SCIENTIFIC AMERICAN

STARTING A TUNNEL WITH A PNEUMATICALLY-OPERATED ROCK EXCAVATING MACHINE.—[See page 657]

June 24, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

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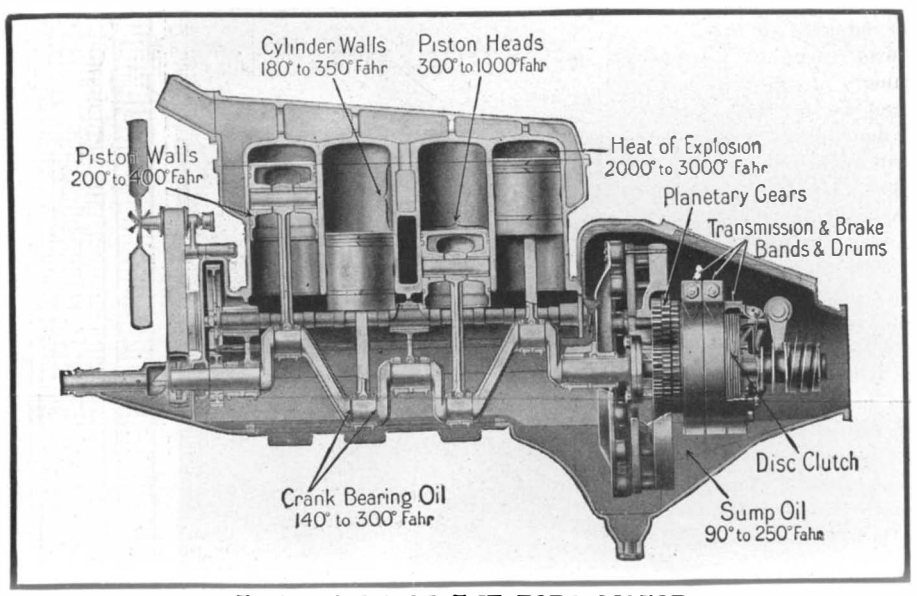

THE INSIDE OF THE FORD MOTOR

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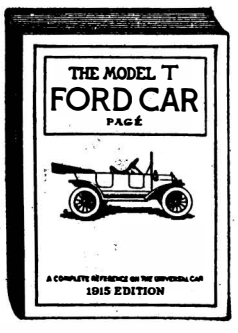

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SEVENTY-SECOND YEAR

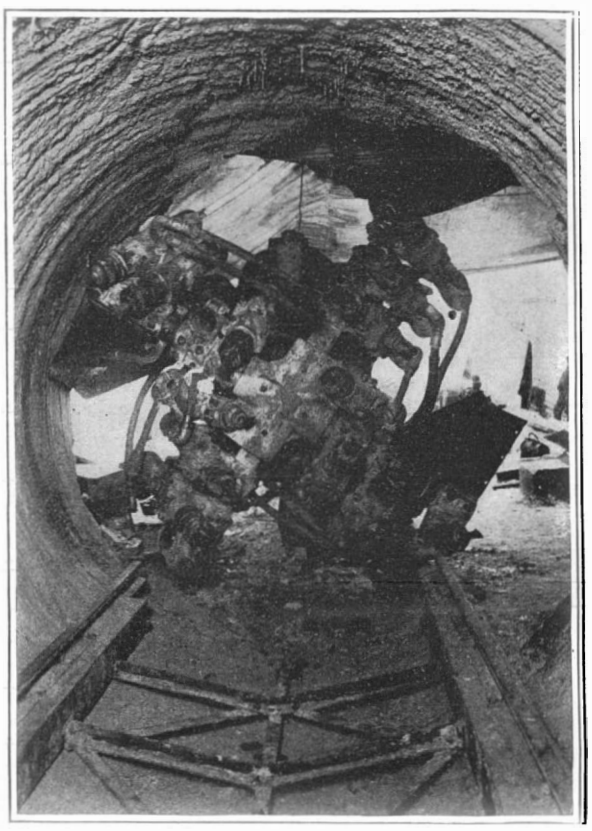
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV. NUMBER 26] NEW YORK, JUNE 24, 1916 [10 CENTS A COPY $3.00 A YEAR

Rock Tunneling Without the Use of Explosives

SOME 40 feet under the surface of Forty-second street, one of New York's busiest thoroughfares, a machine is hard at work chipping out foot after foot of solid rock in pushing through an eight-foot tunnel of its own making. Already the machine has pierced the rock to a distance of 70 feet, with—at the moment of writing—some 30 feet more to go to complete its present task, which is the boring of a connecting tube between the new Lexington Avenue subway and the



Front view of the rock excavator, showing the chipping hammers and rotary head

present subway, in front of the Grand Central Station.

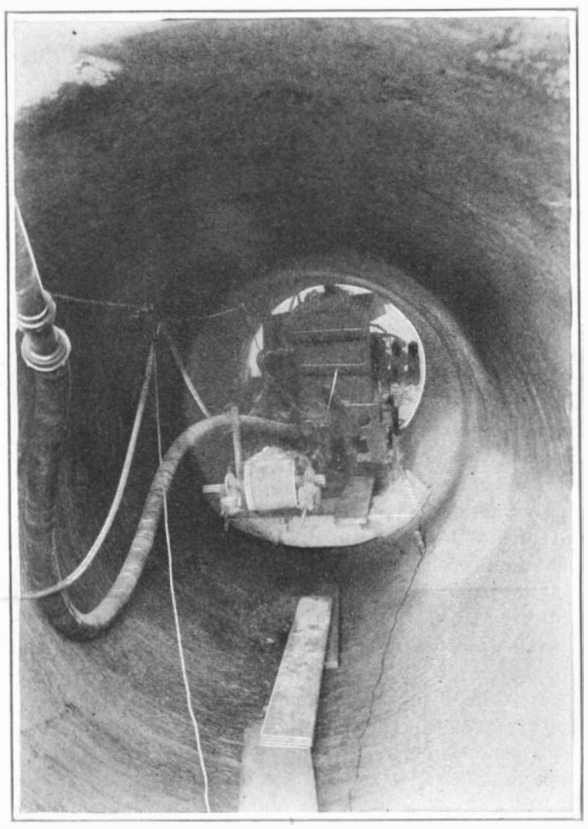
The present rock tunneling machine is the fruit of the work of Oliver O. App, of New York, who has devoted a great number of years to the subject of rock drilling. In its main essentials the machine he is now using does not vary to any great extent from that described in the SCIENTIFIC AMERICAN for January 10, 1914, yet a vast amount of improvement and refinement has been incorporated into the apparatus in developing it to a commercially practical stage.

The rock-excavating machine may be described as consisting of three main members: first, the rotating head, which carries 14 powerful pneumatic chipping hammers; second, the carriage or main member, which is provided with means for turning the head and for feeding the front part of the machine steadily toward the tunnel face; third, shovels and a belt conveyor for picking up and carrying to the rear the broken rock or muck resulting from the action of the chipping hammers. The machine is absolutely automatic in operation, although adjustments, such as moving the rear portion of the machine forward at intervals and setting the chipping hammers and tools, obviously require the presence of an operator.

The rotary head carries the chipping hammers adjustably mounted on a pair of cross-arms, which in turn are mounted on the main shaft of the machine—a tube 12 inches in outside diameter with an 8-inch bore, through which compressed air or any other suitable agency of motive power is supplied to the rock hammers. In operation, the head turns at a slow speed, so as to bring the hammers in contact with every part of the tunnel face, and as they chip away the rock the leading part of the machine is automatically and steadily moved forward by means of screw jacks that have a total feed of 36 inches, the rear portion of the machine being held securely in place either by screw jacks which engage with the roof of the tunnel or by clamps placed on the track on which the machine travels, just in the rear of the second pair of wheels. The track is of standard gage, 4 feet 8½ inches, and is moved forward at certain intervals as the excavator progresses with its work. Whenever the screw jacks have pushed up the head to the desired limit a clutch is thrown in which operates them in the opposite direction, pulling up the rear portion of the machine toward the face of the tunnel. The rear end of the machine is then secured in place, either by jacks or track clamps, and after the few minutes taken for this readjustment the machine is ready to proceed with the work.

The idea of drilling through rock with a battery of pneumatic drills is not a new one, and in the past machines capable of drilling through the hardest kind of rock formation at a surprising rate of speed have appeared from time to time. However, the basic principle of these machines has been wrong in most instances, for the designers have depended on the reciprocating action of the drill for cutting away, or rather pulverizing, the rock face. While such work as they have accomplished has been carried out in record time, the constant jar or vibration of the rapidly oscillating pneumatic drills has caused the self-destruction of the machines in a short space of time. Then again, the constant renewal of the tools used in such machines has formed an important and expensive item which has counted heavily against their commercial application.

There is only one practical way of cutting rock, and that is the method used by the stonecutter: the cutting tool is brought to bear on the projection to be removed and is then given a sharp blow with a mallet or hammer, chipping off a piece of the rock. So long as the tool is brought into firm contact with the rock before the blow is delivered it sustains no appreciable injury

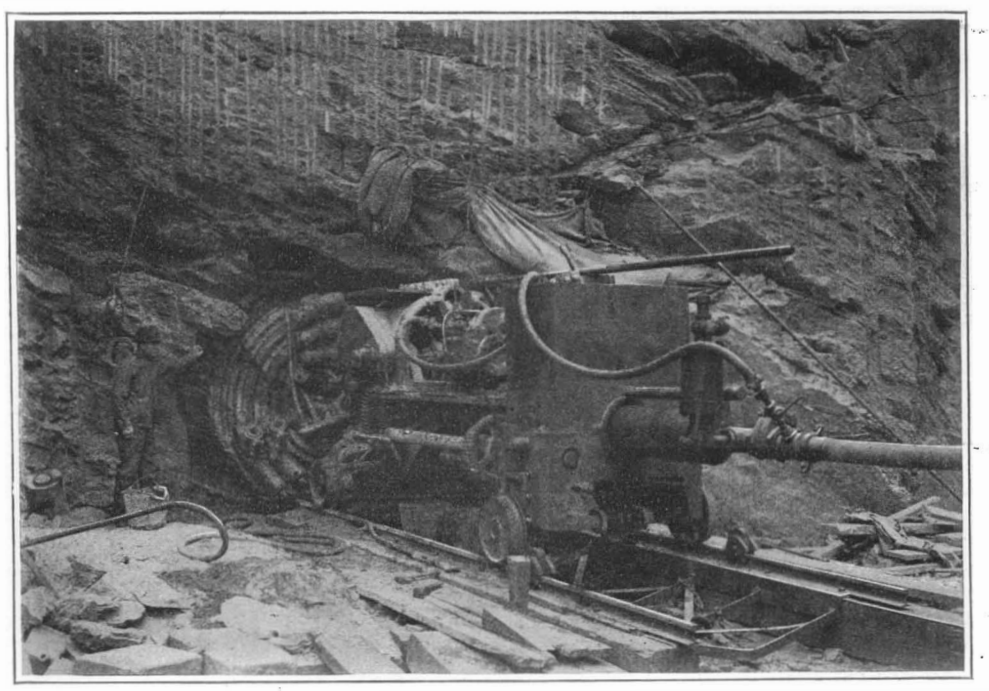


Rear view of the rock excavator at the head of an 8-foot tunnel of its own making

