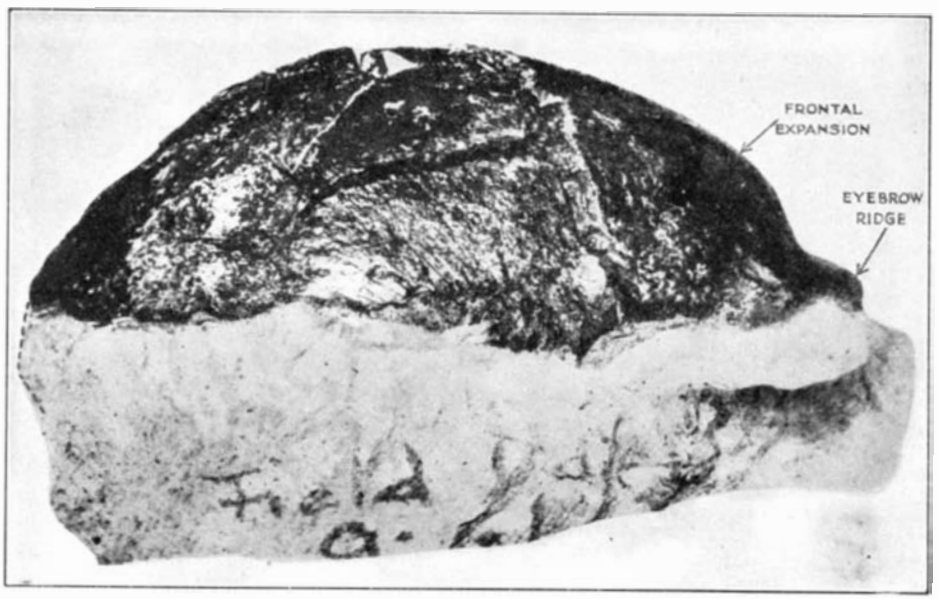
From our contemporary, the *Illustrated London News*, we reproduce the accompanying illustrations and quote the following comment on the Peking Man (by the way, the single skull found has turned out to be that of a woman), written by Professor G. Elliot Smith, Professor of Anatomy in the University of London, author of "The Evolution of Man" and other books, also of several articles previously published in the SCIENTIFIC AMERICAN, and one of a dozen leading authorities on human evolution. Professor Davidson Black, to whom Dr. Elliot Smith refers in his opening paragraph, is a Canadian anatomist attached to the Peking Union Medical College, and has had more to do with the discoveries of *Sinanthropus* than any other man of science.

"The discovery of the first complete brain-case of one of the three earliest and most primitive members of the human family is obviously an event of exceptional interest and importance. Most people are sceptical of reconstructions of ancient skulls built up from fragments. Hence the finding of a specimen which is intact provides a more convincing demonstration. Professor Davidson Black's courtesy in permitting the reproduction of the photograph, which reveals part of the wonderful fossil, makes it possible for us to appreciate something of the significance of what is probably the most illuminating discovery of early human remains ever made.



"Until November, 1928, nothing was known of the existence of the early Pleistocene Man in China, beyond some teeth, on the basis of which Professor Davidson Black, with great daring, created the new genus and species of the human family, *Sinanthropus pekinensis*, to which he assigned approximately the same antiquity as the famous ape-man of Java, *Pithecanthropus*, found by Dr. Eugene Dubois in 1891. On the last day of the excavations in 1928, however, Dr. Black's boldness was completely justified by the discovery of fragments of two jaws, those of an adult and a child, in association with the fragments of two brain-cases of corresponding ages.

"History repeated itself last winter: again on the closing



SINANTHROPUS PEKINENSIS

Above: Restoration drawing from *Illustrated London News*, by A. Forestier, from scientific data by Prof. G. Elliot Smith. *Below:* The Peking skull mounted on a plaster of Paris base

day of the season's excavations (Dec. 2, 1929), the young Chinese paleontologist, Mr. W. C. Pei, of the staff of the Geological Survey of China, while excavating the sheltered recess of the main deposit at Chou Kou Tien, discovered the greater part of an uncrushed adult skull of *Sinanthropus pekinensis*. Mr. Pei at once recognized the importance of the specimen, and personally carried out the difficult work of excavation and preparation of the block of matrix in which it lay. It is entirely due to his skill and devotion that this bulky mass, with its unique and fragile contents, reached the Peking Laboratory quite undamaged.

"CONTRARY to the reports which have been circulated, no skeletal parts other than the skull and numerous isolated teeth have been recovered during this year's excavations. The different sites where *Sinanthropus* has been discovered in the Chou Kou Tien deposit are all clearly contemporaneous with one another, being Lower Quaternary in age. The evidence collected in a preliminary report on the geology and paleontology of the site by Père Teilhard de Chardin and Dr. C. C. Yong definitely establishes this fact. Though hundreds of cubic meters of material have been examined, no implements or artifacts of any kind have been found, nor has any trace of the use of fire been observed.

"The photograph of this skull enables us to get a much more exact idea of the nature and affinities of this early inhabitant of eastern Asia than earlier descriptions conveyed, and we are able to correct misunderstandings arising out of the telegraphed reports. The greater part of the left side and the forepart of the base of this unique skull is still embedded in a block of very hard travertine. The vault, from its massive brow-ridges in front to the back of the skull, and the whole right side seen in the photograph, were embedded in a relatively soft matrix, which has now been removed. The braincase has been almost completely preserved, while most of the facial region would seem to be lacking.

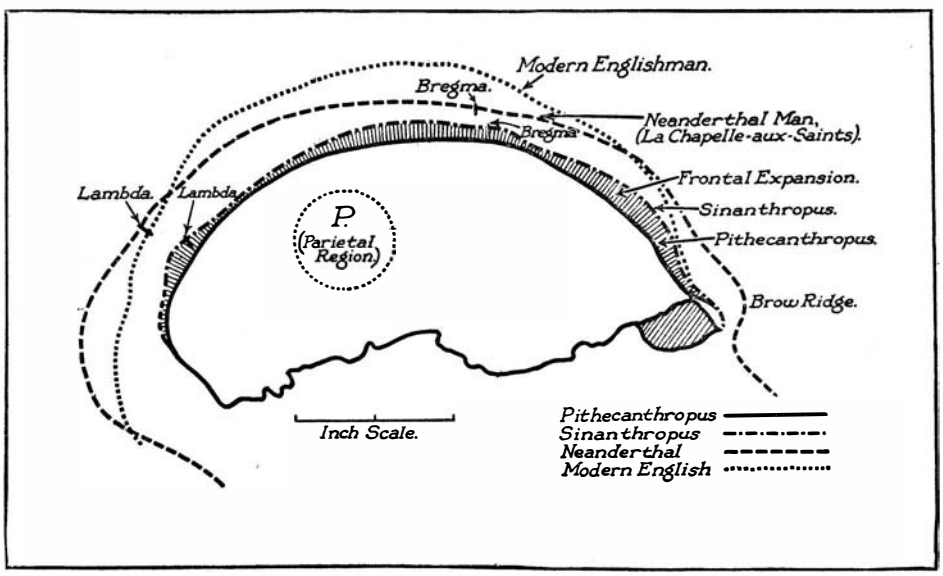
"The skull of *Sinanthropus* is of approximately the same length as that of *Pithecanthropus*, and, like the latter, is provided with massive brow-ridges. However, *Sinanthropus* differs from the Java ape-man in the following important features: there is a slight filling out of the forehead; expansion of the localized parietal eminences on the sides of the head above the ears; and a greater height of the vault. All these differences point to a relatively greater brain capacity in *Sinanthropus*. The mastoid processes (not seen in the photograph) are small and rugged. The sockets in which the lower jaw articulated are well preserved on both sides, a circumstance which will be of great value in the restoration of the lower jaw from the fossils recovered in 1928. While the new specimen bears out what little was already known from the fragments found in the previous year, the perfection of its preservation will enable much to be learned that is now obscure concerning the evolution of the head in early man.

EOANTHROPUS, PILTDOWN MAN

Like the drawing below, this was made by A. Forestier from Prof. G. Elliot Smith's data

PITHECANTHROPUS, OF JAVA

The Java ape-man was a more primitive being than the Peking man, who was human

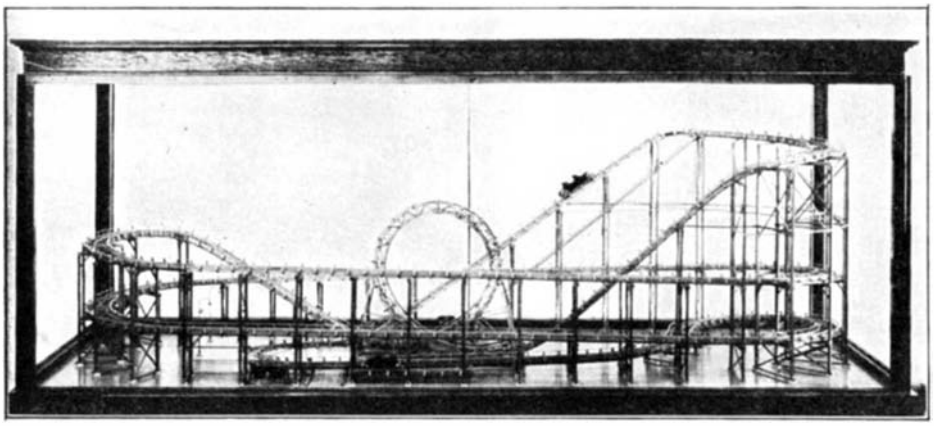


THREE FAMOUS FOSSILS COMPARED

A drawing by Professor G. Elliot Smith. Skull of Peking man compared with the Java ape man, Neandertal man, and modern man. Shape, not size, is the principal criterion

"TO show the distinctive characters of this newly found specimen, its outline, as seen from the right side, has been superimposed (in adjoining diagram) on similar projections of the cranial fragment of *Pithecanthropus*, the La Chapelle skull (Neandertal species), and a random sample of a modern Englishman's skull. Neandertal man and *Pithecanthropus* have been chosen for comparison because the new skull presents a much closer analogy to these two types than it does to the Piltdown man. There is a similar flattening of the skull, and all three have very pronounced eyebrow ridges. It will be seen, however, that in the frontal region there is a distinct fullness of the skull of *Sinathropus* in comparison with that of *Pithecanthropus* in the region marked 'frontal' in the drawing; and that the skull is slightly loftier. According to the report (quoted from Professor Davidson Black), there is a greater fullness in the parietal region marked 'P' in the diagram, which is one of the significant areas in which the human brain differs from that of the apes, and modern man from primitive man.

"The skull is, therefore, one of particular interest."



"LOOP THE LOOP"

This daring amusement device of 1901 consisted of a roller coaster with a loop in the center. The car is raised to the highest point. The centrifugal force prevents falling out

Coney Island's Museum

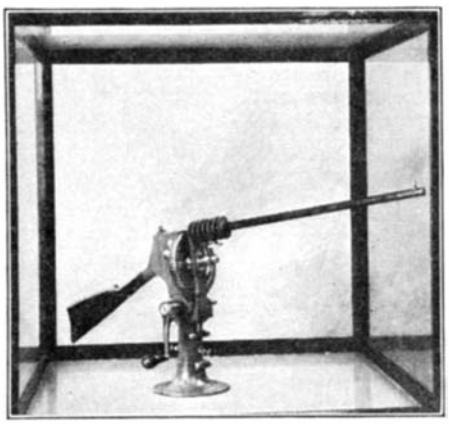
The First Institution Designed to Show Human Play-Reaction

IN a small building not far from the Coney Island boardwalk, where pleasure-seeking crowds pass up and down, is a museum which epitomizes the whole idea of the amusement center. This summer resort furnishes facilities for enjoyment which are fully equal to its more aristocratic New Jersey neighbors. Once you are on the wide boardwalk you have the sand, the same sun, and the same ocean. In no other country can such a fine sea resort be reached from a center of population, for only five cents. You can go from Queens Borough through Manhattan and Brooklyn to the "Island" for a nickel.

This summer will probably see plans mature for a larger museum building located on Ocean Parkway and accessible from all quarters. The City of New York will give a plot of ground of sufficient size to build a museum which will be adequate to the subject and which will be a fitting monument to the period of the Elegant Eighties and the Golden Nineties when the amusement enterprises of Coney Island were raised to a high, clean level. This was done with the aid of a band of inventors who are to be commended for their efforts to promote a good time for many who live a rather drab life and whose occasional outing by the sea gives healthful relaxation.

THROUGH the courtesy of Mr. William F. Mangels, himself a well-known inventor of amusement devices and one of the moving spirits in the enterprise, we are enabled to give our readers the first description and illustrations of the "American Museum of Public Recreation."

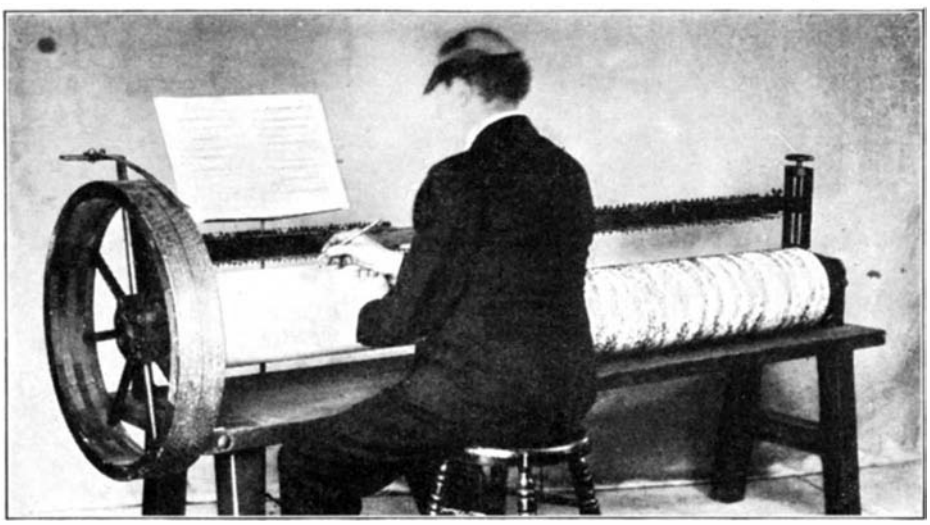
At present the Museum is housed in a temporary laboratory and storehouse on West Eighth Street, on the corner of Sheepshead Bay Road. The underlying plan is to resurrect the Coney Island of other days from authentic sources. This is the first institution ever devoted to the showing of the human play-reaction as expressed through facilities which man has created and developed. Recreation has become a scientific study in recent years. The establishment of a museum which will show the genius and development of outdoor amusements, the



MACHINE GUN FOR GALLERIES

The gun fires by turning a crank. It can be pointed to all parts of the gallery

change in public taste and demand from year to year, and the psychology on which the success of recreations depends, fills a well defined need. The functions of such a museum are defined in the Charter which states that the institution acts "as an historical museum of public recreation exhibits, with power to collect and publicly exhibit amusement and recreational devices, novelties, inventions, mechanical and decorative amusement conceptions, and to accumulate and maintain a library and records pertaining to the history and progressive development thereof." The wealth of material

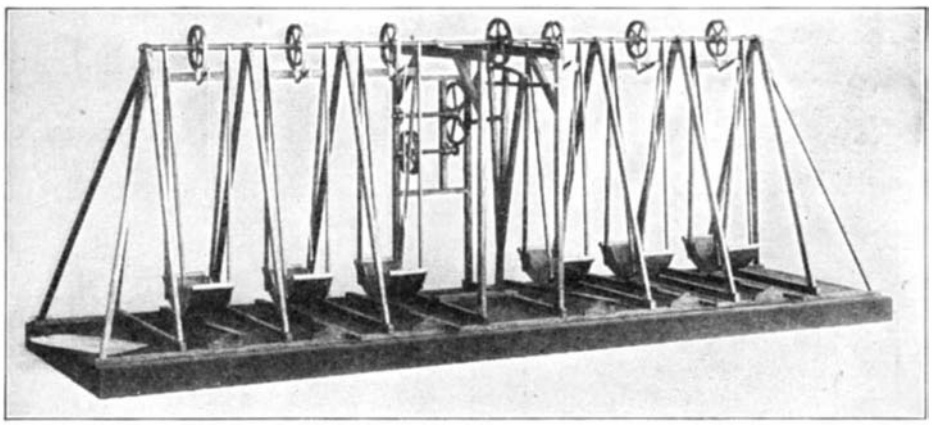


ORCHESTRIAN

The "orchestrian" was a forerunner of the unit orchestra of today. It was operated by weights and was coin controlled. Instead of a perforated roll it had pins driven in a barrel

available for this institution is apparent. America leads the world in the production of novel recreational devices and the development of municipal playgrounds. The National Association of Amusement Parks is sponsoring the Museum.

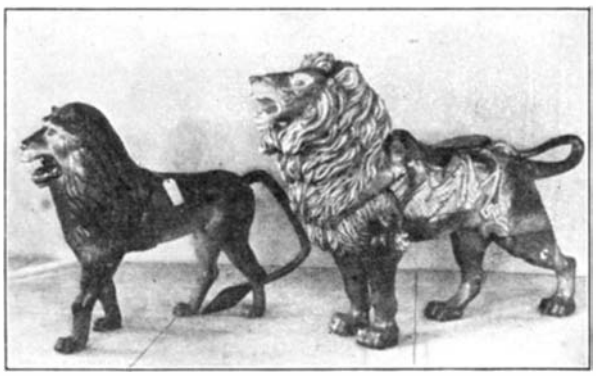
HERE we find examples of the work of Frederick Thompson, who was the creator of "Luna Park," "A Trip to the Moon," and "Toyland," and who built the New York Hippodrome that is so soon to succumb to the crowbar and torch of the house-wrecker. In the Museum will also be found a unique set of carving tools, benches, hand screws, et cetera, used in carving some of the original lions for carousels by the American founder of this industry, G. A. Dentzel. The collection of musical instruments is highly interesting and includes some of the early "orchestrions" operated with pin cylinders and weights. There is also a monkey organ 150 years old and a street piano of 1862 which inspired the ever-popular "Sidewalks of New York." Most of us have forgotten the "melodian" but an example is here. Some time the phonograph of 1885 will be a great rarity, but one will be found in this collection.



STEAM OPERATED SWINGS

Here operation by the exertions of the persons occupying the seats was replaced by steam power. The occupants started swinging by pulling the cord which operated a band brake

Some of the framed photographs and posters are priceless to the collector and student. Many of the devices can only be shown by models, their bulk is so great. A model of a roller coaster may cost several thousand dollars. Such models are being built at Mr. Mangels' amusement device factory a short distance away, where expert model makers are engaged in their fabrication. It is fascinating to watch these clever mechanics work to the minute scale which the model demands.



A PAIR OF LIONS

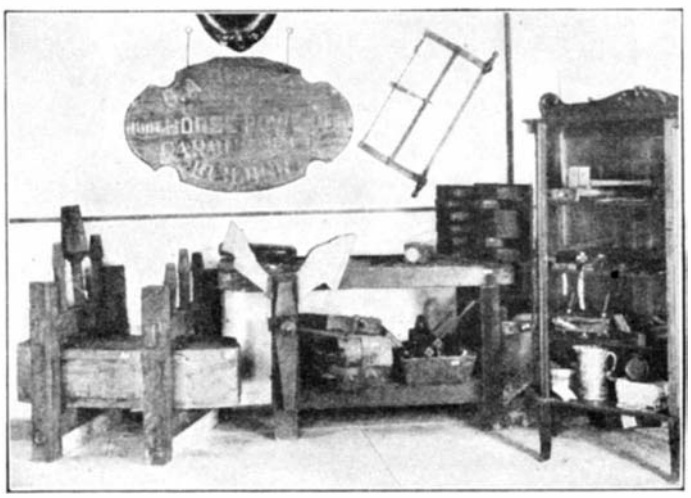
Here we have a pair of carousel lions. There is approximately one hundred years difference in their ages

Perhaps the most amusing exhibit in the entire Museum is a pair of carved lions. The smaller lion is of the vintage of 1831. It was carved by Michael Dentzel and was brought to this country on a sailing ship. The other lion was carved by his grandson, William A. Dentzel in 1926. This exhibit shows a real development in the art. We are now going to give away a secret of the business—most of the "merry-go-round" horses, lions, and other animals are now not carved at all but are cast of aluminum and are made of two pieces joined together.

The Museum is one which does not rule out modern devices. For example, Mr. Mangels exhibits one of his machine guns for shooting galleries. The revolving disk holds 60 .22 caliber cartridges. The gun is operated by turning the crank. It can be pointed to all parts of the gallery but stops prevent its being turned in other directions. The empty disk may be quickly replaced by a loaded one. The barrel is easily replaced by another if overheated.

THE MODEL-MAKER

The clever little models are made to scale. The "loop the loop" model shown on opposite page cost 3200 dollars to build

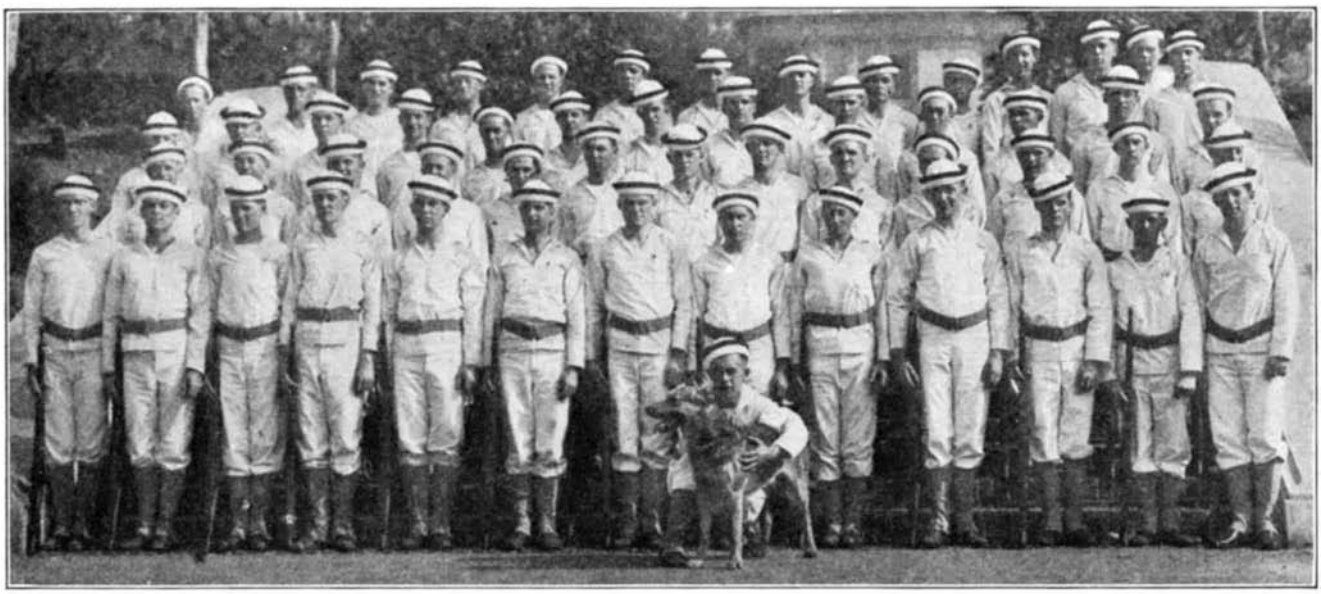


OLD TOOLS

These old tools are priceless. Here we have benches, vises, saws, clamps, and everything the old carver needed; a unique collection

PART OF THE MENAGERIE

No, this is not the "zoo," but a collection of the playmates of children during the last century. Some of them were worn out



PIONEERS OF THE CALIFORNIA UNIT

The 1930 class at the University of California, soon after their enrollment in 1926. The successful ones will receive with their diplomas this June commissions as Ensigns in the United States Naval Reserve. Much of their training has been aboard ship

Midshipmen at 'Landlubber' Colleges

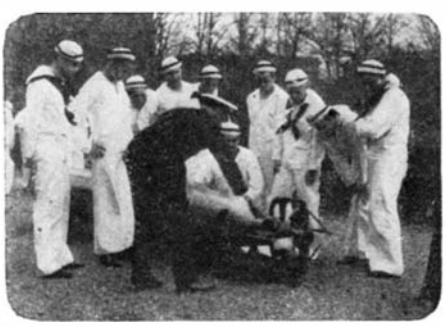
Six Great Institutions Co-operate With the Navy in Preparing Naval Reserve Officers for Sea Duty

By CAPTAIN W. D. PULESTON, U. S. N.

THE senior classes at Harvard, Yale, Georgia Institute of Technology, Northwestern University, University of Washington, and the University of California, now include for the first time a group of Reserve Midshipmen, who have completed their naval course. The successful ones will be tendered with their diplomas commissions as Ensigns in the United States Naval Reserve. In the event of war, these specially trained graduates will be qualified to take their places aboard ship as junior line officers of the Navy, carefully prepared for their specific duties aboard ship. Behind this pioneer class of 1930, there are already entered Reserve Midshipmen in the classes of 1931, 1932, and 1933, and it can now be safely stated that the Naval Reserve Officer Training Corps is fairly launched, and that each succeeding class in the years to come will graduate its quota of Ensigns of the Naval Reserve.

DURING the World War the commissioned line officers on the active list of our Navy were increased from about 2100 to about 21,000 — roughly ten-fold. The additional officers came from various sources. Many were former warrant officers and enlisted men of the regular service; others came from the Naval Militia and merchant marine; and still others came into the Navy directly from civil life. Some of those from civil life, who were recent graduates or under-graduates of colleges or universities, were sent, soon after their enrollment in the service, to the United States Naval Academy at Annapolis where they were given an intensive course, lasting three to six months, in seamanship, naval ordnance, and navigation.

Graduates of this intensive course made unusually good junior officers, readily adapting themselves to life aboard ship, and quickly grasping the essentials of their various tasks. To indicate the Navy's dependence on its reserve officers, it is only necessary to recall that during 1918 the commissioned complement of a destroyer in the war zone usually consisted of three regular naval officers, the Captain, the Executive (who also navigated) and the Chief Engineer, while the Ordnance Officer, the Signal Officer, and all the watch officers were volunteers, most of whom were college men who had successfully taken the intensive course given at Annapolis. The Atlantic Fleet, based in home waters and engaged on a huge training program, carried an even larger proportion of volunteer officers.



PRACTICAL INSTRUCTION

Students at the Georgia Institute of Technology study torpedo mechanism

The United States Army during the World War was obliged to train and commission many more reserve officers than the Navy, and immediately after the war very wisely determined to establish a permanent system that would produce in time of peace an ample supply of trained reserve officers. The Army worked so effectively that in a very few years it had available in numerous colleges and universities in every part of our country, courses of instruction that, in addition to the usual courses taken by the undergraduates, would qualify these students for appointment as Second Lieutenants in the Army.

THE Navy, also, realized the necessity of training reserve officers in peace time, but it was 1925 before authority was obtained from Congress to establish Naval Reserve Officer Training Corps units similar to the existing Army units. The Navy's delay permitted it to profit by the Army's experiences, and much of the success of the Navy's effort is due to the cordial co-operation and assistance

it has received from its sister service.

The Navy's need for officers in the event of a major war, will never be as great as the Army's, so, at the start, naval units were established in only six institutions, with the intention that, as experience was gained in the operation of these units, a few additional units would be established in other institutions. In order that these courses might be readily available to American students in all parts of the United States, it was necessary to distribute them in educational institutions regionally; it was also necessary to establish them in institutions with a sufficiently large student body to insure obtaining enough students to justify the maintenance of a naval unit; and most important of all, it was essential that the standards of scholarship at the selected institutions be so high that the Navy could be sure that the students would be well grounded in all the regular university courses. Another important factor in the selection of the six institutions was the attitude of the president, faculty, and student body towards the naval unit, and it is a pleasure to record that, in all of those chosen, a warm welcome has been given naval units by the entire personnel.

HARVARD has always been conspicuous for its willingness to cooperate with the government in any endeavor, and from the beginning, President Lowell gave the new naval unit his powerful assistance. The headquarters of the First Naval District and one of our largest navy yards are in Charlestown; and their proximity to Cambridge also facilitates the administration of the naval unit, and enables the students to familiarize themselves with the operation of a navy yard and to inspect visiting ships. Much of the Navy's early history centers around Boston and vicinity, Harvard treasures many traditions of our early days, and an intangible but powerful bond between Harvard and the Navy results.

Yale, located on Long Island Sound, is no less favorably situated for a naval unit. During the World War it almost converted itself into a naval academy, and President Hadley in one of his annual reports calls attention to the ease with which Yale could be made into an emergency naval academy. Finally, the famous Yale spirit assures a fine morale among the members of the naval unit.

STUDENTS AFLOAT

Part of the unit at Georgia Tech takes a turn at the oars on Lake Piedmont

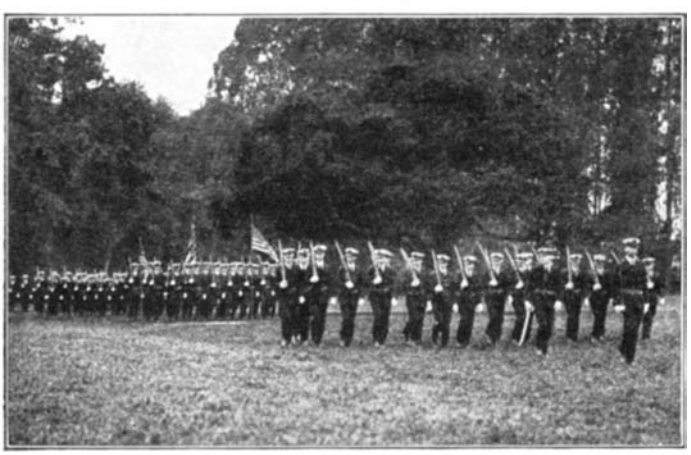
Situated inland at Atlanta, the Georgia Institute of Technology may not, at first thought, seem adapted for a naval unit, but the enthusiasm of President Brittain and the loyal support of the faculty and students have overcome the geographical difficulties. On Lake Piedmont, in the heart of Atlanta, the naval students are trained in navy cutters, to pull an oar and to handle boats under sail; while on the campus an ingeniously designed bridge, fitted with a standard compass and wheel, permits instruction in compass correction and steering. The Tech unit is very enthusiastic and always sends a large contingent on the summer cruise. The standard of scholarship at Tech is very high, and athletics and physical training are encouraged, so the student body furnishes plenty of excellent officer material.

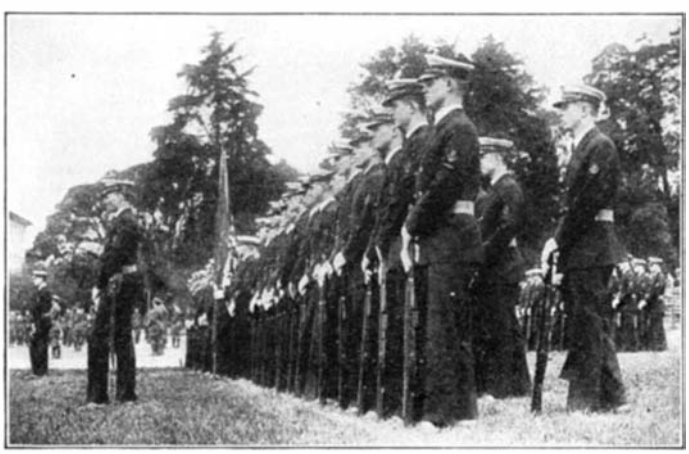
Northwestern University, at Evanston, on the shores of Lake Michigan, lies about half way between Chicago and the Great Lakes Training Station. Like Yale, in an emergency, it could readily be converted into a naval academy. President Scott served in the Army during the World War and is still in the Reserve Officer Corps. Through his interest, a handsome boat house has been built on the campus for the use of the naval unit. Northwestern offers the young men of the middle west an opportunity to fit themselves to serve their country in the Naval Reserve.

The Ninth Naval District includes the heart of the country and embraces the populous states that border the Great Lakes, the navigable portion of the Missouri, and the Mississippi north of Cairo. It will surprise many readers to hear that this inland naval district contains more Naval Reserve officers than any other. It is expected that the graduates of the unit at Northwestern will be the future source of supply of junior officers to these mariners of our inland seas and waterways.

WASHINGTON University, on Lake Washington, on the outskirts of Seattle, is perhaps best known in the east for the superb crews it sends each year to Poughkeepsie. Dr. Suzzalo was President when the Navy Department asked if the University would be interested in a naval unit. In reply he telegraphed that the University of Washington wanted a unit and would comply with all conditions prescribed by the Navy. His fine enthusiasm evoked a similar spirit on the part of the Navy, which accepted his offer by despatch, so that Washington has the honor of being the first institution formally selected by the Navy for an R. O. T. C.

Dr. Suzzalo's patriotic interest in the Navy is a natural consequence of his enthusiasm for sea-going and the American merchant marine. During his presidency he was fond of calling the University of Washington a "sea-going university," and among its many courses is one devoted to the merchant marine and cognate subjects. Shortly after the naval unit was established at Washington, Dr. Suzzalo was succeeded as President by Dr. Spencer,





FOURTH YEAR EFFICIENCY ON PARADE

The two photographs above show the California unit in 1929 after three years of training. Comparison with the photograph at the top of the opposite page will indicate the progress in numbers and efficiency. Other institutions show a corresponding improvement

who has continued his loyal support of the naval unit.

The University of California, located on San Francisco Bay, with one of the largest student bodies in the United States and a varied curriculum that could easily furnish a course practically identical with the one given at the United States Naval Academy, was an

NAVIGATION AT YALE

Above: a group of students of the Yale naval unit receiving instruction in compass correction. *At right:* members of the Yale unit are shown plotting ship's position

inevitable choice for a unit. President Campbell, a firm believer in national defense, from the beginning has been stalwart in the support of the naval unit. Among California's faculty are several reserve officers, all of whom have helped in the establishment of the unit.

Vessels of the Battle Fleet frequently visit San Francisco harbor, and the Naval Reserve Midshipmen are cordially welcomed aboard and are thus afforded ample opportunity to combine practical work with their naval studies. The proximity of the Navy Yard at Mare Island and the dry dock at Hunter's Point permit the students to see the material side of the Navy.

There is a zestful spirit on California's campus which its students bring with them to their practical work on board ship.

THE purpose of the Naval Course offered to students at these six institutions, as stated in the original regulations prescribed by the Bureau of Navigation, is to supplement the regular courses taken by the naval students so that successful graduates of both courses will possess:

(a) A good general education.

(b) Sufficient knowledge of such subjects as seamanship, navigation, ordnance, military and international law, naval engineering, naval strategy and tactics, and naval communications, to fit them to perform their duties as Junior Officers of the Naval Reserve.

(c) A well disciplined mind and body.

(d) The quality of self-reliant leadership.

The naval courses are conducted by regular naval officers, who are chosen with care for this particular and exacting duty. They come to the campus directly from sea duty or from some important shore duty, and bring to the classroom the prestige of a successful career in the profession they are detailed to teach. The Navy Department is careful to send only successful officers to represent the Navy in the life of these populous educational centers, and to personify the naval service to the numerous undergraduates.

In some of the institutions, the regular professors assist in the instruction of the Reserve Midshipmen and, in return, naval officers are sometimes permitted to assist in other departments. Thus at Harvard, which for years has maintained an excellent Department of Navigation, the regular and naval classes in this subject are combined, and the instruction is carried out jointly by civilian professors and naval officers. At another university one of the naval officers was unusually well informed on combustion engines so his services were utilized in the regular aeronautical engineering course at the university. This cooperation directly adds to the effectiveness of the naval course and promotes a friendly understanding between the regular faculty and their naval colleagues.

Some difficulties were encountered in establishing these units, and while they have been overcome, it is well to note them. At every educational institution there is a positive lack of space because the demand for higher education in our country is actually much greater than our higher institutions of learning can supply; practically every department could advantageously use larger offices, more class rooms, and more extensive laboratories; so when the Navy appeared asking for its share of space it was crowding into an already over-populated region. Similarly the advent of a new course added somewhat to the complications already existing in the various schedules of study, but these difficulties were faced and gradually surmounted. The question of credits towards the regular degree for the successful completion of the naval course was one that required careful handling: the Navy Department required sufficient hours in the classroom and of outside preparation to enable naval students to master its course properly; the students could not give this time to the naval course unless they obtained sufficient credit towards their regular degree; the deans could not give the credit until they were satisfied of the intellectual content of the naval course and its cultural value to the student.

THE situation created a neat triangular problem between the Navy Department, the institutions, and the students, but it was solved when the deans realized that there was nothing easy about the naval course, and that the naval instructors would insist upon high standards of scholarship and in many cases would bring to their tasks the experience of an instructor or even of a head of a department at the Naval Academy.

But it should be added further that there are compensating factors. Responsible university authorities realized that the presence of a well-conducted naval unit on the campus would have a stabilizing effect on the student body, that a group of naval students who had learned from practical experience aboard ship the absolute necessity of discipline and who had unconsciously imbibed a respect for constituted authority would have a steadying effect on the other students that would be helpful to the university. And it was generally acknowledged that the quality of self-reliant leadership resulting from naval training would be of great value to the students after graduation.

Even the best universities can not produce junior naval officers without giving them actual sea duty, so the Navy Department provides that no

student will be commissioned as an Ensign unless he has successfully completed one practice cruise on a battleship and all are encouraged to take practice cruises every summer during their school vacation. Students from California and Washington cruise in the Pacific and usually visit Victoria and Vancouver in addition to their home ports on the coast; students from Harvard, Yale, Northwestern, and Georgia Tech cruise in the Atlantic and usually call at Halifax, Bermuda, or Havana in addition to some of our east coast ports.

On these cruises, which last about two weeks, the Reserve Midshipmen obtain a practical knowledge of their duties at sea; they work navigation, carry out gun drills and target practice, stand junior officer watch, familiarize themselves with the routine of a man-of-war, and at a receptive age unconsciously absorb our naval traditions and habituate themselves to the customs of the sea.

IN addition to becoming acquainted with Navy personnel on these practice cruises, members of reserve units get well acquainted with each other, and while they are encouraged to retain the spirit of their own institution, their surroundings influence them to join together in one body, to develop a Naval Reserve spirit, and, finally, to merge themselves entirely with the naval service.