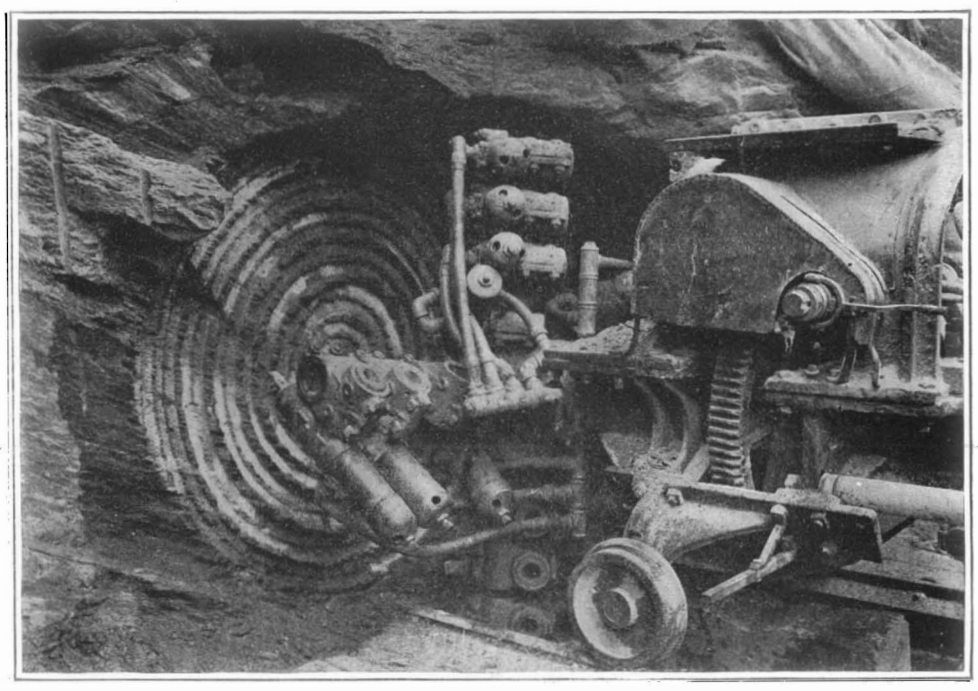
and its life is long; but use the same tool to break or cut the rock by a series of blows with its cutting edge and the steel is soon reduced to a ragged and inefficient instrument. Again, it is highly important that the cutting edge should not be dragged on the rock between blows, for this tends to wear it down rapidly.

The method of the stonecutter is used in the rock excavator developed by Mr. App. Each pneumatic hammer, fitted with 1½-inch cutting tool 6 inches long,

(*Concluded on page* 672)



Rock excavator starting work on a tunnel. The boxlike structure at the rear, used for ballast purposes, has been recently discarded



Rotary head and chipping hammers which cut the face in a series of concentric rings. Each tool cuts a clearance for the tool proceeding it

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, June 24, 1916

Charles Allen Munn, President, Frederick C. Beach, Secretary, Orson D. Munn, Treasurer, all at 233 Broadway

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

What the War Has Taught American Industries

SIX months ago the SCIENTIFIC AMERICAN launched a campaign of Industrial "Preparedness for Peace" with the object of warning America against the industrial struggle that will follow the termination of the present European war. In pursuance of this campaign we have been publishing articles on our opportunities and how they may be realized; on our wonderful resources and how they may be developed; on our manufactures and how they may be improved; how we may eliminate waste of material and waste of effort.

Although the campaign, as such, dates from an announcement in the issue of December 25, 1915, it was really many years before the war that we urged upon manufacturers the necessity of studying their waste heaps and refuse piles for valuable products. We made a special personal study of conditions in Germany and told the American manufacturer of the benefits that accrued to his foreign competitor from the close coöperation with research bureaus. However, the war, in the score of months of its duration, has done more to awaken this country than did all our preaching in as many years. Not until we were absolutely confined to our own boundaries did we begin to learn the value of our resources, and how much we had been dependent in the past upon products of the Old World. Men who were afraid to try domestic materials for fear they might not measure up to imported materials, and might thus work injury to their finished product and reputation, have now been compelled to rely upon the domestic supply, and have found it in most cases equal, and in some, superior to that which has come from abroad.

But, best of all, in order to find these materials, and to make sure of their quality, manufacturers have been forced to go to the research bureau and lay their problems before scientific experts. As a result their eyes have been opened to the wonderful detective work that may be done with the test tube and the microscope. Secret processes that have been guarded jealously, abroad, have yielded to the research of our analysts. Products which it had been supposed could only be made in certain parts of Europe, we now learn may be made just as well, if not better, in America.

The Bureau of Standards, at Washington, is rendering an invaluable service to our country in its present extremity. New products are being developed. We are finding new uses for our materials, and in taking stock of the resources of this country we have discovered that practically all our needs may be supplied from the natural products within our own boundaries. Our country is so vast that it has not as yet been thoroughly explored. It seems probable that even the few products which may now seem to be lacking will in time be discovered.

Having experienced the benefits of coöperation with men of science, American manufacturers will continue to make use of their services. Already they have learned so much that were the war to end to-morrow, our industries would not revert to the condition of absolute dependence upon Europe in which they were held prior to the great conflict. But we still have many problems to solve. The SCIENTIFIC AMERICAN will continue to tell the fascinating story of the great awakening of American industries. The story has only just begun.

Superstitious America

IF an intelligent Chinaman or Hindu, who had enjoyed the advantages of a modern education, should visit the United States and, on returning home, should write down the results of his observations in this country, he would probably make such statements as the following:

"The Americans are a very superstitious people. Nearly all of them believe in a great variety of childish signs and omens. One notion particularly common among them is that the number thirteen is unlucky. Travelers will refuse to occupy a bedchamber numbered thirteen at a hotel, or a stateroom numbered thirteen on a steamboat; hence thirteen is frequently omitted in numbering such rooms. Highly educated men and women refuse to sit at a table at which the number of guests is thirteen. Fortune-tellers, palmists, phrenologists and astrologers flourish in every American city. The widespread belief in astrology is especially remarkable in a country where astronomy is more assiduously cultivated than anywhere else in the world. My educated countrymen, who have heard of the marvelous scientific achievements of the Yerkes, Lick and Mount Wilson observatories, will probably be astonished to learn that many of the leading American newspapers publish a daily 'horoscope,' supposed to be based upon astrological calculations, and frequently devote long articles to particular astrological prophecies regarding public events. There are also many books published in the United States every year in which astrology is treated quite seriously as a legitimate branch of science."

Alas, too true! Only a few months ago a New York publishing house of the highest standing issued a book on astrology, which was advertised in one of our most dignified literary magazines in the following terms: "A book about star influence on human destiny. A *powerful* and *stimulating* introduction to astrology. *Practical* information about drawing horoscopes." (Our italics.) In short, this was by no means a book that anatomized the ancient and picturesque superstition of astromancy from the point of view of the twentieth century, as we anatomize the history of the Olympian gods or the folklore of the Australian aborigines. Such books have been written, and they are decidedly valuable. In the year 1916 a knowledge of astrology is a useful accomplishment—not as a means of divining the future, but as an aid in understanding the past. Much history and a great deal of our finest literature are not fully intelligible without such knowledge. Our very language enshrines a multitude of astrological notions; and we use such words as "consider" and "disaster," "saturnine" and "jovial," with a finer discrimination for being able to trace them back to the vocabulary of astrology. The book in question was, however, not written from the standpoint of the twentieth century, but from that of the middle ages. And it was not published in Peking, or Bagdad, or Seringapatam, but in New York City!

In Portland, Oregon, a "college of astrology" has flourished for years. Perhaps this explains why so many astrologers are "professors." The fiction that astrology is extinct in civilized countries is kept up by the encyclopædias, which in their articles on this "art" almost invariably refer to the practice of it in the past tense. Yet of the scores of "medical" almanacs, issued in enormous editions every year in America, there is scarcely one that does not contain the venerable Man of the Signs, or Anatomy of Man's Body, in which the sign of the zodiac responsible for the welfare of each part of the human organism is graphically indicated.

It is true, of course, that a great many ridiculous beliefs prevalent among us are only half-beliefs. The thirteen superstition, for example, retains its vitality because of the large number of people who find themselves at various stages between the extremes of positive belief and positive disbelief with respect to it. Indeed, there is nothing more difficult than to determine the real attitude of the public mind toward prevalent popular delusions.

One morning last winter, during the sessions of the Pan-American Scientific Congress in Washington, a newspaper of that city published, between two columns devoted to the proceedings of the congress, a half-column article recording the ravings of a soothsayer with regard to the future progress of the European war. Science and soothsaying bore equally conspicuous headings and were apparently looked upon, from the journalistic angle, as possessing approximately equal news interest. The juxtaposition was striking; but just what interpretation should be placed upon it we are unable to decide.

Human Nature and Election Theory

AT the present day it is difficult for each of us to recall the mental attitude which one possessed before the war. A catastrophe of such magnitude affects not only material interests, but causes a curious psychological change in both participants and observers. The change is obviously a permanent one. It is quite incredible that Europe will go back to the same general ideas after the war that characterized it before the war. It was the Napoleonic wars, more than anything else, which destroyed feudalism in Europe. It is interesting to recall some ideas which the war has modified and to see why and in what way they have been modified.