Besides the regular summer cruises, the Navy Department has authorized these students to embark on the regular week-end cruises given reserve officers and crews, to take passage on vessels of the fleet whenever convenient for them, provided their presence aboard does not interfere with the ship's schedule of work, and on special

IN WORKING CLOTHES

Gun practice at Georgia Tech. Such work reflects the completeness of the course

occasions students have been allowed to take passage on a man-of-war going from one coast to the other.

Aboard ship, the Reserve Midshipmen are treated exactly as regular Midshipmen. Their service uniforms are identically like those worn by the regular Midshipmen except for a device on the sleeve; they mess together in junior officers' quarters usually referred to as the "steerage"; and are furnished white working clothes in which they can pull an oar, load a turret gun, crawl through a boiler, or inspect a double bottom. From the moment they are accepted as Reserve Midshipmen they are treated as junior officers and in return are expected to bear themselves at all times in an officer-like manner.

A requisite for enrollment in the naval unit is a deep interest in the Navy, which the Department hopes to make abiding, and a sincere determination to enroll in the Naval Reserve after graduation. Obviously, the government can not afford to give this training to students who at the end of four years will turn their backs on the service. There has been no difficulty in securing sufficient students who are fond of the sea and interested in naval affairs to enroll.

Wherever these young reserve officers go in the United States after graduation they will find fairly close to them some Naval Reserve unit or some regular naval activity to keep them in touch with the service. Generally speaking, it is probable that a majority of the graduates will eventually settle in or near the region of their alma mater. Consequently it is a reasonable hope that in time the Naval Reserve of the various naval districts will come to regard the institution within their district as their Naval Academy from whence they can annually expect their quota of reserve ensigns to replace those who for any reason have disenrolled or have retired.

FORTUNATELY for the success of this new Navy undertaking, Secretary Wilbur realized its importance from its inception and never failed to give it his strong support; amid the press of other duties he would find time on his inspection tours to visit units adjacent to his route and took pains to inspect the units embarked on board ship for the summer cruise.

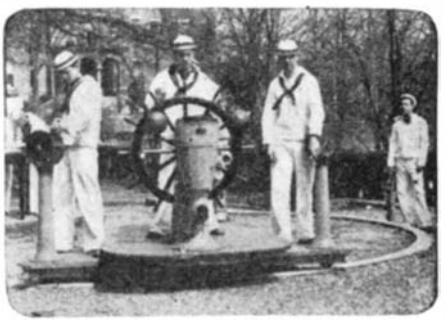
Secretary Adams, whose long association with Harvard has familiarized him with modern university life, also takes a keen interest in these naval units, as is indicated by the following extract from his letter to Mr. Richard Chamberlin, Commander American Post Number 42, American Legion, Evanston, Illinois, expressing the Department's appreciation of a medal awarded annually to the honor student of the naval unit at Northwestern University:

"The course in Naval Science and Tactics is intended to fit students to perform duties as junior officers in the Naval Reserve. But it does more than that. It brings out and ripens the qualities of self-reliance and leadership which are not only required in young officers but are essential in promoting the highest type of American citizenship. It is fitting, therefore, that recognition of merit among students of the unit at Northwestern should have been given by the American Legion.

Very truly yours,

(Signed) C. F. ADAMS."

In the spring of 1917 after the United States had severed diplomatic relations with Germany, and when it became increasingly evident that hos-



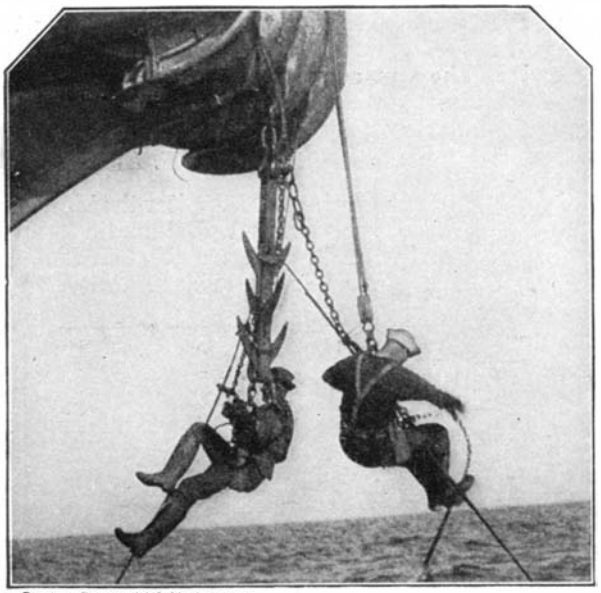
SHIP'S BRIDGE ON LAND

Compass correction and a trick at the wheel on the campus of Georgia Tech

tilities could not be avoided, the Navy began to enroll for active duty some volunteer reserve officers. The first enrolled were some young yachtsmen in the Second Naval District who, on their own initiative in the summer of 1915, had organized a volunteer patrol squadron of their own yachts and trained themselves under the direction of regular officers to operate against submarines. From this very small beginning, the Navy continued throughout the war to carry on simultaneously its training program and its operations against Germany.

But our just pride in their abilities and the Navy's war achievements should not blind us to the fact that even such fine raw material required at least a year, with all the stimulus of a war atmosphere, to become useful naval officers. Manifestly, in future wars we should not depend upon the enemy giving us a year after hostilities begin to prepare our commissioned personnel.

RESERVE officers who served in the Navy during the World War should regard members of these Naval Reserve Officers Training Corps units as their natural professional descendants, and aid and encourage them in every way; and the members of these units should familiarize themselves with the achievements of the reserve officers in the last war so they will realize fully their future duties and responsibilities. As these reserve officers grow in numbers and efficiency, it is not too much to hope that their existence only may prevent a possible enemy from attacking us as did Germany on the assumption, happily erroneous, that the United States could be defeated before it could develop its latent military power.



Courtesy Commercial Cable Company

THE CABLE IS UP

Workmen lowered in bosun's chairs attaching stoppers to cable. After cutting, both ends are hoisted on board

Linemen of the Sea

When Transatlantic Cables Are Broken, Men Must Be Sent to Splice Them

By JOSEF W. VON STEIN

AN epic of the sea was enacted during the past winter in the icy, gale-torn reaches of the cold North Atlantic. A continuous struggle was staged by storm and elemental forces pitted against Man and his aides: highly developed scientific equipment and organized industry. Little did many of us realize at the time, that resolute "linemen of the sea" were fighting against overwhelming odds—midwinter cold and terrific storms—to maintain electrical communication service between two continents.

The earthquake* which upheaved the bed of the Atlantic and which seismographs registered November 18 and 19, caused havoc among the spider-like webs comprising the transatlantic cables. "About half past three on the afternoon of November 18," we were informed by Mr. A. E. Powell, Vice President and Chief Plant Engineer of the Commercial Cable Company, "we had the first intimation of the tasks confronting us, when a 'phone message from the main operating room in New York informed us that they had 'lost London' on all circuits.

"A FEW minutes later other messages began to come in from relay stations that their circuits were upset. The Canso, Nova Scotia, station reported a severe earthquake. Their instruments were badly shaken, and they believed that breaks in the cables had occurred. Routine repair work was begun, and three circuits were patched up to get the most important messages across. Within 15 minutes after the earthquake disturbance, reports came through from the Far Rockaway, Long Island, station to the effect that their tests showed that both cables from New York to St. Johns had been broken at approximately the same geographical position.

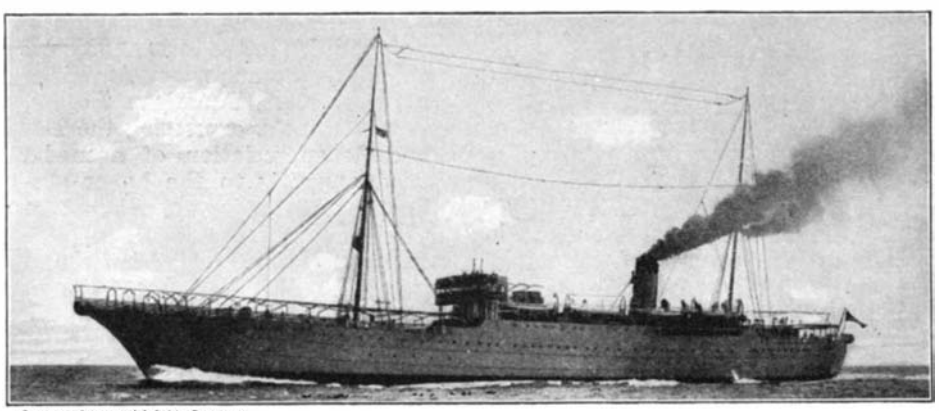
"Communicating with Mr. G. H. Ridge, Chief Cable Engineer, Western Union Telegraph Company, we learned that their tests showed breaks in both of their New York to Bay Roberts cables running through the same geographically situated sector. Meanwhile, Canso had effected temporary repair of their shaken instruments; but their tests showed the loss of the two Canso to Fayal cables which also passed through this apparently disturbed center."

The final tabulation showed that a total of 12 of the 21 cables connecting North America with Europe had been silenced. The powerful machinery of the highly organized cable industry began to function. The Commercial Cable Company's repair ship, *John W. Mackay*, was off Cape Cod repairing a feeder cable. Orders were issued to stop these repairs and rush to Halifax. Two days later this ship was well under way on its trying task in the earthquake zone.

The *All America* was in the Canal Zone. Word was flashed to this vessel and it raced northward. The *Faraday* was dispatched on November 24 from England. Meanwhile, the Western Union Telegraph Company's cable ships were also put to work. The *Cyrus Field* was dispatched to work on the 1926 fast, loaded cable, which was broken in two places. The *Lord Kelvin*, working at the time with the *Dominia* to repair the 1924 New York to Azores cable, which was broken in two places, later went to complete the work begun by the *Cyrus Field*.

THE first indication that a cable is broken or faulty is the failure of the receiving instruments in the cable stations to record incoming signals properly. When a conductor is completely broken, there is an absolute loss of electrical continuity; but in the case of a leakage in the insulation, there is an escape of current without complete loss of continuity. These leakage faults are the most difficult to localize for repair.

When the receiving instruments indicate something wrong in the line, a test is immediately made from each end of the line by means of extremely sensitive apparatus using a mirror galvanometer. Several methods of testing are used, the most general being the Wheatstone bridge balance. In this, the galvanometer, or a similar sensitive instrument, is joined up between the arms of the bridge. Since the resistance of each mile of cable was tested and charted as it was laid, accurate location of the breaks is determined by altering the resistance of the resistance box that is used, until the beam of light in the mirror galvanometer remains stationary at the neutral point. Assuming, therefore, that the known resistance per mile of cable is two ohms, and the measuring apparatus indicates a total resistance in the cable of 800 ohms, the break would be ascertained by dividing the 800 ohms by



Courtesy Commercial Cable Company

THE "JOHN W. MACKAY"

One of the largest cable ships which took an active part in the repairing of the Commerical Cable Company's broken cable. She can remain at sea for about three months if necessary

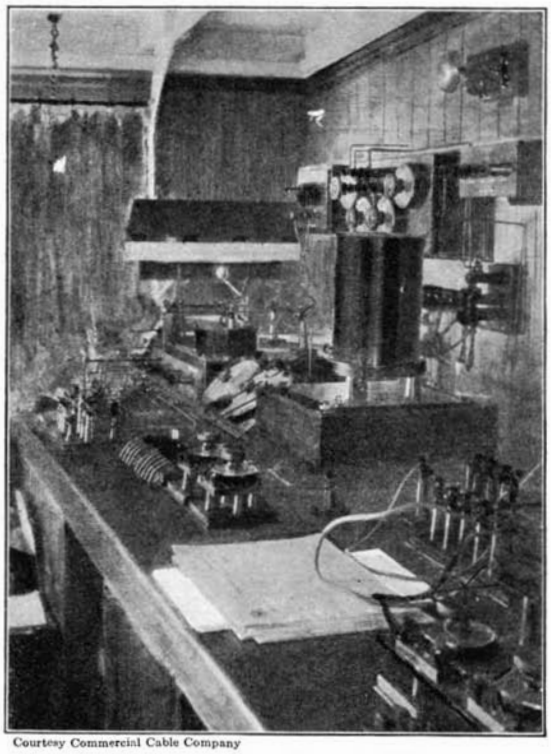
* See page 184, March, 1930, SCIENTIFIC AMERICAN for comprehensive map of earthquake region and cable lines.

2, which would place the rupture 400 miles from the shore.

With such information, the captains of the cable-ships were able to determine, on charts showing the positions of the cables, the latitude and longitude of their projected activities.

The ship is aided in locating the supposed position of the cable by electrically driven deep-sea sounding machines which indicate the depth, nature of bottom, and temperature at the ocean bed. Knowledge of the depth aids in finding the location by comparison with known, charted soundings; the character of the bottom determines the type of grapnel to be used; and the temperature indicates what allowances should be made for this factor in repairing the cable. The sonic depth finder is also generally employed.

HAVING arrived at the apparent location, a marking buoy is moored by mushroom anchor and line. If weather conditions are satisfactory, the actual work of grappling for the cable, reposing in the soft ooze below, can begin. Inasmuch as it may take fully an hour before the heavy grapnel reaches the ocean bottom, the ship steams to a suitable distance from the line of the cable. Should there be a strong current, the grappling is done against the current. There are different kinds of grapnels, but all have similar general features. The ordinary kind for general use has a shank about four feet long with five prongs and



Courtesy Commercial Cable Company

THE INSTRUMENT ROOM

Some of the delicate instruments aboard the *John W. Mackay*. When the cables are brought up from below, they are tested to determine the location of the fault. Cable is also tested mile by mile as it is being laid

HARD WORK

Fastening cable to grapnel chains after pulling on board, to facilitate the testing and splicing operations

weighs about 250 pounds. For very deep water work, a special type of grapnel is employed, which cuts one side of the cable and clutches and holds the other. This is done to avoid excessive strain on the cable, and this type was often used during the repair work of the past winter.

As the ship proceeds across the line of the cable at a speed of one knot per hour, the iron fingers of the grapnel rake the bed. The hooking of the cable is indicated on deck by a dynamometer, which registers a steadily increasing strain on the grapnel rope, or one of the crew "sits on the cable." If rocks or other obstructions are encountered by the grapnel, the fact is shown by the irregularity of the strain on the dynamometer. In grappling for a cable only an inch in diameter far below, the cable ship must be maneuvered and handled with the greatest delicacy. It is no simple problem to move a 4000-ton ship just a few yards one way or another, especially when there is a current or heavy, wintry seas. Frequently ships had to grapple for days this past winter before the telltale strain began to register on the dynamometer.

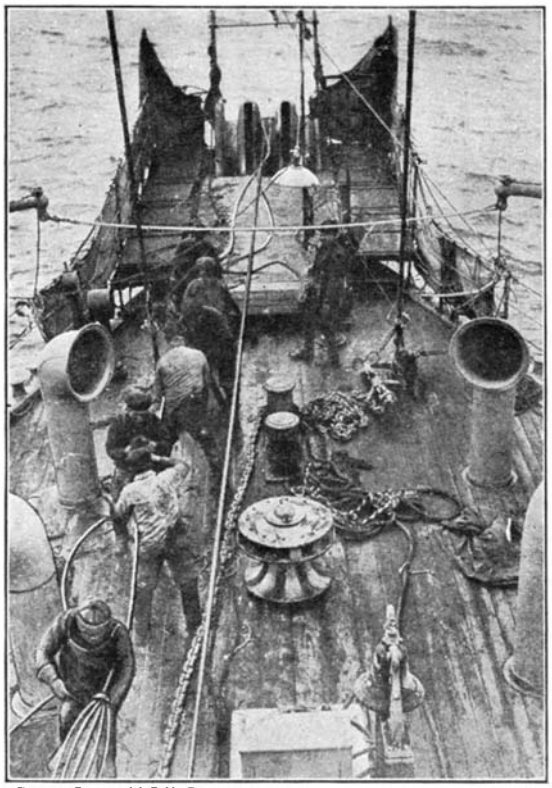
"When, at last, it appears that the grapnel has hooked the cable," related Mr. Higginson, who saw service as Chief Electrician on the *John W. Mackay*, "the engines are momentarily stopped to ease the strain on the cable, and orders are issued for 'full speed astern,' to keep the ship in this position. The dynamometer is carefully watched. Practical experience has taught us to know if the cable is hooked. If this is the case, word is passed to 'stand by to pick up.' There is a tense expectancy all over the ship.

"If the visibility is low, 'lights on' are ordered. The boatswain calls the watch. The ship is brought up to keep the long, heavy grapnel line leading away now from the bow sheaves. The captain stands on the foc'sle head, alternately watching the line coming slowly aboard and turning around to watch the strain registering on the dynamometer. Between times he shouts orders to the crew or to the quartermaster nearby, who stands by a duplicate engine-room telegraph. There is great danger of stretching the cable too tightly or allowing too much slack. The rise and fall of the vessel may snap the cable. The ship, barely making headway, is steered by her engines. At her slow speed, she will not answer the helm satisfactorily.

"THE 'skipper' tries to get his ship directly above the cable at the moment the cable begins to get free of the bottom. In this way, the cable will have the shortest distance to travel to the ship. The long line continues to come slowly in. It passes along the big bow sheave and over another wheel and in turn over and under the various other wheels and braking gears. At last! The beginning of the 15 fathoms of grapnel chain, polished to a bright silver by the chalky sea bottom, breaks water!"

Men are then lowered over the bow, strapped in "bosun's chairs," and "stoppers" are placed on the picked-up cable. This means that the cable is secured by chains passing over sheaves on each side of the sheave holding the grapnel line. The cable is then cut and both ends hauled on board and connected with the ship's electrical testing room. Tests similar to those described in the land terminus are applied. The end of the cable which is found intact to the shore, is then chained to a mooring anchor with a massive seven-ton buoy attached and dropped overboard temporarily. The short end to the point of fracture is either abandoned or picked up and stowed away. When the cutting type of grapnel is used, there is, of course, no short end.

The ship then proceeds on her way to grapple for the other end. The above grappling process is then repeated. This end is then spliced onto a length of spare cable on board. A skilled jointer and his assistants clean and solder together the ends of the



Courtesy Commercial Cable Company

THE FINAL SPLICE

Scene aboard a cable ship while the splice is being made between grappled cable and the new section

central copper wire or conductor. In the newest types of cables the copper wire is wound around with flexible copper tapes. Thus, should the central wire break, these flexible copper conductors will carry the current around the gap. Around this conductor is wound a single continuous strip of Numetal one eighth of an inch wide and six thousandths of an inch thick.

The total diameter of the conductor and its Numetal wrapping is just a fraction short of a fifth of an inch. Over this central core, the jointer then draws the gutta-percha covering from each side and applies two or three more coats of the same material.

Oddly enough, at this point the health of the men who work the hot gutta percha is important. If the jointer's perspiration is acid, this would cause the gutta percha to harden soon and develop a fault. Also, an imprisoned air bubble will later cause trouble since the pressure at a depth of 18,000 feet is 8000 pounds per square inch.

WHEN the jointer has finally completed his task, the joint is placed in cold water for about 20 minutes to harden. The splicer then places a serving of jute yarn around the core as a cushion for the armor wires. These wires are put back as nearly as possible in their original lay, and a heavily tarred jute yarn is put on tightly over a distance of 15 to 20 feet. The splice is complete and the cable is dropped overboard.

The ship then begins to pay out toward the end which was originally left buoyed. This is again located and taken on board. The two ends are tested in the electrical testing room by the chief electrician. If the results are satisfactory, the ends are then spliced, dropped overboard, and another cable has been put back in service.

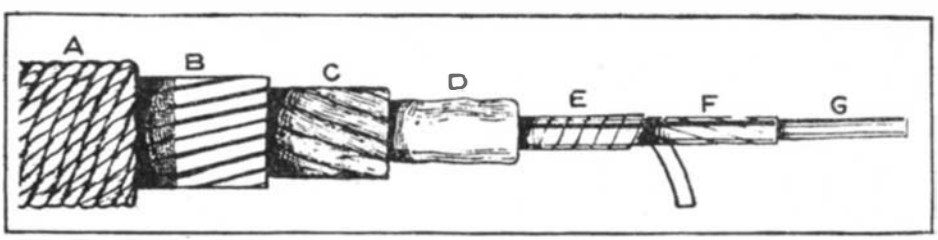
It is interesting to note that this laying of a new length of cable is not an easy matter even in calm seas. It is of utmost importance to know the topography of the ocean bed before the cable is laid, to avoid suspending the cable between submarine hills. Unless it rests on the bottom all the way across, it would be only a matter of time before it would break under the strain. Since it was feared that the earthquake had changed the contour of the ocean bottom, new surveys were necessitated. These surveys, as mentioned before, consist of deep-sea soundings which determine the depth of water, produce specimens of the bottom, and give the temperature of the water. If, by chemical analysis, it is learned that there is any mineral deposit on the bottom which would seriously affect the cable, or if the temperature should show that there is volcanic action at certain places, these places have to be avoided.

THE sounder invented by Rear Admiral Sigsbee, United States Navy, probably possesses the essential features of the others and may be taken as a typical one. It consists of a central tube fitted with valves at top and bottom, and three smaller tubes fixed beneath the central one. As the sounder descends, the valves open upward and the water rushes through. When the bottom is reached, the valves close, and a sample of the bottom water is retained. The three smaller tubes sink into the ooze, and bring specimens of it to the surface for analysis.

A low temperature increases the conductivity of the copper wire and the insulating qualities of the gutta percha covering, and is therefore desirable for cables. It is known that a conductor when normal gives a certain resistance per nautical mile at a given temperature. Thus a knowledge of the temperature of the bottom is indispensable for accurate results should the cable require testing for some future break, and in taking soundings a thermometer is always attached to the wire a short distance above the sounder. As we know, an ordinary thermometer cannot be used in great depths as the pressure causes an error of 8 to 10 degrees, Fahrenheit, and has been known to cause implosion of the bulb. Thus, for deep sounding, a special thermometer, the Miller-Casella, is used. The bulb of this instrument is enclosed in an outer bulb three-quarters full of alcohol. Before this outer bulb was sealed, the alcohol was warmed to expel some of the air. Between the two bulbs there is formed a cushion which takes up the pressure, and the inner bulb remains unaffected.

ONE of the most interesting spots on board a cable ship during the laying of new lengths of cable is the testing room. In front of a table covered with various testing devices, sits an electrician, watching a spot of light as it sways to and fro on a graduated scale. This spot is the reflection from the galvanometer mirror, and the swaying movement is caused by the induced currents set up in the coiled cable by the rolling of the ship. At the end of every fifth minute the spot gives a kick sideways on the scale, and the electrician duly notes its magnitude. This kick is caused by a signal from the shore, and proves that the continuity of the conductor is being maintained.

During this phase of repair work, careful nautical records are kept. When the length of cable has been laid, a copy of these records and charts are filed for future reference, together with results of tests and electrical measurements by engineers at both ends of the line. These records and data may prove useful at some distant date in case trouble is again experienced with the cable. It is safe to assume, however, that not one of the men who took part in the gigantic repair job of the past winter, is anxious for this time to come; for the work is infinitely hazardous and difficult.

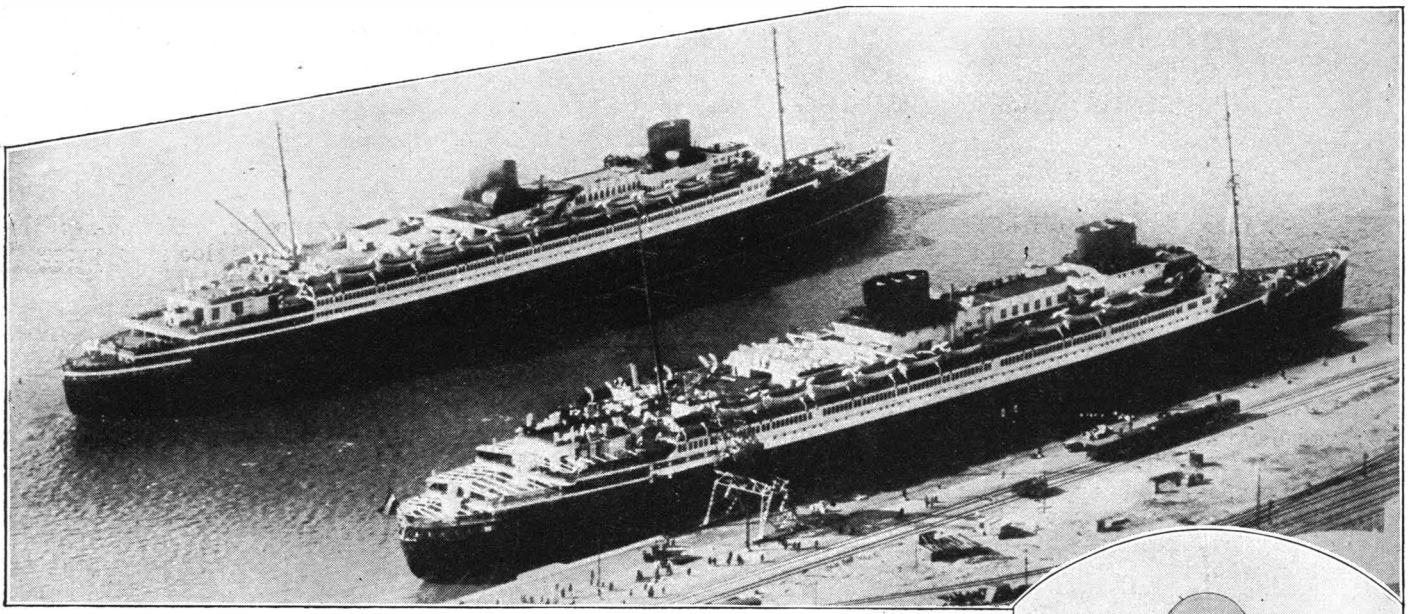


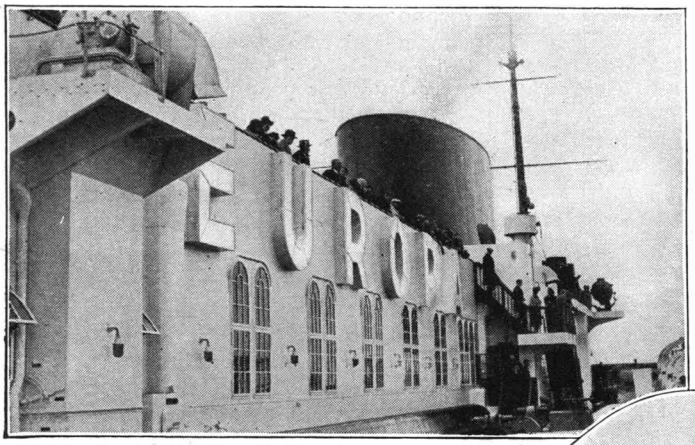
Courtesy Western Union Telegraph Company

THE MAKE-UP OF THE CABLE

New fast cables are made as follows: A, tarred hemp cord wrapping; B, steel armor wires; C, jute cushion; D, gutta-percha insulation; E, Numetal; F, copper tape; G, copper conductor

Speed Queen Smashes Sister's Record

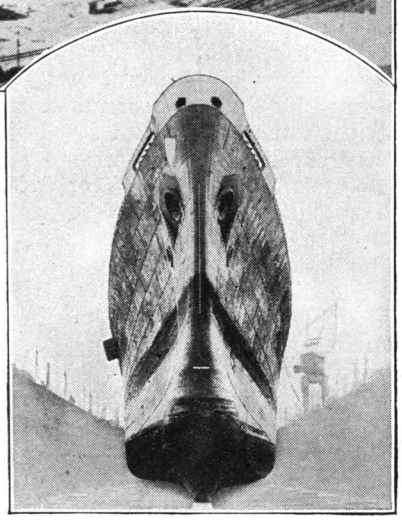




All photographs courtesy North German Lloyd

"EUROPA"

Above: The *Europa* at the dock, with her sister ship the *Bremen* alongside. The *Europa's* time from Cherbourg to Ambrose Lightship was 4 days, 17 hours, and 6 minutes, beating the *Bremen's* time by 18 minutes. Note the smoke stacks in the funnels and (*left*) the illuminated sign

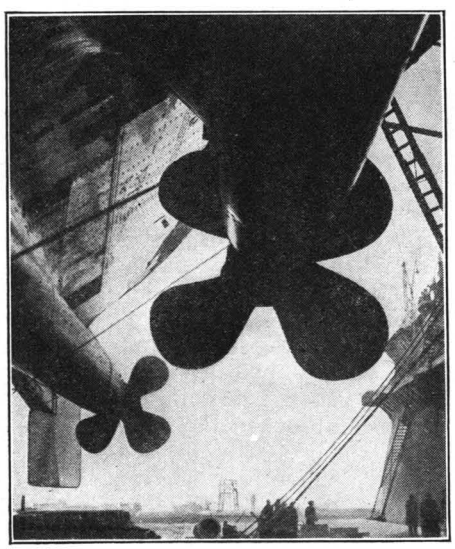


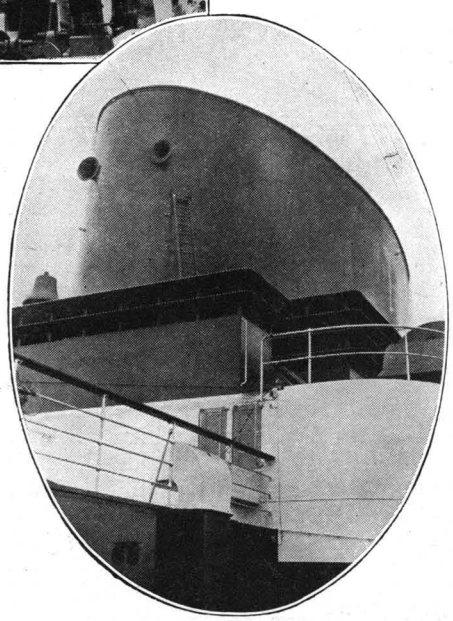
"SLIGHTLY BULBOUS"

The rounded bow was forecast after the World War, when sharp-bowed liners held the record. It creates dead water for the propellers, as against the outward push from a sharp bow

FOURTEEN-TON PROPELLERS

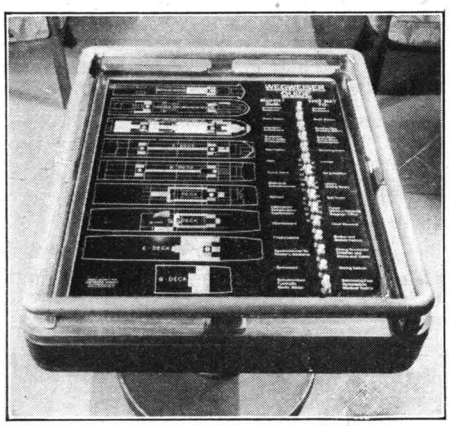
The *Europa's* propellers are smaller than those of the *Bremen* and make more revolutions per minute. Two of them churn the water outward, and two inward. The huge turbines are of 138,000 horsepower





SIRENS

The funnels, instead of being pear-shaped, as in the case of the *Bremen*, are of elliptical shape, measuring 50 feet long diameter, and 21 short diameter. The products of combustion of the oil fuel are thrown upward by a blower system. Note the semi-concealed sirens forward



THE "WEGWEISER"

These indicators, to direct passengers, are in many locations on the boat. If you want to go to the shooting gallery or the swimming pool, just press the button opposite the name and an electric light flashes up under the part of the proper deck plan and directs you understandingly

Is There An Ether?*

Aid for the Layman Who Attempts to Keep Abreast of the Changing Concepts of the Modern Physicist

By PAUL R. HEYL, Ph.D.†

Physicist, United States Bureau of Standards

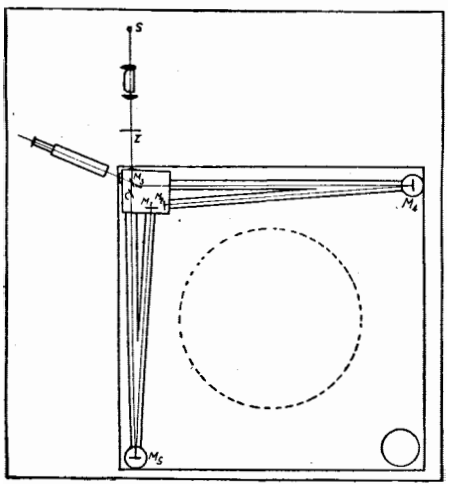
THE ether had its origin in human need and will last as long as human thinking requires it. Not always in the same form, perhaps, but unchanged in function.

The word "ether" comes down to us from the Greeks, but with their concept we have little interest. The "divine ether" to which Prometheus made his impassioned appeal was merely the rarefied upper air. The ether of physics dates from the time of Newton, who, like all the natural philosophers of his day, was greatly puzzled by the fact of apparent action at a distance. The full force of this was first felt when Newton showed that the earth's gravitative action extended to the distance of the moon. The question then presented itself: "Can a body act where it is not?" And the universal answer was: "No; it is unthinkable. There must be some connecting medium."

THUS arose the concept of the ether, at first a substance of rather vague physical properties. This hypothetical substance, while it did not succeed in explaining gravitation, at least furnished a medium by means of which it might be shown some day that gravitation could act.

In Newton's day the ether was not generally regarded as a carrier of light, for the corpuscular theory of light was then in favor. The early part of the 19th Century saw the establishment of the undulatory theory for which a medium of some kind was a necessity, and the luminiferous ether, as it then came to be called, was soon considered an indispensable part of physical theory. Later in the century Maxwell added to the duties of the ether the explanation of electro-magnetism, and with this additional responsibility came an increased measure of authority. In the eighties and early nineties the ether was everything in physical theory, and while it had not yet been shown capable of explaining gravitation it was confidently expected that this would also come to pass, perhaps in the near future.

The 19th Century felt very well acquainted with the ether, almost as well as with matter. Said the physicists of that time: "We know the ether just as well as we know iron or coal, and by the same evidence—its properties. True, it is transparent and invisible, but so is air. The ear can perceive air vibrations, and the eye those of the ether. Though it is not so simple a matter to weigh air as water, yet it can be done indirectly; likewise we can determine indirectly that the ether has a density of 10^{-18}. Moreover it must possess the properties of a solid rather than of a liquid or a gas, else it could not transmit the transverse waves which constitute light. The ether may be thought of as



From Proceedings National Academy of Sciences. Vol. 12. p. 622

THE KENNEDY EXPERIMENT

Professor Kennedy stated that air currents and temperature effects sufficient to change the optical path one part in 1,000,000,000 would produce the ether-drift effect Miller obtained, so he sealed up his apparatus in a closed atmosphere of helium. Otherwise the set-up was the same in principle as that of the Michelson-Morley and Miller experiments. It was compact—about one yard square

a vast mass of transparent, frictionless, tenuous jelly in which all material things are embedded, and through which we slip and slide without being conscious of it. Nay, matter itself may be only a kink or twist in the ether. One continuous substance filling all space, which can vibrate as light, which can be sheared into positive and negative electricity, which in whirls constitutes matter, and which transmits by continuity and not by impact every action and reaction of which matter is capable. This is the modern view of the ether and its functions."[1]

But with the 20th Century there came the new physics with its revolutionary concepts. How does the picture of Nature look at present?

The jelly-filling of space is gone; matter can no longer be distinguished from electricity; the atom is a little bunch of waves traveling like a moving corpuscle; space is curved, and this causes gravitation; energy is atomized into quanta—

But stop! Let us catch our breath! Where is the ether? Is there anything left of it? And how are we ever going to get along without it?

These are very human questions. They suggest the alarm with which inherited tradition has ever viewed the iconoclast. It is easy enough to break down, but what have you to put in its place?

I think that a little study of the subject will show that the 20th Century has changed the form rather than the function of the ether; that action at a distance is as great a challenge as ever, and that modern physics binds every particle of matter to every other no less closely than did the older theory.

IN common opinion Einstein perhaps bears the blame for doing away with the ether. It is true that he asserts that there is no force of gravitation between the earth and the sun, and therefore it would seem that there need be no medium to serve as the physical basis for such an attraction; but the circular orbit of the earth must be accounted for, and this is how he does it.

Gravitation is not a pull, but a push. The earth is not drawn toward the sun by some mysterious force, but pushed out of what would otherwise be a straight course by—space itself!

Sink a large shallow bowl into smooth ice with the upper edge flush with the frozen surface. Stand off a little distance and send a golf ball rolling over the ice toward the bowl. What will happen?

That depends on the speed of the ball and on where it strikes the bowl. If it strikes well to one side and if it be not going too fast the ball may be captured by the bowl and describe several circles before settling to the bottom. But if it is going fast enough it may climb out of the bowl and proceed again in a straight line over the ice, after suffering a slight deflection from its original course. This deflection, or circular motion, as the

*Publication approved by the Director of the Bureau of Standards of the United States Department of Commerce

†See "Among Our Contributors," page 421

[1] Composite of Kelvin and Lodge (1882)

case may be, does not mean that there is any force of attraction originating at the center of the bowl; the curved path is caused not by a pull but by a push of the curved surface of the bowl against the moving ball.

In a similar manner Einstein says that the motion of the earth in a circular orbit is due to a push from curved space, and that this curvature of space is caused by the mass of the sun. According to Einstein, space is not mere emptiness, but a sufficiently robust entity to be curved and to deflect the earth. It is this very resistent space itself that forms the bond of union between the sun and the earth and relieves us of the necessity of assuming action at a distance.

RATHER a neat substitute for the ether, is it not? We need no medium filling all space if space itself is capable of doing the trick. And after all, whether we spell the connecting medium E-T-H-E-R or S-P-A-C-E—what does it matter?

Let us now look at the latest concept of the atom. I do not mean the Bohr atom, though to many this attractive planetary concept still represents the 20th Century idea. The readers of the SCIENTIFIC AMERICAN know that the Bohr atom has for some time been superseded by a more powerful and plastic form—the wave atom of Schrödinger. According to this concept an atom is a little bunch of vibrant energy, spreading out in all directions and thinning as it goes, so that all atoms are connected, though rather tenuously, into one great vibrating system. And what is it that vibrates? Electricity.

Schrödinger assumes a filling material in space, a universal electric plenum which in vibration constitutes matter. Here we see again our old friend the ether in a new disguise. There is no escaping it. Scientific thought demands it and inventiveness supplies the demand under a different form suitable to the changed times. The ether is indeed protean in its properties, all things to all men. From the vague, imponderable medium of Newton's day we have come by way of the tenuous jelly of the 19th Century to the curved space of Einstein and the universal electric plenum of Schrödinger. In one form or another the ether will last as long as human thinking requires it.

But, then, is the ether nothing more than a logical proposition? What does experiment say? Can it give us no evidence of the ether as a physical reality?

Apart from the ever present evidence of our sense of sight and the stars of heaven there is no evidence available. Many times has the attempt been made to detect the ether by our motion through it, but to no avail. Not one but several independent lines of evidence concur in this negative answer.

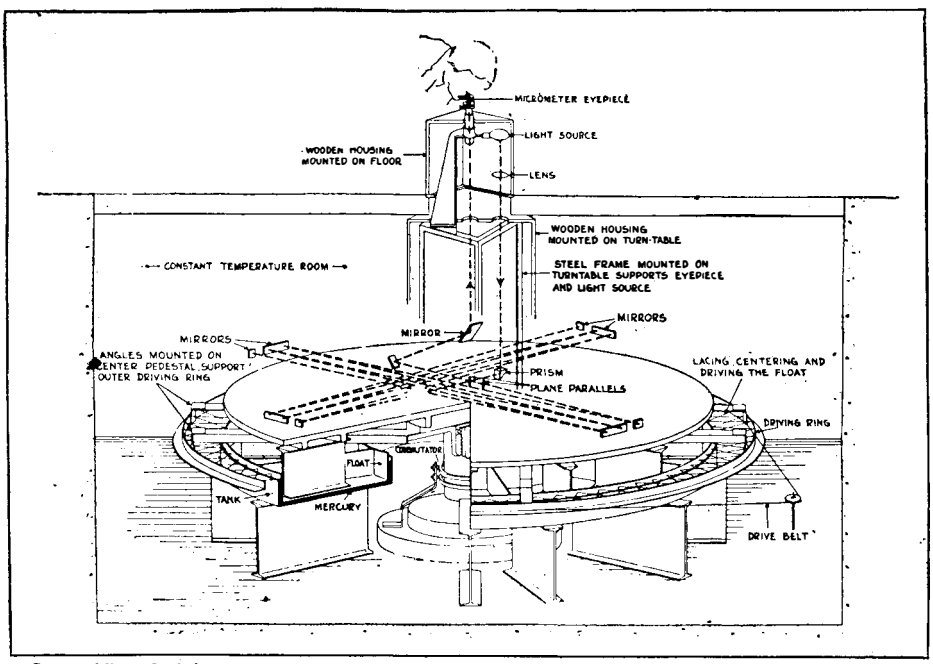
But, you may say, is there not at least one positive result—that of Miller? And does not the evidence of one skilled observer who has seen an elusive phenomenon count for more than the negative testimony of the many who have failed to notice it? This is often true, but it happens that in this case the presumption is exactly the other way. The well known Michelson-Morley experiment is carried out by means of interfering light waves. The adjustment is one of extreme delicacy, difficult to obtain and to maintain. It is a very easy thing to get an apparent positive result and a very difficult thing to avoid it. It is a matter of wonder and admiration on the part of those who know the ropes that Michelson and others should have been able to reach their negative conclusions.

For there have been others. Miller's first announcement stimulated a number of experimenters in Europe and in this country to repeat his experiment under different conditions, some in a balloon, some on a mountain, and some on earth at sea level, and in no case was any confirmation of Miller's result reported. Of all these other experiments those of Kennedy, of California, have perhaps had most weight with physicists. Kennedy succeeded in reducing the dimensions of the classical Michelson-Morley apparatus to a relatively small volume, and by a very ingenious optical device preserved all the sensitiveness of the larger form. He was therefore able to enclose his apparatus in a case filled with helium, thus obtaining unquestioned control of pressure and temperature. And his result was negative.

EXPERIMENTERS of the first rank have more than once been self deceived. There will be recalled the case of Ramsay, one of the best chemists of England, and a co-discoverer of argon. Soon after the discovery of radium it was found that radium emanation gradually turned into helium. This was the first recognized case of transmutation among the elements, and aroused great interest. Ramsay, as a result of some very carefully conducted experiments, came to the conclusion that not only helium but neon could thus be produced, and that even copper could be changed into lithium. Other experimenters failed to confirm Ramsay's results, and it took five years to settle the question. Finally J. J. Thomson developed the unexpected fact that certain gases were retained by glass under the most severe treatment, such as heating to the softening point. Ramsay's alleged results are now of historical interest only.

And so it is with the supposed "anti-Einstein" evidence today. Miller's results stand alone. Without independent confirmation they can not gain acceptance. Half a dozen attempts at confirmation have failed, and their very failure is the best proof of their claim to recognition.

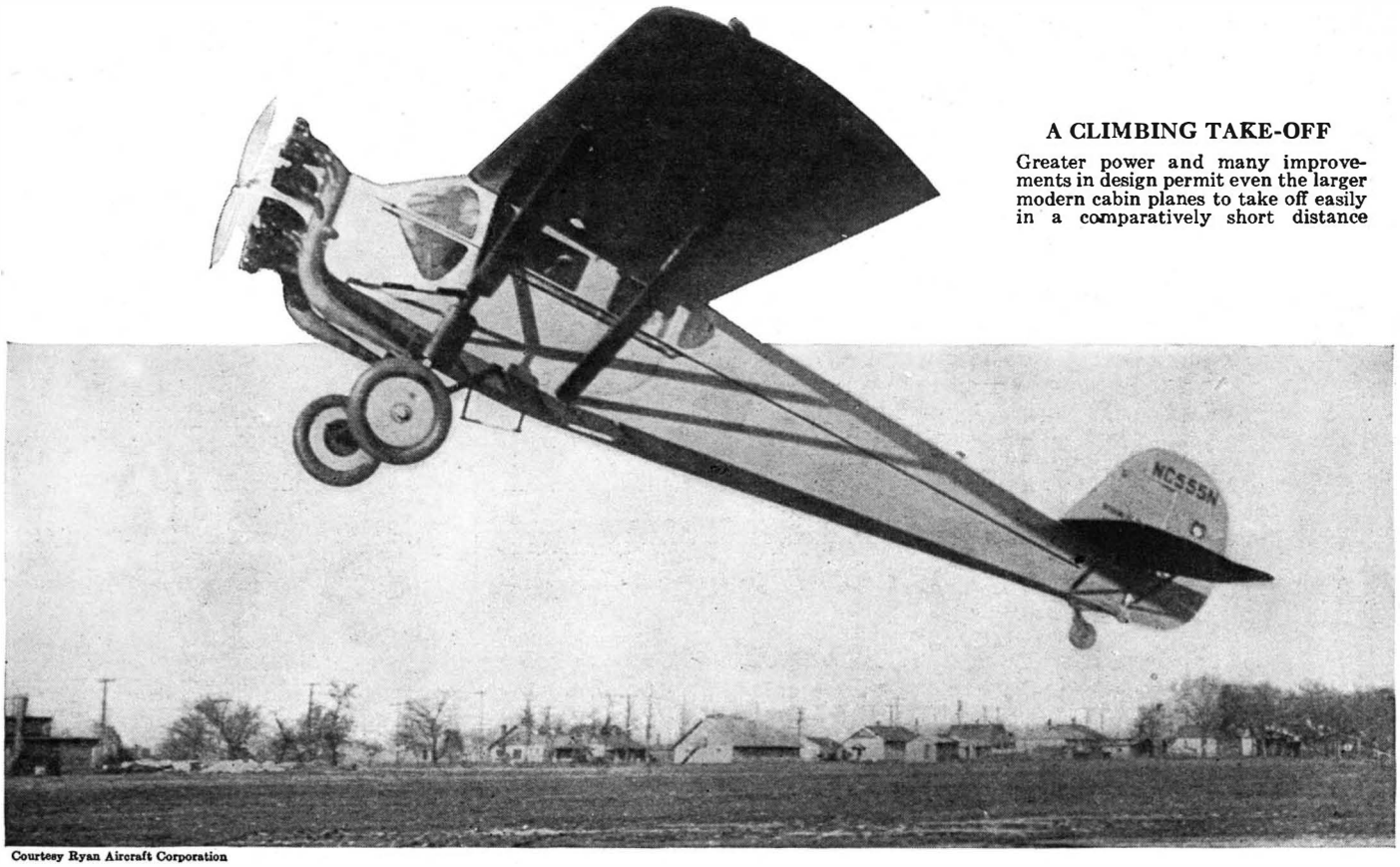
¶ *"Waves and Particles" is the title of a thought-provoking article written by Professor G. P. Thomson of Scotland, and soon to be published. Professor Thomson helped prove the new wave-atom theory.*



Courtesy of *Nature* (London)

REPETITION OF THE MICHELSON-MORLEY EXPERIMENT

In 1926-'28 Michelson, Pease, and Pearson re-performed at Mount Wilson Laboratory the original Michelson-Morley experiment on the basis of which Einstein dispensed with the ether, in order to check Miller's findings—i.e., of an ether drift, hence the existence of an ether. Their results did not support Miller's findings, which connote the existence of an ether



A CLIMBING TAKE-OFF

Greater power and many improvements in design permit even the larger modern cabin planes to take off easily in a comparatively short distance

Courtesy Ryan Aircraft Corporation

Better Days for Aviation

Present Safe, Dependable Airplanes Will Be Further Improved and the Industry Placed on a Sound Business Basis

By EDWARD S. EVANS*
President, Detroit Aircraft Corporation

AT a Chamber of Commerce dinner which I attended recently, two men were talking about the future of the aviation industry.

"Five years from now we shall all have our air flivvers parked in our garages, and regulating traffic in the skies will be as much of a problem as street traffic is now in downtown business sections," one of them said to me. "I have half of my investments in aviation securities, and I expect to see these make a small fortune for me in the next five years."

"You are wrong," said my neighbor on the left. "Air transportation offers few practical advantages over other means of travel. It has yet to be developed to a safe practical basis. Aviation offers a thrill to the young man and woman, and airplanes are useful for carrying mail, but they cannot compete with other means of transportation. One hundred years from now our successors in business may travel by airplane regularly, but our generation will never see aviation developed so that it is of much value to the public."

*See "Among Our Contributors," page 421.

Both of these men had entirely the wrong picture of aviation, but their opinions are held by many business executives, so that it may be of interest to consider some of the questions that are confronting the industry, as well as some of the past and probable future developments. In the next few years, every executive of a large corporation, who has not already done so, will have to give consideration to the place of air travel in his organization.

IN order that present conditions may be understood, it is necessary that we review briefly the development of popular interest in aviation. Colonel Lindbergh's historic flight may be said to have marked the beginning of commercial aviation in this country. Immediately after this flight, every airplane manufacturing company was flooded with orders for new planes.

In 1925 the writer made a record-breaking trip around the world in 28 days, using airplanes for a large part of the trip. Many of my friends at this time thought I was writing my death warrant every time I stepped into a plane. And yet these same men and women and millions of others all seemed to want to get into the air in 1927, and there were not planes enough to accommodate them. Commercial operators were making small fortunes from taxi hops and cross-country flights; and scores of planes were purchased for various advertising and other commercial services.

At the old San Diego plant of the Ryan Aircraft Corporation which built the *Spirit of St. Louis*, it was not unusual for purchasers to offer from 1000 to 3000 dollars over the advertised price of a ship for immediate delivery. Not one of the companies then in business was equipped for anything like quantity production, and by the fall of 1927, the company that could make delivery within two months after receipt of an order was unusual. Many purchasers were willing to buy anything that would fly, regardless of the plane's reputation or design. This surplus of orders caused the formation of a large number of new manufacturing concerns, many of which were not making planes based on sound engineering design. The crashes in which such planes figured did much to shake the public's confidence in flying. Fortunately this situation has

now been corrected by the strict Department of Commerce regulations requiring engineering approval and flight inspection of every new plane, and periodic inspections of all planes used in inter-state travel.

Although there was undoubtedly far more business than the existing plants could take care of, the fact that many purchasers tried to obtain planes from two or three companies before finally placing their orders gave rise to the belief that there were more purchasers than was actually the case. Many plants were doubled and tripled in size; scores of new ones were built; and everything possible was done to speed up production.

LINDBERGH'S plane was one of the few cabin ships on the market, and the demand for that type was so great that many companies were forced to design entirely new ships. All materials entering into aircraft construction were difficult to obtain, competent men in all departments were scarce, and the industry was suddenly confronted with the new problem of quantity production. Selling planes was the least of the worries of aircraft company executives.

In view of these conditions, it is little wonder that the industry has made many mistakes. It was to be expected that certain promoters would seize upon the public's desire to invest in aviation enterprises as an opportunity to organize companies having no economic reason for existence. The history of the aviation industry has been no different from that of other new industries in this respect.

It has been only recently that aviation companies could offer high enough remuneration to attract men of broad and successful business experience. Originally, the pioneer work was done either by engineers or pilots. The country owes a debt of gratitude to these men who carried on through nine years of almost insurmountable obstacles, bringing the airplane to its present stage of reliability. It was only after this tedious pioneer work had been accomplished that the country's purse strings were opened and the necessary money provided for establishment of air transport lines and aviation schools, and for the development of improved airplane designs and manufacturing facilities.

We have heard much in recent months about overproduction in the aircraft industry, and many unfounded rumors as to the general condition of the industry have given rise to opinions in some quarters that the aviation industry is in anything but a strong position. Despite the fact that aviation has just had the most successful year in its history, production did fail to come up to certain over-optimistic predictions made early in 1929. In 1928, approximately 5000 planes of all types were built in this country. Some aviation enthusiasts predicted that the 1929 production would be over 10,000. Figures for 1929 recently released by the Aeronautical Chamber of Commerce give the airplane production at 6034 planes and the value of motors and planes manufactured at 98,000,000 dollars.

In 1929 the production of planes for commercial use increased 51 percent by number and 93 percent over the preceding year in value. There is nothing phenomenal in this increase, but it is a record which few industries could point to last year, and one of the best indications of the increasing air-mindedness of the American public and business man.

The Army and Navy are taking a rapidly decreasing proportion of the total production. Seven years ago, all airplanes produced were intended for military purposes, while last year this market absorbed less than 25 percent of the production.

The greatest problem now confronting the industry is that of educating business executives to the practical value of air transportation. It is true that the industry has been somewhat backward in adopting a sound merchandising policy. From 1918 up to the present time aviation has been presented the greatest amount of publicity ever given a new industry. In some ways this has hurt rather than helped in educating potential users as to the value of this modern mode of transportation. Far too much emphasis has been placed on the romantic appeal of flying, the danger of traveling by plane, and the thrilling experiences encountered by pilots and passengers.

THE whole American business structure is based upon speed. Small inventories require fast deliveries, the many recent mergers have placed a great premium on the time of business executives, the necessity for frequent changes in the design of products requires many consultations with high salaried consulting specialists, and present conditions require frequent personal contacts between salesmen and the home office.

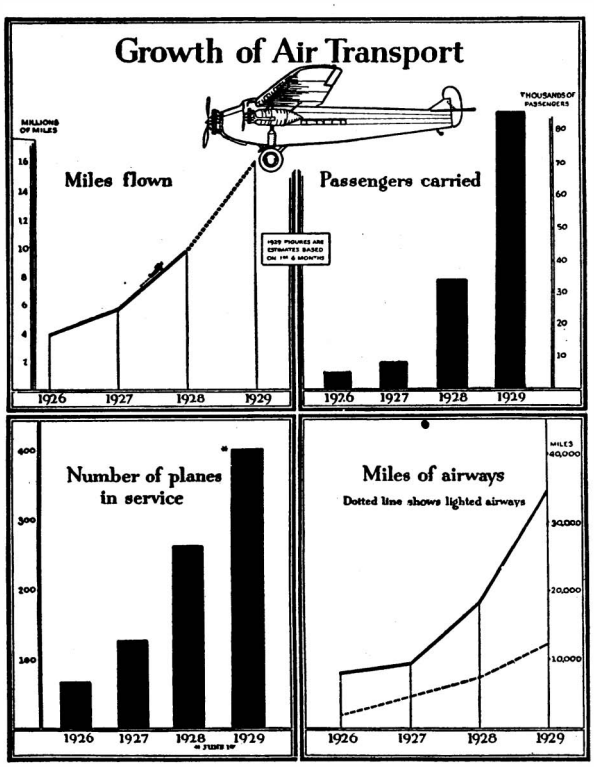
A survey recently conducted by the Detroit Aircraft Corporation showed that approximately 180 companies now own one or more planes. At least 20 of these own two or more ships, and it is believed that this list will be increased to many hundred by the end of 1930.

During the recent scramble to increase production in an attempt to meet the sudden demand for planes, many plants were expanded more rapidly than future economic conditions warranted. Certain companies now find themselves with uneconomical manufacturing facilities on their hands, and this will result in a certain

Courtesy Ryan Aircraft Corporation

THE AIRPLANE IN CHINA

The awakening interest in aviation of oriental and South American businesses and governments is expected to open a rapidly increasing foreign market for American-made aircraft



PROGRESS TO DATE, FROM 1926

A self-explanatory series of graphs which strikingly show the increasing use of airplanes in this country

amount of new plant construction in the near future.

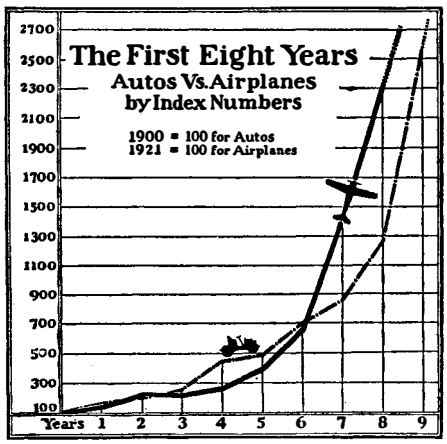
Airplane buyers today are most discriminating, and usually carefully compare the performance, reputation, and price of all ships that might fulfill their requirements. This has placed certain of the smaller companies, whose planes are not soundly engineered, in a serious position, and will undoubtedly result in a great reduction in the number of aircraft manufacturing companies. The Department of Commerce recently listed 240 companies that claimed to manufacture airplanes. The great majority of these were not equipped for anything like production, and many were founded purely as a basis for stock promotion. The production of 20 of these companies accounted for 85 percent of the 1929 production. By the end of 1930, it is probable that the number of companies engaged in all phases of aviation will be greatly reduced.

The prospective investor will do well to limit his investments in aviation enterprises to those companies which have a long record of achievement behind them, or holding companies controlling a well rounded group of organizations the permanency of which is assured by past accomplishments.

THE most significant factor of the industry for 1929 was the vast amount of new money that was poured into aviation, and the many mergers which were consummated. In the last 18 months, some 60 formerly independent companies have been merged into the "Big Four," composed of the Curtiss-Wright Corporation, the Aviation Corporation of America, the United Aircraft and Transport Company, and the Detroit Aircraft Corporation. Each of these companies controls a well rounded group of from 10 to 20 organizations specializing in various lines of manufacture and operation. There are still some 20 strong independent companies that have enough reputation and financial backing to meet the larger groups in any period of competition. In view of the stock market situation, it is not probable that there will be much further consolidation during the present year except possibly in the accessory or raw material fields.

The industry is now going through the third stage of its development. From the time of the Wright brothers' first flight until Colonel Lindbergh's flight in 1927, aviation was going through an engineering development. During this period, the basic aerodynamic problems were solved; and the next 18 months were devoted to meeting problems of efficient production. The latter half of 1928 and 1929 saw nearly 500,000,000 dollars of new financing poured into various aviation enterprises, the merger of many companies, and the introduction of more highly efficient business management.

We now approach 1930, when the main emphasis will be laid on efficient merchandising and selling the public and the business man on the practical time and money-saving value of flying. Until the last six months, airplane sales took care of themselves, but now with more discriminating buyers and the ready market from commercial operators and transport lines well covered, the industry has had to branch out and seek new purchasers. Up to the last year, not more than five companies had developed anything like a nation-wide distributing organization. Now every company is making efforts to establish dealers and distributors in all parts of the country. Most of the companies are requiring that these distributors make arrangements for servicing and storing planes, and some are requiring that they carry a stock of replacement parts.



LAND VERSUS AIR

Progress of aviation compared with that of the automobile: first eight years of each

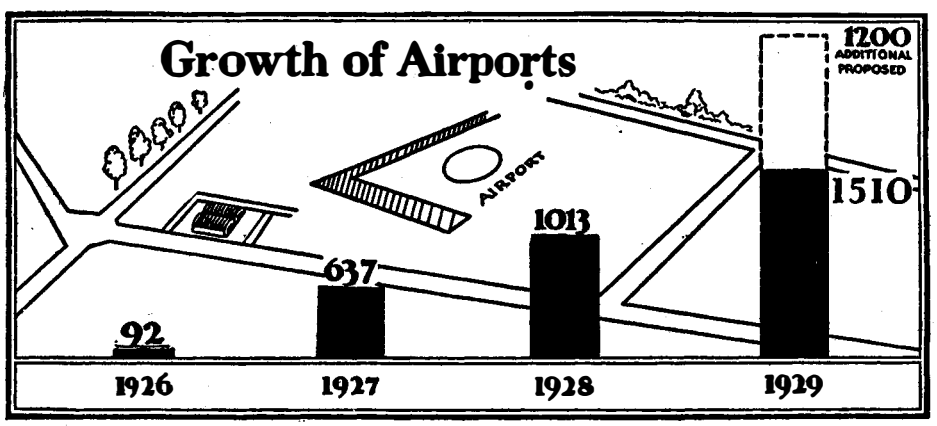
Showrooms have already been established in some of the larger cities, and the next few years will probably see even cabin planes on permanent exhibition in the business sections of every large community.

Financing plans have recently been put into effect by the better established companies, and it is now as easy to finance the purchase of an airplane as it is to buy an automobile out of income instead of capital.

Every few months we see some statement predicting that in the future we will all have "flivver" planes parked alongside our automobiles in our garages, that soon we will be flying directly to the roofs of our office buildings, and other startling developments. Such things may come in the next generation, but it is doubtful if the readers of this article will ever witness much change in design.

IT is a brave man indeed who is willing to make any predictions as to what the future holds in store for aviation, but there are some things that stand out as fairly certain. In spite of all the many new developments in the field of aeronautics, it is doubtful if we will see much basic change in airplane design in the next few years. Improvements and refinements, of course, will be made. These will increase the speed and carrying capacity, reduce the length of run required to land and take-off, give more comfort and even greater reliability. We will see many spectacular experiments in the next few years, but our present modern planes incorporate the features that make for safe, dependable operation. The engineering departments of several of the larger airplane manufacturing companies are working on radically different designs, but it will be many years before any of them will have gone through the engineering development necessary to bring them to the point of safe, practical application to air travel.

The present year will see the aviation industry settled on a definite stable business basis, with healthy increases in the value of products, and popular confidence in flying. Spectacular achievements will be less frequent, for there will be less need of them. The problem which is rapidly being solved will be to place dependable, economical aviation equipment at the convenient disposal of every individual and corporation in need of fast transportation.



EVERY SIZABLE TOWN BOASTS ONE OR MORE AIRPORTS

In 1926 there were very few well-equipped airports but at the end of 1929 their number had multiplied over 15 times. Now many communities have several and others are being added

Tangled Commerce Abides Where Children Smoke and Swim

The Antipodean Manus Are the Pack Peddlers of the Pacific

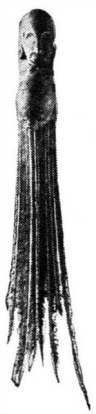
DR. MARGARET MEAD, Assistant Curator of Ethnology in the American Museum of Natural History, recently returned from the Pacific where she had been investigating Melanesian tribes on the islands off the coast of New Guinea. Dr. Mead's presence in the Admiralty Islands was prompted by a desire to see how children and adolescents of a primitive people compare with children and adolescents in civilized society. The Admiralty Islands formed a part of what was German New Guinea, but they are now governed by Australia under a League of Nations mandate.

These islands were selected because they have been little studied. The Manus, while a primitive people, are highly developed commercially. The Manus number about 2000 and they live in several thatched Venices on stilts like Swiss lake villages. Why these people should have left the mainland for the reefs and tiny volcanic peaks where there is standing room only, is a mystery of the South Seas.

Dr. Mead learned the language of the Manus and made an excellent collection to illustrate their manners and customs. The Manus are born traders and they exchange anything at a profit. They bring sea water to the mainland and exchange it for fresh water with those who live on the mainland. The fresh water is transported to their island home. The legal tender is dog's teeth, but the currency was becoming debased because wily traders had been importing the teeth from China and Turkey. In trading with the whites, Louisiana tobacco twist is the standard of barter and as it passes from dirty hand to dirty hand it becomes mouldy and it has to be consumed in a pipe or rolled into cigarettes with the aid of old newspapers. Children of both sexes begin to smoke at the age of three and it apparently does them no harm, nor does it stunt their growth —but it surely looks extraordinary.

GIRLS MAY SMOKE

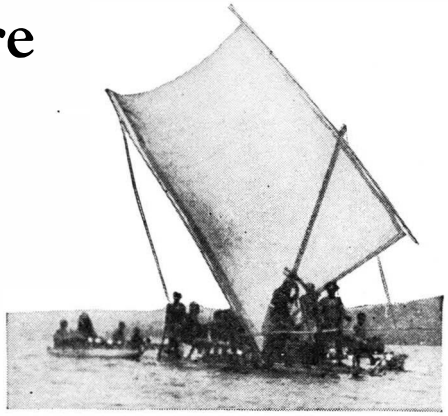
An adolescent girl holding up the skeletons of fish she has eaten. It looks like a perpetual Lent. Below is a war charm, one of the interesting specimens collected



The Manus developed the character of traders because they have a virtual monopoly on fish, while the mainlanders had virtual monopolies of everything else. The Manus catch fish, trade them to one mainland tribe for carved wood, trade the wood to another tribe for pigs, and trade the pigs to another tribe for dog's teeth, making a profit on each transaction.

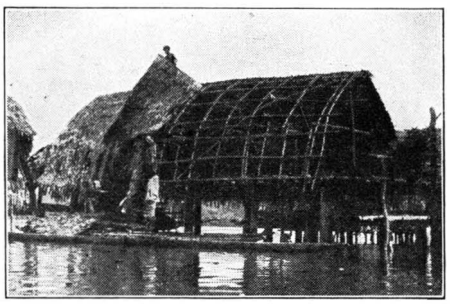
The Manus are so isolated that they must use canoes or swim. Even children three years old swim and are able to handle canoes. The oldest member of the tribe can remember only one case of drowning. Two children were out in a canoe which capsized and the younger, aged three, was drowned. The father wanted the other child, aged five, punished for murder, as any five-year-old child should be able to swim half a mile and tow another one. There is eternal wrangling about nothing among the tribesmen, and they like nothing so well as to foregather at the sound of a native drum.

Their religion is based on worship of the spirits of ancestors and the community laws are maintained by religion and shame rather than by civil punishments.



A CANOE FUNERAL

The Manus of the Admiralty Islands have curious death customs. It is necessary to bury the deceased on the land

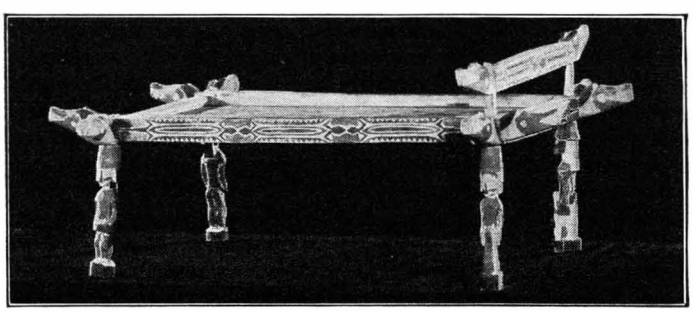


POST MORTEM HOUSE MOVING

After a death it is customary to remove a house to a new location, as is being done

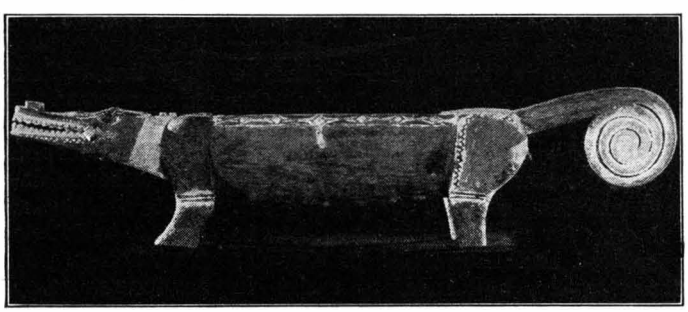
BUILT ON PILES

A South Sea Venice. Visiting and trading is done by water with the aid of canoes



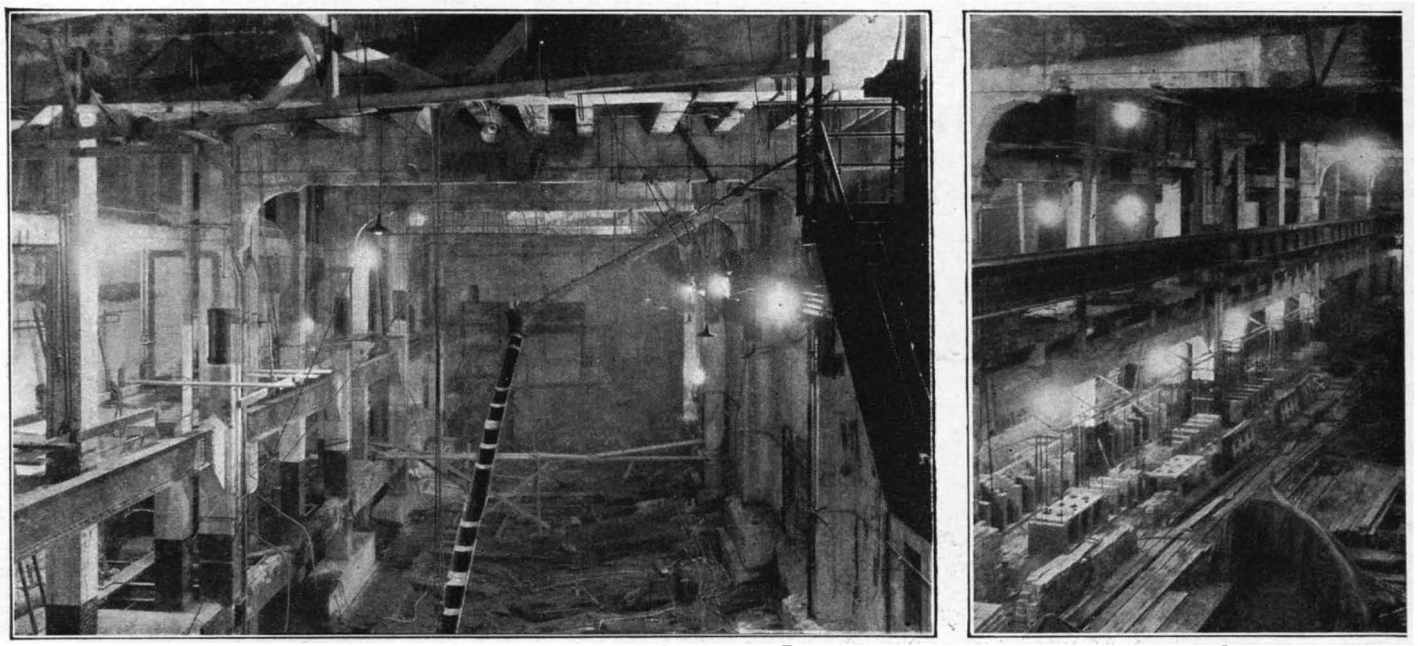
BED MODEL

The Manus are the only South Sea people that sleep in regular beds. This bed certainly looks hard, especially the pillow



NATIVE ART

Here we have a wooden bowl with a crocodile's head and a pig's tail. This is probably the South Sea Islander's conception of art



THREE VIEWS OF PROGRESS IN THE DYNAMO ROOM OF GRAND CENTRAL

Moving a Substation Underground

Without Interruption of Service, Substation Is Moved Seven City Blocks to New Underground Location

By F. B. FREEMAN
Chief Engineer, New York Central Railroad

WITH the co-operation of the General Electric Company and the Thompson-Starrett Company, the New York Central Railroad Company recently completed the unique engineering feat of dismantling and transposing the Grand Central Terminal power plant —a city block in area—from its former location on the surface at Lexington Avenue and 50th Street, New York City, to a site about 100 feet underground and seven blocks distant. The present installation constitutes the world's largest power substation.

Light, heat, and power is distributed by this plant to more than 60,000 persons occupying floor space exceeding 256 acres. This plant provides the electricity which illuminates 100,000 or more electric lights, moves more than 650 trains daily, operates 325 elevators in 28 buildings, and supplies these buildings—among the largest in the world—with the hot water which heats some, the steam that heats others, and hot water for general purposes. It also distributes steam to warm innumerable railroad cars, and it compresses air, not only for railroad purposes, but to open and close hundreds of elevator doors in the buildings, to assist in cleaning, and for other uses.

The magnitude of this moving job becomes apparent when one considers that the engineers were compelled to dismantle the plant, move much of it the distance of seven blocks, and add new apparatus, without interfering with the operation of the terminal or of the trains entering it, without hampering street traffic, which is quite heavy, and finish the job on a scheduled date which necessitated the work being placed on an emergency basis, all due to the former site being required for the construction of the new Waldorf-Astoria Hotel.

The economic necessity for a change in the location of the old plant was foreseen, due to the ever-rising mid-town real estate values, some years ago, and careful studies showed the advisability of moving the power plant facilities underground. It was presupposed in all plans, however, that the major apparatus would remain at 50th Street.

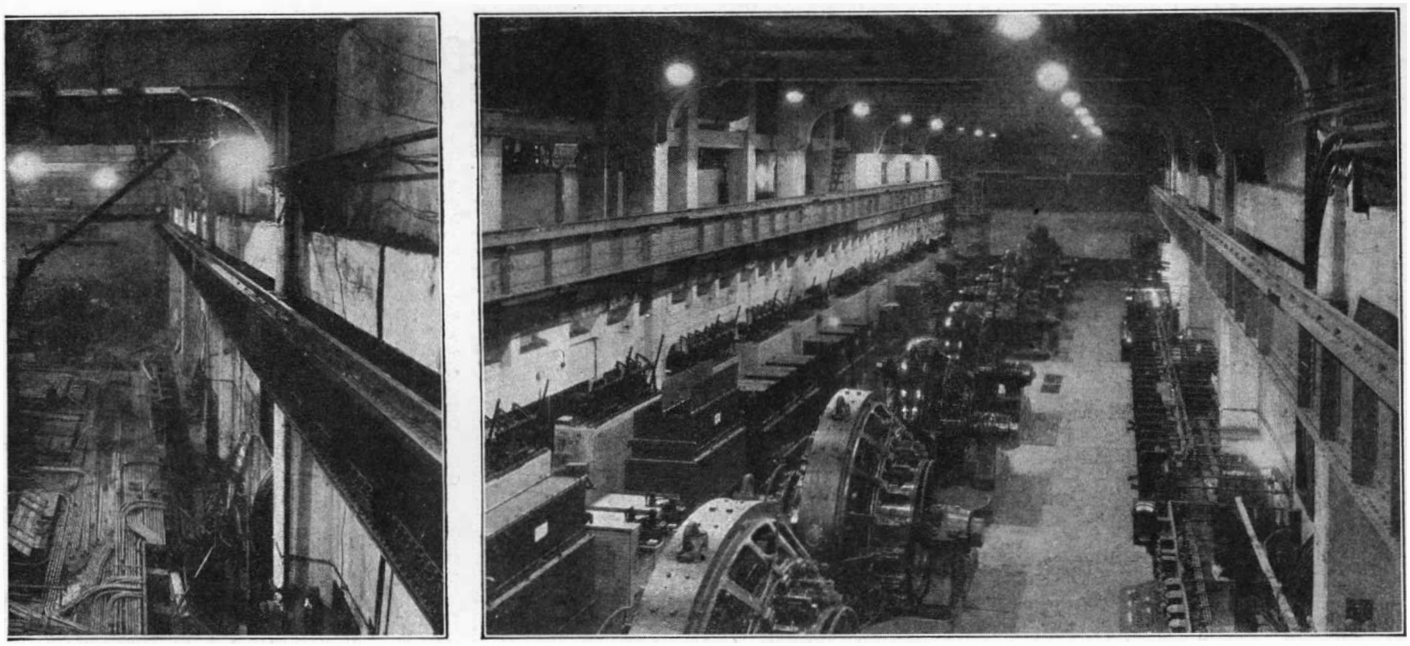
IN line with the company's general expansion program, the present site of the substation—an excavation about 90 feet deep and 225 feet long by 60 feet wide—had previously been made in the solid rock under 43rd Street, to accommodate a boiler plant. Two boilers were installed, with room for four more. This plant consisted of four floors: a basement, a boiler room, a meter room, and the coal bunkers. The stack extended to the top of the Commodore Hotel and was concealed in that structure.

Another vast cellar was also dug out under the southern end of the Graybar Building, adjoining this boiler plant excavation, for the accommodation of the mechanical facilities which, under the early plans alluded to, were not to be included among those to be placed underground at 50th Street at some future date. Calculations then established the fact that it would be possible to utilize the great stone vault, intended for the boiler plant, as the new site of the substation.

Ordinarily, six months would be required to draft the plans, and at least a year for the construction and removal. The lease was signed March 4, 1929, and dates set for the clearing of the various buildings for demolition. Although no drawings had been prepared, other than preliminary sketches, work was begun at once under verbal direction, followed by drawings as soon as possible. Despite these trying conditions, no change in any major plan was necessary during the course of this work.

Briefly, the following broad plans were carried out:

The steam generating plant was abolished and steam was purchased from the New York Steam Company system; and the space under the Graybar Building was turned into



TERMINAL'S NEW HEAT, LIGHT, AND POWER PLANT, 100 FEET UNDERGROUND

a heater and pump room to utilize this steam to heat the immense quantities of hot water needed, utilizing tanks of 20,000- and 50,000-gallon capacity. In this space were also placed the fire pumps, hot and cold water pumps, air compressors, and other auxiliary apparatus.

The two boilers were removed from the "boiler plant" excavation, the basement was enlarged, concrete foundations constructed for the 10 rotaries, an operating floor provided for conduits and with spaces for transformers, switchboards, oil switches, and other apparatus. Also, crane girders and a 30-ton electric crane were provided.