Before the war there was an appreciable and growing number of people who honestly thought that a war between any two of the great civilized countries was practically impossible. Many well-known men, at the time this horror suddenly burst upon the world, showed in their writings a kind of indignant amazement—amazement at the very notion that war was still a possibility, and was about to be an accomplished fact. They thought that the mental and moral enlightenment of the masses had gone sufficiently far, particularly in Europe, to form a solid basis of feeling against war which the ruling classes would be unable to overcome. How far they were from the truth we see now, when, after seventeen months of unparalleled slaughter, all the European nations involved are prepared to continue the war with unabated ferocity. This complete contradiction of many hopes and some prophecies is instructive. The main assumption which events have shown to be lamentably wrong is the assumption that education can profoundly modify the nature of man. According to the psychologists a man's nature is a combination of inherited psychological predispositions and acquired characteristics. The mob motives which impel men to war must be sought amongst the former class, amongst those fundamental instincts which are modified only very slightly from one generation to another. These mob impulses of human nature are not absolutely invariable, it is true, but they change very gradually, and it would seem that all schemes of social reform which presuppose a rapid alteration of these primitive, and, in some circumstances, undesirable traits are foredoomed to failure. It is very important, from the scientific point of view, to recognize these two divisions of human nature. We have an analogous phenomenon in modern physics. It is well known that on the modern election theory the dimensions and mass of a material body change in the direction of the motion of the body, the extent of the change depending on the velocity of the body. Well now, this is a very important fact, and yet in all ordinary dynamical calculations we take no notice whatever of this fact. We treat the bodies concerned just as if no change of the kind took place. Our justification is that *at the velocities with which we are concerned in ordinary dynamics* the change is experimentally inappreciable. The moral for social reformers is obvious. We grant that man's fundamental nature may change and is changing, but we suggest that for the *periods of time* with which the social reformer is concerned, such changes are inappreciable. Of course, there may be social reformers who are chiefly concerned with what human society will be like a million years hence. Our remarks do not apply to them; in this respect their researches are analogous to the researches made on particles moving with velocities approaching that of light; except that in the latter case we know the researches have furnished valuable results, while in the case of the former we may be permitted to doubt. The fact that the fundamental qualities of human nature are practically invariable seems simple enough, and yet not only many Utopias, but many schemes of immediate social reform fail to take that fact sufficiently into account. For those of us who wish war to be abolished from the earth, it would be bad policy to rely upon the extension of education to effect our purpose. Actual repressive measures will have to be introduced, and it is difficult to see how this can be done without making the ultimate appeal an appeal to force. We cannot alter the nature of man, and the fact that many people now dislike war has probably less to do with education than is generally supposed. There have always been people who disliked war, and in the Agamemnon of Æschylus we find exactly the same comments on the senseless waste of war that we find at the present day.

The lesson is sufficiently plain. Education, particularly as at present understood, counts for little in this connection. Poetical extracts, the elements of trigonometry, and a knowledge of the lengths of the chief rivers of the world, are powerless materially to modify the instincts transmitted to us by the fighting tribesmen of past ages. A permanent peace for the world is something which can only be obtained by strenuous effort: we cannot trust mankind to drift into it.

Reverting to our analogy with election theory, Schott has shown, in his "Adams Prize Essay," that the election very slowly pulsates. We need not go into details, but he reaches the interesting conclusion that owing to this peculiarity of the election, the catastrophic upheaval of the entire material universe will probably come to pass in a certain number of years. The number is, of course, inconceivably large. It is, at any rate, interesting to find that there are some writers who think that man's nature contains within itself the seeds of its own destruction. The idea is interesting, and does not lack plausibility. The analogy with election theory is obvious. The difference is equally obvious. Man cannot control the pulsations of the election, but he can, though but slightly, control his own nature. Small changes, accumulated over a long period of time, can produce big differences. This does not alter the fact, that, for our present purposes, we must recognize that such changes are indeed small.

Astronomy

Variable Stars Near the South Pole.—According to a Harvard College circular an examination of photographic plates of the region in the neighborhood of the south pole has led to the discovery of 19 new variables, the variation of which ranges from 0.6 magnitude to nearly 4 magnitudes.

Has Venus Ever Been Seen Crescent-shaped With the Naked Eye?—Prof. W. W. Campbell has recently discussed this question, which is raised by a paper in the *Journal* of the Royal Asiatic Society, in which Mr. Joseph Offord quotes cuneiform literature from ancient Mesopotamia containing references to the "horns of Venus." Mr. Offord argues from these references that in the clear air of Mesopotamia the crescent form of the planet was detected in early times without optical aid. Since Venus, when at a sufficient angular distance from the sun not to be lost in the glare of the latter, is hardly more than half a minute of arc in diameter at the utmost, such an observation seems quite out of the question, and Prof. Campbell thinks the allusion to the horns was merely a lucky guess on the part of the ancient astronomers.

Community Observatories.—A happy suggestion looking to a revival of popular interest in astronomy—now apparently at low ebb—is made in a recent article by Dr. Edward F. Bigelow. This writer describes a model "community observatory" which has been built under his direction at Sound Beach, Conn., by means of funds collected from many friends of science, and points out how much more valuable such an institution is in an educational way than the ordinary type of observatory. He suggests that every community ought to have a small observatory for the use of the people, as distinguished from institutions devoted to research. This should take the form of a building with a sliding roof instead of a dome, so that when in use the whole sky would be visible. Several small telescopes would be preferable to one large one. The observatory at Sound Beach cost about $1,300. Dr. Bigelow records the discouraging fact that astronomy has been banished from nearly every high school in the land, and that such outdoor organizations as the Boy Scouts and the Campfire Girls require of their members only an utterly insignificant acquaintance with the stars, such as ability to recognize Polaris and the "Big Dipper."

The Real Forms of Ring Nebulae.—In the course of studies on nebular velocities made at the Lick Observatory during the past three years some evidence has been collected as to the real forms of the apparently ring-shaped planetary nebulæ, which are rather numerous. If these objects are really ring-shaped, one would expect a considerable number of them, as seen from our system, to present the appearance of extremely elongated or highly elliptical bodies. None of these have been observed. If, however, instead of being rings these nebulæ are really ellipsoidal in form, then they would present the aspect of relatively broad ellipses from whatever angle they were viewed. The comparatively dark central area, completing the illusion of a ring, would be explained if we assume such bodies to be ellipsoidal shells of nebular material, surrounding the central nucleus with a relatively vacuous space between. The measurements of the rotational velocities of planetary nebulæ which are in progress at the Lick Observatory make it possible to draw some conclusions as to their probable masses. Unless their distances from us are much smaller than is supposed, the masses of certain nebulæ recently examined must be several times that of the sun.

A Comfortable Observatory for Cold Weather.—A very interesting illustrated article by Russell W. Porter, in *Popular Astronomy*, deals with the problem of constructing an observatory in which the astronomer may enjoy a comfortable temperature on cold winter nights. Previous attempts to solve this problem appear to have been limited to refracting telescopes, including the equatorial coudé in Paris, the Hartness turret telescope at Springfield, Vt., the Gerrish polar instrument at Harvard, and the Sheepshanks telescope at Cambridge, England. The author, however, has built adjoining his house a small observing room, above the roof of which he has installed a 16-inch reflector, in conjunction with a siderostat, all the optical parts, except the eyepiece, being external to the observing room. The siderostat is driven by a clock and is fitted with setting circles, so that the observer at the eyepiece can bring any part of the heavens within the field of view, except a small region around the north pole, which is cut off by the housing of the mirror. The observer sits in a comfortable chair in a room lighted and heated like the rest of the house. Apart from the loss of light due to the use of the siderostat. the only serious disadvantage of this device appears to be the condensation of moisture on the three mirrors, which on some nights proves very troublesome.

Science

Weather Reports from Light Vessels.—The Lighthouse Service announces that, at the request of the Weather Bureau, arrangements have been made for taking weather observations on the light vessels at Nantucket Shoals, Mass.; Diamond Shoal, N. C.; Frying Pan Shoal, N. C., and Heald Bank. Texas. The vessels are equipped with radio, and can therefore send in reports for current use when desired.

"Rocky Ford" Melons.—This expression long ago ceased to be limited, in popular parlance, to the product of the pioneer muskmelon district of Rocky Ford, Colorado. A recent food inspection decision of the Department of Agriculture takes cognizance of this fact, and declares that muskmelons of the Rocky Ford type, labeled "Rocky Ford," will not be regarded as misbranded under the Food and Drugs Act if they come from other localities, provided the name of the state or territory where they are produced is stated on the principal label.

Avalanche Warnings.—In the Cascade Range and the Rocky Mountains of the northwestern United States, more or less destruction of life and property is occasioned every winter by avalanches. During the winter of 1909-10, the deaths from this cause amounted to more than a hundred, and several hundred thousand dollars' worth of property was destroyed. During the past winter the district forecaster of the Weather Bureau at Portland, Oregon, Mr. E. A. Beals, inaugurated the practice of issuing special warnings whenever the approach of warm and windy weather, with rain, favors the occurrence of these disasters. The warnings thus far issued have been fully verified.

The Second Pan-American Scientific Congress has issued, from its headquarters in Washington, a substantial volume containing the text of the "final act," adopted at the close of the congress, together with a detailed commentary thereon by Mr. James Brown Scott, reporter-general of the congress; also a complete programme of the sectional and plenary sessions, and a list of members and coöperating organizations. The "final act" contains an imposing number of sonorous resolutions and recommendations; some of which may be taken seriously and acted upon, though most will probably share the fate common to *vœux* of this sort. The proceedings of the congress will fill a great many large volumes—but their publication is not yet in sight.

Remarkable Snowstorms in Great Britain.—Strange to say, while the British Rainfall Organization, with its great corps of observers, has for years maintained very thorough observations of precipitation, no systematic attempts have been made by this service to measure snowfall as such; hence it is impossible to furnish comprehensive and authoritative figures regarding the great snowstorms which occurred in England, Wales and southern Scotland last February and March, culminating in a destructive blizzard on March 28th. From the information available, however, it is evident that these storms were quite exceptional; especially in view of their occurrence so late in the season. The storm of the 28th demoralized railway traffic on most of the main lines. In the hill districts of the Peak, the Cotteswolds and Exmoor many villages were snowbound, while sheep were buried beneath gigantic drifts, estimated in some cases as forty feet deep.