The meter room was made into an exhaust fan room, taking air from the top of the substation and exhausting it into the boiler breeching of the old arrangement and thence up the stack. The bunker space was converted into a stand-by battery room. Here was installed an 8000-ampere battery consisting of 150 cells, each weighing 4550 pounds.

The transfer of this battery was a major problem. A city ordinance prohibits the transportation of acid in open tanks through the streets, and use was made of an underground trucking passage. Time being at a premium, the battery could not be dismantled. Part of the acid was removed, the plates were clamped in place, and each cell was placed on wheels and lowered by tackle a distance of about 55 feet. They were hauled underground by an electric truck to 43rd Street, and raised by an elevator to their present site. During the moving not a drop of acid was spilled and not a cell was injured. The care that had to be exercised may be judged by the fact that the weight of each was sustained on glass plates.

Reliability of service was assured by connecting the lighting substation at 50th Street to the New York Central high-tension system and the lighting substation at 43rd Street to the New York Edison system. This stand-by battery was removed and re-assembled and placed in service in 53 days.

The total weight of the 10 rotaries installed, their transformers and other major electrical apparatus, was 850 tons. Much of this had to be lowered piece by piece a vertical distance of 50 feet from the unloading platform to the substation main floor. All materials were moved by flat cars from 50th Street on tracks which could be kept out of service only a few hours at a time. To remove 30-ton armatures in a limited number of minutes required exceptional skill.

THE traction system of third-rail feeders, 36 in number, extended through a complicated system of ducts from the substation at 50th Street to various third-rail sections on both levels of the terminal. To lead them all to the new substation would require an expensive duct system and miles of cable. Therefore, a circuit-breaker house was constructed at 49th Street and all these cables connected to switchboard panels therein, but under distant control from 43rd Street. Twelve cables were connected between the 43rd Street substation and this circuit-breaker house.

These cables carry the average current to this 49th Street house, where it is subdivided among the various third-rail feeders. The electrical effect is the same as though the 50th Street substation had not been moved; but the relaying by miles of wires was eliminated.

Since the piping system of the terminal was laid out in a square with one corner near 50th Street, where steam, water, and air were introduced, and another corner near 43rd Street, it was decided to open these pipes at 43rd Street as a new feeding point and to close them at 50th Street, thus using the same pipes.

Existing masonry conduits were used, as far as possible, to contain the electric cables and supplement these by an overhead metal conduit system in existing trucking subways. It was necessary to install and support in an elevated position throughout the terminal, approximately 20 miles of 3½-inch steel conduits. Into these conduits and the existing masonry conduits, 35 miles of cables of large size were drawn. These are the lighting and traction feeders. In addition, several miles of high tension and control cables were installed. The conduits concealed in the floor of the substation have a total length of 25,000 feet. In each conduit, from one to 16 wires are installed.

The high-tension masonry bus is 175 feet long and is divided into five sections. Connecting to it are 36 high-tension oil switches. More than 70 tons of bar copper was used in the buses. This all had to be drilled, bent, insulated, and supported.

All this work was accomplished without any interruption to, or interference with, the normal operation of buildings, in the lighting or signal power supply, or in the traction current for the movement of trains. No traffic delay occurred in connection with the loading or unloading of apparatus, although such work took place on tracks in daily rush-hour service. Each unit of the new plant started operation on or ahead of schedule. No damage was done to any piece of apparatus during transfer. And during the entire intricate operation, which was completed at a cost of more than 3,000,000 dollars, not a single man was injured.

Warmed By Satan

An Engineer's Discussion of the Familiar Proposal to Derive Power from the Earth's Hot Interior

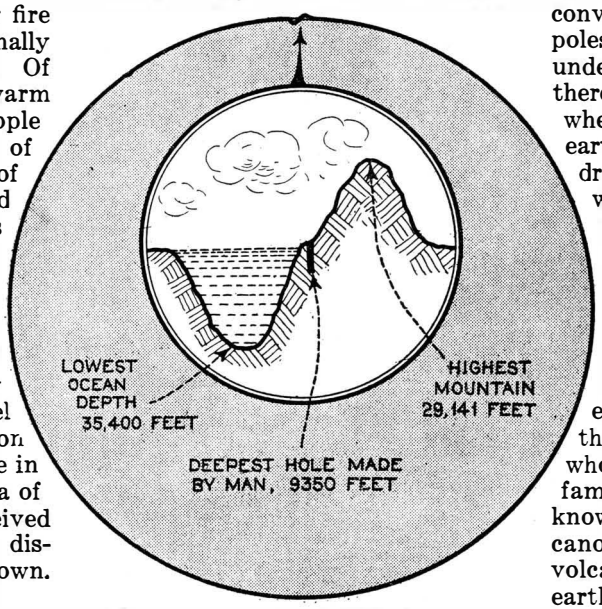
By THOMAS T. READ, E.M., Ph.D.*
Vinton Professor of Mining, Columbia University

THAT the interior of the earth is very hot is one of the things that people generally believe, without knowing anything about it. Primitive men needed no evidence other than volcanic outbreaks to convince them of it, but then the number of people who have ever seen a volcano at any time, much less one in eruption, must be very small indeed, and it is probable that the idea is one of those that the superstitious mind (and most of us are superstitious) has a natural tendency to believe. Millions of people believe that there is somewhere a place of everlasting fire where the wicked will be eternally punished for their sins on earth. Of course, such an idea originated in warm countries, where heat makes people uncomfortable. The primitives of the northland believed the place of eternal punishment was a cold place. The inside of the earth was a conveniently inaccessible place to assign as the locus of Sheol, Gehenna, Hades, or whatever the hot place was called.

Interest in Hell as a place of eternal punishment has generally waned and many people now feel that they catch enough Hell on earth, without expecting any more in the hereafter. Meanwhile the idea of a hot interior of the earth has received some scientific support from the discovery that the earth is cooling down.

OF recent years public attention has been stirred, every now and then, by someone's suggestion that since the interior of the earth is very hot, all we have to do is to find a way of bringing the heat to the surface and we will thereafter have a perpetual source of heat, without having to dig and burn coal. There is something peculiarly comforting in the thought that the presiding genius of the hot place, instead of being an evil spirit who will torture us forever, may really be a beneficient individual who will bless our descendants by freeing them from coal strikes and furnace tending, and it seems worth while to consider whether there is any more inherent probability in the new view than there was in the old one.

Why do we believe the interior of the earth is very hot? The distance from the outside of the earth to the center is about 21,000,000 feet and the deepest hole men have made into it is about 9350 feet or about 0.045 percent of the whole distance. But hold up, where is that measured from? From the top of the hole, of course. It does not require a very alert mind to see that a man who dug a hole in the bottom of a valley would be starting nearer the center of the earth than a man who dug a hole, starting on top of a hill. The deepest hole is Oscar Howard's No. 7 Hathaway well in the Sante Fe Spring Field in California, and it does not get as near the center of the earth as many "deeps" in the Pacific Ocean,



JUST A SCRATCH
The deepest place in the sea, exaggerated six times, is shown at the top of the outer circle representing the earth. In actual distance this place reaches only 1/620 of the distance to the earth's center

for its reported depth in January was 9350 feet. The highest mountains stick up nearly six miles above mean sea level, and the deepest holes in the ocean bed are even deeper, so that the holes that men have been able to make are only about one quarter as deep as the holes Nature has made.

But men have made lots of holes several thousand feet deep; the total number of oil-wells in the world is somewhere near a half million, not to mention water wells and mines. I have myself been 6700 feet below the surface of the earth in the St. John del Rey mine in Brazil, which has since been deepened to over 7200 feet. Workings in South Africa are 7600 feet deep. As you go down in these holes you find the temperature rises as you descend. To make matters more difficult for us, the rate of increase is different in different places. In some it is as much as one degree Fahrenheit for every 60 feet in depth. In South Africa where there are many deep mines, the rate is only one degree for every 250 feet.

It is all very puzzling, for if the earth was uniformly hot all over hundreds of millions of years ago and has been cooling down ever since, it is evident that it ought to have cooled down faster near the poles, and the rate of increase as you go down there ought to be slower. No one has yet found it convenient to dig deep holes near the poles, so we do not know what it is like underground, but we do know that there are active volcanoes in Iceland where there ought not to be any if the earth has been cooling off for hundreds of millions of years. The only way to get around that is to suppose that relatively recent cracks in the earth's crust have let hot material come up from below, just as hot lava comes up in a volcanic outburst.

Explaining the mechanism of a volcano is much more difficult than explaining that of a radio set, for there are at least a thousand people who are interested in and somewhat familiar with radio, to every one who knows or cares anything about a volcano. The simplest way is to say that volcanoes are local hot spots on the earth's surface, much as a steam radiator is a local hot spot in a room. We know very well where the steam in a radiator comes from, but there are at least seven different hypotheses as to what makes lava melt. The one which nobody believes any longer is that the interior of the earth is molten, and that the lava comes up from below as steam does from the boiler in the cellar.

ALTOGETHER, figuring out that the interior of the earth is at a temperature of 7000 degrees, or 27,000 degrees, as various people have done, seems to me to be a good deal like the well known process by which a city dweller figures out, with pencil and paper, how he can get rich by raising chickens. The scientist calls the process extrapolation; you know the course of the line from A to B, and you simply prolong it to C. It is perfectly easy to prolong a straight line, but when the known points make a line that looks like the track made by a two-day old

*See "Among Our Contributors," page 421

calf trying to get to the other side of the pasture, prolonging it is anybody's guess. Anyway, you always can say, if anybody denies your conclusions, that he can not prove it is not the way you say it is.

After all, it doesn't matter just how hot the interior of the earth is, as long as it is a good deal hotter than the outside, and everybody who knows the evidence of observations made can at least agree on that much.

The next question is, what of it? Everybody knows that Palm Beach is considerably warmer than Kennebunkport in January, but the only practicable way for a Kennebunkporter to benefit by it is to buy a ticket to Florida. The people who dream of having Satan for a janitor are pleasantly vague about it. They propose to dig holes anywhere from five to 25 times as deep as the deepest artificial holes yet made and somehow bring the heat up the hole.

Maybe the digging of the hole can be done. It costs from 75,000 to 150,000 dollars to dig a deep oil well and the deeper you go the more expensive it gets. A hole five miles deep probably could not be made at all with present methods and equipment, and even if it could no one could guess whether it would cost 5,000,000 or 50,000,000 dollars. Obviously we would have to have two holes, for if the water to make the steam went down an inner or outer tube in the same hole that the steam was coming up, the heat in the steam would go into the water. In fact, it is a very puzzling problem how, starting with steam at the bottom of a hole five miles deep, you could get it to the top without having it cool down and condense to water again. But maybe it could be done if the steam passed through the hole fast enough, for the rate at which the heat would leak away is so many heat units per minute and if the quantity of steam passing through is multiplied by ten the percentage of heat lost is reduced to one tenth. So let's say it can perhaps be done, and that we will trust inventive genius to find the way.

ASSUMING that we can make a hole for the water to go down and another for the water to come up, the next question is, how to connect them at the bottom. The only reasonable answer is, I do not know. The boring of oil wells is done from the surface, but to make a hole five times as deep as the present deepest would probably involve getting down inside it, and since we are being so generous let us concede that perhaps people could somehow get to the bottom of the hole and make a cross passage. It is only a few years since nearly everybody was quite sure that men could never fly through the air, and it is decidedly risky to say anything cannot be done, merely because no one now knows how to do it.

ONE OF THE EARTH'S "HOT SPOTS," THE GEYSERS, CALIFORNIA

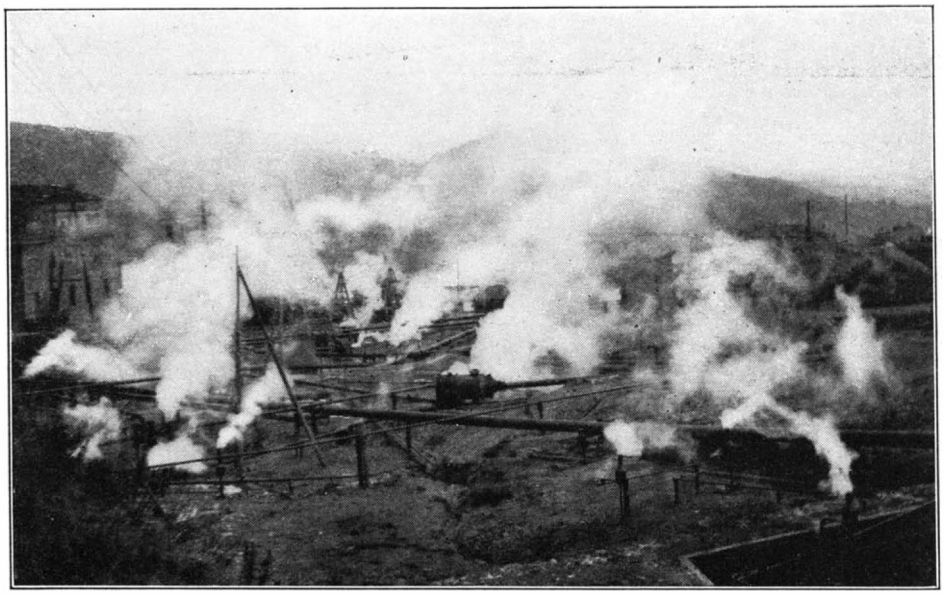
Wells drilled into the warm ground at The Geysers, 60 miles north of San Francisco, give steam at high pressure. This thermal region has been studied scientifically by Dr. Arthur L. Day, Director of the Geophysical Laboratory of the Carnegie Institution of Washington and Dr. E. T. Allen of that Laboratory. This photograph, showing escaping steam, was taken by Dr. Day, as was the one on the cover of our number for November. Through an inadvertence having to do with editorial routine that fact was not then mentioned

But here another question troubles us. How would we keep the hole open, even if we could make it? Everybody knows that in making the tunnels under the North and East Rivers, in New York, much engineering skill is required to guard against the pressure forcing the soft materials of the river bottom into the hole that is being made. At these shallow depths the pressures are such that compressed air, cast iron rings, and concrete are able to cope with them, but when we talk about depths of five miles, or 25 miles, we are in a region of immensely greater pressures. From laboratory experiments Professor Adams, of McGill University, concluded that holes could exist in solid granite at a depth of 11 miles. Whether they could exist at twice that depth is extremely doubtful; where the rock is not solid much difficulty is experienced in keeping the holes open in ordinary mines.

Finally, there are those inexorable things, the laws of thermodynamics. Lest the reader hastily turn over the page, let me say at once that I am not going to tell what they are. Everyone knows that you can not cook eggs on top of mountains, because the water boils at too low a temperature to cook the eggs. The reason is, that the lowered pressure lowers the boiling point. So it is easy to understand that raising the pressure raises the boiling point, but the interesting thing is that it finally gets to the point where you can not boil it at all. Perhaps it would be better to say that at such high pressures and temperatures no one can say whether you would have water or steam. If a hole five miles deep were filled with water flowing down it, to come up the other hole as steam, the pressure at the bottom would be about 11,500 pounds per square inch and the temperature, on the basis of one degree for every 200 feet, would be 130 degrees above what it started down at, or say 200 degrees. This is below the boiling point at surface pressure. The critical pressure of water is about 3000 pounds per square inch; at that pressure it boils at 690° Fahrenheit, and above that pressure no increase in temperature would make it boil. Since the pressure at the bottom of the hole would be nearly four times the critical pressure, even the heat of an oxy-acetylene blowpipe would not suffice to make it boil there. But this difficulty could be met by letting the water, after it had descended a limited distance, discharge into an open catch basin, and so go on down, arriving at the bottom at a pressure corresponding to the last drop, or 433 pounds to the square inch for a drop of 1000 feet. At this pressure a temperature of 450° Fahrenheit would suffice to make it boil.

Of course it is not necessary that the

water should boil at the bottom of the hole, but what we are after is heat, and a pound of water raised 130° Fahrenheit in temperature has taken on 130 heat units, while a pound of water that has been converted into steam 130° Fahrenheit above its initial temperature (whatever that was), has taken on 1102 units. Because of the greater heat-transporting power, therefore, we should much prefer to bring the heat up in steam. Let us see whether there is any chance that we could do this.



ANOTHER WELL KNOWN HOT SPOT—IN ITALY

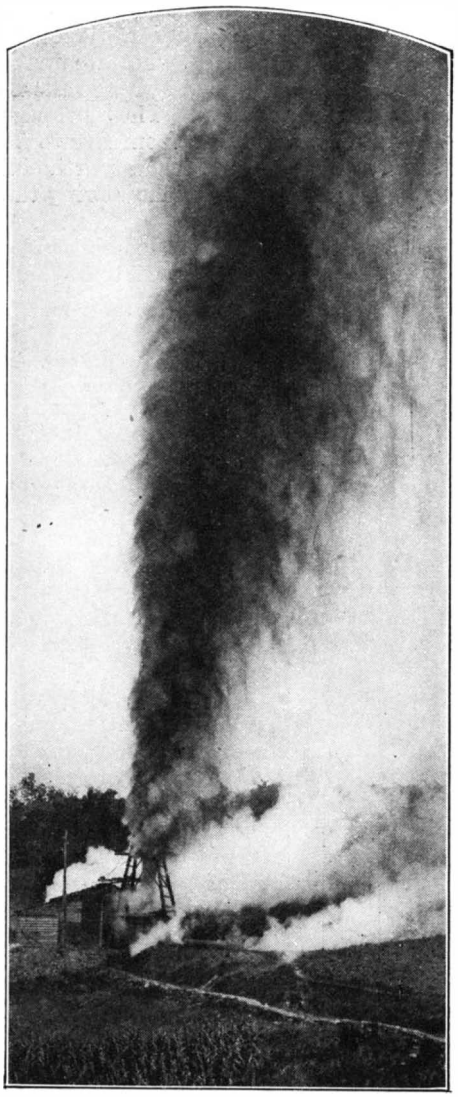
Steam escaping from thermal region at Lardarello in Tuscany. Here several thousand horsepower of energy have actually been developed but, as the author states, these thermal areas are not a promising source of vast energy such as the world needs to keep the wheels moving

Suppose that at the place where we are trying to get heat from the depths the rate of temperature is 1° Fahrenheit for every 100 feet; which certainly is the upper limit, according to the borehole records. At this rate the temperature at 26,000 feet would be 320° Fahrenheit, or that inside an ordinary steam boiler which is working at 75 pounds pressure per square inch. By cutting our last drop down to a little less than 200 feet we could reduce the water pressure to 75 pounds and, after all this trouble and expense, we would have——a set-up as practicable as an ordinary cheap coal-fired boiler; with the sole advantage that we would not use any coal in it, if—and there is a big "if"—we could get the heat out of the rock into the water.

The cause of that "if" is that rock is, as geologists know, not much better as a conductor of heat than the protective coverings that are put on steam pipes to keep them from losing their heat. The first few pounds of water would cool the surface of the rock, and the heat would have to pass through the rock by conduction and this rate is exceedingly slow even where considerable differences of temperature exist between T_1 and T_2—the respective temperatures of the two working substances. Perhaps a Jules Verne could imagine some way in which the water could be made to pass out through channels to great distances from the bottom of the hole, finally returning to the bottom of the other hole to emerge as steam, but my own fancy is unequal to the task. Engineers naturally hesitate to say that anything can not be done, but they may say they can not imagine any way of doing it, with present knowledge.

Someone will here say that there must be something wrong somewhere, because he has seen natural steam coming out of the ground in Yellowstone Park and has read that there are numerous other places where steam escapes, while hot springs are even more common. There are many of these local hot spots on the earth's surface and the scientists do not know how they get that way. Many explanations have been offered; such as that by earth movement molten rock has been brought up from below to near the surface and that the steam represents either surface water that has been heated by coming into contact with the hot mass, or else that it is water vapor that was in the molten material and is now escaping from it. There are difficulties in all these explanations, and we may here accept the two facts that over most of the earth's surface the rate of increase of temperature as we go down is too slow to offer hope of practically drawing heat from the interior of the earth, and that at some places there are local hot spots at which steam issues at the surface.

Suppose, then, that we forget about the rest of the earth and concentrate on the hot spots. There we have what Kipling would call "another story," one that I shall not attempt to outline here![1] Suffice it to say that the "steam" is not just steam, but contains a good deal of uncondensible gas and also, usually, chemicals that make it impracticable to use it directly in a steam engine, so some of the attempts that have been made to utilize it depend on using the "steam" to heat water and make ordinary steam that can be used in an engine. Add to this the fact that these hot spots are usually at places where there is nobody nearby who is a consumer of power and you arrive at something like the familiar water-power problem of having a source of power but the cost of harnessing it for utilization makes it cost more than power from coal.[2]



NOT AN OIL GUSHER

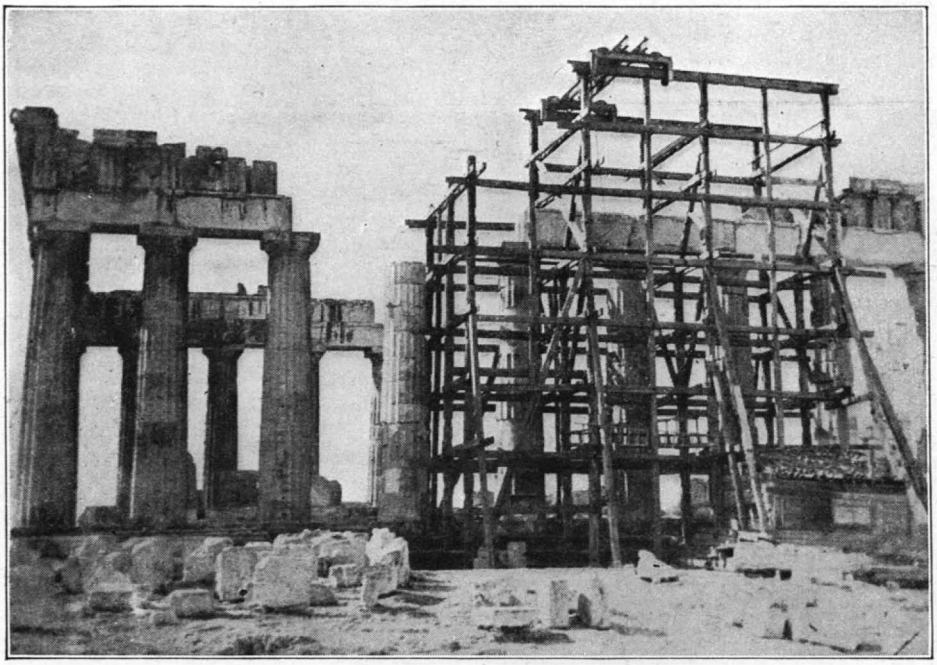
The eruption of a large steam well drilled in the thermal soil of a small area in Italy

THE conclusion therefore is that coal producers need not lie awake nights worrying over the possibility of having their markets invaded by heat drawn from the interior of the earth.

[1] See "Power from the Earth," describing one such development in Italy, SCIENTIFIC AMERICAN, November, 1929, pages 422-424—Ed.

[2] See discussion of various power sources of the future, SCIENTIFIC AMERICAN, February, 1930, pages 141–145—Ed.

From the Archeologists' Note Book



REPAIRING THE PARTHENON

The drums of the columns of the 5th Century B.C. Parthenon at Athens are being placed in their original position, having been thrown down in 1687 during the siege of that city

Digging up Athens' Broadway

AMERICAN scholarships and American dollars have combined to excavate the *Agora* or market-place and forum of ancient Athens. This might be likened to the Broadway or Fifth Avenue of the antique city of culture. The cost will run into millions and it will require ten years to make the excavation in an orderly manner. Prof. J. Leslie Shear of Princeton University will direct the work. The Greek Parliament has passed a special law by which the American archeologists may condemn the houses by properly compensating the owners. The scientific enterprise is backed by over 40 universities and colleges of the United States. The buildings which now occupy the site are squalid and unimportant.

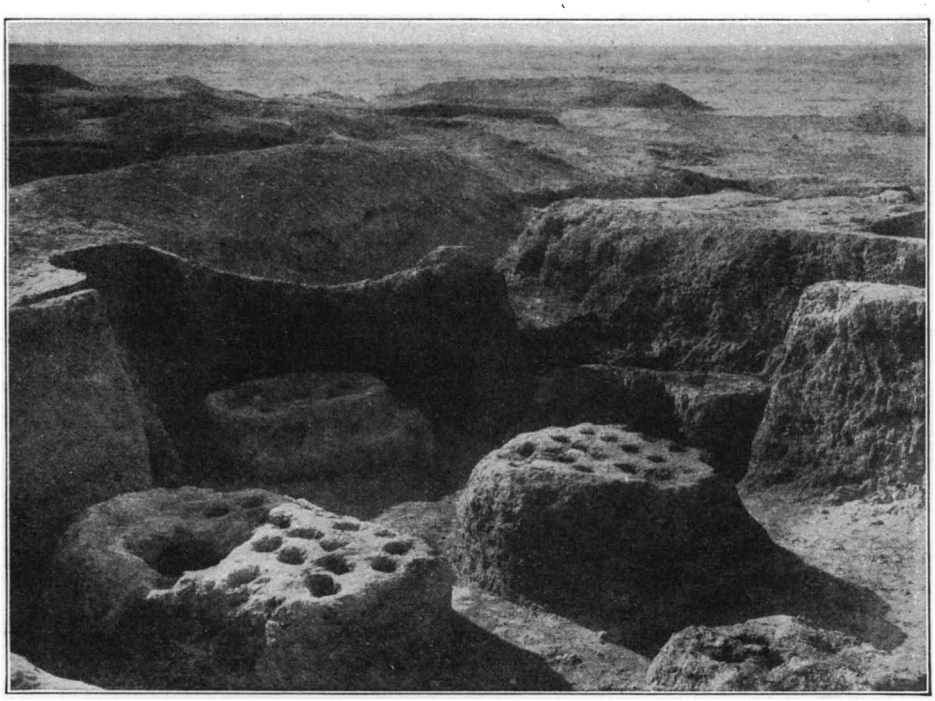
The *Agora* was the heart of Athens—commercially and socially. Here we had shops, markets, studios, and forums for discussions of all kinds. Here Apelles exhibited his paintings and here occurred the memorable meeting of Diogenes and Alexander the Great. Trading was carried on to a considerable extent, for Athens was a great center for luxurious merchandise. Trial by jury was also inaugurated here and we can almost see the reluctant potential jurors of yore trying to get excused from duty.

There are so many references to the *Agora* in classical literature that the task of the archeologists is much simplified. The excavated regions will be transformed into a park, as far as the maintenance of the antiquities permits. The site is the most promising in all Greece and the finds will probably be very important. When the excavations shall have been completed we can visualize the Athens of Socrates and Plato, as well as that of the dandies and revelers, for all sorts and conditions of men foregathered here.

Our illustration shows the repair rather than restoration of the Parthenon. This is not a part of the *Agora* plan but is a necessary although belated attempt to salvage one of the world's most precious structures.

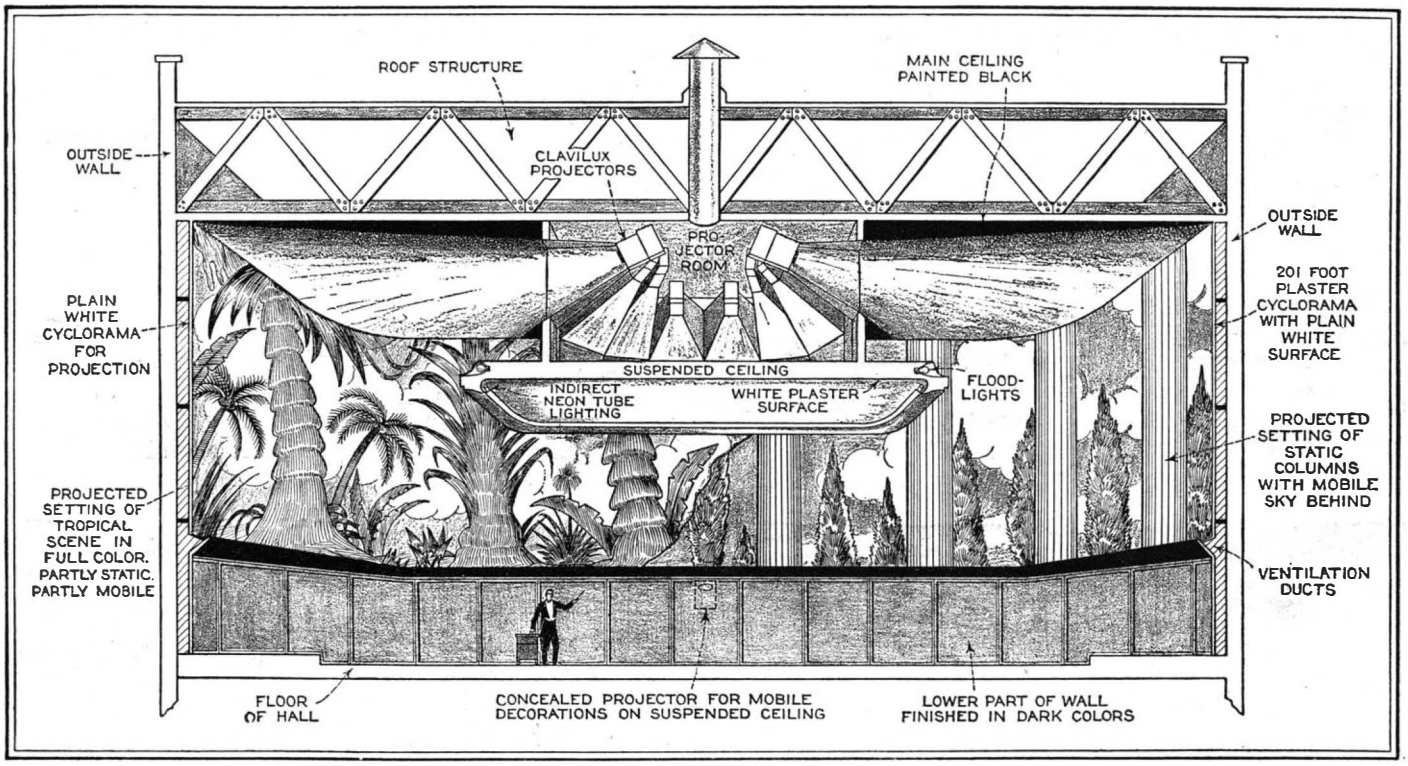
An Ancient Bakery

THE remains of what is believed to have been the earliest bakery established by any civilized people were found recently by the Field Museum-Oxford University Joint Expedition to Mesopotamia on the site of the ancient city of Jemdet Nasr. The bakery consists of a group of clay ovens, estimated to have been built about 4000 B.C., according to Mr. Henry Field, assistant curator of physical anthropology at the Field Museum of Natural History. The ovens consist of large clay mounds, hollowed out inside, and with holes through the top to permit the passage of heat. At their bases are fire holes large enough for a man to crawl into. Huge piles of cinders of ancient fires were found inside. Pots and pans containing the bread to be baked were placed on the tops of the ovens, where the heat reached them through the holes.



THE OLDEST BAKERY IN THE WORLD

Remains of clay ovens discovered in Mesopotamia at the ancient city of Jemdet Nasr by the Field Museum-Oxford University Joint Expedition. *Above:* an Arab in the fire hole



A HUNDRED HALLS IN ONE

In the ballroom of the Hotel Sherman at Chicago the new art of light has found one of its practical applications. Here all the decorations are projected from a suspended chamber

Light Furnishes Ballroom Decorations

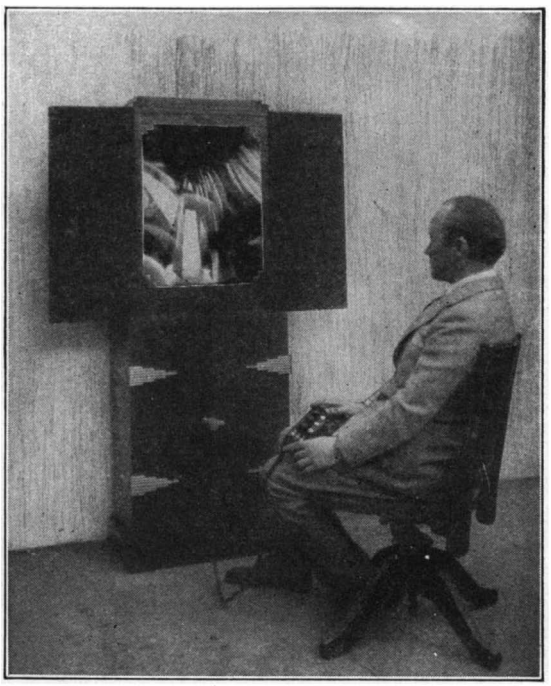
Color-Harmony Introduces a New Mode of Expression

SINCE Bainbridge Bishop patented his "color organ" in 1877, many artists and inventors have been at work on the creation of an art form of light somewhat similar to the age-old art form of sound-music. In its early stages this pioneer work was greatly hampered by the unfortunate and totally unfounded belief that each color corresponded definitely to a musical note. Now, however, the light artists of later years have come to look at light as an independent medium for esthetic expression no more related to music than to painting or sculpture. Form, color, and motion are the basic factors, according to the theory of Mr. Thomas Wilfred, an artist in light who has developed his dreams into the practical applications which we illustrate in this article. He has designed a clever keyboard from which lighting of any kind can be controlled with such delicacy as to enable an artist to express himself in form, color, and motion.

The Hotel Sherman in Chicago, wanted a mobile decoration for their ballroom—one that would be flexible enough to allow rapid changes to be made for varied functions. The hall may thus be used for a piano recital in the setting of a Grecian Court: For the Rotary Club luncheon the turning wheels, their well-known emblem, would be appropriate: For a woman's club tea in the afternoon, it can be decorated by diaphanous moving forms of a purely abstract nature: At night it can be turned into a Persian garden, slowly changing and opening vistas of enchanting beauty.

Our first illustration shows the means by which this is accomplished. The ballroom is finished in plain white plaster without a trace of decoration, which is all to be provided solely by means of light projection. The decorations are filed like phonograph records and are instantly available. The suspended projection chamber takes the place of a portion of the ceiling proper and carries its own ceiling below. This ceiling in turn is also decorated by projected mobile forms which issue from concealed wall instruments. Huge projection instruments in a semi-circle are directed toward every point of the white walls. Below in a small chamber is the keyboard from which the operator commands a view of the entire hall. No operators are required in the projection chamber as the keyboard controls the light effects. The projection chamber is surrounded by a runway from which dancers can produce moving shadows of themselves on the walls.

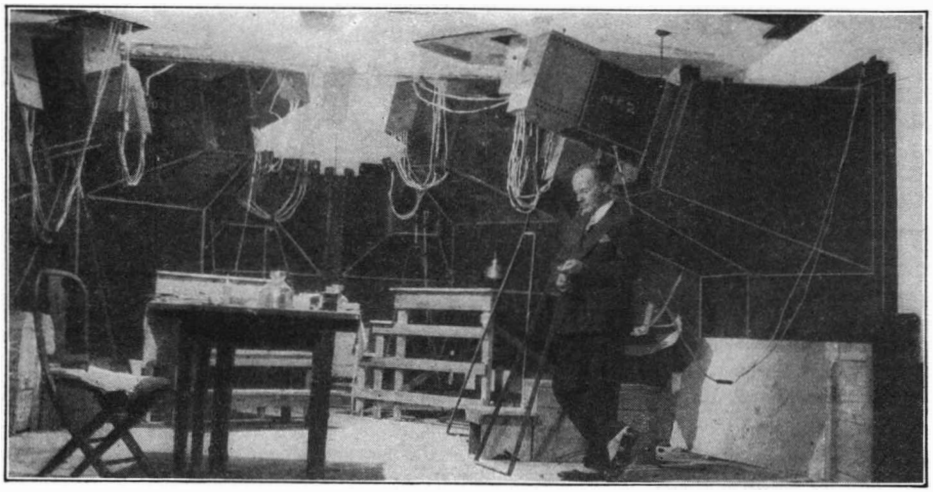
To enhance further the projector images, a flood-lighting system is installed in the edge of the runway and an indirect neon-tube system furnishes



SUPERSEDING THE FIRE-PLACE

An instrument which plays form and color as a phonograph plays music. Colored disks are used

light on the suspended ceiling. The true ceiling is not seen, as it is painted black and no light is projected on it, which would differentiate it from the false or suspended ceiling. The effect is that of a vast cyclorama, but the true surface is entirely obliterated by means of the three-dimensional projecting system used. The illusion of three dimensions is achieved by utilizing a new principle of optics. One of the effects which can be obtained, for example, is a tropical forest. Through the spaces between huge tree trunks can be seen vistas of tropical undergrowth, flowers, sky, and water, constantly moving and changing in form and color. A cathedral with sunlight streaming in through a number of stained glass windows is another possibility. Using pure decoration, the entire hall may be covered with abstract forms apparently in three dimensions, rhythmically advancing and receding. Or there may be a modern city with a semi-abstract treatment of towers, cranes, girders, and bridges, swinging and moving. Or, at the operator's fancy, there can be an oriental fantasy suggesting the "thousand and one nights" with movements of festoons of large jewels among minarets and crystal towers.