Horizontal Rainbows.—When is a rainbow not a rainbow? One answer might be: "When it is not produced by drops of rain." On this basis the white rainbow would be excluded because it is produced by fog, and the horizontal rainbow would also be excluded because it is generated by droplets of water spread out in a horizontal sheet and not falling through the air. During the past ten years many such bows have been seen on the surface of Lake Mendota at Madison, Wis., and Mr. Chancey Juday, who describes them in the *Monthly Weather Review*, presents a history of previous observations of the same phenomenon in various parts of the world. As seen at Madison, the bow, when complete, assumes the form of a parabola, the apex of which coincides with the position of the observer. The outer extremities of the bow—often the only parts visible—consist of bright spots of spectral colors, sometimes repeated once or twice, as in the case of the supernumerary bows of the ordinary rainbow. In some cases fragments of a secondary bow have been seen. The conditions under which these phenomena appear on Lake Mendota are (1) a scum or film on the surface of the lake, which may consist of oily soot or of plankton organisms, (2) minute drops of water deposited on this scum from fog, (3) calm weather, permitting both the formation of the scum and the persistence of the particles of water as individual droplets, and (4) a bright sun. The author quotes an early observation by Clerk Maxwell, in England, of a horizontal bow on the frozen surface of a pond, attributed to the presence of drops of water lying on the ice.

Aeronautics

The Curtiss "Baby" Tractor, which underwent air tests at Newport News recently, is an extremely sturdy appearing machine, despite its diminutive size. It has a wing spread of 24 feet, and is equipped with a 90-100 horse-power engine. Although of a totally different design, the Curtiss "Baby" is reminiscent of the "Baby" Wright, which made its appearance at the Belmont Park Meet in 1910.

Priority of Invention of the Hydro-aeroplane was awarded on June 1 by the District Supreme Court to Albert S. Janin against Glenn H. Curtiss, according to the New York *Times*. A decision of the Commissioner of Patents was reversed on the ground that Janin had established a date of conception three years ahead of Curtiss. The court held, however, that its decision would not take from Curtiss the patentable "subject matter he may have originated."

Explosive Bullets are being used in the machine guns carried by Austrian and German aircraft on the eastern front, according to the *Russkoye Slovo*. German prisoners in the hands of the Russians say the order to fire explosive bullets from aeroplanes has been given to all German aviators. If this be true, it gives the Teutons a distinct advantage over their adversaries, for one hit scored on the enemy's petrol tank would almost always cause a disastrous explosion.

Observation Balloons of the French.—From a reliable source it is learned that practically all French observation or "kite" balloons are provided with parachutes which may be used by the observers in cases of emergency. Recently some 15 balloons broke away from their moorings during a high wind and drifted toward the German lines. It is reported that the majority of observers succeeded in alighting behind the French lines by the timely use of their parachutes.

A Super-Zeppelin 750 feet long has been seen making trial flights over Lake Constance, according to a report reaching Zurich from Romanshorn, a Swiss town on the lake. The total capacity is believed by observers to be 54,000 cubic meters, or about double that of Zeppelins of the earlier type. The weight of the new craft is estimated at 40 tons, and it is fitted with seven motors, four armored gondolas, machine guns, and bomb and aerial torpedo apparatus. The report is interesting; but is it authentic?

Steam-Driven Aeroplanes.—Not only is the Navy Department engaged in experiments having for their object the application of steam power to aeroplanes, but from reports from various parts of the country it would appear that many private investigators are hard at work on the same problem. Thus far the equipment most favored is some form of flash boiler and a compact steam turbine. Because of the simplicity and high order of dependability of the steam power plants, it is not unlikely that in the near future steam will supplant gasoline on heavier-than-air machines.

Predominance of Water-Cooled Engines.—Although previous to the war the leading aeronautical powers of Europe, aside from Germany and Austria, leaned strongly toward the use of air-cooled, rotary engines, one of the outstanding features of the air fleets of the Allies is the coming predominance of water-cooled, fixed-cylinder engines. It is frankly admitted that French, English and Italian designers have copied to a greater or less extent the Mercedes engine of the Germans. It is even reported that the French are using a number of Mercedes engines taken from German machines that they have brought down.

Supplying Food by Aeroplane.—Speaking before the House of Commons recently, Harold J. Tennant, Parliamentary Under Secretary for War, disclosed the fact that British aeroplanes had dropped more than 18,000 pounds of food, in addition to mail and military and other stores, into the besieged Kut-el-Amara between April 11 and 29. In spite of the dangers attending the aerial delivery of packages to the beleaguered garrison of the town, Mr. Tennant stated that only one British aeroplane was shot down, notwithstanding the Turkish reports that a number of aircraft had been brought down.

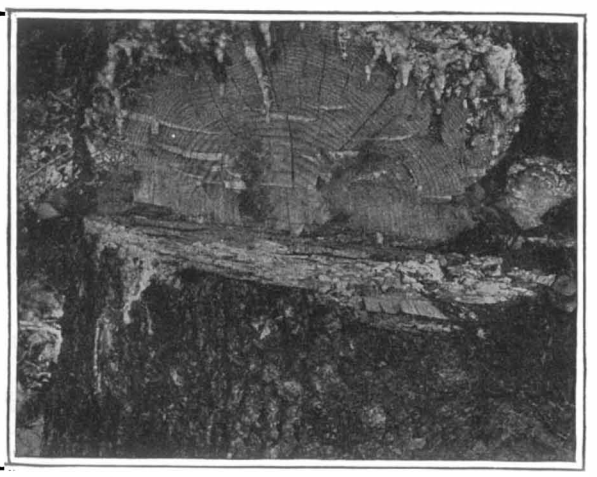
How a Machine Gun is Fired through a revolving propeller is told in a recent issue of *Aeronautics*, in an article describing the more important features of two German Fokkers brought down behind the British lines in France. On these monoplanes, according to the description, the machine gun is fired through the propeller by means of a small lever actuating a Bowden wire. Provision is further made to throw the machine gun mechanism momentarily out of gear as each whirling propeller blade comes into line with the muzzle. This is done very simply by means of a double cam fixed on the engine shaft and acting on a system of levers. The French Morane, after which the Fokker type has been modeled, also fires its machine gun through the tractor screw.

A frost crack, showing the spruce gum

The Spruce Gum Industry

An Important Article of Commerce from the Northern Woods

By Samuel J. Record



Under cut on a spruce tree, showing the pitch exudation

ONE of the minor industries of the North Woods is the gathering of spruce gum. It furnishes regular employment to a hundred men and is casually engaged in by several hundred others. It is in Maine that this industry is at its best and there every year some 15,000 tons of crude gum, valued at a third of a million dollars, is harvested. There are two gum diggers or pickers, of whom the writer has personal knowledge, who bring out of the woods every year a total of 1,000 pounds of lump gum and from six to eight tons of scrape. The value of each man's gleanings is between $1,500 and $2,000 a year.

Crude gum is formed as the result of injury to red and black spruce trees. Hedgehogs feed upon the inner bark of the trees and the injuries they cause, known as "hog cuts," are fruitful sources of gum. Lightning scars, frost cracks, old blazes, and the abrasions caused by falling trees, and even sap sucker drills are other occasions for gum formation. Around the edges of such wounds little nodules appear and gradually develop into lumps or teats. A wide scar heals slowly and may produce gum around the entire wounded area, while a narrow seam closes so quickly that only a single row of these "nuggets" is possible. At first these are mere pitch exudations that become sticky when placed in the mouth and are of unpleasant taste. It requires at least five years to transform this material into the hard and brittle amber-like gum. If it remains on the tree too long spruce gum deteriorates and becomes very dark colored.

The stimulation of the gum by artificial means is not practiced. Very recently, however, some experiments to this end have been started by Mr. V. C. Isola of North Newry, Maine. Four different methods have been used, namely, rossing the bark from portions about a foot square near the base of the tree, similar to the work of porcupines; removing a strip of bark 2 inches wide and from 15 to 20 feet long from the south side of a tree to imitate the scar made by another tree in falling; splitting the bark for a vertical distance of 20 feet to give the effect of a frost crack; removing two parallel strips of bark and leaving a two-inch strip between them.

Preceding these experiments study was made of the factors affecting the production of gum. It was noted that the sunny side of a tree is more productive than the shady, that trees on exposed ridges yield more than those in cover and on protected slopes, and that the best gumming is usually found in mixed stands of spruce, hemlock and hardwoods, and not in pure spruce stands. An exception to this was found in the case of ledgy slopes where porcupines were numerous. Weather conditions probably play some part, as yet unknown, in the formation and ripening of the gum.

Gum gathering is confined to the virgin forests as the yield of cut-over tracts and second-growth stands is too meagre to pay. A territory once gummed is ready for a second gumming in from five to seven years. The gatherers work alone, in pairs, or sometimes in parties of three or four. Working just ahead of logging operations has many advantages in the matter of transportation both of food supplies and of the gum. A little log hut near the scene of operations affords better shelter than a tent in cold weather, though the tent has the advantage of being readily moved. Gumming and trapping are often combined.

The spruce gummer cleaning gum at the door of his shack

Gathering gum proceeds the year around, though the best time is when the leaves are off the bushes and undergrowth, thus facilitating travel and making the gum easier to "spot." At such times, too, the flies are absent or less of a pest. Going is best in March when the deep snow covering the underbrush is crusted over. The gum in cold weather is extremely brittle and often flies into fragments when touched with the ax or gathering tool. These would be lost in soft snow, but are easily recovered from the crust. Walking in the deep snow the picker is able to find and reach many choice bits of gum which otherwise might pass unnoticed.

Not all of the gum is high up in the tree. In fact a great deal of it occurs near the base and considerable quantities are picked up from the ground where it had fallen after being broken off by the swaying of the tree in the wind, by frost action, or other means. During the snow season this part of the crop is inaccessible.

In gathering the gum the men work systematically in strips three to four rods wide. Where the gum is within easy reach the gatherer holds a bag or his hat under it and chips it off with a small ax. For higher up the tree he may build a staging, climb the tree, or in exceptional cases cut the tree down. Some operators use a special gathering tool, a chisel (usually made from an old file) inserted in the end of a pole and a tin receptacle fastened just beneath the chisel. The other end of the handle is hollowed out so that a stick can be fitted into it for extension. This enables the collecting of lumps far out of reach otherwise, though so much breakage of the gum results that many profesionals will not use such tools.

Work in the woods begins at daybreak and is usually concluded by 3 P.M. Upon returning to camp the collector goes over the contents of his back pack and sorts and cleans it. Rainy days may also be devoted to this purpose. So far as possible all bark and other foreign material is removed and the lump gum is put away carefully in a cool, safe place. In warm weather the lumps are put in a bag and sunk in a brook or spring to prevent the pieces sticking together. The scrapings and crumbs are stored in a barrel.

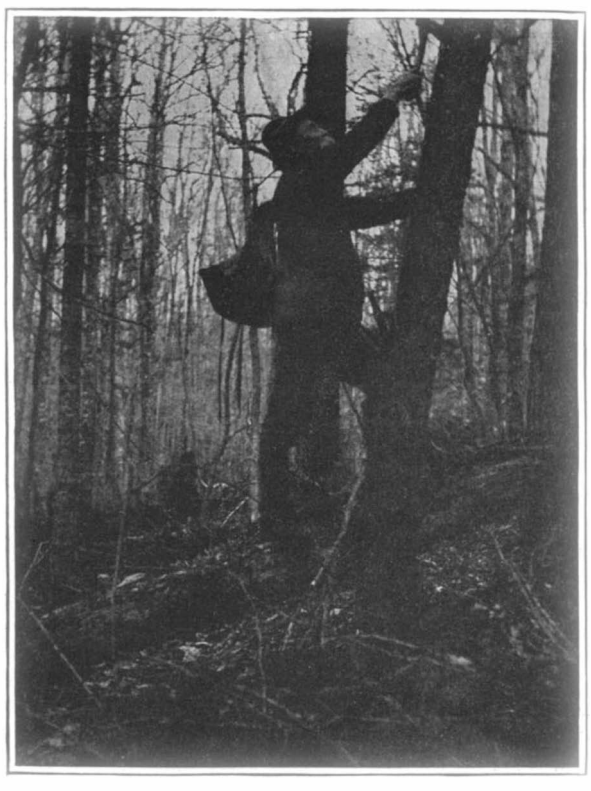
The yield of a day's work varies considerably. Some pickers consider 25 to 30 pounds a fair day's toll while others claim to average as high as 40 pounds, and sometimes make 60 pounds. Getting the chip gum out of the woods is quite a task, particularly when far from logging operations. In winter it is often loaded on a hand sled or toboggan and drawn out by hand.

Crude spruce gum is divided into two principal grades, lump and chip. Lump gum, as the name implies, comprises the nuggets or "tits" as they are known in the vernacular of the trade. This material may be separated into three grades based largely upon color and weight, which are mainly matters of age. First grade is light in weight, porous, and about the color of good honey. It is quite free from moss, bark and other impurities when gathered. The wholesale price for this grade is quite stable at from $2.25 to $2.50 a pound. Second grade is reddish or wine-colored and is not so porous as first grade, though for chewing purposes it may be fully as good or better. The difference in color and consistency is due to this gum being a little older. Third grade is a catch-all for lump gum that will not go into the first two grades. It is old gum that has usually begun to deteriorate and varies widely in color, being often quite dark. It sells for about $1.50 a pound wholesale. It is sometimes put up in small half-ounce pasteboard boxes which retail for five cents each.

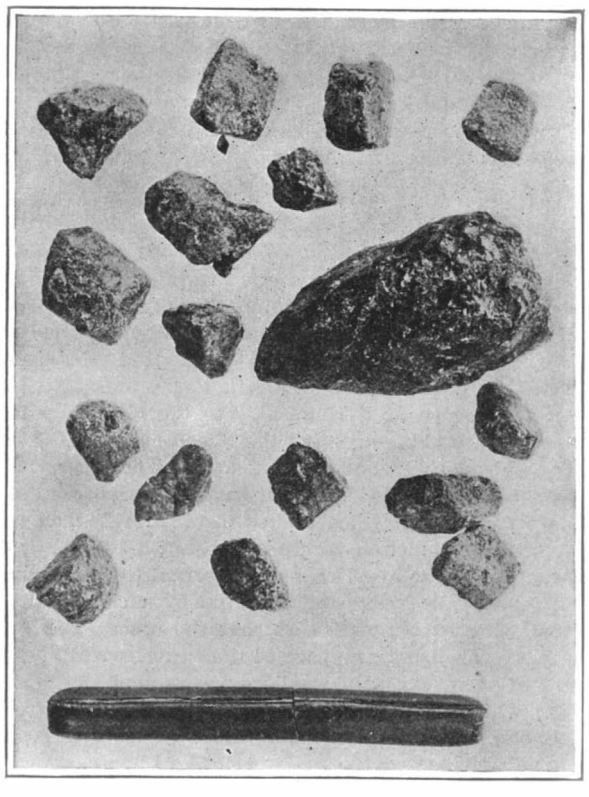
Chip gum contains the scrape from wounds on the tree, and the crumbs and fine particles resulting from cleaning lump gum. This material is so full of foreign matter that it has to be refined before going on the market. It is first washed in three or four changes of water and the free bits of spruce bark, fine moss, and dirt rise to the surface. Some of the bitter pitch is also gotten rid of in this manner.

The next step in the handling of this low-grade gum is to steam it. The steaming apparatus consists of a wooden box 4 feet square and 1 foot deep, fitted over a large funnel 4 feet square at the top and tapering to a narrow neck at the bottom. Between the

(*Concluded on page* 671)



A spruce gummer busy at his daily task



Spruce gum nuggets and a piece of steamed gum in stick form

Railroad Fire-Fighting Apparatus Used in Canada

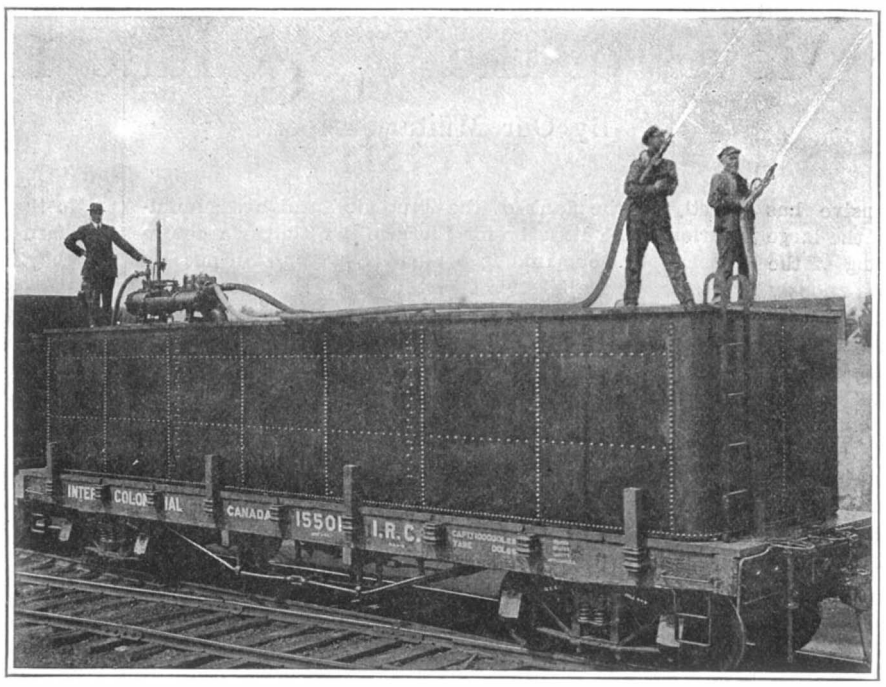
ALTHOUGH it seems almost incredible to say so, it is nevertheless the truth that the railroads of this country are powerless to combat their own fires with effective fire-fighting apparatus. The underwriter's list shows a huge loss annually to the railroads where fires occurred in sections removed from city fire protection. If the city firemen can not respond or the city fireboats can not help fight the fire, the railroad sits idly by and waits until the blaze dies out.

Not a day goes by but what one reads in newspaper accounts of fires where engines pulled away freight cars from the danger zone. But one never reads of engines helping extinguish a blaze. There is no such thing as a fire-fighting locomotive, nor a fire-fighting railroad car—that is, if one excludes the apparatus which forms the basis for this article. From the standpoint of efficiency and preparedness our railroads might be classed with the extreme pacifists of peace at any price.

When it became evident last year to the directors of the Transcontinental Railway of Canada that something had to be done, and done quick, too, in regard to the loss along the right-of-way by fires, an order for a fire-fighting car was turned over to the Canadian Government Railways' Shops at Moncton, New Brunswick. Shortly thereafter an apparatus consisting of a large water tank of more than 10,000 gallons capacity, mounted on a flat car in order that it may be transferred to any point on the system where fire may be threatening, was put in operation. It has already paid for itself many times over, although it is perhaps the only car of its kind in existence.

Mounted on the tank is a steam driven pump having a capacity of 300 gallons a minute. This pump is supplied with all necessary hose, nozzles and other fittings. The steam supply for operating it is taken from the car heater of the locomotive to which the car may be attached, and by setting the car heater regulator of the locomotive at a pressure of 125 pounds to the square inch a water pressure of about 100 pounds is obtained at the nozzle tip.

Before the Transcontinental Railway accepted the apparatus it was tested and found to be capable of throwing two one-inch streams of water a distance of about 200 feet to either side of the track. Two or three men can operate the nozzles and one man the pump, although two men in an emergency can work the apparatus to its full capacity. American railroad men are watching the car with interest. It will not be long before our railroads will have an efficient fire-fighting equipment of their own, if the fire car in Canada proves successful.

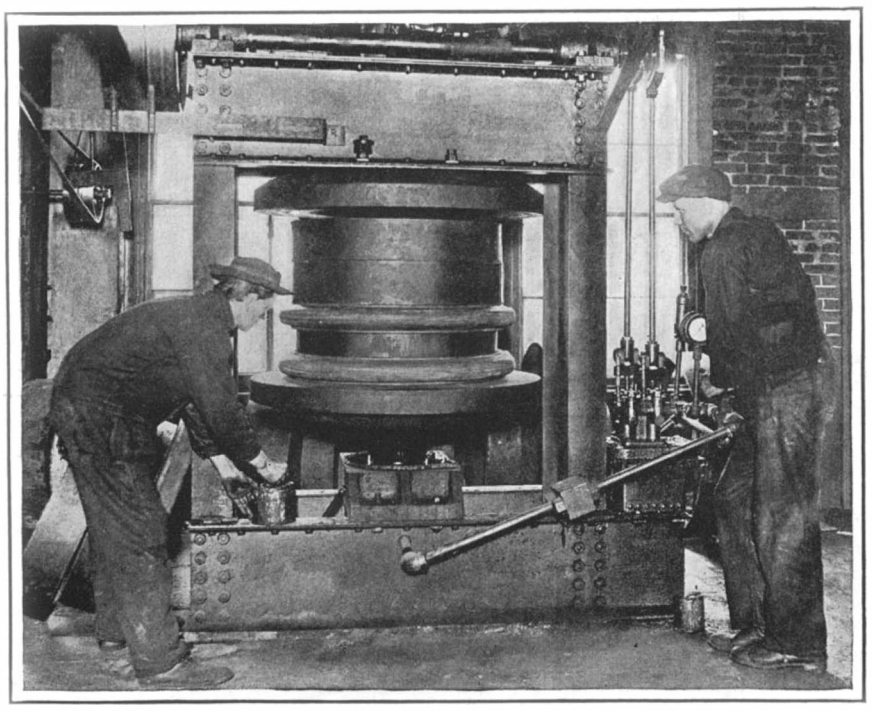


Fire-fighting car employed the Canadian railroads. It consists of a 10,000 gallon tank, a steam pump, and the necessary hose

Applying Truck Tires With a Press

THE accompanying illustration shows how one company re-tires truck wheels in a minimum of time, saving expense and loss of time to the firm that needs every truck to maintain its prompt service delivery.