PROJECTORS

Twenty-three projectors in the suspended chamber cover the walls with unbroken images which are changeable at will

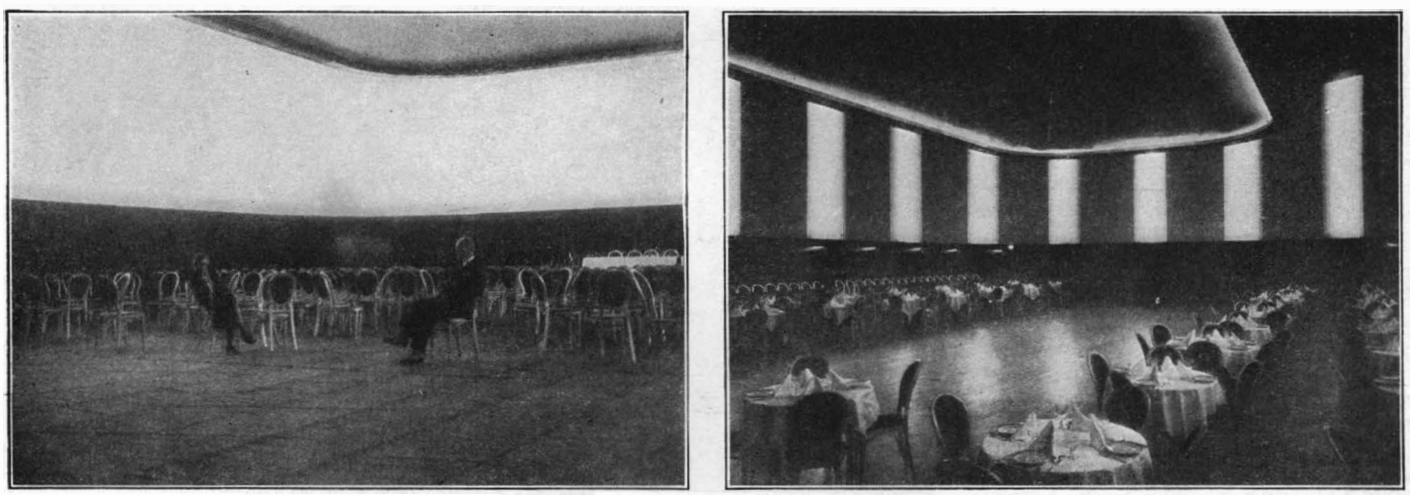
MUCH poetry has been inspired by the fire-place of yore, which has now been largely replaced by the uninspiring steam radiator or the unconvincing gas-log. The charms of story telling around the fire is as extinct as the dodo and the electric bulb has inspired no poetic muse. However, we may now take the very bulb and make it speak eloquently of the "stuff that dreams are made of" by a new instrument for home use. All one does is to open the doors which mask a curved screen, select a record from the drawer, take the tiny keyboard in his lap and the world of make-believe is his. Colored glass records rotating at different speeds are used to allow the lights to be projected onto a screen background lighted from above with the three primary colors from minature floodlights controlled by the player. Eleven buttons enable the player to modify the forms and colors projected through the slowly moving record to increase or decrease the tempo at will, or "freeze" any transitory form which appeals to the fancy, as long as desired.

THE LIGHT KEYBOARD

All projected images, colors, and movements are controlled by means of tiny keys sliding in grooves. This enables a recital to be given by a color artist

These cabinets can be designed to fit the architectural or decorative scheme of the room. They take up no more space than the modern phonograph or radio set. They are self-contained and all you need is to connect to an outlet, as with any other electrical device. The effect when seen for the first time is remarkable. You can give a home "color recital" with it.

With our noise-racked nerves, it would seem logical to seek recreation through silent beauty. We might even visualize, with Mr. Wilfred, large temples of light where people can find a place of silence with light as the only language of beauty.



"BEFORE AND AFTER"

At the left is seen the ballroom with light decoration omitted and all control keys at zero. Only a blank wall is seen. At the right the projectors are functioning and we have a Grecian court with three-dimensional fluted columns with night sky between

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Individual Hothouses for Plants

A NEWLY developed paper cover for plants, in effect a miniature hothouse for each plant, is coming into widespread use in some parts of the country. These paper covers, called "Hotkaps," are in the form of cones made of specially prepared

Individual "hothouses" for plants being placed by means of the metal setter. The pre-formed paper caps fit snugly into this special device

waxed paper about 11 inches in diameter at the base. When placed over the plants, it is claimed that they protect fully against late frosts, wind, insects, and heavy rains.

The paper cones are inserted in a setter made of metal in the exact shape of the Hotkaps and the setter then placed on the ground over the seed or plant which is to be protected. Slight pressure on the handle of the setter forces the Hotkap into the ground a distance of ¼ to ½ inch. The edge of the paper cone which protrudes from under the edge of the setter is then heaped with soil, the setter is removed, and the paper is permanently in place. After the seeds have germinated and obtained a good start, a slit is cut in the side for ventilation; and later the top is cut out for the plant to grow through.

It is claimed that Hotkaps force a much earlier growth than would be possible under ordinary circumstances.

General Electric's Foreign Interests Gain

THAT the General Electric Company in the future will derive a greater proportion of its income from sources other than operations is evident from the substantial increase in its investments in associated companies, both in this country and abroad.

The greatest gain in such investments last year was in leading European companies, in some of which the General Electric Company, through International General Electric Company, previously had stock interests.

As a result of these acquisitions, investments of International General Electric Company at 74,665,063 dollars December 31, last, showed an increase of more than 100 percent over the total a year previously —35,418,307 dollars—funds for such investments being advanced by the General Electric Company.

General Electric retains intact its holdings of 1,240,530 shares of common of Radio Corporation of America, and these, too, are included, at conservative values, in the investments in associated companies, as well as additional capital supplied in 1929 to Electrical Securities Corporation and United Electric Securities Company to finance normal expansion of the latter's operations.

Income from investments in associated companies and miscellaneous securities, the latter being comparatively small, has been increasing each year for the General Electric Company and in 1929 represented 45 percent of all "other income." Against a total net of 67,289,880 dollars; including that from operations and other income, in 1929, total "other income" represented 31.8 percent.

The 9,681,387 dollars interest and dividends received from associated companies and miscellaneous securities in 1929 represented 6.6 percent of average value at which these investments were carried on the books of General Electric at the beginning and end of the year. It compares with a 7.6 percent return in 1928.

If the General Electric's proportion of undistributed earnings available for dividends of associated companies had been taken into income, the increase in total net would have been approximately $1.74 a share on the 7,211,482 no-par common shares outstanding at the close of 1929, bringing the per-share figure to $10.71, against the $8.97 that was reported.

Considering undistributed equities and various other items, the nearest calculation of share earnings would be around 13 dollars on the common, or an increase of more than 40 percent above reported figure. Total net, on this basis, would be in excess of 90,000,000 dollars, whereas actual reported income was 67,289,880 dollars.—*Barron's.*

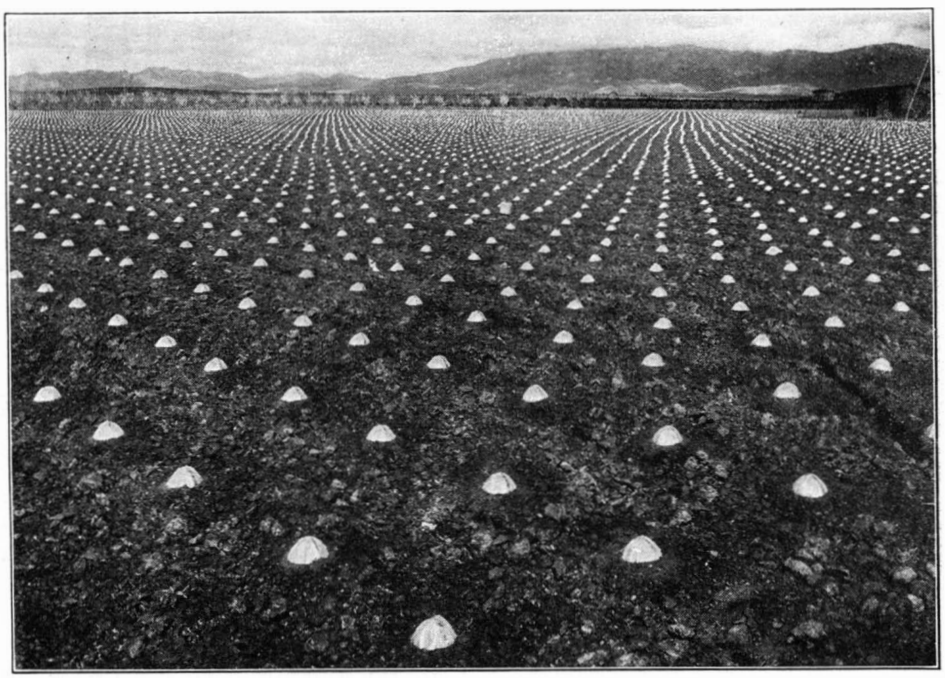
New Rubber Plants in the United States

RUBBER plants, of a species so productive that it has been exploited almost to the point of extinction in its native home in Madagascar, are now growing in southern California and Florida and have withstood the climate during the past winter with no apparent damage. So far only a few plants have been established but this number will be increased as rapidly as possible.

These rubber plants belong to the species *Euphorbia intisy*, and were brought to the United States more than a year ago by Dr. Charles F. Swingle, botanist of the United States Department of Agriculture, who spent several months on a plant exploration trip in Madagascar with Professor Henri Humbert of the University of Algiers.

Intisy is a shrub or small tree reported to reach a height of approximately 20 feet, although no specimens of this height are known to exist at this time. The trees are leafless, and present a scraggly appearance. Their ability to grow in the very dry regions of southern Madagascar is accounted for by an unusual root structure. The roots resemble links of sausage, and act as reservoirs for water.

With the discovery of this plant in



"Hotkaps" in place in a large field. They speed germination of the seeds beneath. The paper is stiff enough to resist the force of wind and rain

Madagascar in 1891, commercial exploitation followed at once, and annual rubber exportation jumped from less than 50,000 pounds to almost a million pounds. The ruthless exploitation soon showed its effect, reports Doctor Swingle, in an article in the *Journal of Agricultural Research*, and within a few years *intisy* had become so rare that observers reported it was very difficult to find specimens.

In some of the regions where Doctor Swingle found *intisy* growing there are periods of six years at a time when there is no rain.

"The manner of obtaining *intisy* rubber," Doctor Swingle says, "is very simple and is one of the factors that led to the commercial disappearance of this plant. The latex, which flows from any cut, coagulates in the air without further treatment. All that the native has to do is to make cuts in the stem, return in a few days and pull off bands of rubber of very high quality, especially desirable for the manufacture of automobile tires.

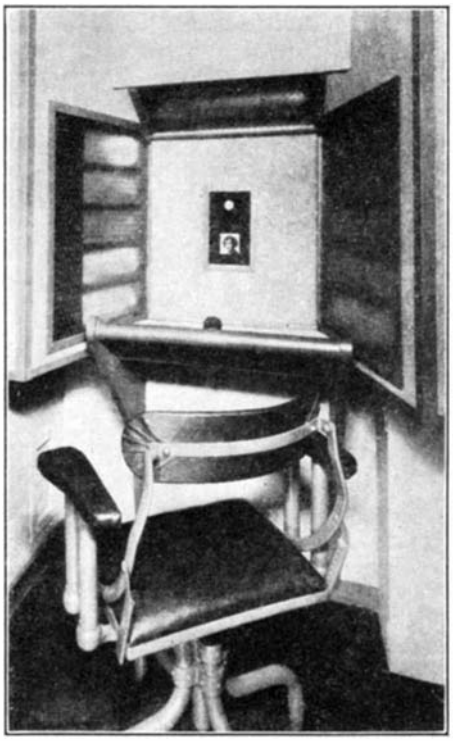
"The yield of rubber from stems less than one inch in diameter is so slight that it does not pay to tap them. However, during the time of commercial exploitation, spiral cuts were made all the way up the tree, and yields of 15 pounds or more of rubber would be obtained from a single tree. In many cases the first tapping was so severe that the tree died outright."

Two-Way Television Demonstrated

TELEVISION has taken another step in its development, with the production of an experimental system of two-way television supplemented by the usual two-way telephone, permitting the parties to a conversation to see as well as to hear each other.

An experimental service between the American Telephone and Telegraph Company's building at 195 Broadway and Bell Telephone Laboratories at 463 West Street, which has been in operation for some time, was disclosed recently to the editors of this magazine. Special telephone-television booths were installed at these two buildings.

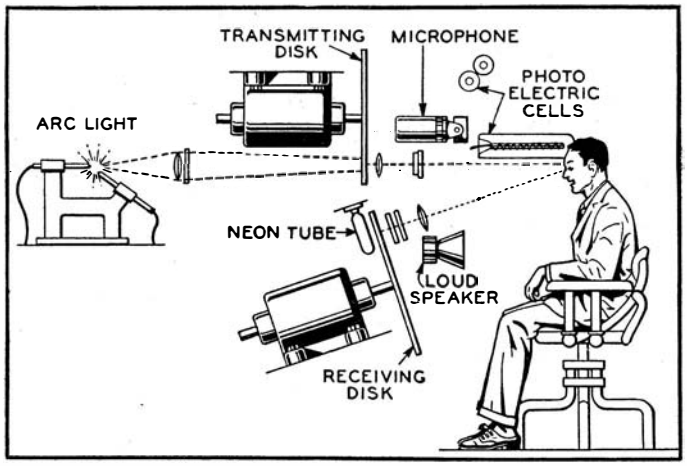
In one of these booths a person seats himself before a frame in which he will see the face of the person with whom he is talking. His own face is rapidly scanned by a mild beam of blue light which reflects from his face to the photoelectric cells and gives rise to the current which transmits his image to the distant booth. There is no fierce glare to the scanning beam; and one is not annoyed by its presence and may even gaze directly at it without inconvenience.



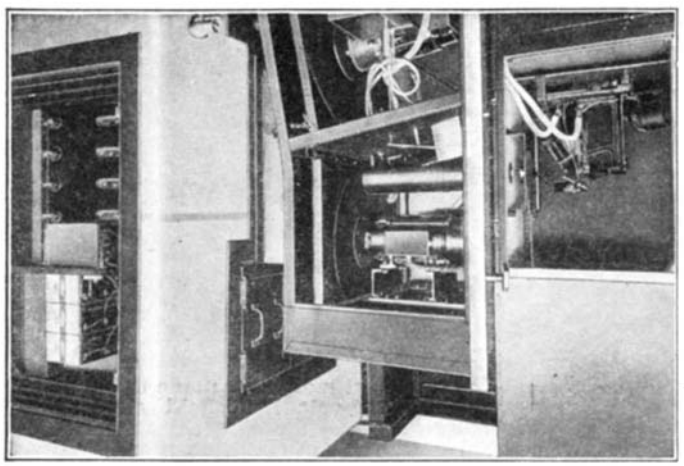
One of the two-way television cabinets. On the small "screen" in the center, one sees the person at the distant end; and above this is the scanning-beam hole

The first thing which strikes the observer when he steps into the booth—which is lighted with a dim orange light to which the photo-electric cells are insensitive—is the absence of the usual telephone. Special telephone transmitters and receivers are concealed in the booths. One talks face to face to the distant person and a hidden receiver speaks the words which seem to issue from his mouth. The other party to the television-telephone conversation appears with sufficient detail for recognition of facial expression.

The television image is greatly improved over that originally demonstrated by Bell Telephone Laboratories in 1927, and is about twice as large with a corresponding increase in detail. The image, which has the detail of about five thousand discrete points of light, is formed 18 times a second. The photo-electric cells, used in picking up the face which is to be transmitted, have been much improved in sensitiveness and give rise to about 10 times the current for the same amount of light as did those developed for the earlier demonstration. This increased sensitivity and the use of the blue scanning beam have made possible the reduction of the dazzle and glare which occurred to a certain extent in the earlier forms of apparatus. The increased area and detail of the image necessitate the use of a transmitting band of 40 kilocycles.



At right: **Arrangement of apparatus in two-way television. As the incoming image is viewed through the lower scanning disk, the speaker's face is scanned by the upper disk. A microphone and loudspeaker complete the layout**



At left: **Opened doors of the three major cabinets of the television-telephone apparatus show photo-electric cells at right, scanning disks for receiving and sending in the center and the arc-light for sending at left**

New Inexpensive Eight-inch Fan

THE Westinghouse Electric and Manufacturing Company has recently announced a new eight-inch fan of the non-oscillating type in the price-range of five-inch fans now on the market. It is a portable type, the body being made of cast iron in an attractive black finish, the fan blades are heavy gage sheet steel, and the guard is of heavy steel wire. It is single speed and is controlled by an on-and-off switch in the base.

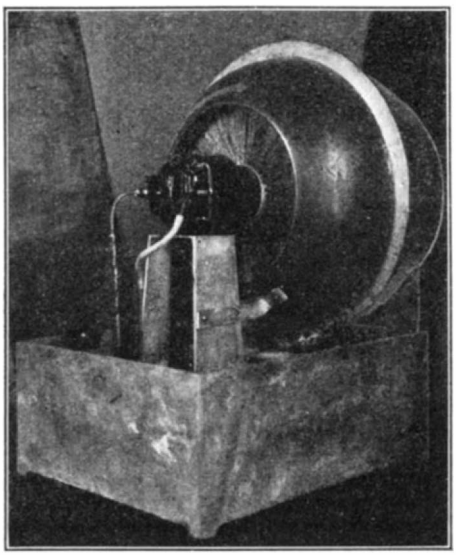
Wasteful America Saves Billion in Scrap Annually

EVEN if Americans are wasteful, as is often claimed, they salvage nearly a billion dollars' worth of their waste every year. This is according to figures of the United States Bureau of Mines on the amount of scrap and secondary metal recovered, which is increasing every year.

The waste trade industry is concentrating in large units. Even gold and silver is recovered in quantity from jewelry and dental waste. Photographic solutions contain half an ounce of silver to the gallon and 1,000,000 feet of waste movie film yield 800 ounces.

Of the 500,000 tons of secondary copper recovered annually, part comes from 300,000 burned out electric lamps collected by one company. About 40 percent of the annual supply of tin and lead has been used before.

The iron and steel saved in a year is worth 500,000,000 dollars. Other metals



Rear view of the small air conditioner showing all of its parts

salvaged in quantity from scrap, sweepings, skimmings, and dross are mercury, zinc, antimony, aluminum, and nickel.—*Science Service.*

A Home-Size Air Conditioner

FOR reasons of health and personal comfort, stress has recently been placed upon the necessity for purifying and cooling the air in which we live and work, in home, office, and factory, but most attempts to solve the problem have resulted in the production of the elaborate air washing and refrigerating equipment now commonly used in theaters and, in a few cases, in office buildings. Recently, however, a compact air washer-cooler-ventilator which can be used for small offices or even in the home was developed by John H. Fedeler, Building Superintendent of the New York Public Library.

Mr. Fedeler first realized the necessity for such a device when he worked, in 1895, as a draftsman for Mr. Edison at the ore mines in Edison, New Jersey. When the crushing plants at the mines were in operation, he noticed that the whole countryside was enveloped with a dense dust cloud. He later conceived the idea for the unit which he finally developed, but many experiments lasting over a period of 30 years, and the expenditure of thousands of dollars were necessary before he attained his goal.

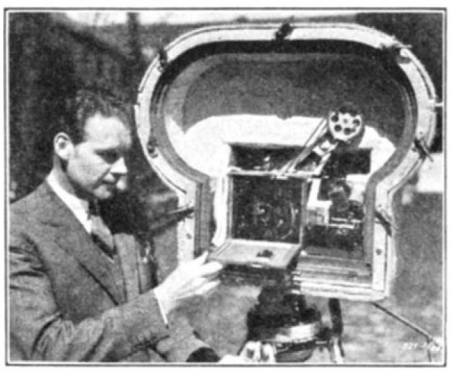
The complete machine is shown on this page. Its parts are: a circular brush, the "bristles" of which are of crimped Monel metal wire; a scientifically shaped casing of light-weight metal; an electric motor; a small water pump together with necessary tubing of metal and rubber; and a water box or tank on which the other equipment is mounted. As the motor rotates the brush at a speed of 1500 or 2000 revolutions per minute, the pump, which is also run by the motor, draws water from the tank and throws it into the brush. Due to the shape of the casing, air is drawn in and as it comes in contact with the wet brush, dust and dirt in the air are captured by the water and thrown by centrifugal force to the casing. The constant flow of water carries the dirt down into the tank where it settles out and may be removed periodically. The air also is thrown by centrifugal force to the casing and, because of the shape of the latter, is deflected through the unit into the room beyond. The rapid evaporation of water in the current of air causes the temperature to be appreciably lowered and a partial adjustment of humidity.

When desirable, a small amount of perfume may be added to the water used, so that the air will be perfumed. Also, when the air of any locality has been found to be acid, a neutralizing alkali such as ammonia may be dissolved in the water.

Feeding Helps Sick Trees

A RECENT development in the care of shade trees is the importance now given to "feeding" a sick tree before a lot of tree surgery work is attempted. Workers in the United States Department of Agriculture explain that this does not mean that pruning and other surgical work is not necessary, but if a tree is not vigorous, an application of plant food is likely to prove very helpful in restoring the tree to a healthy condition. Fertilizers which give immediate effect include nitrate of soda and sulfate of ammonia, applied broadcast in the spring or early summer at the rate of two to five pounds for a medium-sized tree.

The direct effect of such an application usually lasts for only a year, but the indirect effect may be apparent the following year, as it usually stimulates the healing of wounds made by pruning or cavity work. An excess amount of fertilizer or an application late in the season may cause injury by stimulating excessive development of foliage and failure to mature the new wood properly before winter sets in.



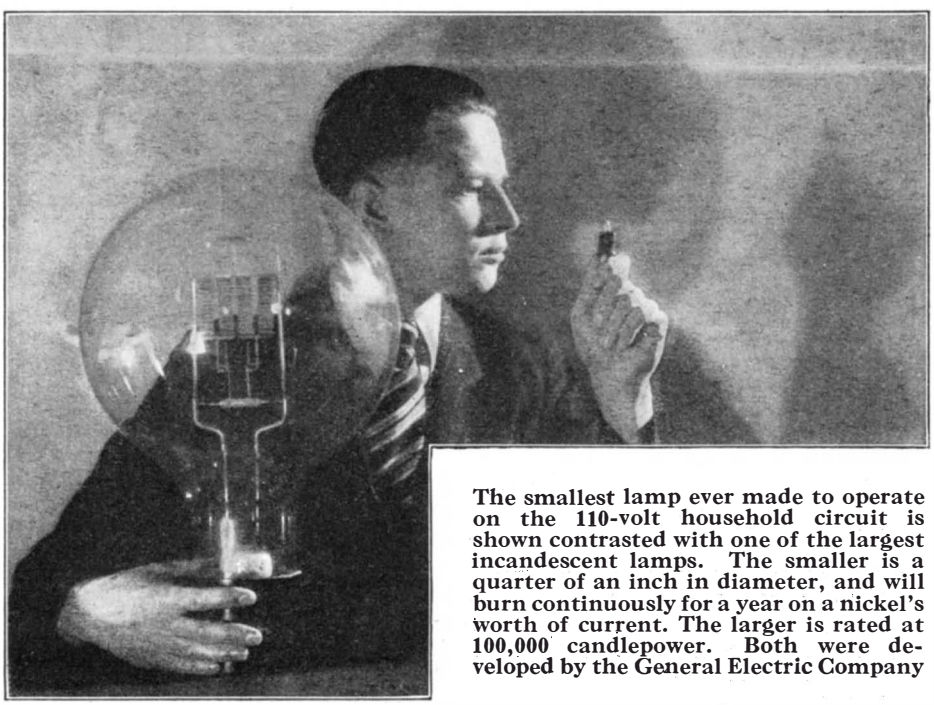
Lane Chandler, movie operator, is shown with the "blimp" camera cell he has devised. By enclosing the camera in this padded cell, all clicking is kept from the microphones while making "talkies"

Centennial of the Modern Scale

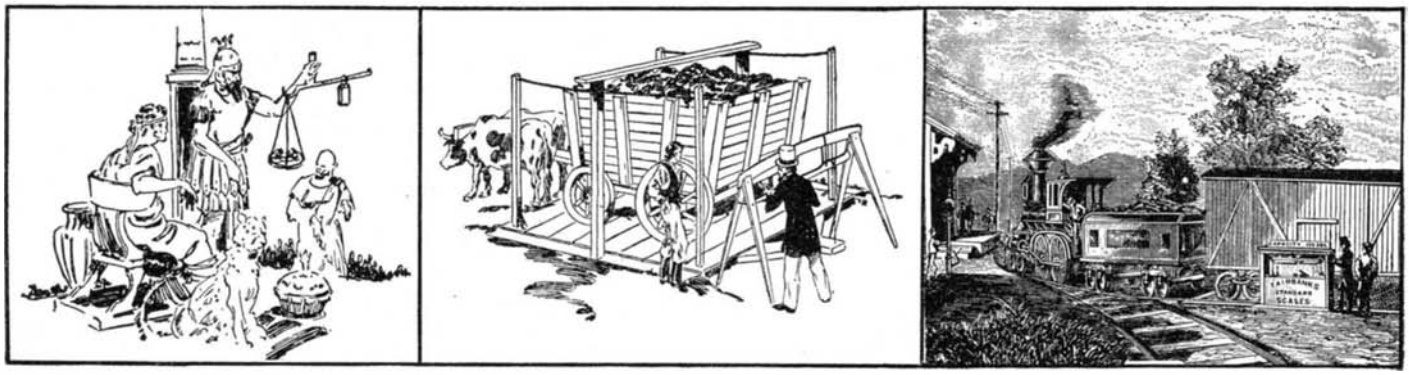
MANUFACTURING methods of today are concerned chiefly with mass production and the waste both of time and materials. It naturally follows that accurate weighing plays an important part in almost every phase of the production schedule. Thus it is that the year 1930, marking the centennial of the platform scale, is particularly interesting in that it shows what may come out of small beginnings.

From the steelyard of ancient days, there was no improvement in methods of weighing until, in 1830, Thaddeus Fairbanks invented the platform scale, the prototype of all modern scales.

It was in 1815 that Major Joseph Fairbanks moved from Brimfield, Mass., to St. Johnsbury, Vermont, and set up a grist mill and saw mill on the banks of a little creek that ran through this old Vermont town. His sons, Erastus and Thaddeus, had even broader visions and established a wheelwright and foundry business and then developed the manufacturing of saws, pitchforks, cast-iron plows, and stoves. In about the year 1830 the "hemp craze," as it was called, struck Vermont and the farmers expected to make substantial fortunes in raising hemp instead of corn. Contracts for making hemp-dressing machines were awarded to the Fairbanks brothers. The question now arose—How was the hemp to be weighed? The old steelyard was of little use for this service and so Thaddeus conceived the idea of constructing a huge steelyard beam suspended from a high frame with chains to grapple the axle of the cart. An approximate weight was thereby obtained by a process that was both slow and laborious.



The smallest lamp ever made to operate on the 110-volt household circuit is shown contrasted with one of the largest incandescent lamps. The smaller is a quarter of an inch in diameter, and will burn continuously for a year on a nickel's worth of current. The larger is rated at 100,000 candlepower. Both were developed by the General Electric Company



Evolution of the modern scale. At the left is shown the steelyard which was used by man from early times until Fairbanks invented the platform scale. Fairbanks' scale, in center, was the prototype of the one at right

Thaddeus studied the problem and finally conceived the idea of supporting the platform upon an A-shaped lever with the tip of the lever connected to the steelyard by a rod. Though not suspected by Thaddeus at the time, he had revolutionized all weighing methods and at that moment the steelyard of old Rome took its departure.

From this small beginning the platform scale in all of its ramifications was developed until today the same principle is in use, whether in a health scale, a laundry scale, or the ponderous ones used for weighing the largest railway locomotives.

Pump Dry Cement Across River

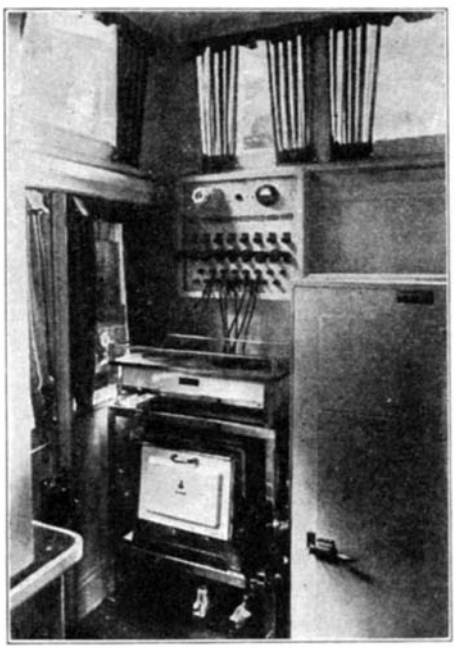
ALL the cement required for the recent construction of a 16-mile concrete highway along the Allegheny River in mountainous Warren County, Pennsylvania, was pumped across the river in dry bulk through a three-inch pipe.

Compressed air at 100 pounds pressure carried the cement in powdered form from freight cars a distance of 768 feet, the length of the pipe, to the batching plant. This unusual method of handling cement proved thoroughly practical and economical. The pipe was suspended across the river from a cable.—*Science Service.*

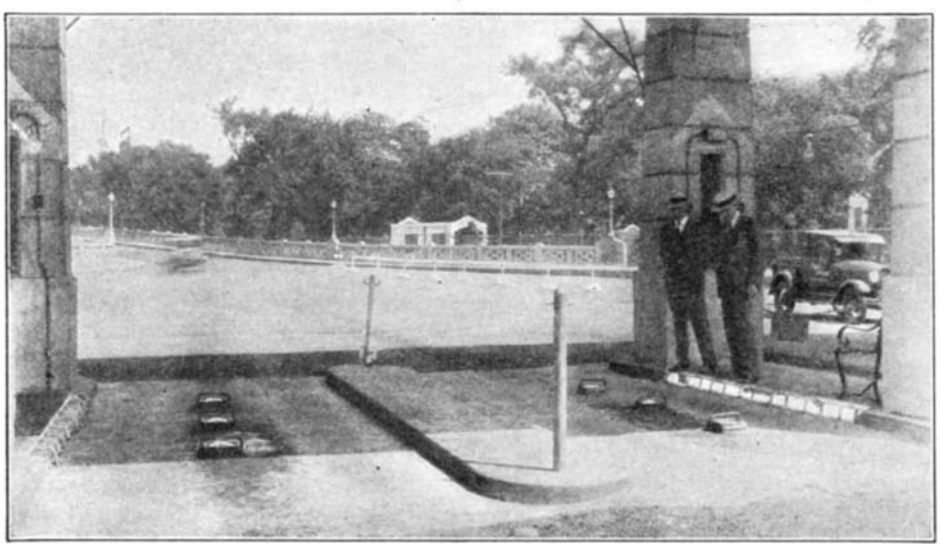
Ford Profits—81,797,861 Dollars

AFTER showing a deficit for 1927 in excess of 42,000,000 dollars due to the shut-down the latter half of the year for re-tooling incident to the production of the new model, and a deficit of over 72,000,000 dollars for 1928 due to large expenditures to bring up production, the Ford Motor Company showed a profit of 81,797,861 dollars for 1929, the second year of production of the Model A. These figures are given in the annual balance sheet filed recently with the State Commissioner of Corporations of Massachusetts.

Profits for last year were equal, according to *The New York Times*, to $473.79 a share on the 172,645 shares of stock, all of which are held by Henry Ford, Mrs. Henry Ford, and their son, Edsel Ford.



More evidence of the machine age in which we live. View of an electric range on one of the latest German motor buses. It was shown at a Berlin automobile show recently



One of the toll gates on the American approach to the Peace Bridge at Buffalo, showing the under-car lights and mirrors for detecting contraband in cars

Floodlight Units Help Prevent Liquor Smuggling

BY an odd twist of the illuminating engineer's mind, the Aqualux underwater floodlight, usually operated under water for the illumination of swimming pools and fountains, is now used to help keep the United States dry.

A unique method for enforcing the Volstead Act has been worked out with the United States customs and immigration officials. One of the installations has been made on four of the traffic lanes on the Buffalo end of the new 4,000,000-dollar Peace Bridge linking the United States with Canada.

It was found that a few of the cars returning to the United States over this bridge had hiding places constructed on the underside designed to contain quantities of contraband. Such hiding places, it was thought, could not be detected. It was a different story, however, after the floodlights were installed.

Three Westinghouse floodlights are buried in the concrete in the center of each traffic lane, and are equipped with 100-watt Mazda lamps which are completely enclosed by the waterproof housings. The spread lenses are protected by a heavy iron reinforcing rod embedded in the concrete over each light. The Aqualux floodlight is a cubical cast-aluminum box 8⅞ inches on a side with a gasketed cover containing an 8⅜-inch spread roundel. A chromium plated metal reflector is supplied in order to withstand the severe operating conditions.

With the car well illuminated on the underside, a view is obtained by merely looking downward into mirrors which are located for a distance of 10 feet along the curb, and set at an angle of about 45 degrees. These are five and one half inches high and are also protected by iron rods set in the concrete.

When a car stops in the lane for the usual inspection, the customs officer can see at a glance the details of the underside of all cars. If he sees the usual machinery and open spaces, there can be but little concealed. But, if the mirrors reflect large areas of sheet iron, or suspicious boxes or tanks, the car is ordered out of line for closer inspection of under-body parts.

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

Experiments in Fog Flying

EXPERIMENTS in blind flying, under the auspices of the Daniel Guggenheim Fund for the Promotion of Aeronautics, were recently related by Lieutenant James H. Doolittle before the Society of Automotive Engineers.

A number of flights including 180-degree turns were made with remarkable accuracy, with the pilot seated in an entirely covered cockpit, and an assistant in the rear cockpit to take charge in case of emergency.

Success was due as much to the remarkable instruments employed as to the skill and pluck of the pilot. The instrument board of the *N Y 2*, Consolidated training plane employed in these tests, is shown in one of our photographs. The instruments included standard tachometer; oil pressure gage; oil-temperature gage; airmeter; voltmeter; compass; bank-and-turn indicator; air-speed indicator; altimeter; and rate-of-climb indicator. In addition, a very sensitive Kollsman altimeter, graduated in 10-foot intervals, a Sperry artificial horizon, and a Sperry directional gyroscope are shown in the photograph.

The directional gyroscope is not truly a gyroscope compass because it does not seek the north, but once set in a given direction, it will maintain that direction without serious error for a two-hour period.

Another very useful instrument employed was the Sperry artificial horizon. Here again a gyroscope is employed (driven by a small air turbine which is connected to a Venturi placed in the airstream) in this case with its axis placed in a vertical position. The instrument is so constructed that a tiny airplane is seen by the pilot to be in normal attitude, climb, dive, left wing low, or right wing low, according to the position of the plane on which the instrument is mounted.

The ground radio equipment consisted of (a) an audible-type radio-beacon, the

An airplane cockpit equipped for experimental flights under conditions simulating flying in fog

purpose of which was to direct the incoming airplane to the vicinity of the field or to keep the outgoing airplane on its course, (b) a visual type localizer-beacon, the function of which was to lead the pilot to the exact point where he should touch his wheels in landing; and (c) a ground receiving and transmitting set.

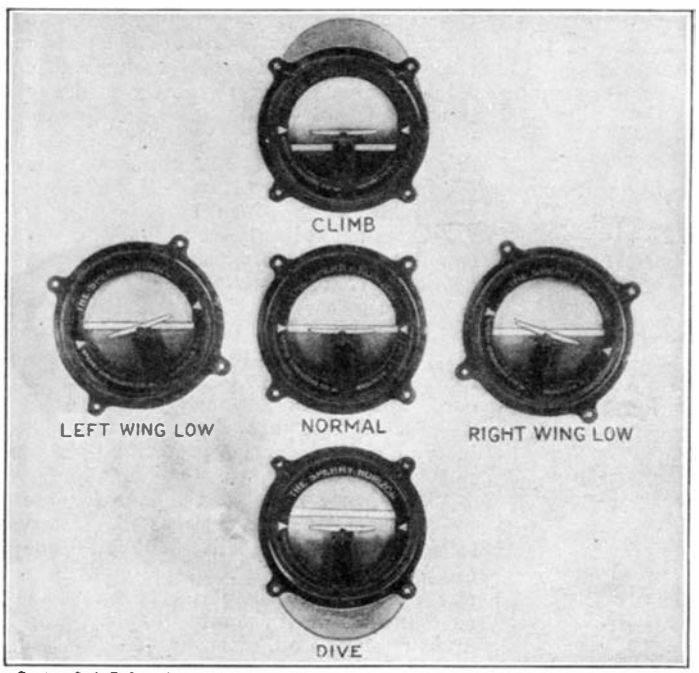
The visual-type indicator consisted of two vibrating reeds, indicating to the pilot his position with respect to the beam center. When to the right of the beam, the right reed vibrated through a greater amplitude. When to the left of the beam, the white streak caused by the vibration of the left reed became longer. When exactly over the center of the beam path, the reeds vibrated with equal amplitude. Upon approaching the beacon house, the intensity of the signal increased rapidly. At the exact moment of passing over the beacon house, the reeds stopped momentarily, and then started to vibrate again in the opposite direction.

The beacon employed was of the loop type entirely enclosed in a small building, with no wires on the outside. In the center was the goniometer which tunes the loop aerial, so that the correct guiding beam was transmitted to the pilot.

The airplane was taxied out onto the field in position for the take-off, and directly on the radio beam. The altimeter was set at zero, and the gyros speeded up. At take-off the pilot was able to hold the airplane straight by the gyro and the tail in the proper attitude by the artificial horizon.

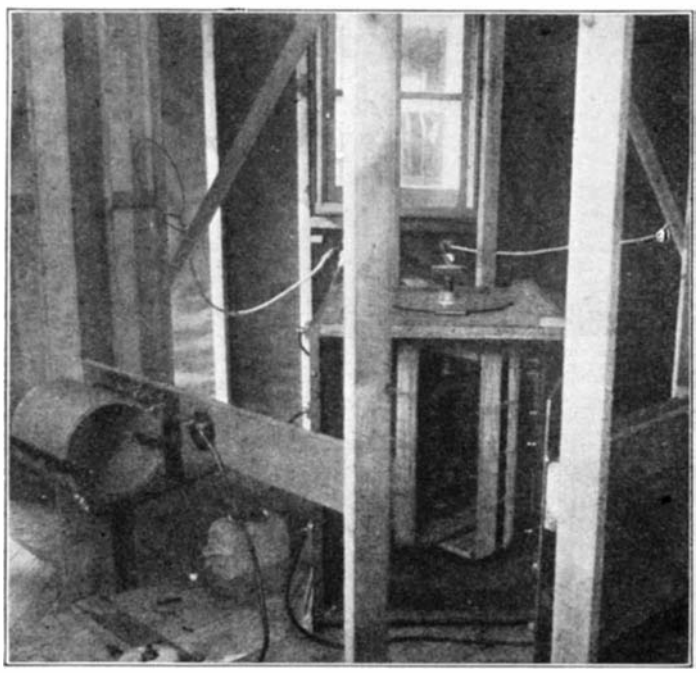
The localizer beam was followed for about four miles and the plane climbed to about 1000 feet. A 180-degree turn was made at this point and the beam followed to the beacon. As the beacon was approached the beam became narrower, and the course more exact.