The wheel needing a new tire is placed in a hydraulic press. With steel cylinders acting as buffers, the old tire is pressed off under 100 tons pressure, to be rebuilt or discarded. A steel band for the felloe, if such is needed, is taken care of by appliances on hand. A band heater, fed with natural gas, prepares it for the wheel, and cold water quickly shrinks it immovably into place. Replaced on the hydraulic press, the wheel receives its new tire under necessary pressure, steel cylinders again acting as buffers. The entire operation requires but a comparatively short time.



A typical hydraulic press in the act of pressing dual solid tires into position on a motor-truck wheel

In the accompanying illustration is shown how dual solid tires are forced into position on a truck wheel, in a few moments' time

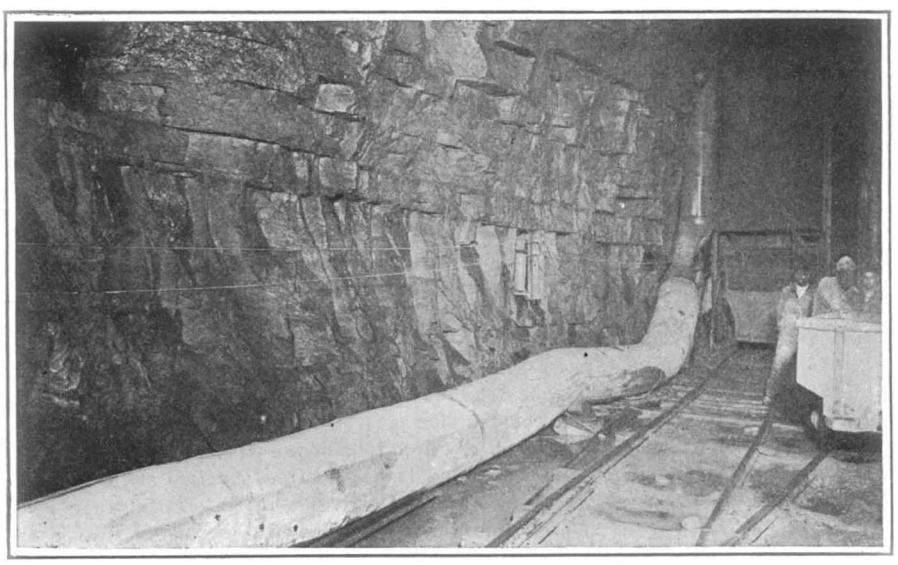
Supplying Fresh Air Through Canvas Tubes to Underground Workers

THERE is a two-fold reason for supplying an abundance of fresh, pure air to miners and other underground workers: first, it is of vital importance to the health of the workers; second, the removal of inflammable gases, particularly in coal mining. In tunneling and similar subterranean work a circulation of air must be constantly maintained, for gas, foul air, explosion dust and powder fumes retard labor, cause inefficiency in the work, and result in additional expense to the contractor.

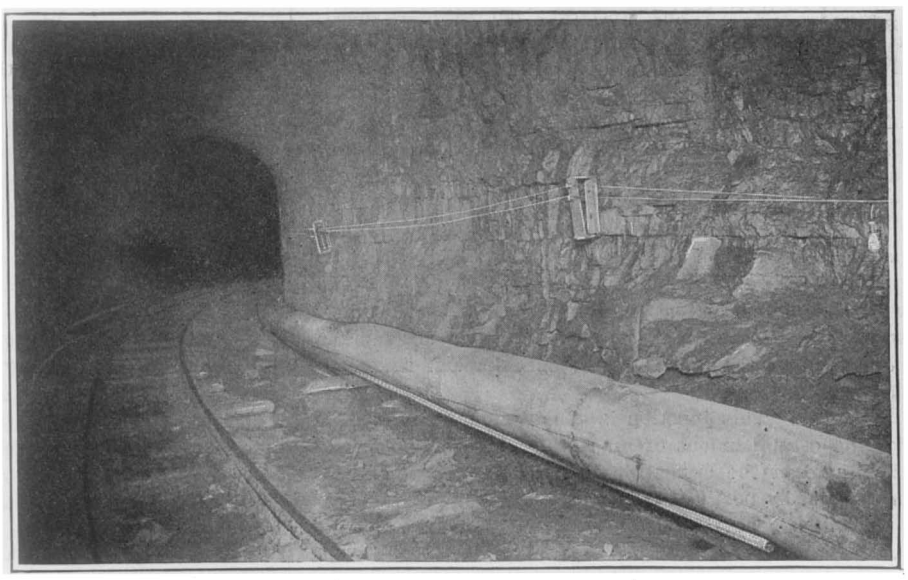
A manufacturer of canvas bags recently had brought to his attention the difficulties and inconvenience accompanying the use of a tin duct in the ventilation of underground workings. He was not slow to act on the suggestion that suitable duct might be made of canvas tubing, and in a short time he succeeded in evolving specially-treated canvas duct that has met with great favor since its introduction.

The advantages of the new form of tubing are numerous. In the first place, it is not necessary to have a smooth or level floor as with tin or wood tubing, for the canvas is just sufficiently pliable to adapt itself to any position in which it is placed. It is much lighter than either the tin or wood duct, and can be carried back from the face of the tunnel by one or two men preparatory to blasting, and dropped along the side. This operation can be done in a few minutes' time, whereas with a tin duct each joint would have to be disconnected and carried back and the operation repeated after the blast was made, obviously consuming considerable time. If a hole is punched in the tubing, it can be easily patched or a section of any length-desired can be inserted in a few minutes. With fans of suitable capacity, it is possible to deliver air for distances varying from 500 to 600 feet with ease. When the fans are not working the tubing collapses and can be hung on, or pushed against, the side of the tunnel. When the fans are started the tubing fills out and remains so as if it were reinforced with a spiral of steel wire.

It is particularly in the ventilation of mines without cross-cuts that the canvas tubing is attracting much attention. Heretofore it has been the practice to force a great volume of air through the shafts and entries of a mine, dividing or splitting the current at different points in its course so as to carry it to every part of the mine. Usually the galleries or tunnels are driven in pairs, and at frequent intervals connecting-tunnels or cross-cuts are driven between them so as better to circulate the flow of air. As the work in each gallery progresses and the face advances farther and farther, the cross-cuts in the rear are closed or sealed up in various ways in order that the air current will not find a ready by-path and thus fail to reach the head of each gallery in any appreciable volume. By means of the canvas duct it is believed that successful ventilation of mines can be carried on without the use of frequent cross-cuts.



Canvas air duct in a mine, at the point where it connects with a metal tube leading to the fan



Installation of a canvas air duct in a mine. Note how it adapts itself to floor irregularities

Strategic Moves of the War, June 15th, 1916

By Our Military Expert

THE timely and powerful Russian offensive has achieved immediate results in addition to the large local territorial gains secured, by the lessening of the Austrian assaults which a few days ago seriously threatened the Italian line guarding the Venetian province. Already the Italian troops have been able to press forward for the double purpose of regaining lost ground and holding their former assailants in position in their immediate front, to prevent detachment of troops to the eastern line.

Reports at the moment these lines are written indicate that the Russian offensive has extended north of the Pinsk topographical features which practically divide the eastern line into two grand sections. To the northward of Baranovichi seven powerful thrusts have been made by the Czar. At the moment it seems likely that this attack was merely for the purpose of preventing detachment of German troops to reinforce their hard-pressed Austrian allies in Volhynia, Galicia and Bukovina, although after the tremendous surprise of the Russian general attack—which surprised the Austrians most of all—it is by no means impossible that Russian forces have gathered in sufficient strength to extend their determined activities even farther north of Pinsk than the 75-mile point where Hindenburg was attacked. The Germans previously attempted counter movements on the Riga-Jacobstadt-Dvinsk front, to create a diversion in favor of the southern portion of the line, but according to the dispatches, they made little or no impression on the Russian front. These small counter-offensives are so obviously called for as relief measures that it may be taken for granted that they were expected and, further, that adequate provision had been made by the Russians to meet them. As on numerous former occasions, the Austrians have been compelled to call upon Germany for immediate and unstinted aid. Hitherto it has been forthcoming, with definite results; in this case the response remains to be seen. The dispositions of the German general staff are so invariably excellent that if no strong development ensues in answer to the call, it may furnish a very real confirmation of reported lack of reserves, and of unreplaceable losses which have been sustained on the fields of Verdun.

In the Russian offensive the principal massing of troops appears to have taken place before the Volhynian triangle of fortresses, as well to the south of Tarnopol, in Galicia and Bukovina. The Austrians are holding directly to westward of Tarnopol, but the powerful thrusts to either side threaten to force evacuation of the salient thereby formed, and at no distant date. As matters now stand, however, the salient is on the other side, and it is reported that strong Teutonic forces have massed between the northern face of the Russian salient and the Pripet. A successful downward thrust on the part of the Germans would almost certainly upset the Russian communications, not only effectively checking the offensive, but in all probability breaking the Russian line definitely. But it is seriously to be doubted whether sufficient Teutonic reserves are available to force such a breach or carry it through if a local break of any respectable dimension should occur.

The Russian attack has for its ultimate object, of course, the thrusting back of Teutonia from the Czar's domains and the winning of a victory which would decide the war. But there are first local objectives to be gained, and these seem to be about as follows:

Kovel. The Russians are now about 22 miles southeast of this most important railway junction, where five roads meet, and there has been no report of check in their forward movement for several days. The loss of this point would seriously handicap the Austrians, flank their line north and south, and the menace to the more important Brest-Litovsk farther to the northwest would become immediate.

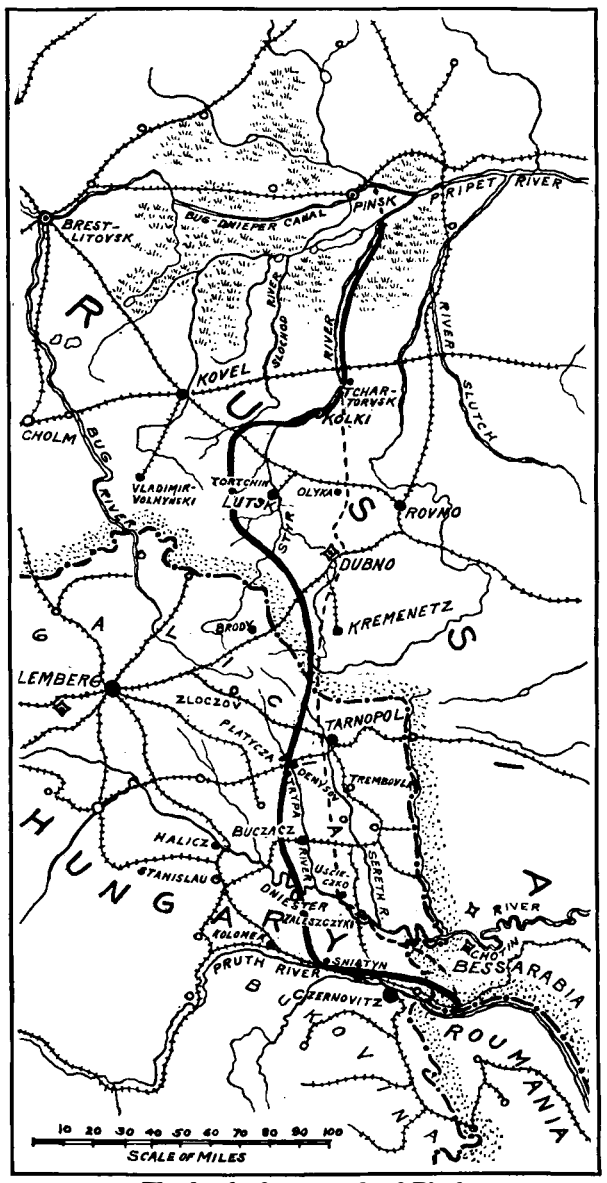
Lemberg. Eight railways center here and its importance is obvious.

Halicz. A minor junction, but one closely connected with a second junction not over 15 miles to the southward; possession of either would almost accomplish possession of the other and at once imperil the communications of—

Kolomea. This junction is of paramount importance for the establishment of an advanced base for operations against the Carpathian passes. It lies about 65 miles west by north of Czernovitz

It seems generally to be expected that the success or failure of the Russian enterprise will be indicated within the next few days. Military observers are looking for a movement from Saloniki, where General Sarrail commands between 500,000 and 600,000 men, directly on the flank of the Teutonic-Turkish communications with little beside the army of Bulgaria before them. If Roumania is persuaded by Russian success to attempt the hoeing of her own row, little short of a miracle could prevent the crushing of Bulgarian aspirations and the definite severance of Turkey from the Central Empires, with the Grand Duke battering at the back door of the Ottoman territory.

The English on the western line appear on the verge of inaugurating movements of moment, while the French give every indication of determination that Germany shall not be allowed to break off the battle of Verdun. Perhaps the international military conferences of the Entente have borne sufficient fruit to guarantee that no element of the alliance will again be required or permitted to sustain an offensive alone. Such concerted action, however, has not as yet developed, although there is ample indication of imminency.



The battle front south of Pinsk

Former front shown by broken line. Russian positions on June 15th shown by bold line.

At this date the position of the Russian line south of the Pripet marshes is about as follows:

The difficult country immediately south of the marshes, in conjunction with strengthened Teutonic forces, has not as yet become the scene of Russian gains. This inactivity, however, constitutes a factor of safety to Russian as well as to Teuton, for movements are difficult for an attacker and passive defense is comparatively easy. The ground therefore establishes a reasonably safe rest for the right flank of the attacking Russian line which extends to southward.

Almost west of Kolki the Russians have gained ground past the Styr to the Stokhod River, about 20 miles from Kovel, the line appearing to run almost west from Kolki to Boguchovka, on the Stokhod. From this point the line runs southward to Tortchin, which is about 15 miles west of Lutsk. It is on the Sierva River and within 45 miles of Vladimir-Volhynski, a railhead on an affluent of the Bug, which is but a few miles west of it. From here the line seems to sway eastward to a point from 10 to 15 miles west of Dubno, gradually straightening out further to the southeast, a few miles west of Kremenetz.

West of Tarnopol there is little change. The Austrians, reinforced by German troops, have made a desperate stand, and the Russians have been unable to gain much ground at the present writing.

To the southwest of Tarnopol the Russian line sags forward again, having reached a point to westward of the Zlotalipa River. Buczacz has fallen, and the Russians are pressing forward along the railway toward Halicz.

Zaleszczyki has been passed and a considerable section of the Dniester has been lost to the Austrians. The Russian line now reaches Sniatyn, almost directly to the southward. This point is about 20 miles northwest of Czernovitz, and its occupancy has automatically cut the railway leading northward from Czernovitz. The Russian line is also within easy artillery range of the railway to Kolomea. For all practical purposes, communications along this line have been severed by the Russians, and evacuation of Czernovitz seems but a matter of hours. There is, however, ample means of egress from Czernovitz to the southward, as a railway extends to the not-distant Carpathians and their passes.

Should the Russian offensive through Galicia prove successful and any material distance be gained, as, for instance, should Lemberg and Przemysl be reached, it would establish a situation new in the great war. When Russia previously held these important places the Germanic armies were well to the northwest, with their communications absolutely safe from menace. But with the Germans in their present position north of Pinsk to Riga, Russian occupation of Przemysl and Lublin would rip the very lining out of security and form one side of a most promising bag in which the entire German force might be inclosed. There is little likelihood of any such development, however, for if the Russian movement shows signs of making any such vast territorial gains, the German line will undoubtedly retire, and that hastily. Valor has nothing to do with it; it would be discretion of the most ordinary sort and dictated by direst necessity.

The most interesting aspect of the Russian offensive, after the surprise of Russia's powerful "comeback," is that of wondering how her allies are going to back her up. Will they coöperate in full and give her every chance to beat her way through? Or will some unknown factor of warfare require them to wait longer before sailing in with every ounce of energy? Those forces at Saloniki draw the attention of an observer like an arc light in a dark street. Surely the time is almost here when the *raison d'etre* of their concentration will be demonstrated.

And an equally interesting subject of speculation is: "What is the Kaiser's staff going to do about it?"

The Current Supplement

THE issue of the SCIENTIFIC AMERICAN SUPPLEMENT of June 24th, No. 2112, completes the volume including the first six months of the year, and contains an *Index* covering that period. It will be valuable to preserve for convenient reference. *The Fallacy of the Nebular Hypothesis* reviews an important subject, and gives a concise history of the various theories that have been brought forward regarding the motions of the heavenly bodies, together with reasons for discarding them. The fifth, and final article of the series on *Economy in Study* appears in this issue, and should not be missed by anyone who has read the previous interesting papers. *The Making of Military Roads* tells something of the extensive work necessary for the efficiency of a modern army in the field, and there are a number of illustrations. A timely article is the one on *Liquid Fire* which treats of one of the novel weapons brought forth by the war. A number of sketches illustrate the description. *The Purification of Water Supplies* is a subject of vital importance to every man, woman and child, especially in these days when theorists and politicians so generally control the character of this necessary article. *Making Roads and Men* tells of methods of using convict labor in some western states for building roads that not only are of material benefit to the state, but are especially successful in redeeming and reforming the convicts, thus resulting in a double gain to the community. *A Lecture Room Oscillograph* describes the details of construction of an instrument that is required in every well-equipped physical laboratory. Excellent detail drawings make the construction perfectly clear. *A Marine Disaster on the Coast of China* tells of the wrecking of a big modern steamship, and is accompanied by two striking photographs. *Modern Air* gives many interesting facts relating to the air we breathe with relation to health, and explains popular theories. *Capillarity and Soap* films gives a summary of a discussion by Prof. Dewar on problems in capillarity. Other articles of value are *The War Zeppelin* and *The Reform of the Man of Science.*

Correspondence

[*The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.*]

The Binding of Books

To the Editor of the SCIENTIFIC AMERICAN:

The SCIENTIFIC AMERICAN'S object is in part "to reflect the most advanced thought in *science and industry throughout the world*."

In regard to the above statement I would like to see some good sense reflected in the way that books and pamphlets, in my humble opinion, ought to be bound.

To be sure books have been bound for hundreds of years and many, no doubt, think that they have arrived at perfection. But they are a long way from it.

I had a brother-in-law, in Germany, who was in that business for more than 60 years. All his books were always bound so that wherever you opened the book, it would always stay, but the majority of the books bound in these days of commercialism are bound so that you almost have to put it in a vice to keep it open.

There is no comfort in reading such a book, because your attention is continually diverted from the subject matter and directed to the mechanical part of squeezing the leaves apart. This is not all, but I believe that a great many books are ruined in precisely that way. It is true I might bring this matter before the bookbinders' associations, but they would most likely only laugh at it and say they "know better," and "that is the way we have learned the trade" and "we always bound books in that way," etc.

Another thing ought to be abolished, namely the wire binding of pamphlets, etc. In a short time, particularly in damp weather the wires get rusty and the leaves not seldom literally rot off. When I get a book or pamphlet wire-bound, I immediately take out the wire and stick the leaves together with needle and thread. To be sure that is work and takes time, but it pays with the comfort you get out of it.

Of course, the SCIENTIFIC AMERICAN is not specially charged with helping the bookbinders; but as the SCIENTIFIC AMERICAN is "to reflect the most advanced thought in science and industry throughout the world," I thing it will be very appropriate to give the millions of readers a hint about making some little but very timely improvement.

DR. J. MÜLLER.

Chicago, Ill.

The Dye Industry as a Factor of National Security

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial on page 574, Industrial Number, June 3rd, 1916, "The Dye Industry as a Factor of National Security," is the very best combination of words to cover *Preparedness* that I have had the chance to read.

That small section in italics, "a dye factory may be changed within a week into a factory for the production of high explosives," ought to be in *black letters* about half an inch high.

If that piece isn't copied by newspapers broadcast, I'll think the searchers after the right matter are petering on their job.

There is another section which ought to come in good and hard—*big letters*—I mean—the safeguarding of the new dye concerns by our Congress.

Can't you say the same things again, before long? Maybe you will have to change it a bit so that it will look newer, but if it can be put before the eyes of the SCIENTIFIC AMERICAN'S readers again and again, it will accomplish a great deal of good.