Upon passing over the beacon house again, the reed stopped vibrating, the engine was throttled so that the plane came down to a speed of 60 miles per hour, the plane was kept absolutely level by the artificial horizon, and then flown directly to the ground without leveling off. The



Courtesy *S. A. E. Journal*

The Sperry artificial horizon. See text above



Goniometer in the ground radio transmitting station

shock of landing was uncomfortable but could probably be eliminated by correctly designed landing gear.

"Had the airplane actually been coming into a fog-bound airport from a distant point," said Lieutenant Doolittle, "it would have come in along the audible-type beacon until it arrived at a point which indicated the intersection of the audible and visual-type beacon beams. At this point the pilot would radio in and request that the more powerful beacon be shut down to avoid interference. He would then follow on along the localizer-beacon beam, and at the same time request the ground barometric pressure, wind direction, ceiling, and visibility under the fog. Next the pilot would set off the correct ground pressure on his altimeter and put himself in the proper position to land into the wind."

These tests covered several months, and hundreds of landings were made without breakage. They are extremely encouraging, even if they cannot yet be considered commercially applicable.

Plumbing and Heating in the Air

IT is extraordinary how the airplane constructor has to reach out into every industry and trade to make his craft really comfortable for the passenger. In the matter of plumbing and heating, the aircraft designer has had to become his own plumber because the trade could not supply him with sufficiently light and compact equipment. John F. Hardecker, writing in *Domestic Engineering*, describes some of these very interesting developments.

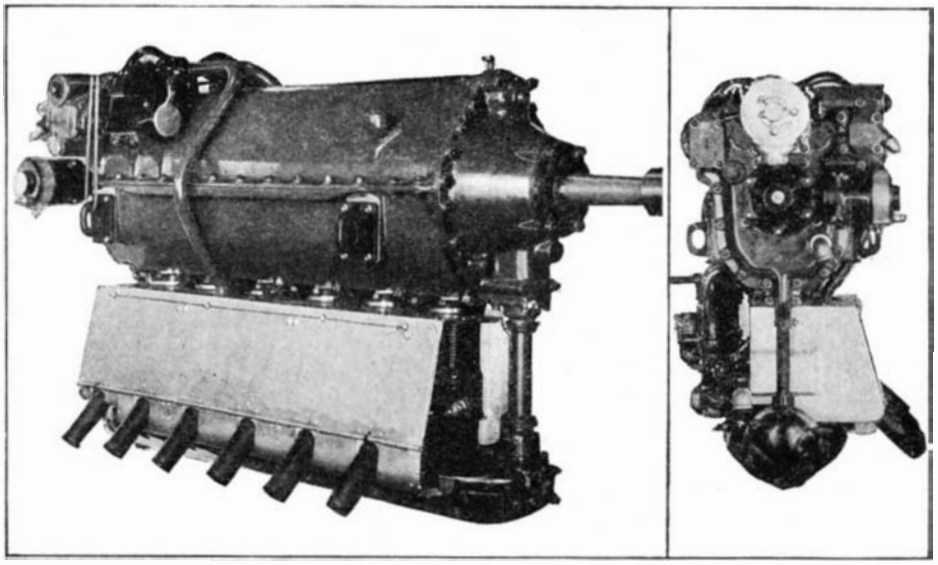
In the matter of plumbing, the limitations in the airplane are very severe. The fixtures must be light and small, because space is very valuable. Governmental regulations rigidly prohibit the discharge of any waste while in flight.

Designers have met these limitations by providing light combination water tanks and washstands of polished metal, weighing less than five pounds. Water tanks have been made of triangular and quarter-cylinder shapes so as to fit in corners and against cabin walls. A folding washstand has been developed which weighs only three pounds and fits snugly against the wall when not is use. Chemical hoppers have been provided, with sloping bottoms so as to fit sloping floors. Lavatory compartments on large passenger planes are fully equipped with washstands, closets, towel racks, small cupboards, and so on.

In the matter of heating, similar ingenuity has been displayed. Thanks to the courtesy of *Domestic Engineering*, we are able to show a special photograph indicating the heating arrangements on the Ford tri-motors now in use on the T. A. T. lines. The center motor exhaust pipe is installed along the under side of the plane. Over the exhaust pipe a large housing is placed with a clearance of approximately one inch on all sides. The bottom of the plane is protected by a heavy sheet of asbestos.

Fresh air is taken into the housing at the point 1 on the photograph. As the air passes through this housing it is warmed by contact with the hot exhaust pipe. The warm air is directed into the cabin by pipes of sufficient size, located in the floor at the center of the cabin. Registers may be opened or closed at the will of the passengers. The valve located at the end of the exhaust housing, at point 4, is operated by the last register in the cabin. When this register is closed, the valve is opened and allows the hot air to pass out to prevent overheating of the cabin. The funnel shaped opening, at point 2, and the register, at point 5, lead heated air into the cockpit. The opening at point 3 is for heating the air for the carbureter and operates in the same fashion as the cabin heater.

This simple and inexpensive method of heating has proved entirely satisfactory in practice, although temperatures under operating conditions vary from 35 degrees below zero, Fahrenheit, to 135 degrees above, and the flying ranges to 12,000 feet altitude.



Side and end views of the Fairchild 6-390 engine described below

Illustrating "Plumbing and Heating in the Air" above at left

A New Inverted Engine

THE in-line air-cooled inverted engine for small planes is still growing in popularity. This type offers somewhat less head resistance than the star or radial air-cooled engine and also less hindrance to the vision of the pilot. The pilot's vision is particularly satisfactory when the in-line air-cooled motor is inverted. The development of a six-cylinder in-line air-cooled engine by the Fairchild Engine Corporation is therefore of considerable interest to the aviation industry as a whole. The Model 6-390, as this new engine is called, has the following specifications:

Bore 4″
Stroke 5⅛″
Total displacement 386 cu. in.
Compression ratio 5.2 to 1
Weight dry 335 lbs.
115 h.p. at 2000 r.p.m.
Fuel consumption—.55 lbs. per BHP /hr at rated power and speed.

The engine has undergone a satisfactory 50-hour non-stop run at approximately full power.

The crankcase of the 6-390 is in two parts, and designed with special reference to ease of maintenance. A novel feature in the design is the use of four finished pads, two on each side, for mounting the engine. This makes for ready installation and removal of the engine from a plane.

The camshaft and rockers at the bottom of the engine are supported and enclosed by a housing, the cover of which serves as the engine oil sump. This makes for less noise and greater cleanliness.

The airplane pilot and mechanic should be particularly pleased with the grouping and location of the accessories on this engine, which are all placed towards the rear. Through a single opening about 12 inches by 16 inches in the cowl over the engine, it is possible to get at all the accessories as well as the starter and generator, oil pressure relief valve, and tachometer drive connections.

Glider Carnival Postponement

POSTPONEMENT of the New York Glider Carnival till late in June was announced by Edward P. Warner, chairman of the Carnival Committee. The event was originally scheduled for April 25 and 26 at Queens Borough Golf and Country Club, Bayside, L. I., N. Y.

The Carnival was postponed in order to allow a number of organizations which had entered, sufficient time to complete the construction of gliders which they will fly. This action was taken following a meeting of the executive committee, which consists of Miss Amelia Earhart, Norman Siegel, C. T. Stork, and E. P. Warner.

Postponement to a date late in June also will enable a number of the collegiate glider organizations to take part in the event, Mr. Warner pointed out. The program of 14 events for novice, second, and first class glider pilots will remain the same as scheduled for the earlier date.

Avoidable Causes of Accident

A FORMER Bulgarian army pilot, A. Jordanoff, has graphically depicted some avoidable causes of airplane accidents in the *New York Times*. These sketches are reproduced below.

1, indicates a plane striking the side of a mountain in a fog. Some sensitive warning of the presence of the mountain is an invention still to be made. The present remedy is to land rather than to attempt to fly through fog at low altitude.

A misguided effort to stretch a glide by putting the plane at a large angle of incidence and so getting it out of control is illustrated in 2. The longest glide from a given altitude occurs at an angle of attack of about four degrees for the wings. Raising the nose slows down the speed of the glide, but actually diminishes the gliding radius.

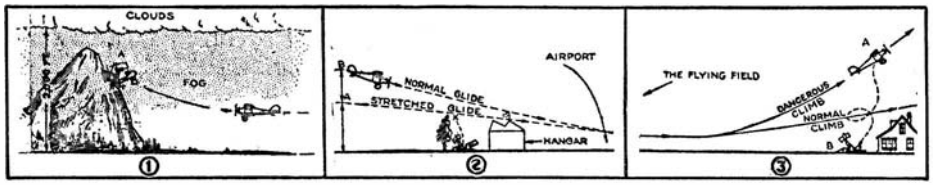
The dangers of too steep a climb are shown in 3. If the climb is too steep, the engine may not provide enough power to maintain the climb, the wings may stall, and loss of lift and control lead to trouble.

Turning in a sharp climb may be dangerous, as shown in 4. We beg to differ with the author-artist here. Once the airplane is up aloft in a steady wind, the wind has no effect on its maneuver relative to the air—whatever may be its effects from the point of view of ground speed.

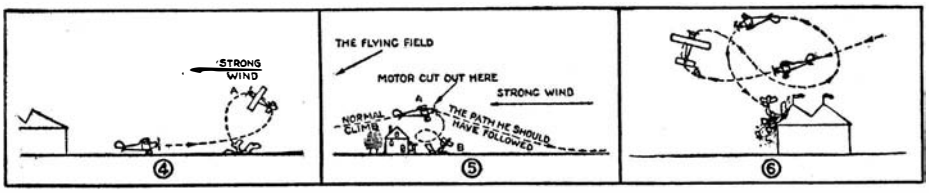
The golden rule is illustrated in 5. Never attempt to turn back when the engine quits. Turning without power may result in a stall, with consequent disaster.

Illustration 6 speaks for itself. Stunting at low altitudes is always dangerous.

Such diagrams published in the daily press may give the public an erroneous idea of the hazards of flying, but, on the other hand, if every pilot took such rules to heart the number of accidents would be greatly diminished.



Above and below: Illustrations of six avoidable types of accidents



Testing Gasoline in the Air

THE importance of using the best gasoline for aircraft is of course obvious and a great many of the large oil companies now have special aircraft gasoline departments with experienced aviation men at their heads, ready to supply pertinent information to aircraft engine builders and operators.

Equipment in cockpit for use in testing gasoline during flight

The Natural Gasoline Association of America, in collaboration with the Phillips Petroleum Company, has gone a step further by equipping a Wasp engined Travelair monoplane with a complete set of instruments for testing gasoline under conditions of actual flight.

The accompanying photograph shows the installation of the switch panel and recording instruments in the cabin of the plane, using delicate thermocouple and resistance thermometers. A most comprehensive survey of temperatures may be made at any one time; namely, temperature of the right wing, temperature of vapor space and gasoline in the tanks, temperature in the gasoline feed line, temperatures in the carbureter bowl, fuel pump, strainer, air intake, cylinder heads, and temperature in cylinder-head flanges.

If these temperature measurements are accompanied by the usual determination of altitude, air speed, and climbing and gliding angles, it is clear that a very thorough study of the motor's operation will be available. The temperature of the engine parts has an obvious bearing on the reliability of the motor.

Model Meet

A NEW YORK State model airplane meet will be held at Binghamton, New York, on May 30 and 31. Junior events will be for boys under 15 years of age, and senior events for young men from 16 to 21 years of age.

Outdoor models are to be twin pushers or tractors with 40-inch fuselages and a minimum wing surface of 125 square inches. Indoor models are to be somewhat smaller, with single tractor or pusher, propellers and with 15-inch fuselages and 24-inch wing spreads.

Nothing spreads interest in actual flying as much as the education of our youngsters in model work.

Radio "Flag Stops" in Air Transport

A MOST interesting development is the introduction of flag stops by the Transcontinental Air Transport. In order to serve more cities along its route, the T.A.T. has created three flag stops along its transcontinental line; one at Vandalia, Ohio, about nine miles north of Dayton; one at St. Elmo, Indiana; and one at Terre Haute, Indiana. Passengers will be able to board the planes at these points by simply notifying the company's representatives in time to have the pilot instructed. This will be done by radio while the plane is in the air.

Progress on the Lindbergh Line

WORKING in active co-operation with the Pennsylvania and Atchison Railroads, Transcontinental Air Transport Lines have issued interesting figures regarding the first six months' operations of their transcontinental air lines called the Lindbergh Line, in recognition of Colonel Lindbergh's service as Chairman of the T.A.T. Technical Committee.

Since its inauguration last July, T. A. T. has carried 4346 passengers for a total of slightly more than 2,000,000 passenger miles.

Its operating ratio, obtained by balancing the number of miles scheduled against the miles flown, has been 90.5 percent. There were 603,700 miles scheduled and 545,354 miles flown. Out of the 669 trips scheduled, 578, or 86.5 percent, were completed, and 70.6 percent of the plane arrivals were on time. These figures are quite encouraging and it is to be expected that, as confidence increases, a great many more passengers will be carried during 1930.

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Dead Sea Becomes Center of Live Industry

THE Dead Sea, in Palestine, long known to contain potash and other valuable salts, is now being exploited by a chemical company which will recover potash from its historic waters. Palestine Potash, Ltd., has been formed in London with 2,000,000 dollars in capital to exploit the chemical resources of this body of water. Actual work will be begun immediately at the confluence of the River Jordan and the Dead Sea, where elaborate drying plants have been erected and 400 workers engaged.

The Earl of Lytton, former Viceroy of India, is chairman of the new company, which intends to increase its capitalization as business warrants. Shares already have been subscribed by the British and American directors, but additional shares will be offered to the public in accordance with the terms of the concession. Among the American directors are Felix Warburg and Bernard Flexner of New York.

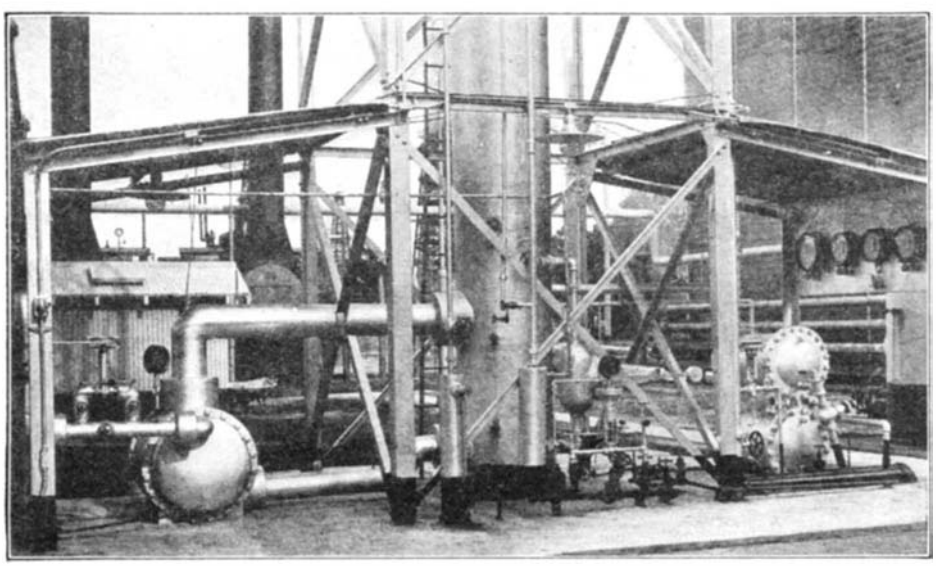
Although the start necessarily will be slow, the company is bound by its concession to produce at least 50,000 tons of potassium chloride annually after the tenth year. The work will be carried out by means of huge drying tanks built on the hills on each side of the mouth of the Jordan.

The water of the Dead Sea, which is 300 feet below sea level, is said to be among the world's richest repositories of valuable salts, and potash is expected to become one of Palestine's most important products. The potash will be taken by motor truck to Jerusalem and thence to Haifa by rail for export.

Automatic Control of Gasoline Plant

THE chemical engineer is not slow to adapt the ingenious devices of the electrical and mechanical engineer to his own problems, thus providing automatic control for the operations with which he is concerned. Often, a few degrees variation in temperature will make the difference between success and failure in a chemical reaction, so the automatic thermostat is called into use to keep its tireless vigil over many a vat, still, or digester. An equal degree of mechanization is now being realized in the control of pressure. Thus, for example, in the recovery of gasoline from natural gas, a very careful control of pressures in pipe lines and towers is essential. J. V. Thomas, in a recent issue of *Chemical and Metallurgical Engineering*, describes the almost human devices which take the place of manual control in plants of this kind.

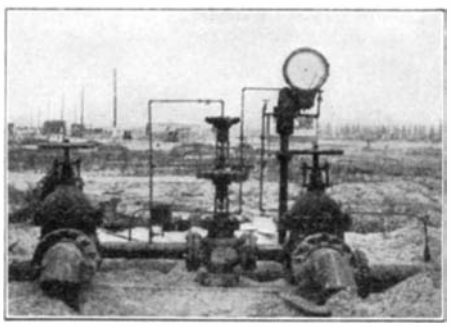
Not only are pressures and temperatures controlled automatically, but liquid-level controllers maintain constant levels in tanks and absorption towers.



These pressure regulators, liquid level controllers, and temperature controllers are used in automatically maintaining a stabilizing column in a gas plant

Mystery of Poison Island Solved

WHEN a large number of workmen, engaged in building a new power plant for the Duquesne Light Company, on Brunot Island in the Ohio River near Pittsburgh, were mysteriously overcome on the job, the engineers decided it was time to call in the chemists. A hurry call to the United States Bureau of Mines, Pittsburgh Experiment Station, brought a corps of specialists equipped with breathing apparatus, gas masks, and gas detecting devices. On arriving at the construction project, it was found that the employees affected by gas had been overcome or partially overcome while changing clothes in a change-house before going to work. Tests made by the Bureau of Mines safety engineers with a carbon monoxide detector showed that there was approximately 1 to 2 percent of carbon monoxide in the atmosphere of the building.



Automatic regulator used in gas line to reduce the pressure from 250 to 5 pounds, and maintain it

Investigation as to the source of carbon monoxide disclosed one of the most novel occurrences of the gas that has ever come to the attention of the Bureau of Mines specialists. The entire upper end of the island has been formed by the dumping of cinders from a boiler plant operated for a period of at least 20 years. This bed of cinders and ashes is at least 40 feet in depth in various places. Various sections of this cinder-ash field had been on fire as recently as two or three months previous. Thus a great area was giving off carbon monoxide, the formation of the deadly gas from the cinders being similar to the formation of water gas.

An intake tunnel was being constructed under the cinder-ash field, and the compressed air from the tunnel, under about 7½ pounds pressure, was being forced up through the cracks and the interstices similarly to the passage of air through a blacksmith's blower. This air movement increased the production of carbon monoxide, the formation of which was also considerably aided by the melting of a fairly heavy snow followed by rain, resulting in little or no air movement on the surface. The change-house in which the employees were overcome was located several feet from the site of the tunnel, illustrating the widespread distribution of the carbon monoxide.

Electrocute Methane to Form Acetylene

AT the Kaiser-Wilhelm Institute für Kohlenforschung, Germany, chemists have developed an "electrocuting" apparatus through which they pass a gas such as methane, whereupon it emerges as acetylene. Almost any of the hydrocarbons, when subjected as gases to the "shocking" effect of this electrical device are converted to something else, indicating that the effect of the discharge is to blow the molecules of gas into atoms which then rearrange themselves into new combinations, something like a game of electrochemical puss-in-the-corner.

Of the several kinds of electrical discharges which have been applied to chemical reactions, the most important from the practical standpoint are the arc, the silent discharge, and the low-pressure discharge. The arc process has been used, notably in Norway, for the conversion of the nitrogen in air into nitric acid. Another use of the arc discharge in chemistry is the production of carbon black and acetylene from

Weighing quartz crystals in the trays in which they will be melted to form window panes, and loading the trays on the holder for the electric furnace

hydrocarbon gases. The silent electric discharge is useful for its polymerizing effect and for activating gases. Its industrial use is limited by low yield and low current density. Low-pressure discharge gives a useful means of effecting endothermic and ionic reactions at relatively low temperatures.

The Germans have now found that not only methane but the higher hydro-carbons (naphthalene, anthracene, petroleum oils, and even pitch) can be converted into acetylene by a low-pressure discharge. In the presence of nitrogen, prussic acid can be obtained. Removal of products as formed makes possible excellent yields in the laboratory trials. Production on a commercial scale has not yet been accomplished, but energy relations and other considerations which affect costs do not indicate any fundamental obstacles.

Making Glass Which Passes Health-giving Rays

WHILE it is only recently that electrical manufacturers have developed lights which artificially produce the health-giving rays formerly available only in natural sunlight, nevertheless, the beneficial effects of these rays has been known for centuries. The ancient Egyptians were familiar with the benefits of sunlight.

The importance of ultra-violet rays of the sunlight to health and the fact that ordinary window glass cuts out nearly all of these beneficial rays has long been recognized. Several years ago Professor Elihu Thomson, director of the General Electric's great research laboratory at Lynn, Massachusetts, took up the work of developing a material which would transmit the health rays, to replace window glass. Fused quartz was known as the best medium for the purpose but to make window panes of it was a problem that required years to solve. The difficulties of making quartz windows can be appreciated when it is realized that the melting point of quartz approaches a temperature of 3200 degrees Fahrenheit, about three times that of glass. Moreover, it is extremely viscous, or thick. Many methods were investigated and special furnaces were developed before the engineers finally succeeded in making quartz in sheet form, and at a reasonable cost.

One of the first methods developed to produce a high quality quartz glass consisted in fusing, in a vacuum, specially selected and treated quartz crystals in a square fabricated graphite box, and pressing the fused mass of quartz at 1000 pounds per square inch while in the molten state. A block of quartz 8 by 5 by 5 inches was thus obtained. This block when cooled was sliced into sections one eighth inch thick and each pane was ground and polished by hand.

This method of manufacture was considered too expensive for common use, and further research was carried on to get a satisfactory quartz window that would be sufficiently reasonable in cost that the benefits of fused quartz could be available for more general use. This additional development work resulted in an entirely new process which cut the cost of manufacture to about one fifth of previous costs and made it feasible to use quartz in large solariums.

In the present process, quartz crystal, crushed to one quarter inch mesh, is fused in a vacuum on flat graphite disks between thin graphite slabs in the form of a 7½ inch square. A number of these trays are stacked in a form and placed in a high-temperature furnace. When the quartz is fused, nitrogen gas is admitted to the furnace at a pressure of 150 pounds per square inch to compress the bubbles. The resulting quartz plates, upon cooling, require only squaring of the edges by grinding. The plates themselves are 7½ inches square by one quarter inch thick. This new method does away with cutting, grinding, and polishing each pane, and the trays can be used a number of times.

United States Alcohol Consumption only Half Capacity

ETHYL alcohol ranks first in quantity and value of production of all organic chemicals. It is a basic raw material in the chemical and process industries and finds application in a multitude of products. An approximate distribution of denatured alcohol by uses is as follows:

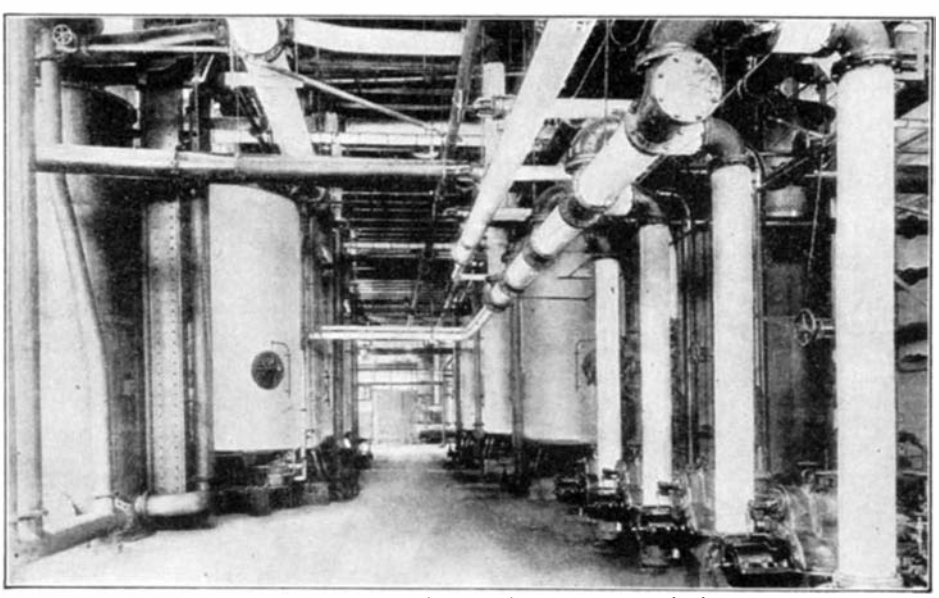
	Wine Gallons
Anti-freeze	40,000,000
Cellulose industries	25,000,000
Shellac and varnish	8,000,000
Toilet and perfume preparations	5,000,000
Miscellaneous	15,000,000

The total available capacity in the United States for producing alcohol, says W. N. Watson, of the United States Tariff Commission, writing in a recent issue of *Chemical and Metallurgical Engineering*, is about 220,000,000 wine gallons, of which about 15,000,000 wine gallons is for production from grain, and the balance, 205,000,000 wine gallons, from molasses. The annual consumption is about 100,000,000 wine gallons, or somewhat less than one half the present capacity. The capital invested in molasses alcohol plants is about 55,000,000 dollars and in grain alcohol plants about 5,000,000 dollars.

In the manufacture of alcohol from corn, the by-products consist of distillers' grains, a valuable cattle feed, which has sold in recent years for from 35 to 45 dollars per ton, or on an average of about 2 cents per pound. Each bushel of corn gives about 12½ pounds of distillers' grains. In addition, fusel oil is another by-product of small importance, and in certain cases, corn oil and corn-oil meal are obtained.

It is estimated that if all the alcohol produced in America were made from corn,

(*Please turn to page* 483)



Evaporators in a modern industrial alcohol plant

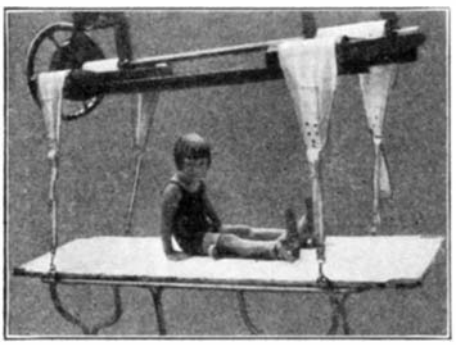
The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

The Care of the Crippled

WITHIN the last few years special attention has been paid throughout the world to the use of the swimming pool method for developing and educating tissue that has lost its function through infantile paralysis. Among the leaders has been the



Traveling hoist with hand control. New apparatus for carrying patients will be electrically controlled

Orthopedic Hospital of Los Angeles. There a special pool was built in which all forms of paralysis are treated. The chief values of the pool treatment seem to be the greater ease and freedom of movement in painful conditions, the easier handling of painful joints and easier development of weakened muscles, the fact that the water bears the weight, the enjoyment and interest, and the special value of the baths on the general morale of the patient.

In developing a pool particularly for this purpose, arrangements have been made for carriers which deliver the patient at the pool and for special sprays to clean the patient before entering the pool and on leaving. Foot baths are provided and cleanliness is carefully controlled by chlorination, and by the use of copper salt for algae. Metal equipment is made of bronze, chrome nickel or enamel so that it will not be corroded by the chlorine in the water.

Special tables have been arranged which allow the head and shoulders of the patients to be supported out of the water, and permit the attendants to manipulate the tissues while the patient is in the water.

As may well be imagined, such special equipment is exceedingly costly, but it is of value in the relief of pain and the cure of defects, which makes cost a secondary consideration.

First-Aid for Motorists

APPARENTLY European countries are far beyond our country in anticipation of the difficulties associated with modern tourists and their safety. France has had established for some time a series of first-aid stations along many of the highways. The Red Cross Society of Belgium established its first-aid stations three years ago and now has a complete series of them in working order along the roads from Brussels to Ostend, Antwerp, Liege, and Namur.

Because of the tremendous number of roadside accidents in this country, the American Red Cross might give serious consideration to this work. Persons who are injured are usually carried by the first passerby to some hospital. Hospitals are dubious about taking care of such patients, particularly when they come from outside the state, and the whole problem of responsibility for the care of the patient is in doubt.

Operations on the Heart

IT is not so long ago that any operation on the human heart was considered invariably fatal. With gradual improvement in methods of operation and in the use of anesthetics attempts were made to do various surgical operations involving the vital organ. In this country men have had wounds of the heart sewed up, a bullet has been removed from the heart, and in one instance the heart was opened, a constricted valve cut, and the patient recovered.

In a recent meeting of the Vienna Medical Society several interesting cases were presented in which operations had been performed on the heart. In one case a man was stabbed and when the patient was opened the wound was found to have penetrated the outer covering of the heart and the heart itself. The heart had apparently stopped beating. The space between the outer covering of the heart and the heart itself was filled with blood clots. The sac was opened and the blood clots were removed, whereupon the heart began to beat. The heart was sewed, the outer covering was sewed, and the wound in the chest closed.

Another instance was reported in which a bullet had penetrated the heart. When the body was opened and the heart examined, an opening was found into the heart, but no exit opening was found. The opening was closed and during the operation the heart stopped. After massage it began beating again. The use of the X-ray some three months later showed the projectile buried in the tissue of the heart, but the patient up to that time had not suffered any unusual symptoms.

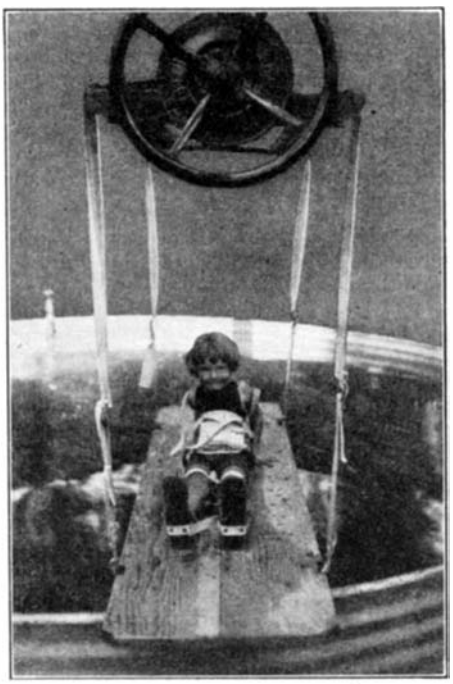
Hospitals of the United States

ONE of the most interesting phenomena of the last quarter century has been the rise of hospital care in this country. There are today 6665 reputable hospitals providing 907,133 beds and 47,939 bassinets. This is an increase of 486,068 beds or 115.4 percent since 1909. The average number of people constantly in hospitals in 1929 was 726,766. There are approximately 150,000 physicians in this country, of whom about 125,000 are in practice. It is almost impossible to realize that 98,491 doctors have connections with hospitals and indeed 84,579 are actually attending in such institutions.

Sinus Infection and Vitamins

IT has long been known that vitamin A deficiency produces an inflammation of the eyes. More recently it has been quite definitely shown that vitamin A is related to the resistance of the human body against infection. Following a deficiency of vitamin A in the diet, rats develop inflammations of the eyes, infections of the nasal passages and sinuses, of the ears, the tongue, and even of the lungs. Most investigators are now convinced that the value of cod-liver oil in preventing colds, if it has any such value, is due to the vitamin A in the cod-liver oil and not to the vitamin D.

In the research laboratories of the Detroit College of Medicine and Surgery, Drs. Burt R. Shurly and R. G. Turner made a special study of the relationship of vitamin A to infections of the breathing



Hoist for transporting patients between pool and dressing room

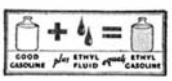
tract, and particularly of the sinuses. They made a special study of the bacterial organisms found in animals which had been on vitamin deficient diets. They found certain organisms in such cases which were especially virulent.

In the University of Iowa, in 1916, Doctors Daniels and Armstrong showed that deficiencies in diets encouraged infection of the sinuses as well as of the ear. There seems to be no doubt that deprivation of vitamin A permits germs to exercise extraordinarily virulent effects.

The *proof* that Ethyl develops more power

Right: This is the instrument board of a knock-demonstration machine. The wattmeter (at the left) registers power. The tachometer (at the right) records engine revolutions per minute. When this picture was made, the engine was running on ordinary fuel.

Below: When the lower picture was taken, Ethyl had been fed into the carbureter. The wattmeter shows that the power has risen to the maximum; the tachometer shows a corresponding increase in revolutions per minute.



"Knocks out that 'knock'"

ETHYL GASOLINE

"SEEING is believing." These pictures of a knock-demonstration machine let you *see* how Ethyl Gasoline will increase the speed and power of your motor.

A simple valve switches the fuel from ordinary gasoline to Ethyl and back again. When Ethyl goes in, "knock" goes out, R. P. M.'s (engine revolutions per minute) increase, power goes up. That is how Ethyl improves motor car performance.

The Ethyl anti-knock compound in Ethyl Gasoline makes the difference. This remarkable fluid was developed by General Motors Research Laboratories after years of experiment to find an ingredient which would make gasoline a better fuel. Make this convincing experiment in your own car. Use up the ordinary gasoline in the tank; then fill up with Ethyl. You'll see and feel the difference.

* * * *

Wherever you drive—whatever the oil company's name or the brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of anti-knock rating sufficiently high to "knock out that 'knock'" in cars of average compression and bring out the additional power of the new high-compression cars. Ethyl Gasoline Corporation, Chrysler Building, New York City.

The active ingredient used in Ethyl fluid is lead

Current Bulletin Briefs

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

AXE MANUAL OF PETER MCLAREN (America's champion chopper). Axemanship as sport and as an art; how to handle an ax expertly and how not to; how to conduct a chopping contest, a new outdoor sport; how to put an edge on an ax scientifically. 84 pages illustrated. *Fayette R. Plumb, Inc., Philadelphia, Pa.—25 cents.*

TESTS OF LARGE TIMBER COLUMNS AND PRESENTATION OF THE FOREST PRODUCTS LABORATORY COLUMN FORMULA, by J. A. Newlin and J. M. Gahagan. (Technical Bulletin No. 167, Department of Agriculture). The authors have made a valuable contribution to timber mechanics. *Superintendent of Public Documents, Washington, D. C.—15 cents, coin.*

INDIAN CORN, by James B. McNair. A 33-page summary of information on our largest crop plant. Origin of corn; how Indians used it; modern industrial and experimental products such as starch; uses of corncobs (corncob flour, wood sugar) and of stalks (syrup, wall board, paper, artificial silk). *Field Museum of Natural History, Chicago.—Ten cents.*

PERMISSIBLE EXPLOSIVES — Information concerning their characteristics and their use in gassy and dusty coal mines. *E. I. du Pont de Nemours Co., Wilmington, Del.—Gratis.*

SAND AND GRAVEL IN 1928, by Estelle R. Phillips (Excerpt from Mineral Resources of the United States). Gives complete statistics of the industry. *Superintendent of Documents, Washington, D. C.—5 cents, coin.*

PULLMAN PROGRESS 1859–1929. A very attractive folder giving eight pictures in color of sleeping cars at various periods. Valuable for schools. *The Pullman Company, Chicago, Ill.—Free to teachers.*

ALLEGHANY PORTAGE RAILROAD. Interesting pamphlets on the forerunner of the Pennsylvania Railroad. *Publicity Bureau, Pennsylvania Railroad, Broad Street Station, Philadelphia, Pa.—Gratis.*

PORT OF HAMBURG (Foreign Port Series No. 1, Department of Commerce). Contains maps and 300 pages of information, bound in buckram. *Superintendentent of Documents, Washington, D. C. One dollar, money order.*

PORT OF LIVERPOOL. (Foreign Port Series No. 2, Department of Commerce). Contains 300 pages giving full information. There are maps, and it is bound in buckram. *Superintendent of Documents, Washington, D. C.—One dollar, money order.*

UPPER COLORADO RIVER AND ITS UTILIZATION. (Water Supply Paper No. 617 of the U. S. Geological Survey). It is of special interest to engineers and agriculturists concerned with projects in this district. *Superintendent of Documents, Washington, D. C.—65 cents, money order.*

TOBACCO AND ITS USE IN AFRICA by Berthold Laufer, Wilfrid D. Hambly, and Ralph Linton, is illustrated with drawings showing the many novel types of smoking equipment used by the natives in Africa. *Field Museum of Natural History, Chicago.—25 cents.*

YUKON: THE LAND OF THE KLONDIKE is a 46-page illustrated booklet showing the great changes that have taken place in the Yukon Territory since the storied days of '98. Both scenic attractions and industrial development are covered in the booklet. *Department of the Interior, Ottawa, Canada.*

FOR HOME LOVERS is the title of a new booklet illustrating houses of a wide variety of types, with floor plans and sketches showing construction details. *National Lumber Manufacturers Association, Transportation Building, Washington, D. C.—Gratis.*

ROMAN SURVEYING INSTRUMENTS, by Edward Noble Stone, is an illustrated short general description of the principal instruments used by Roman engineers in land-surveying and leveling, in laying out sites for camps and towns, and in the construction of roads and aqueducts. The descriptions and line drawings will prove interesting to present-day surveyors and engineers, as well as to students of Roman antiquities. *University of Washington Press, Seattle, Washington.—75 cents.*

THE NEW NEWS is a significant study of journalism and its place in the life of a great nation, particularly from the viewpoint of the advertiser. The publication is also interesting typographically, and presents some striking reproductions from line plates depicting modern America. *The United States Daily, Washington, D. C.—Gratis.*

YEAR BOOK FOR 1929. CARNEGIE INSTITUTION OF WASHINGTON. Summary of a single year's research in archeology, biology, chemistry, genetics, history of science, mathematics, meteorology, nutrition, paleontology, physics, physiology, seismology and others, conducted at the subordinate laboratories of this vast institution, each piece of research being described in a technical abstract. *Carnegie Institution of Washington.—One dollar.*

JOURNAL OF THE SOCIETY OF MOTION PICTURE ENGINEERS; published monthly, contains many important engineering papers on various topics pertaining to the technical improvement of motion pictures. *Secretary, Society of Motion Picture Engineers, 5th and Sussex Streets, Harrison, N. J.—$1.50 per copy to non-members.*

HOW THE 13-PERIOD CALENDAR WORKS IN BUSINESS, is a leaflet containing the views of executives of many prominent corporations which have adopted the use of the revised calendar. *National Committee on Calendar Simplification, 343 State Street, Rochester, New York.—Gratis.*

NATIONAL PHYSICAL LABORATORY REPORT FOR 1928. Detailed 270-page account of researches performed at Britain's institution corresponding to the United States Bureau of Standards. *His Majesty's Stationery Office, London, England.—9 shillings net.*

GREAT BRITAIN AND IRELAND, CALENDAR OF HISTORIC AND IMPORTANT EVENTS 1930 is a little booklet printed in black and red giving the principal events month by month together with information useful to travelers. *The Travel Association of Great Britain and Ireland, Kinnaird House, 1 Pall Mall East, London, S. W. 1, England.*

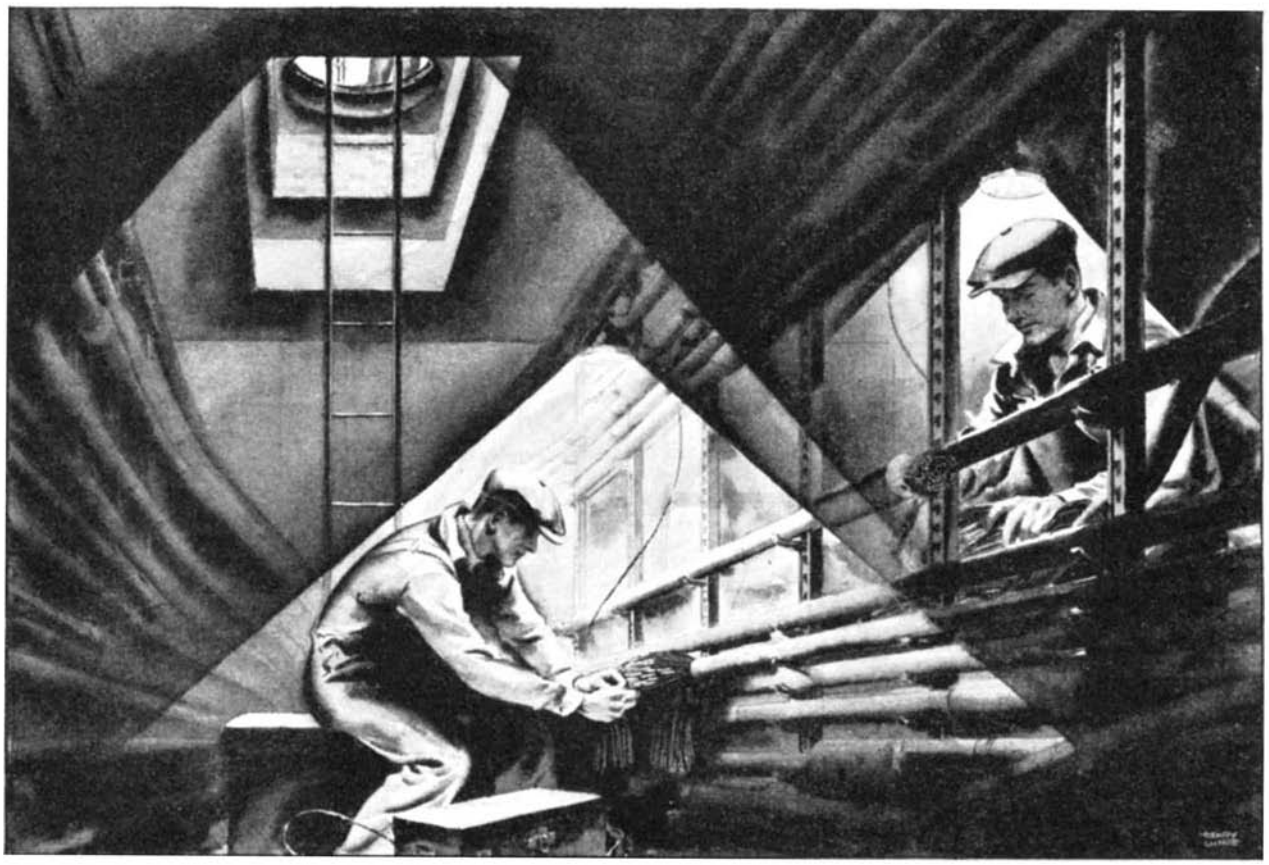
NICKEL-CHROMIUM STEELS FOR HIGH TEMPERATURE SERVICE VALVES AND BOLTS, by V. T. Malcolm. *The International Nickel Co., 67 Wall Street, New York City.—Gratis.*

SAFETY RULES, a pamphlet on safety in factories issued by the General Electric Co., Schenectady, New York. *Address G. E. Sanford, Chairman of the Safety Committee, 1 River Road, Schenectady, N. Y.—Gratis.*

SAFETY PRECAUTIONS WHEN HANDLING ACIDS, ALKALIES AND POISONS. General Electric Company, Schenectady, N. Y. *Address G. E. Sanford, Chairman of the Safety Committee, 1 River Road, Schenectady, N. Y.—Gratis.*

SAFETY RULES FOR MEN HANDLING ELECTRIC CIRCUITS OR APPARATUS. General Electric Company, Schenectady, N. Y. *Address G. E. Sanford, Chairman of the Safety Committee, 1 River Road, Schenectady, N. Y.*

RAYON AS A PAPER-MAKING MATERIAL, by Merle B. Shaw and George W. Becking, (Research Paper No. 143) is a reprint from Bureau of Standards Journal of Research. The test data indicates that rayon is valueless in the rag stock for high-grade papers and may actually be detrimental to their quality.—*Superintendent of Documents, Washington, D. C.—5cents, coin.*



THE INCREASING USE OF THE TELEPHONE REQUIRES THE EXPENDITURE OF HUNDREDS OF MILLIONS ANNUALLY FOR EXTENSIONS AND IMPROVEMENTS

It keeps faith with your needs

An Advertisement of the American Telephone and Telegraph Company

You have found a constantly growing use for the telephone. You have learned its value in business. You have found it helpful in keeping contact with family and friends. Its increasing use has given the telephone its humanly important place in modern life and requires the expenditure of hundreds of millions annually for extensions and improvements.

In 1929 the Bell System's additions, betterments and replacements, with new manufacturing facilities, meant an expenditure of 633 million dollars. During 1930 this total will be more than 700 millions.

Definite improvements in your service result from a program of this size and kind. They start with the average time required to put in your telephone—which in five years has been cut nearly in half. They range through the other branches of your service, even to calls for distant points—so that all but a very few of them are now completed while you remain at the telephone.

In order to give the most effective, as well as the most economical service, the operation of the Bell System is carried on by 24 Associated Companies, each attuned to the part of the country it serves.

The Bell Laboratories are constantly engaged in telephone research. The Western Electric Company is manufacturing the precision equipment needed by the System. The staff of the American Telephone and Telegraph Company is developing better methods for the use of the operating companies. It is the aim of the Bell System continually to furnish a better telephone service for the nation.

The Amateur Astronomer

A Monthly Department

THE reader who decides to take up the home hobby of building and using an astronomical telescope—grinding and polishing his own glass optical parts and becoming one of a growing host of amateur astronomers—is urged to tackle nothing larger for his first effort than an instrument of six-inch diameter. Such a telescope will, however, magnify 50 to 200 diameters, depending on conditions. At a cost of about 25 dollars for materials (which can be obtained in a "set," that is, ready-to-use), if he possesses only average handiness he can make an instrument equaling in performance one he might purchase for 500 dollars. Hundreds of our readers scattered far and wide already have done this, using the practical working instructions in the SCIENTIFIC AMERICAN book "Amatuer Telescope Making," where numerous types are clearly described.

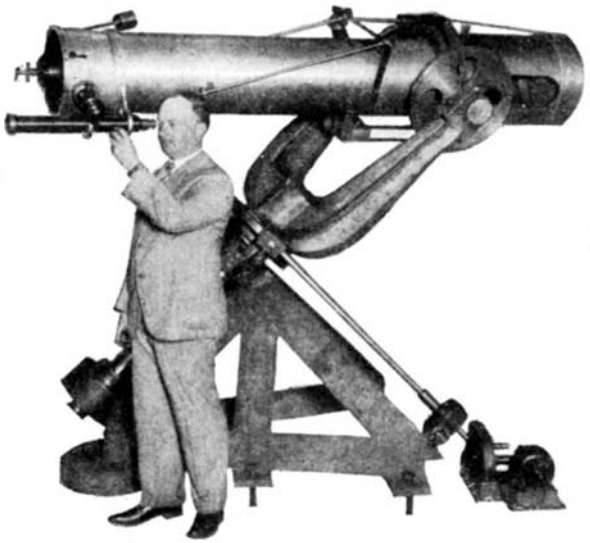
MR. W. L. Chamberlain, 519 Liberty Street, Meriden, Connecticut, sends in a photograph of his telescope and writes as follows:

"A talk on telescope making by one who had made a very successful telescope himself, inspired me to attempt the same thing. A friend loaned me a copy of 'Amateur Telescope Making,' and after securing glass disks and other materials, a start was made. The photograph submitted shows the finished instrument, a six-inch Newtonian reflector of 48-inch focal length.

"In grinding the mirror mistakes were made, as is usual with the novice, but the work proved to be so fascinating that the extra time required to make corrections was not regretted, for it was a good schooling in the art.

"Not wishing to be confined to a post and one location, it was decided to make the mounting of the alt-azimuth type, so that a tripod could be used as well. The sockets for the fork stem are identical on each. The fork, which has an offset angle, allows the tube to clear the post when directed at the zenith. The whole sky is seen.

"The post is an iron pipe 3½ inches in diameter, surmounted by a metal ball which just fits the inside diameter of the pipe. This ball is drilled and tapped for a short piece of steam pipe which makes the fork socket, and is held in place by three pointed set screws which are inserted through threaded holes near the top edge of the post into countersunk holes in the ball, one half of which protrudes out of the post. Two of these set screws are placed so that they form an axis on which the ball socket tube can be tilted over toward *Polaris*, thus forming a polar axis by which the telescope can be converted quickly into an English equatorial. The third set screw locks the ball in either position. The fork has two removable pins at the angle which, being reinserted in other properly located holes, straightens the fork as is usual in equatorial mounts.

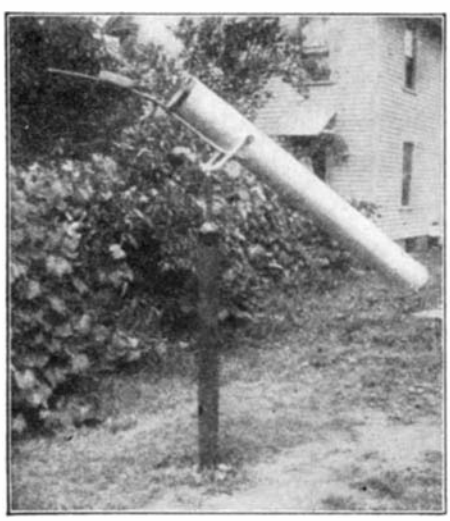


Mr. Patton and his one-ton telescope

"When the telescope is used as an alt-azimuth, the eyepiece is inserted in the end of the declination axis. This gives the observer the great satisfaction of always having the eyepiece at the same height from the ground no matter where the telescope is pointed, and always directly above the post. This makes it possible to use a detachable bicycle seat on the post.

"The performance of the instrument exceeds my expectations. The definition is good. With my strongest eyepiece, estimated, with my focal length, to give 90 diameters magnification, the components of *Zeta* in Ursa Major are thrown wide apart, that is, *Sidus*, *Alcor*, and *Mizar;* and then the larger component *Mizar* is again split up into a close but clearly defined double. Star cluster M13 in Hercules gives momentary glimpses of individual components.

"I want to say a good word for honeycomb foundation strips in bringing up a low center when figuring a mirror. It is a most valuable addition to the possible methods of doing it."



Chamberlain's reflector

AN interesting, though brief, letter has been received from Mr. G. O. Neser, Senior Science Master at the Boys' High School at Paarl, South Africa. He writes:

"Sir:

"As I recollect seeing only one photo of a South African amateur's telescope published in your journal, I am sending you a snap of my reflector. It has a six-inch mirror, focal length fifty-two inches, and is mounted temporarily and rather precariously as shown.

"I am very much indebted to the SCIENTIFIC AMERICAN for initiating me into the mysteries of mirror making. I am starting on a 10-inch one shortly. Kindly have your book department forward me a copy of the latest edition of 'Amateur Telescope Making'."

MANY amateur telescope makers have jumped from six inch to eight or ten inch size on their second instrument, or even to larger sizes. Few have jumped quite so far, however, in refinement of mounting, as Mr. Ralph C. Patton of the Patton-Macguyer Co., Baker Street and Virginia Avenue, Providence, Rhode Island, makers of stampings and novelties. At our request Mr. Patton has prepared the following description of his instrument:

"The telescope shown in the illustration has a clear aperture of 12 inches and a focal length of about eight feet. The mounting is of the English fork type, which is inherently balanced without counterweights. A tapered cylindrical aluminum casting, threaded inside throughout its length to break up light reflection, forms the main tube, and is forced into the short cast-iron barrel which acts as the lower end of the tube. This barrel is also threaded inside, so that no part of the interior presents a reflecting surface.

"The cast-iron fork has a tight, forced fit on the end of the polar axis. The latter is made of chrome vanadium steel,

Made in South Africa

heat treated and ground to exact size.

"The principal mirror is about 12¼ inches outside diameter, and is about two inches thick. It weighs 20 pounds and is mounted in a revolvable cell, with three sets of push-and-pull screws for adjustment. The revolving feature was devised so that true axial alinement of the mirror could be determined readily.

"The sky end of the tube has a cast-aluminum revolving head, carrying eyepiece and finder to insure a comfortable position for the observer, regardless of the altitude of the object being observed. The finder has a two-inch aperture.

"Five eyepieces are provided, and these can be used interchangeably in the finder or main telescope. In the latter they give magnifications varying from 64 diameters to 500.

"The mounting has closely divided circles, and is provided with clamps and slow motions for both declination and right ascension motions. The principal right ascension dial is rotated continuously during observation by means of a synchronous induction motor, which drives it through three sets of worm reduction units, having a combined ratio of more than 2,500,000 to 1.

"In using a synchronous motor drive for a telescope, it is necessary to interpose a pair of meshed gears having respectively 365 and 366 teeth, in order to change mean solar time into sidereal time. These have helical teeth to reduce vibration.

"The frame which carries the main tube is provided with two precision spirit levels for zenith setting. The declination axis and the polar axis run in eight ball bearings, which are protected from dust by felt washers within brass guards. All gearing is totally enclosed and runs in grease.

"The approximate weights of the principal parts are: base 1060 pounds; fork 410 pounds; polar axis shaft 104 pounds; assembled tube in ring with trunnions, mirror, cell, finder, and so on, 492 pounds; the total weight being over a ton.

"The telescope is housed in a sliding roof observatory, 15 feet by 18 feet, and the roof, which weighs about 2600 pounds, is moved on and off the building by a small electric motor, operating through sprockets, racks, and pinions.

"The telescope was designed, constructed and built in about two years. The mirrors were furnished by Mr. Wilbur Perry, of Springfield, Vermont. Inspiration for the work was furnished to a great extent by your book 'Amateur Telescope Making.'"

Amateur telescope makers may be surprised to learn that the first man to see the image of the new trans-Neptunian body on the photographic plate at Lowell Observatory was one of their number, Mr. Clyde W. Tombaugh. When the find was announced all the newspapers told how Tombaugh had made a telescope. Suspecting he might have used "Amateur Telescope Making" as his guide we looked in our file of purchasers, which is arranged by states, and found that he purchased the book in 1926. A wire brought from him the reply, "I used 'Amateur Telescope Making' in the construction of my telescope." Apparently, however, when he made his telescopes he never sent in a picture of the instruments for publication.

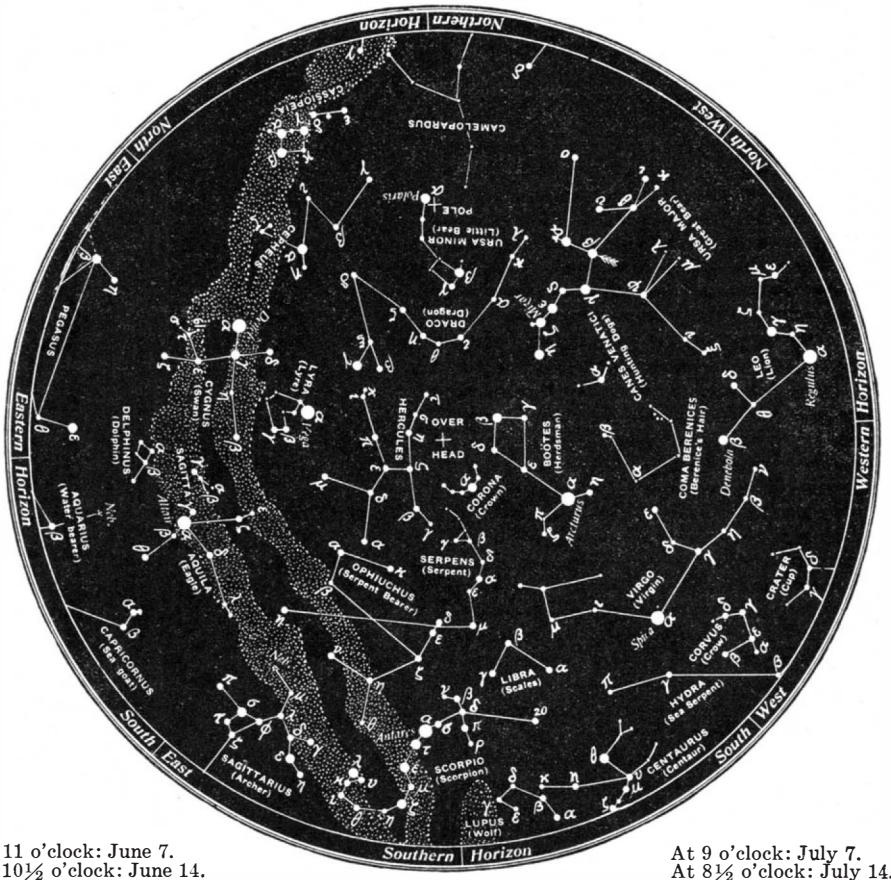
In a letter he now tells us that he has been swamped with correspondence since the discovery was made but appreciates

our interest, as a brother in the mirror art. At spare moments he says he is working on an article describing his construction of three telescopes, an eight-inch, a seven-inch and a nine-inch. In a later communication he apologizes for failing to keep his promise, as he has been side tracked with extra work, but ultimately will do so.

We hope this matter will reach us in time for the next number. It appears that the construction of his telescopes led Tombaugh to throw in his lot for astronomy. He asked for a place as assistant at Lowell Observatory and was accepted. Quite romantic, as it turned out.—*A. G. I., Tel. Ed.*

The Heavens in June

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.
At 9½ o'clock: June 30.
At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

MERCURY is a morning star and is best seen about the 15th when he rises about 3.30 A.M. Venus is an evening star setting about 9:30 P.M., and is extremely bright. Telescopically she looks like the moon about half way between the quarter and the full. Mars rises a little after 2 A.M. in the middle of the month and still counts as a morning star. Jupiter is in conjunction with the sun on the 20th and is therefore unobservable. Saturn is approaching opposition and is observable in the latter part of the evening, though his low altitude is unfavorable to good telescopic definition. Uranus is a morning star and rises about 1 A.M. on the 15th; while Neptune sets at 11 P.M.

The moon is in her first quarter at 5 P.M. on the 3rd, full at 1 A.M. on the 11th, in her last quarter at 4 A.M. on the 19th, and new at 9 A.M. on the 26th. She is nearest the earth on the 27th and farthest away on the 16th. During the month she passes near Neptune on the 2nd, Saturn on the 12th, Uranus on the 20th, Mars on the 22nd, Mercury on the 24th, Jupiter on the 26th, Venus on the 28th, and Neptune for the second time on the 30th.

UNLESS protests are received from a sufficient number of its regular users the present feature, The Heavens (but not of course Dr. Russell's main articles), will be dropped and the space otherwise employed. Some believe there is but small overlap between the increasing numbers who are keeping up with the newer astronomy, mainly astrophysics, which is ably covered in Dr. Russell's monthly articles, and those who use the star maps and planet data. If the proposed change is made, a series of maps from the same plates will be especially printed in a small pamphlet for distribution to regular readers on request, and the same planet data as well as much other data not contained in the space allotted to the present department, could be obtained by the reader from the annual "Observer's Handbook" of the Royal Astronomical Society of Canada, at an outlay of only 25 cents, or from some other similarly accessible source.—*The Editor*

Chemistry in Industry

(*Continued from page* 474)

the production of distillers' grains would amount to from 225,000 to 250,000 tons.

Beware of Noisy Grapefruit

READERS may recall the old story about the Italian fruit vendor who, annoyed by the critical examination of his wares by canny housewives, exclaimed, "If you mus' pincha da fruit, pincha da coconut!" After all, "pinching" does not prove much about the quality of the fruit and it is not surprising that a more scientific method has been sought. Now, the Bell Telephone Laboratories have developed a method of determining whether or not a grape-fruit is "good" without cutting it open.

This rather spectacular application of science is a method of detecting the Mediterranean fruit fly when it is inside citrus fruits. So far, says *Food Industries*, no way has existed for the detection of the larvae of the fruit fly inside the fruit without cutting it open—an operation which, of course, renders the fruit unsalable. The skins may appear to be healthy and yet cover a fruit that is infested with larvae that should be destroyed.

Since the worm eats by tearing off morsels of fruit, it has been argued by government entomologists that a noise should be caused by the operation, and if this sound could be sufficiently amplified by means of the thermionic valves, or tubes, used in radio, the noise of the larvae eating in the fruit should be audible to human ears. Apparatus in the nature of a glorified stethoscope has been constructed to test out the theory, and it has been found that "suspected" grape-fruit were noisy, and on cutting them open they were found to contain the offending pests, whereas noiseless grape-fruit were found to be free from larvae.

Human Chemist Can't Compete With Art of Lowly Bug

THE tremendous popularity of rayon as a substitute for natural silk must have created an unemployment problem among the silk worms. While the chemist with his wood pulp has outdone the worm with his diet of mulberry leaves, there is another insect, even humbler, which still retains his supremacy as a chemical factory. His name is *Carteria lacca* and his product is a resinous material which he produces to enshroud himself; but which man converts into the substance known as shellac.

W. H. Zinsser, writing in *Chemical Markets* reveals some of the many industrial applications dependent upon this louse-like inhabitant of India and Siam. Shellac is an organic resin produced through chemical processes taking place in the life of an insect and which, because of resiliency and soluble qualities stands out in world commerce in contrast to the vegetable resins. It has qualities possessed by no other gum and is soluble in alcohol or in an alkali water solution, but is not soluble in turpentine.

As long ago as 1590 there is a record of shellac having been dissolved and used as a coating or crude varnish, and from that date, uses, to which it is now so universally put, have been developed until to-day it

is the "open sesame" to all phases of the painting and decorating art; the friend of the sculptor, electrician, and metal worker, and the companion of the woodworker and furniture finisher. It is the facile aide of the foundry pattern makers, the base of buttons, phonograph and talking machine records, telephone parts such as receivers and mouthpieces, and imitation ivory products such as billiard balls and poker chips. It is shellac that holds the filament of the electric light bulb in place, and it is the "size" or stiffening used by the hat maker, which makes possible the many shapes and styles that fashion demands. Shellac is one of the chief ingredients in sealing wax, light drying inks, shoe dressing, and wood cements; it is the "snap" in playing cards and the artful finish for leather, imitation leather, wall paper, hardwood floors, pencils, broom and brush handles, autos, pianos, and what not. Shellac is the modern finish of the up-to-date rubber rain coat; it is the sealer used to make "leak-proof" the myriads of gasoline tanks that line the highways; and is even used as a cement for sealing the seams in the manufacture of cans for foodstuffs and liquids. It is used in the manufacture of brushes as a cement to hold bristles firmly in place. It is an important ingredient in lacquers, giving them body, adhesion, and flexibility.

Chemists have spent years looking for a substitute for shellac for use in industry but have thus far been unable to better the job done by the diminutive *Carteria lacca.*

Black Light Betrays the Bootlegger

"BLACK" light, the invisible rays which are the longer wavelength part of ultra-violet, may be used to discover the source of industrial alcohol diverted to the bootleg trade, according to Dr. Herman Goodman in a recent paper presented before the Society of Medical Jurisprudence. By adding an invisible trace of certain fluorescent dye to their industrial alcohol, the manufacturers can always identify their own product, no matter how much it has been distilled or rectified, by turning on it the invisible rays of black light.

Moisture Affects Telephone Cords

TELEPHONE cords are insulated with silk and cotton threads, but chemists in the Bell Laboratories found that the insulating quality of the fibers is different according to dampness of weather.

Research located the cause, says *Chemistry and You,* house organ of the Arthur R. Maas Chemical Laboratories. These fibers contain fine traces of chemical salts, which attract and hold moisture, and lower telephone efficiency. So methods have been worked out for washing the salts from the fibers before they are braided onto telephone wires.

The water cannot be used twice, for the infinitesimal trace of chemical salts carried away, causes it to be regarded as "contaminated."

Lake Michigan water was found better for the purpose than water from the city supply at another plant. It was even better than distilled water. This was due to a slight proportion of helpful chemical in Lake Michigan water, and too much harmful chemical in the other water, but the latter has been made satisfactory by delicate chemical treatment.

Our Point of View

Questionable Success in London

(*Continued from page* 429)

The three powers will scrap tonnage as follows:

	United States	Great Britain	Japan
Capital Ships	70,000	134,000	29,000
Destroyers	76,000	35,000	17,000
Submarines	8,000	none	14,000
	154,000	169,000	60,000

This tonnage does not include any obsolete vessels; the capital ships do not go back of our modernized *Florida* class, and only reckons destroyers less than 16 years old and submarines less than 13 years old. So, on the credit side of the Conference is a substantial reduction in tonnage. Great Britain and Japan, having already built practically up to the limit of their cruiser allowance, will have a very small cruiser program to complete. Congress has already authorized a cruiser program that will eventually complete our cruiser quota under the treaty; it will require several years to finish. In the meanwhile we are well below our strength. The President should vigorously resume the program suspended while the Conference was in being. By a happy coincidence this program will help the unemployment situation.

To obtain an agreement our delegation was forced to concede Japan parity in submarines and an increase in the 5 to 3 ratio in six-inch cruisers. We thought we had conceded Japan enough in 1922, when we agreed to cease fortifying our Far Eastern bases; certainly this concession should terminate our constant yielding to our neighbor across the Pacific.

It is reported that there is a clause in our agreement with Great Britain that might permit her to increase her cruiser strength relative to ours in the event that France increases her program; there should be no uncertainties in this treaty. In 1922 we thought parity meant parity in all classes; we so interpreted it while Great Britain and Japan built cruisers, destroyers, and submarines until they upset the ratio entirely. It would be a blow to the future confidence of our people in the efficacy of international agreements if any fine-spun interpretations are placed on this agreement.

In spite of the reductions actually obtained, Americans generally are disappointed by the events of the London Conference; and they will not quickly forget the display of European jealousies so openly disclosed by the negotiations. Americans had been told that the failure at Geneva in 1927 was due to the unyielding attitude of naval officers who sacrificed accord rather than to yield a few cruisers; at least that theory is exploded for only the Japanese delegation contained a naval officer and he was carefully classified as a statesman. Yet these selected delegations of civilian statesmen have been entirely unable to bring about a five-power pact, and only succeeded by extreme concessions to Japan in effecting an agreement for a three-power pact.

Their failure is more significant because

they patiently explored every avenue of approach that held any promise of agreement; and it is also possible that the delegations at London, in their desire to reach an accord, may have gone beyond the wishes of their own countrymen. After carefully following the developments at the Conference, it is hard to escape the conviction that the world powers today are not ready to confide their future to treaties, but still prefer to trust in the efficiency of their own armed forces. This is the most significant fact that has come out of the Conference.

Italy and France have not conceded an item one to the other. The reason for this inflexibility is scarcely concealed. France heads one continental group that includes Jugoslavia, Czechoslovakia, Rumania, and Poland. Italy heads another group that embraces Hungary, Albania, Bulgaria, and hopes to include Turkey. Italy would like to have England dissolve the entente with France and join her group. But for the present at least, British opinion will not hear of any continental entanglements. The old European balance of power has reasserted itself but this of itself need cause us no alarm, for it is the classical European method of preventing a continental colossus; and whatever may be urged against it by world reformers, the balance of power did preserve the peace of Europe between 1871 and 1913.

The desire to create an agreement between France and Italy caused MacDonald and Stimson to suggest a "consultative" pact to be given to France in lieu of the security guarantee she demanded for a reduction of her naval program. It is reported that MacDonald could not carry his own cabinet with him on this proposal and both Baldwin and Lloyd George are known to be against any further guarantees to France.

The reaction in this country was overwhelmingly against any form of consultative pact, on the very sound ground that if it committed the United States to intervention in European affairs it was against all our traditions and if it did not, it would mislead France. All efforts by advocates of the consultative pact to explain that the United States was already committed to an intervention by the Kellogg-Briand renunciation of war and the four-power Pacific treaty failed. And our delegation was unable to explain its complete change of attitude in this matter. Perhaps Mr. Stimson allowed his eagerness for an agreement to blind his judgment temporarily, or he wished to canvass the American public to determine if, for the sake of a reduction in armament, they were willing to re-enter Europe's political orbit. If the latter, the negative answer was plain, and cannot be misunderstood. It further developed that Great Britain is scarcely less reluctant than the United States to guarantee France's position in the Mediterranean so it was not possible to reach a real five-power agreement.

In the early days of the Conference there was some evidence of a desire on the part of the British and American delegations to put pressure on France to make concessions by a threat of a four-power agreement that would leave France isolated. When France failed to respond, the same treatment was applied to Italy without success. Then it was realized that if a five-power treaty was impossible, it was better for the good-will of Europe to go at once to a three-

power treaty, leaving in the framework places for both France and Italy, rather than to create a four-power treaty that would isolate one of them.

Just when the vexed situation seemed at its worst, Italy raised the specter of the League of Nations, by the very pertinent, if unpleasant, suggestion that the London Conference was not a competent tribunal to determine the nature of the security guarantees made by League members and suggested that the French delegation address such queries to the League Secretariat at Geneva rather than to MacDonald and Stimson. This action convinced Mr. MacDonald that Italy was immovable and efforts to secure a five-power pact were abandoned.

The original position of the United States was that if a five-power agreement could not be obtained, a three-power agreement would not be attempted, for it was feared that an agreement between the three largest naval powers would almost surely cause the rest of the world to believe that Great Britain, Japan, and the United States are seeking to dominate the world by their navies. When we recall the persistent French suspicion of a British-American entente after the Rapidan conference, the dangers of a three-power agreement are plainly evident. Nothing we would save in dollars by a reduction in naval expenditures would compensate for wholesale suspicion aroused throughout the world by the belief, however unfounded, of an understanding between the three naval powers. Our delegation must believe they can reassure the rest of the world on this point, else they would have adhered to their original position.

The result of the Conference may be summarized as follows: Great Britain concedes us cruiser parity provided we take part of it in six-inch cruisers and France and Italy restrict their programs; Japan agrees, provided she is allowed equality in submarines and a 10 to 7 ratio in cruisers for the present and the right to re-open the question when and if we build up to a 10 to 6.4 ratio; France and Italy will not join the pact. In 1922 we scrapped battleships and battle cruisers to arrange a 5 : 5 : 3 : 1.75; 1.75 ratio among these five powers. As an additional incentive to Japan, we ceased all work on our bases in the Far East so that the continued passage of time puts them more and more at the mercy of a hostile fleet operating in those waters. In addition to her fleet, Japan possesses the second strongest army in the world; it is futile for her to urge that additional naval strength is needed for defense of her already impregnable position in the Far East.

Yet for the sake of a three-power agreement that only a short time ago we said we would not accept, our delegation has accepted a conditional equality with Great Britain, and has granted Japan an equality in submarines and a 10 to 7 to a 10 to 6 ratio in cruisers.

Surely our delegation has gone to the extreme limit in order to obtain an accord. The Senate leaders will consider the pact in detail, and it is most fortunate for our country that it cannot be committed to any foreign obligations without full discussion in the Senate. The delay entailed by discussion sometimes frets us, but such discussion informs the American people and enables American public opinion to make itself felt.

Books Selected by the Editors

STORAGE BATTERIES—*By G. W. Vinal, Physicist, Bureau of Standards*

SINCE the first edition of this important work appeared six years ago, it has been the authoritative reference, in fact the only one which completely covers the subject so that the average consultant may obtain the information he seeks without plowing through puzzling details. Clear, concise, conclusive, and exhaustive, it is a most able presentation. $5.20 postpaid.

ELEMENTS OF ELECTRICITY—*By A. Zeleny, Prof. Physics, Univ. Minnesota*

AS a book of reference available to look up a wide range of questions that will arise in the ordinary course of reading or study, this text will be found of exceeding usefulness. Every phase is treated in a thorough, concise understandable manner, for the seeker who has no special knowledge, which means therefore that formulas and mathematics have been reduced to a practical minimum. We believe this to be one of the best general references of which we have knowledge. $3.20 postpaid.

CONSTRUCTION AND EQUIPMENT OF CHEMICAL LABORATORIES

THE report of the National Research Council Committee, all of the members of which have planned and built chemical laboratories within the last ten years, definitely answers the leading questions as to the requisites for a practical laboratory building. Plans are prepared in detail for new buildings, or the improvement of existing ones, the data for which was obtained by sending out questionnaires to the directors of recently constructed laboratories. It is thus a compendium of present practice and as such is invaluable to this rapidly growing field of science. $1.20 postpaid.

ARITHMETIC OF ELECTRICITY—*By T. O'Conor Sloane, A.M., E.M., Ph.D.*

BECAUSE the calculations are all in plain arithmetic, this practical little volume has been widely accepted as a boon for those who are rusty on higher mathematics, or for the many who need the information but have not had the training necessary for more difficult computations. A series of rules, all of the simplest forms, each rule illustrated by practical problems and detailed solutions. Extensive tables appear before the last chapter on networks which is added in this edition. $1.65 postpaid.

STANDARD WIRING—1930 EDITION—*By H. C. Cushing, Jr., Fellow A. I. E. E.*

THE new edition of this authoritative work has been brought up to date by the inclusion of new sections and illustrations, the 1930 national electrical code, new tables on wire and wiring for every class of work, and the latest technical terms, and has been carefully checked to the last page. It is rightfully called "The national authority on wiring" for it contains detailed explanations of the proper methods of installing all kinds of electrical equipment. $3.20 postpaid—*F. D. McH.*

PHOTOGRAVURE—*By H. Mills Cartwright, F. R. P. S.*

THE subhead on the title page of this volume aptly expresses its scope: "A Text Book on the Machine and Hand-printed Processes." The author presupposes that his readers have some knowledge of engraving and printing systems and therefore plunges into his discourse with but brief preliminaries. His treatment of the subject, from the practical point of view, is masterly and it gives the interested reader a thorough grasp of this particular engraving and printing process. His summation of its advantages and disadvantages is concise and of unusual interest to anyone who uses printing for any purpose. $3.70 postpaid—*A. P. P.*

BOOKS are one of the most intimate influences in our lives. They both entertain and sustain, they can be our companions in solitude and a stimulation in depression, they often are exhilarating and sometimes risible—of these our own mood is most frequently the gage. It is not an easy matter, therefore, to select from the large number that are now published, those titles which will interest a most cosmopolitan audience.

On these pages will appear each month the selections which The Editors believe likely to interest the greatest number of readers, but if you do not find here just what you like, or if you want to know what is available in some line of your own desire, do not hesitate to write to Louis S. Treadwell, Associate Editor, who is responsible for this department. Every attention will be given to your needs. We want to make these columns of real value to you.

MODERN SCIENCE—*By Professor J. Arthur Thomson, Univ. of Aberdeen*

IN the whole English speaking world there are scarce ten men who can write *accurately* on *every* branch of science and who can really *write*. Professor J. Arthur Thomson is one of them. Qualified critics think it is the direct simplicity of his style of writing which has won him deserved world-wide fame as a popularizer of scientific thought. Nearly everyone is familiar with his famous four volume Outline of Science. His newest book is a general introduction to science, ranging in scope from cosmology, through astrophysics and physics, to the origin and evolution of life, and ending with man and his psychology. The treatment leans rather more toward the elementary than some books in this category, and therefore provides easy delightful reading. 370 pages; illustrated. $3.70 postpaid—*A. G. I.*

SCIENCE AND THE NEW CIVILIZATION
By Prof. R. A. Millikan, Norman Bridge Lab. Physics

THIS is a collection of the author's recent essays put into permanent book form. Two of the eight essays—one which disposes of the former fond dream of inexhaustible atomic energy, and one which lists and describes the 21 greatest discoveries of the last 15 years of physics—are purely scientific. The others, on Alleged Sins of Science, the Future of Steel, the Relation of Science to Industry, Michelson's Economic Value, etc., are broader. Millikan's purpose in writing these classic essays was to make people think.

Two of the statements in the publisher's blurb on the jacket are untrue. The author does not write book-jacket blurbs—the publisher does. Too often those on scientific books are inaccurate, needlessly sensational, not dependable, misleading. Thus they mar good books. $2.15 postpaid—*A. G. I.*

AERONAUTICAL LAW—*By W. Jefferson Davis, Air Law Comm. Amer. Bar Assn.*

IN six parts. The scope of Federal and State control; ownership, operation, and control of airports; regulation of aircraft common carriers, liability, and insurance; aeronautical regulations, bibliography; each part broad in scope as a full reference of this kind should be. An important and necessary adjunct to the increasing importance of technical operation. 600 pages. Buckram. $10.00 postpaid.

AMERICAN CHARITIES AND SOCIAL WORK—*By Warner-Queen-Harper.*

FOR many years the fundamental work on this subject was the first author's "American Charities." The present book has been built on that solid foundation, two thirds being new text, but the original values are retained in this connotation. Everyone who has a vital interest either as worker or giver in this essential field of sociology should have this book—it is a compendium of the research and knowledge attained by the most acceptable authorities who have studied this question during the past thirty-six years. $3.95 postpaid.

SOVIET ECONOMIC DEVELOPMENT AND AMERICAN BUSINESS—*By Saul G. Bron*

HERE are given the results of the first year under the five-year plan and future perspectives. It shows that during 1928-29 national income increased 12.4% as against a scheduled gain of 10.7% while production costs were reduced 11.5% against the original plan of 7.5%. Complete economic statistics will furnish ample food for study to all who desire the facts as ascertained by the author, who was formerly Chairman of the Board of the Amtorg Trading Corp. $1.65 postpaid.

HARTRAMPF'S VOCABULARIES

A CONDENSED workable list of synonyms, antonyms, and relatives indexed under a general classification of group meanings. The index in the back identifies the group to which belongs the word sought, and reference to this group will give related words with their meaning. Quite the best arrangement we have seen and one readily adapted for hurried reference. Cloth. $5.20 postpaid.

ANTARCTIC ADVENTURE AND RESEARCH—*By Griffith Taylor, F. R. G. S.*

A COMBINED short history of all past Antarctic expeditions (including Byrd's) and treatise on the several sciences—geology, glaciology, climatology, botany, biology—in the Antarctic Continent. The author is an Australian scientist who accompanied Scott to the Arctic as geologist, and is now professor of geography at the University of Chicago. The title of this book might be naively (and truthfully) paraphrased as "everything an intelligent reader would like to know about all branches of science as applied to Antarctica." This is no mere book of narrative; nor is it on the other hand too abstruse for the average reader who, anticipating further explorations doubtless to be made in Antarctica, wants to be prepared to read future accounts of them more intelligently than others. $2.15 postpaid—*A. G. I.*

TITANOTHERES OF ANCIENT WYOMING, DAKOTA AND NEBRASKA—*By Henry Fairfield Osborn, Sc.D., LL.D.*

THIS monumental, two-volume, 953-page work is an exhaustive monograph on the titanotheres—extinct, primitive, massive mammals of the Tertiary Period more than 10,000,000 years ago. It represents 19 years of effort on the part of its distinguished author, noted paleontologist and head of the American Museum of Natural History, and in itself will create a new epoch in Tertiary paleontology. While the work is primarily for the professional paleontologist, much of it will be understood by the serious reader of elementary works on evolution. Supt. Documents, Washington, D. C. $9.00 currency—*A. G. I.*

HARVARD ADVERTISING AWARDS

FOUNDED by the late Edward W. Bok to stimulate an improvement in the general quality of advertising, this book records the awards 1924 to 1928 and depicts the examples for which they were given. It presents most excellent material for study as to what is most effective and worthwhile in various campaigns that were inaugurated by some of the best agencies for world-known clients. A fascinating study of illustration and typography well worth close scrutiny by everyone who has aught to do with any phase of the art. We predict it will eventually be found in almost every business library. $2.65 postpaid.

CLEMENCEAU—*By Jean Martet*

ONE is rather confused at the number of titles which have appeared concerning this dynamic and forceful patriot. This one is by his secretary and later intimate personal friend in whose hands were placed the full documentary records and these were supplemented by intimate conversations day after day; for Clemenceau was fully aware Martet was to be his biographer. In fact one long chapter is in Clemenceau's own hand. All facets of this amazing personality are turned to the light. In many ways, therefore, this is the most important portrayal of all the books that have appeared. $5.25 postpaid.

FROM THE MISSISSIPPI TO THE SEA—*By Rear-Admiral R. E. Coontz, U. S. N. (Ret).*

BORN inland, near Mark Twain's home, it seems strange that so much of the author's life should have been spent at sea. But the background serves only to enhance this story from the early seventies through a very large part of the World War. Few careers cover the breadth of experience, exploration, training, supervision of construction, navigation and finally, highest command, that is narrated here with characteristic reserve yet interlined by amusing anecdote and salty yarn. Altogether a most pleasing, interesting, and historically worthy recounting of a life devoted to country and fellowman. $4.20 postpaid.

JOHNSON OF THE MOHAWKS—*By Arthur Pound*

IRISH immigrant, Mohawk war chief, American Major-General, empire builder, Sir William Johnson was one of the commanding figures in our early history. Of tremendous influence with the Indian tribes and powerful among Colonials because of his immense wealth, his was a personality of vital import at a time when civilization was hard pressed to maintain itself on the frontier. Factual accuracy is attained by long and painstaking historical research and yet the story runs smoothly and makes most interesting reading. $5.25 postpaid.

MATA HARI. COURTESAN AND SPY—*By Major Thomas Coulson, O. B. E.*

AMONG the women spies of the Great War, certainly Mata Hari was the most interesting. "A pagan adventuress with nothing feminine about her but physical grace and quick intelligence," her operations, however, are said to have been responsible for the death of 50,000 allied troops. The author strips away the fiction and myth concerning her and gives the facts as far as they can be determined. The sustained interest of this exciting narrative almost cloaks the loathsomeness of its moral fiber. $3.20 postpaid.

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Rules on Patent Appeals Amended

THE Commissioner of Patents, Thomas E. Robertson, has announced an order amending the rules of the Patent Office relating to appeals from its decisions and the printing of the record for use on appeal. The order follows:

Acting under the provisions of section 483 of the Revised Statutes and with the approval of the Secretary of Commerce, rules 148, 149, 150 and 162 are amended as follows, to take effect March 1, 1930:

Rules 148, 149, and 150 by striking out the words, "Court of Appeals of the District of Columbia" wherever they appear and inserting in lieu thereof: "Court of Customs and Patent Appeals."

Rule 162, by striking out in the fourth line thereof the words "Court of Appeals of the District of Columbia" and inserting in lieu thereof: "Court of Customs and Patent Appeals."

And by canceling the last sentence of the first paragraph thereof and inserting in lieu thereof the following:

"The size of the record shall be $7\frac{5}{8}$ by $10\frac{1}{4}$ inches and the type matter shall be $4\frac{1}{6}$ by $7\frac{1}{6}$ inches. They shall be printed in 11-point type and adequately leaded; and the paper must be opaque and unglazed. The names of the witnesses must appear at the top of the pages over their testimony, and the record must contain indices with the names of all witnesses and reference to the pages where copies of papers and documents introduced as exhibits are shown."

Patents for Plants

THE inventor or discoverer of a new variety of fruit tree or plant would receive the same protection by a patent as the inventor of a machine, through an amendment to the patent statutes introduced by Senator Townsend of Delaware, himself an orchardist, who said that he wished to remove the present "discrimination" against agriculture.

The patent would be granted to the experimenter under almost identical conditions governing other inventions and the law would be operative throughout the Patent Office, costing the government nothing, Senator Townsend explained, inasmuch as the Patent Office is self-supporting.

His measure, which has been passed by the Senate and approved by the House Patents Committee, reads, in part:

"Any person who has invented or discovered . . . any new and distinct variety of asexually reproduced plant other than a tuber-propagated plant or a plant which reproduces itself without human aid, not known or used by others in this country before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application, and not in public use or sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law and other due proceedings, obtain a patent therefor."

In evidence of the value of his proposal, Senator Townsend, who owns 130,000 acres of orchards, pointed to the accomplishments of engineers during a century of patent protection.

Pointing out that "it is a notorious fact that the most successful plant breeders have lived and died in comparative poverty," Senator Townsend named as examples Ephraim Bull, Luther Burbank, Peter Gideon, C. G. Patten, J. R. Reasoner, and Dr. Van Fleet.

Californians Lead in Patent Grants

RESIDENTS of California are the nation's most prolific contributors to mechanics and the sciences, according to the records of the Commissioner of Patents. The record of patents granted during the year 1929 showed that citizens of Connecticut pressed closely on the heels of California's inventors, and three other New England states put in strong bids for the *per capita* honor. These were Massachusetts, New Hampshire, and Rhode Island.

As would be expected, the State of New York led by a wide margin in the total number of patents granted to its residents. The compilation, made by Mr. L. Edward Flaherty of Washington, D. C., shows the grants issued to the various states, the leaders ranking as follows:

New York	7755
Illinois	4658
Pennsylvania	3639
Ohio	3595
California	3087
New Jersey	2630
Massachusetts	2309
Michigan	2218
Wisconsin	1321
Connecticut	1121

A total of 42,251 patents were issued in 1929, compared to 40,322 issued during the preceding year.

Shoe Trademarks

THE Assistant Commissioner of Patents has denied a rehearing of the appeal before him in which he decided that the notation "Foot Preserver" is registrable as a trademark for boots and shoes, despite the opposition of the owner of the mark "Arch Preserver" for the same type of goods.

It was held that the essential feature of the mark "Arch Preserver" is not "Preserver," but that "Arch" is the dominant characteristic, and hence "Foot Preserver" is not deceptively similar.

By reason of many trademarks for shoes of like import, the Assistant Commissioner stated that neither party is entitled to such broad protection of its mark as to exclude from registration the mark of the other party, and that the public must exercise unusual care in discriminating between them.

Massachusetts Bans Car Radios

RADIOS may not be operated on automobiles driven in Massachusetts, according to a ruling by the registrar of motor vehicles, George A. Parker.

The ruling followed a conference with the governor's committee on street and highway safety, which recommended that the use of radios on automobiles be discontinued, it was announced.

Automobile and radio manufacturers have joined in a protest to the department, of which the registry of motor vehicles is a part, under a law providing that any ruling by the registrar is subject to appeal to the Department of Public Works.

"Permanize" Granted Trademark Registry

ALTHOUGH two trademarks may have the same suffix, and the goods upon which the marks are used are of the same descriptive properties, they are not deceptively similar if they neither look alike, sound alike, nor convey the same thought. This decision of the Assistant Commissioner of Patents was made in the case of the Simoniz Company *vs* Permanizing Stations of America, Inc., opposition number 9230 to registration of trademark "Permanize" for a polish for auto bodies, et cetera.

The opposer, the Simoniz Company, had appealed from the decision of the examiner of interferences dismissing its opposition to the registration of the mark. The opposition was based on the fact that the mark "Simoniz" for a compound for cleaning and polishing automobile bodies, et cetera, had been adopted and used previously. Although the two compounds contain specific differences, they were held to possess the same descriptive properties.

It was brought out that of the two marks in question, "Simoniz" is derived from the proper name Simon, and suggests the thought that Simon's reputation is back of the goods. On the other hand, "Permanize" is derived from the word permanent, and suggests permanency. The testimony failed to show that any purchaser had been deceived by the alleged similarity of the marks, and it was ruled that the marks are not deceptively similar.

Models for Advertising Purposes Denied Free Entry

ACCORDING to the majority opinion of the United States Court of Customs and Patent Appeals, models of "individual wheel drives" imported by the American Brown-Boveri Electric Company are not admissible duty free, as are models which come under Section 1620 of the existing

tariff act. This action was taken because the models in question were imported for the purpose of free distribution with a view to prospective sales.

In the opinion of the Court: "It is apparent that the imported articles are made to be used not as models, but for advertising purposes alone."

The models in question consist of a solid brass foundation on which are mounted three supports, also of brass. From these supports are suspended an axle and two flanged car wheels. On the outside of one of these wheels is a brass cogged wheel with an attachment by which the axle and car wheels may move in various directions without affecting the cogged or drive wheel. Attached to the supports upon which the axle is mounted are two small levers with suitable arrangements whereby the operation of the mechanism can be demonstrated.

Because of the ambiguity of the language of the statute, it was deemed necessary to take recourse to its legislative history. Earlier tariff acts provided free entry for "models of inventions and of other improvements in the arts, including patterns for machinery, but no article shall be deemed a model or pattern which can be fitted for use otherwise."

The Court ruled that models intended for advertising use did not come under the statute. Judge Bland concurred with Judge Garrett in a dissenting opinion, holding that "advertising" use should be no bar to free entry, because it is inseparable from an inspection of the structure and is a legitimate part of the function of a model.

Old Mining Claim Upheld Over Invalid Homestead Patent

IF the owner of a mining claim fails to do his assessment work for one or more years, the claim is subject to relocation by other parties, providing the relocation takes place before the original owner returns and resumes work upon the claim. However, in the event that the relocation does not take place within that time, the owner's rights may be restored to the same extent as though there had been no failure to do the assessment work. These rulings were made by the Supreme Court of the state of South Dakota in the case of Frank Hebert *vs* Frank C. Bond *et al*, on appeal from the Circuit Court of Pennington County.

The defendants had acquired title to the Tin City Lode Mining Claim from a woman who had obtained a homestead patent on the property by means of false statements made to the General Land Office. The Court held that she had practiced a fraud both upon the Government and the rightful owner of the claim, so that her patent was impressed with a trust in favor of the original patentee who might go into court and have his title quieted.

The evidence showed that in 1886, Frank Hebert had discovered on unappropriated government mineral lands in South Dakota a lode of ore bearing appreciable quantities of tin and mica. He filed a claim promptly, and did all of the proper and requisite things to secure a valid title to the property covered in his claim. Later in the same year, one Mary McDermott built a cabin on an adjacent piece of farming land. After the year 1900, she filed a homestead claim in the land office, later revising her claim from time to time. In 1916 she amended her homestead claim to include the Tin City lode. As late as 1918, the testimony showed, McDermott admitted to witnesses that the mining property was owned by Hebert.

Early in 1919, Hebert contracted to sell the Tin City Mining Claim to one W. N. Hunter, for a consideration of 30,000 dollars. Hunter, with Frank C. Bond, formed the Rare Minerals Company, and entered promptly upon the property, making preparations to mine and ship ore from the mine thereon. At this time, while Hebert was away temporarily, McDermott drove the defendants (Rare Minerals Company) from the property, claiming title under a homestead patent issued by the government. The Rare Minerals Company decided that McDermott had a better title than Hebert, and purchased the McDermott homestead for the amount of 10,000 dollars. Then, attempting to repudiate the old Hebert title, the defendants filed a new mining claim on the Tin City lode.

The only questions involved in the case were: First, did the plaintiff ever make a valid location of the said ground? Second, is the ground covered by the Tin City Lode Mining Claim mineral in character? And third, if such location was made, did the plaintiff lose his rights therein by abandonment prior to the issuance of the McDermott patent? These points were decided definitely in favor of Hebert, and it was established that McDermott had practiced a fraud on both the plaintiff and the government. Under such circumstances, it was held, a court of equity has power to secure the rights of the plaintiff, and as a means best adapted to that end may declare a constructive trust in his favor. The decision of the lower court was affirmed, quieting title in the plaintiff.

"7-11" As a Trademark

THE Court of Customs and Patent Appeals has affirmed the Patent Office in dismissing opposition to the application for registration of the trademark "7-11," for liquid medicinal preparations. The products of the applicant, liquid medicinal preparations for treatment of colds, et cetera, to be taken internally, and of the opposer, owner of the mark "4711," for antiseptic mouth washes and scalp remedies, cold cream, face powder, dental preparations, et cetera, were held not to be of the same descriptive properties. It was also pointed out that the labels were dissimilar and further that the opposer had made no protest to other registrations of the numbers "7-11" for other goods.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payment must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

PROPELLING DEVICE—For air and water craft, whereby increased force is obtained, a quicker take-off will be possible and shorter landings at steeper angles, a gyroscopic action being generated to keep the craft steady while in flight. Patent 1750382. Westinus Boer.

AIRCRAFT—Having a fuselage, laterally extending wings, stabilizers, and a rudder mounted at the tail, the special feature being a sail adapted to use the wind for producing the lifting action and motion to put the craft in flight. Patent 1752241. John Domenjoz.

Pertaining to Apparel

NECKTIE-LINING FABRIC—Composed of a woven integral piece of material, adapted to be cut to serve as tie linings, having areas at one or both ends, which are of different grade of material than the remaining area. Patent 1749634. Edgar K. Frank.

PROTECTIVE GARMENT—Designed to be worn by a messenger carrying money or valuables, so that the articles may be distributed throughout the compartments on the inner face of the garment, and securely locked on the user's body. Patent 1749714. Herman A. North.

SHOE CONSTRUCTION—Which has novel means for removably securing a heel to the body portion of a shoe, a frame receiving the heel, whereby a worn heel may be removed for repair, or a new one disposed in place. Patent 1749864. Joseph Weiss.

CRAVAT ATTACHMENT—For the small end of four-in-hand cravats, may be easily applied to provide an abutment to prevent its withdrawal through the knot, whereby the neck loop is at all times maintained without retying the cravat. Patent 1750232. Segfrid J. Lindskog.

Chemical Processes

PHOTOGRAPHIC CHEMICAL PROCESS AND MATERIAL—For printing from tracings, etc., comprising diazotizing an aqueous solution of pyridine sulphonic acid, then reacting the product with an aqueous tartaric acid solution and an aqueous solution of a nickelous sulphate, coating photographic paper therewith, printing by contact under tracings, and developing the latent image with fumes of ammonia. Patent 1752174. Oliver A. Hall.

Designs

DESIGN FOR A TABLE-RECEPTACLE HOLDER. Patent 80626. Samuel Lapin.

DESIGN FOR A NOVELTY SPUR. Patent 80563. Grover C. Welter.

DESIGN FOR A DRESS.—The inventor has been granted two ornamental designs for dresses. Patents 80658 and 80659. Dorothy Long.

DESIGN FOR A DRESS. The inventor has been granted four patents on ornamental designs for dresses. Patents 80795, 80796, 80797, and 80798. Dorothy Long.

Electrical Devices

MODULATOR FOR RADIOTELEPHONES—For use in connection with the transmitter, use being made of carborundum, selenium, magnetite, etc., to vary in electrical conductivity, hinder action of heat or light, in producing a changing current in the talking circuit. Patent 1750579. Henry H. C. Dunwoody.

ELECTRIC INSULATOR—A tubular casing especially adapted for outdoor aerials in protecting then from moisture, the formation of ice, snow and water, which might tend to bridge the gap and electrically connect the wires. Patent 1750352. John F. Phillips.

ELECTRIC STORAGE HEATER—A hollow body of heat absorbing and retaining material in which a large amount of electrically produced heat may be stored under control for use at such time as desired for various purposes. Patent 1749115. Gunnar S. Tune.

ELECTRIC SWITCH—The construction of which makes it impossible for an operator to leave the blades close enough to the contact to allow any passage of current, unless manually pressed into contact for closing the circuit. Patent 1752236. Vernon A. Conklin.

Of Interest to Farmers

EGG-PROTECTING MEANS—An outer protective covering adapted to be used with egg crates, as generally formed, and packed, for the complete closure and special protection of eggs in transit, when the temperature is below 32°F. Patent 1749675. Paul A. A. Rouis.

DOOR FOR SILOS—Which may be readily removed to provide an opening for the discharge of grain, the door securing means also providing rungs, whereby an operator may climb to the upper portion of the silo. Patent 1750600. Levi D. Houghtaling.

POTATO SEPARATOR—For use in connection with a potato digger, the tension of the balanced separating fingers permitting the lightest stone to drop from the potatoes as the digging, sorting, cleaning, and sacking operation progresses. Patent 1751391. William G. Bunker.

DOFFING DEVICE—For stripping or doffing the needles of a cotton-picking machine after the former has removed the cotton from plants, and for removing any accumulation of gum collected during abrasions of the plant stalks. Patent 1751389. Oscar F. Bledsoe.

SHIPPING BOX FOR BABY CHICKS—Each compartment of which has ventilated chambers of varying temperature so that the chicks may move at will to warmer or cooler places to meet their individual needs, and yet remain fully protected against drafts. Patent 1752177. Albert B. Hilkemeyer.

Of General Interest

VENTILATOR—For use in conjunction with a window allowing air to enter a room, but dividing the air in such manner as to prevent drafts, and also to exclude rain and other elements of weather. Patent 1750413. Albert R. Laube Nstein.

AIR-COOLING APPARATUS—Comprising a water supply pipe, overlapping absorbent fabric strips mounted to retard the water in its descent, and a drip pan on the window sill, the device cools and filters the air as it passes. Patent 1750047. Gustave A. Metzger.

BAG GUSSET—So formed as to join the opposite ends of the side sections that they will be neat in appearance, and define a pocket which will prevent small articles from falling out. Patent 1750375. Anthony M. Vinciguera.

COMBINED ARTICLE OF FURNITURE—A cabinet which includes hingedly connected sections defining storage compartments, a horizontally disposed swingable table, and swingable mirrors, normally housed, the whole serving in the capacity of a dressing table, desk or storage cabinet. Patent 1749686. Theodore Agazzi.

BRUSH HOLDING AND CLEANING DEVICE—A receptacle for receiving a quantity of turpentine or other detergent for cleaning paint brushes, scraper elements being arranged for the removal of the paint and detergent, and valves for draining off the waste matter. Patent 1748789. Harry I. Orkin.

HAIR-WAVING DEVICE—Wherein the cooperating hair-waving members may be closed in engagement with the hair fully and effectually, to produce the desired waves without injury or tearing the hair. Patent 1749748. Martha A. Tienken.

CARTRIDGE GUIDE FOR REPEATING GUNS—So formed that its head portion which is provided with a guiding surface shall penetrate into the breech casing between the magazine and the rear end of the barrel, or the firing chamber. Patent 1749726. Rudolf von Frommer.

FENCE POST—Polygonal in cross section, and formed with means for interlocking engagement by tie wires, in securing the line wires, a projecting member at the lower end being adapted for setting into a fresh concrete base. Patent 1749640. Richard D. Martin.

CONTAINER—A simple and convenient envelope or wrapper for easily and quickly confining articles of personal wear, such as shoes, etc., when traveling, within a relatively small space, and without soiling other articles in transit. Patent 1749680. Gertrude P. Visscher.

MOP HANDLE—Having a simple and efficient means whereby a mop head, or mopping material, may be inserted or removed and when connected will spread out over the end of the stick to prevent contact with floors or furniture. Patent 1752250. John H. Gillis.

DISPLAY HOLDER—Particularly adapted for strap-watches, and formed from a single cardboard blank and a single sheet of velvet, a pocket being formed for the watch, means for displaying the strap, and supporting the holder in tilted position. Patent 1752246. Leo Flier.

SEA TUB—A hollow construction, of rigid buoyant material, such as balsa wood, adapted for floating persons in the water, the size being large enough to permit the average person to lie down in the water, as in a bath. Patent 1752191. Jere C. Moray.

JAR-COVER REMOVER AND FASTENER—A device which may be attached to a wall or other suitable support, for receiving and gripping the metal cap of a jar, while the latter is being turned for screwing or unscrewing, without spilling the contents. Patent 1752189. Joseph Lotz.

WATCH STAND—Comprising a substantially dome-shaped base and a plurality of arms, pivotally mounted, wherein a watch may be quickly mounted or demounted, particularly adapted for use in repairing watches. Patent 1751286. Frank X. Mantsion.

MOP—With mechanism so constructed as to eliminate all necessity for the hands of the user to come in contact with the water in mopping, scrubbing, or wringing, the operation being easily accomplished without undue exertion. Patent 1751349. Clifton O. Morgan.

HOLDER FOR GRAPHIC-INSTRUMENT—A holder connected with a base, for temporarily holding a fountain pen, or the like, in angular position, so that the instrument may be easily removed or inserted, the holder accommodating instruments of various sizes. Patent 1751354. Ernest Oldenbusch

WASHBASIN APPLIANCE—A transportable storage tank for water, the top portion being depressed to form a basin, a lift pump transfers the water to the basin, the device is covered, very compact, and adapted for use in confined places, such as vehicles. Patent 1751294. Clifford Spital.

Hardware and Tools

SCREW—Having the usual slotted head for receiving the screw driver, but being provided with lips adjacent the slot so that after the screw has been forced into position, said lips, or wings, may be swaged over the slot. Patent 1749043. Joseph Neiser.

FLAT IRON AND STEAMER—Particularly adapted for ironing or steaming a hat, and permitting the crown or brim of the hat, or both, being ironed or steamed in a convenient manner; may also be used for other purposes. Patent 1749667. David Freedlein.

KNIFE ATTACHMENT—An attachment for the back of a knife blade, affording a broad support for the fingers, and preventing soreness after long use, particularly adapted for paring knives, as used for vegetables and fruit. Patent 1750577 Joseph de Bracht.

CASEMENT-WINDOW LATCH—Which provides means for securely latching a casement window in slightly opened position for the purpose of ventilation, but in such manner as to prevent an intruder forcing or manipulating the latch to gain access. Patent 1750423. Walter S. Oglesby.

FIRE-FIGHTING TOOL—Comprising a handle, a metallic extension, and a blade with lug-receiving opening and a clamping member for securing the blade against rotation, the wooden handle being removed at quite a distance to prevent charring. Patent 1749103. John C. Kortick.

ROTARY REAMER—For reaming oil wells, the reamer blade having two cutting eges, thus twice the efficiency of ordinary reamers, the tool requiring withdrawal for sharpening with but half the frequency of a single blade, thus saving time and labor. Patent 1750953. Alexander Boynton.

SAFETY SHACKLE SNAP—A snap hook which when engaged about a shackle will automatically close and lock in instances of strain, but may be easily unlocked and relocked by manual operation in the absence of strain. Patent 1751458. John J. Van Valkenburg.

PIPE-BENDING TOOL—Which may be employed to bend the usual standard, or thin wall conduit, in various sizes, will not cause the conduit to flatten, and will prevent slipping or incidental injury during the operation. Patent 1752220. Andrew B. Allen.

Machines and Mechanical Devices

AUTOMATIC WELL-FLOWING DEVICE—A combination pressure fluid and liquid velocity control device embodying a flap movable toward one side by the velocity of the stream and returning to its original position as the stream force diminishes. Patent 1749124. Alexander Boynton.

ROD GUIDE—Comprising a walking beam, for maintaining a polish rod of an oil well pump jack in true alinement, while providing a maximum stroke and the greatest quantity of oil, with the least sucker rod trouble and wear. Patent 1749626. Charles H. Brown.

STRIPPING-FINGER ADJUSTMENT FOR THRASHING MACHINES—Whereby the rows of stripping fingers of machines used for operating upon the pod or hull type of crops may be projected or withdrawn at will, according to the weather conditions at the time of working. Patent 1749040. Carl R. Livermon.

CONVEYER—Of the endless belt type, applicable for quenching and removing furnace or gas producer ashes, or metal articles after heat treatment, or may be applied as a hydro-mechanical conveyer and separator. Patent 1750426. Harry E. Partridge.

DEVICE FOR SEPARATING WATER FROM OIL—A valve and float automatically acting to separate water which has gravitated at the bottom of a settling tank for oil and water, the action being accomplished in a continuous and clean manner. The float may be readily adjusted or removed from the separator tank. The inventor has been granted two patents, 1750489 and 1750490. John W. Pippin.

MOUTH WIPER—For linotype machines of the Mergenthaler type, the movement being actuated by the ejector mechanism and includes a flexible wiping piece resiliently held in taut position and readily removable from or replaced on the structure. Patent 1750402. Henry G Guire and Albin L. Chalfonte.

PISTON - RING - FITTING MACHINE—A machine by which the grinding of piston rings incidental to fitting them in engine cylinders can be accomplished with a mathematical exactness, the machine is adjustable for practically all forms and sizes of rings. Patent 1750195. Granison M. Sanders.

PUMP PLUNGER—A built-up plunger wherein most of the plunger is made from vitreous or other acid-resisting material capable of resisting the action of chemicals in water to be pumped from mines. Patent 1751350. Fred W. Moyer and Frank J. Reninger.

BOX FORMING AND SEALING DEVICE—Adapted to receive a blank which has been indented for determining the side walls, bottom and top, fold the blank, and apply a sealing tape to the abutted edges after the box-like structure has been formed. Patent 1751390. Walter W. Vrust.

CUTTING DEVICE—An attachment in the form of a rotary cutter comprising a disc-like body which may be readily mounted in connection with a paper tube forming machine for automatically cutting the product into predetermined lengths. Patent 1751293. Harold W. Sherman.

WATER-LOCKING SUCTION VALVE FOR HYDROCARBON-FUEL-STORAGE TANKS — Whereby fine dirt, scale, etc., frequently present in gasoline, and which settles in the water strata at the bottom of the tank, cannot be drawn up to prevent a proper closing of the check valve. Patent 1751371. John H. Viele.

REVOLVING LATHE CENTER—For the tail spindle of a lathe, which revolves instead of being stationary, thereby eliminating burning in wood turning, and is lubricated in such manner as to require less energy in running the lathe. Patent 1751711. Harold R. Ong.

COIN - CONTROLLED LIQUID - DISPENSING APPARATUS—Which can be operated in conjunction with gasoline and lubricant pumps, and will expedite the sale, by eliminating employees and permitting autoists to purchase the product at such times as the station is ordinarily closed. Patent 1752150. Ernest E. Cooper.

LONG-STROKE PUMPING JACK—Adapted for use with oil wells, may be easily unlimbered for temporary displacement preparatory to pulling a sucker rod, whereby weight elements may be added or substracted on the reciprocating chains to suit different loads. Patent 1752144. Lawrence G. Burt.

Medical and Surgical Devices

ORTHODONTIC DUMB-BELL—Formed of a temporarily deformable elastic material, comprising a cylindrical shank with an enlarged integral spherical knob at one end, for the treatment of irregular teeth and development of the human maxillary and mandibular bones. Patent 1749632. Harry C. Ferris.

TONSILLOTOME—Of the guillotine type, including a pair of blades one initially directing an electrical current to the base of the tonsil, causing coagulation and reducing bleeding to a minimum, the other severing the appendages. Patent 1750874. Arthur C. Campbell.

DENTAL MIRROR—Having a lighting attachment arranged in such a way that the rays are reflected from the surface of the mirror and illuminate the mouth so as to facilitate the inspection of the teeth. Patent 1750194. Carl G. A. Rydman.

Musical Devices

PHONOGRAPH STYLUS AND SOUND BOX—Wherein a plurality of stylus points may be associated with the sound box for consecutive use in combination with the sound groove of a record, and any one of the style positioned for playing. Patent 1750351. Auguste E. Pasche.

Plumbing and Fittings

COMPOUND FAUCET—A double faucet attachment to a single pipe whereby water may be drawn from one faucet inside the house while the other faucet is being used for a hose attachment outside the house. Patent 1750485. Gustav Muller, Jr.

Prime Movers and Their Accessories

AUXILIARY AIR SUPPLY AND MIXING DEVICE FOR INTERNAL-COMBUSTION ENGINES—Which thoroughly incorporates the air with the explosive charge from the carbureter and causes the mixture to be automatically delivered in correct combustible quality to the manifold at all speeds of the engine. Patent 1748203. Gaston A. Brunelle.

ROTARY INTERNAL-COMBUSTION ENGINE—Wherein carbon deposits are materially reduced if not eliminated, and which will develop a maximum horse-power with a minimum gaseous fuel consumption, utilizing substantially all the power before the exhaust products escape. Patent 1750502. Thomas A. Baker.

INTERNAL - COMBUSTION ENGINE—Designed to perform perfectly the four cycles of the usual four-cycle engine, and employs a new principle of compression and expansion which has distinct advantages over the usual type, the engine being comparatively light in weight. Patent 1751385. George P. Beaudry.

TWO-CYCLE ENGINE—Having a time-controlled valve which will force gases of combustion into a cylinder at the proper time, under the proper pressure and permit these gases to exhaust at the proper time. Patent 1750201. Gardner A. B. Spencer and Harry B. Cornish.

INTERNAL - COMBUSTION PUMP — Whereby charges of fuel are controlled in such a manner as to avoid pre-ignition, thereby enabling greater compression, and so to make it possible for the pump to operate against heads of liquid in excess of two hundred feet. Patent 1752130. Eric W. MacKay-White.

Railways and their Accessories

BALLAST-DRESSING MACHINE FOR RAILROADS—A preliminary ballast spreading and leveling apparatus whereby ballast dropped upon a railroad in piles may be smoothed out or spread in an even and expeditious manner before the finishing operation. Patent 1750506. Solon F. Clapp.

Pertaining to Recreation

DOLL—Constructed with a hollow hard casing and flexible swinging legs, whereby the doll may simulate the movement of human beings in walking by a forward turning movement first one side and then the other. Patent 1750404. Louis Herman.

TOY TARGET—In which the target elements are swingably mounted and have an indicia carrying portion adapted to be swung into position to expose the numerical value associated with each target, when struck by a projectile. Patent 1749689. Fred T. Baum.

Pertaining to Vehicles

BRAKE MECHANISM—Wherein the braking elements will be self-centering, so that the active brake lining will be uniformly applied to the braking surface of the drums, and the wear evenly distributed over the entire area. Patent 1749624. Jonas W. Batson.

ROAD - MAP - EXHIBITING APPARATUS FOR MOTOR VEHICLES—Which is operable by the forward movement of the vehicle to be successively exhibited in a manner to continuously indicate to the motorist his precise geographical location, may be readily applied to an automobile. Patent 1749243. William L. Eglinton.

GEAR SHIFT—An automatic mechanism whereby the shifting of gears from operative into neutral, and into another operative position, during one continuous movement of the clutch, prevents the gears shifting from second or third speed into reverse. Patent 1749837. Arthur C. Nickell, Jr.

TIRE-DEFLATION SWITCH—A signal or alarm, electrically connected with the usual ignition or lighting circuits, and giving warning to the operator of an automobile of the deflation of one or more of the tires during travel. Patent 1750563. Joseph Berger.

STEERING MECHANISM—For vehicles, whereby the operator will be relieved of much manual labor, the operation requiring practically no effort regardless of whether the vehicle is moving or at a standstill, so long as the vehicle's motor is operating. Patent 1749816. William R. Hendrix.

VACUUM - CLEANER — Whereby the suction created in the intake manifold can be utilized to perform the functions of a vacuum cleaner, the dust being prevented from passing into the manifold or interrupting the normal operations of the engine. Patent 1750800. Sydney R. Gould.

INTERNAL SPRING - METAL REENFORCING MEMBER—Which will take the place of the ordinary inner tube, may be readily inserted within a vehicle tire, and conform to the inner walls, and will force the tire beads outwardly against the rim. Patent 1751741. Victor Karbowski.

AUXILIARY CONTROL FOR MOTOR VEHICLES—Which permits the driver of a house-to-house or short-stop delivery zone truck, to automatically start or stop his car, either from the usual driver's seat, or from the delivery door, thus saving much time. Patent 1748041. Herman T. Backhus.

AUTOMOBILE IDENTIFIER—A frangible support for a license plate or other identifying mark, so that in a collision the supporting means breaks and causes the indicia to drop, thus leaving identification in case the driver escapes. Patent 1747446. Stephen G. Krile.

HYDRAULIC POWER TRANSMISSION—In which a fluid is employed for effecting a silent driving engagement and cushioning effect of one shaft with another, thereby eliminating jolts and harsh mechanical connection, as in ordinary motor vehicle transmissions. Patent 1748436. Victor Arkin.

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Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Engineering," "Medicine," "Miscellaneous," etc., under which many items will be found, the location of which otherwise would be very puzzling.

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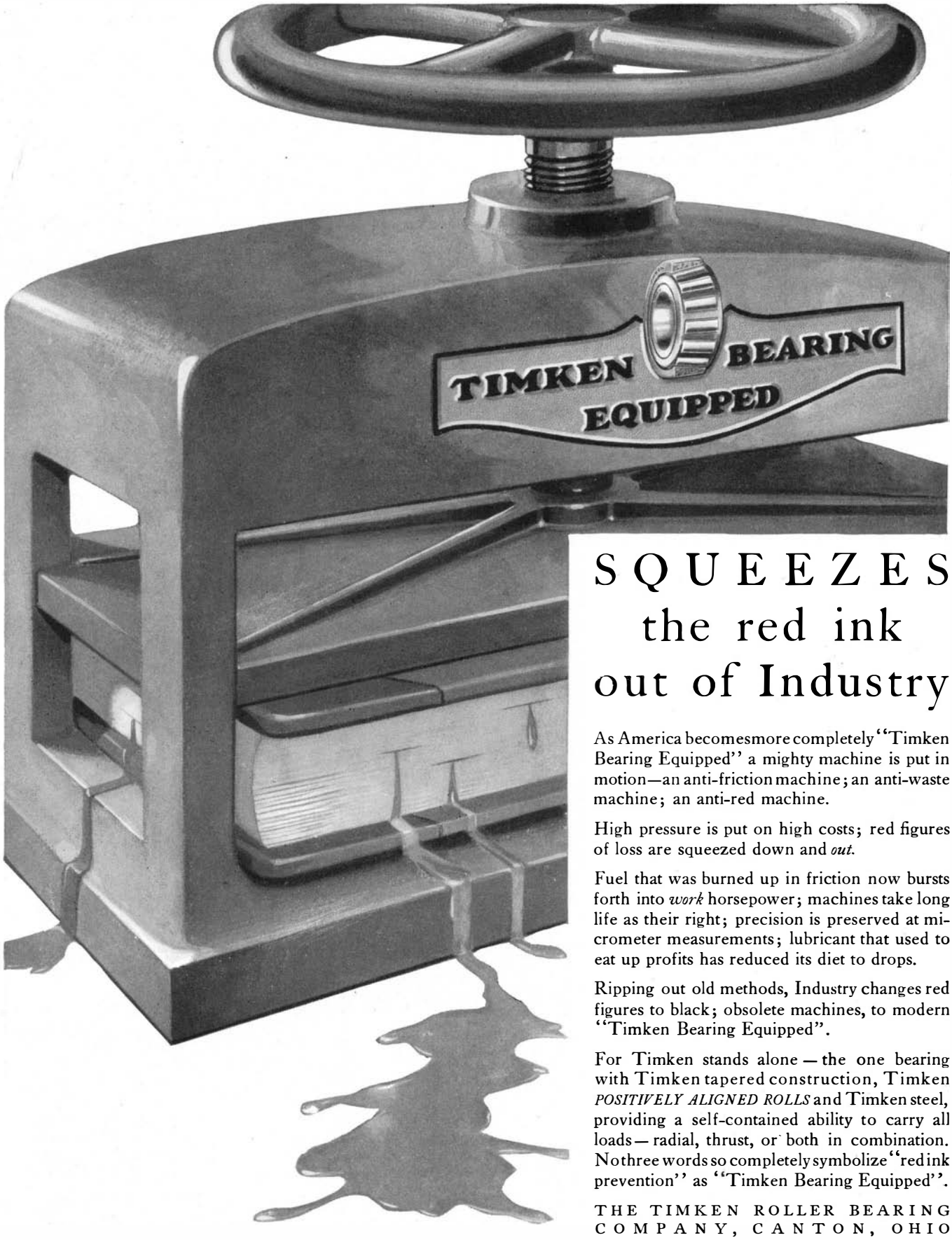

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