It's a corker.

CHARLES FRENCH PERRY.

Bangor, Maine.

The Coudersport Freezing Cave

To the Editor of the SCIENTIFIC AMERICAN:

At Coudersport, Pennsylvania, there is what seems to be a natural rock cavern which apparently is the largest freezing cave yet discovered in the eastern United States. Occasionally notices about it appear in newspapers, and they usually speak of it, as do the natives, as an ice mine, and repeat in various ways the statements and theories which the peasants of France, Germany, Switzerland, Austria and Italy have advanced about freezing caves for some two hundred years. An article in the SCIENTIFIC AMERICAN of May 6, entitled "An Ice Mine That Freezes in Summer and Melts in Winter," says of the Coudersport freezing cave that geologists are not able to explain "why the ice should form, in seeming opposition to the laws of nature, in summer and melt in winter, as it does in this instance."

Subterranean ice, however, is not an uncommon phenomenon. Several hundred instances of it are known, and the causes of its formation have been studied with the utmost care by numerous scientists. Very briefly, the gist of their many observations is as follows: Subterranean ice is formed only in localities where ice forms in the open in the winter time. Two factors are necessary for the formation of ice: cold and water. For ice underground the cold of winter furnishes the first; the thaws of spring furnish the second. In all known cases the body and main side passages of the rock hollow are below its mouth, and into these the heavy cold air of winter sinks by gravity. When, then, the spring thaws occur, the water runs into the cave and freezes. More slowly the light hot air of summer in turn permeates the cave, and as it does it melts the ice.

A series of weekly, or even monthly, observations made for a year at Coudersport by a competent observer—and surely there is some school teacher or physician at Coudersport who is competent—would show doubtless that the ice formation there obeys the same natural laws which subterranean ice formations in other parts of the world obey. Such a series of observations was made, for instance, about the freezing cave at Decorah, Iowa, by Mr. A. F. Kovarik, and his results were published in the SCIENTIFIC AMERICAN SUPPLEMENT, November 26, 1898. Until this is done at Coudersport, all sorts of erroneous notions will be peddled about by visitors as well as by natives, and a well understood natural phenomenon will continue to be spoken of, with bated breath, as a mysterious, unique marvel.

EDWIN SWIFT BALCH.

Philadelphia, Pa.

New Ways of Using Wood Waste

To the Editor of the SCIENTIFIC AMERICAN:

The statement by J. Gordon Dorrance in the article on *Wood Waste* at page 427 in the SCIENTIFIC AMERICAN of April 22nd, 1916, is an instance of careless writing. The "New England paper manufacturer" does not develop a lard substitute from "pulp wood waste." This would be impossible. What he does is to utilize the hydrogen evolved in electrolytic bleach work for the hydrogenation of oils. It is a side industry. The same paper manufacturer utilizes an excess production of chlorine for making chloroform, the daily production of which is 2,000 pounds—but this is not a "by-product from this pulp wood waste" any more than the lard substitute is.

T. J. KEENAN.

New York City.

How Celluloid May be Manipulated

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 26th appears the article "Celluloid Covers for the Laboratory." I have used celluloid sheet for a variety of purposes where lightness, compactness and transparency were desirable features. Sharp bends may be produced with relative ease by applying a hot iron or other device to the line of the angle. Joints I have and frequently make now with acetone. The two overlapping pieces are held together, acetone is applied from a dropper so as to flow between the surfaces, and these are then pressed firmly together. Adhesion results very quickly so that usually no mechanical holding device is necessary. Irregular bends, especially at junction points, can likewise be made by allowing sufficient acetone to be absorbed by the one part so that it becomes plastic and can be molded into contact with the other part by pressure of the fingers. In this way a dustproof cover can be produced having also more rigidity when completely dry than the one described in your article.

Collodion sheets obtained by cleaning spoiled negative films is very useful and handy for many purposes, and can easily be manipulated and joined by aid of acetone.

HERMAN S. RIEDEBER.

Baltimore, Md.

Engineering Maxima in the United States

[*Some foreigners seem to hold the opinion that the greatness of this country lies in the extremes to which we go. This may or may not be a compliment to us, though the foreigner seems to think it is. An American engineer received a request recently from a friend abroad to send him data concerning a number of the extremes which have been reached in this country in engineering structures, and in return for some assistance rendered by the Editor of the* SCIENTIFIC AMERICAN *in making this compilation, the compiler has sent us the data for publication. As such maxima are of some interest we suggest that if any readers know of any of them having been exceeded, we will be pleased to publish such revisions from time to time. The data refer to this country only, though including our neighbor Canada.*—EDITOR.]

Railroad Bridges. The longest span is the cantilever bridge over the St. Lawrence River, near Quebec. The spans are 515—1,800—515 feet. It contains 63,000 tons of steel. The next largest single span, but the longest if the bridge approaches are included, is the one over Hell Gate, New York City; the total length with approaches (some of which are stone arches) is 18,130 feet and it contains 87,000 tons of steel. The longest single span is 1,000 feet. The longest single structure steel bridge is probably the one at Kansas City, which is 1¾ miles long.

Steam Locomotive. The largest and most powerful steam freight locomotive ever constructed is the articulated Erie Triplex built by the Baldwin Locomotive Works. It has 12 pairs of driving wheels, four of which are under the tender, besides two-wheel leading and trailing trucks. The total wheel base is 90 feet, and it weighs with the engine and tender in working order, 853,050 pounds or about 426.5 short tons. It has a tractive force of 160,000 pounds when working compound. The tender has a water capacity of 10,000 gallons and a coal capacity of 16 tons.

Electric Locomotive. The largest electric passenger locomotives are those operated on the Chicago, Milwaukee & St. Paul Railway, developing 3,440 horsepower each, or 3,000 continuously, measuring 112 feet 8 inches overall, and having a tractive force of 800 tons, over all grades up to 2 per cent. On a level track they will also haul the same tonnage at a speed of 60 miles per hour. The largest electric freight locomotives of the same railroad have a capacity to haul 3,000 tons up a 1 per cent grade at 15.5 miles per hour, or the same load on a level track at about 30 miles per hour. The largest freight locomotives on the Norfolk & Western line are the single-phase-three-phase, consisting of two sections, weighing together 540,000 pounds and having a motor capacity of 2,400 horse-power and a tractive force of about 135,000 pounds at 14 miles per hour.

Trains. The longest freight trains in regular use are believed to be those on the Erie Railroad, consisting of 80 to 90 cars weighing about 70 tons each; the total length is about 3,400 feet, or about two thirds of a mile. A test train of 251 loaded cars of a total weight of 17,912 short tons back of the tender, and a length of 8,547 feet or about 1.6 miles, was pulled by this locomotive, but this is not regular practice.

The longest passenger train run occasionally in commercial service on the Pennsylvania Railroad has 16 cars of 60 tons each, and a locomotive weighing 200 tons. The longest one run regularly has 12 cars. The longest freight train on that road has 135 cars of 70 tons each when loaded and a locomotive of 220 tons.

Central Stations. Among the largest are: that of the Commonwealth-Edison Co., Chicago; approximately 310,000 kv-a., generated by steam. The two New York Edison stations approximating 280,000 kv-a., also steam-driven. The Mississippi River Power Co. has at present 135,000 kv-a. installed, with an ultimate capacity of 270,000 kv-a., generated by water-power. The Philadelphia Electric Co. has approximately 162,000 kv-a. installed, all generated by steam. The Niagara Falls Power Co. operates 67,000 kilowatts in three different plants. These central stations are not always entirely under the same roof, but when under separate roofs they are interconnected electrically, forming one system. Of these, the largest one furnishing city service is the Commonwealth Edison Co. with the New York stations next and the Philadelphia stations probably third.

Electric Transmission. The longest distance is 275 miles at 150,000 volts (nominal) on the system of the Pacific Light & Power Co. in California.

Voltage. The highest voltage used in transmission is 150,000 volts nominal (actually 148,000) on the Y-connected transformers of the Pacific Light & Power Co. in California.

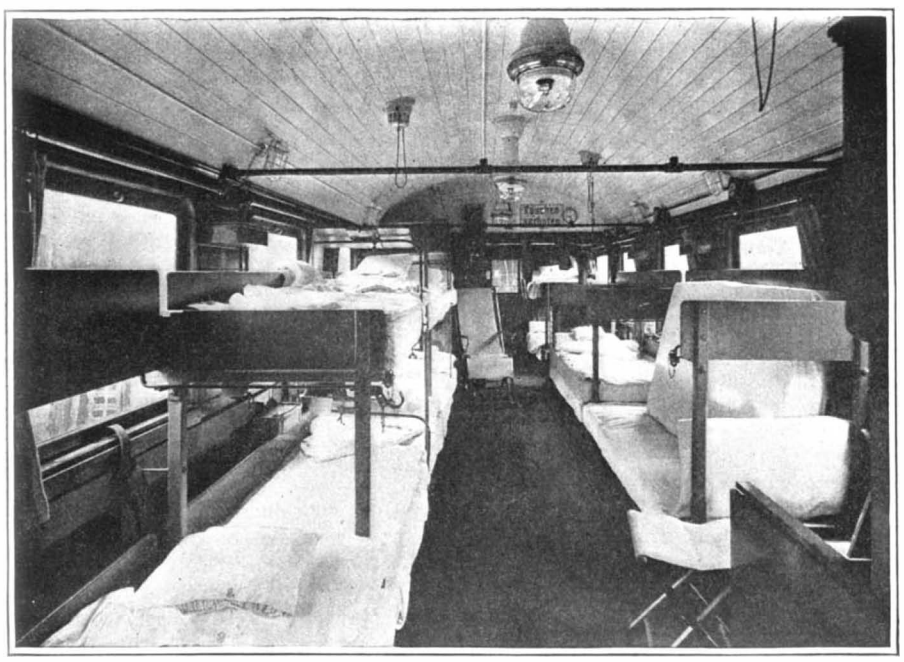
Generator. The largest single electric generator is 47,000 kv-a. which is to be installed in the near future at the Duquesne Light Company's plant in Pittsburgh. The largest now installed is the 35,000 kv-a. unit at the Philadelphia Electric Company's plant.

Arc Lamps. The largest in regular use for lighting is a flaming arc of 12.5 amperes, 110 volts, and for flood lighting as high as 100 amperes at 110 volts. For photographic purposes as high as 30 amperes at 110 volts. For etching glass 95 to 150 amperes at 110 volts. For searchlights 200 amperes.

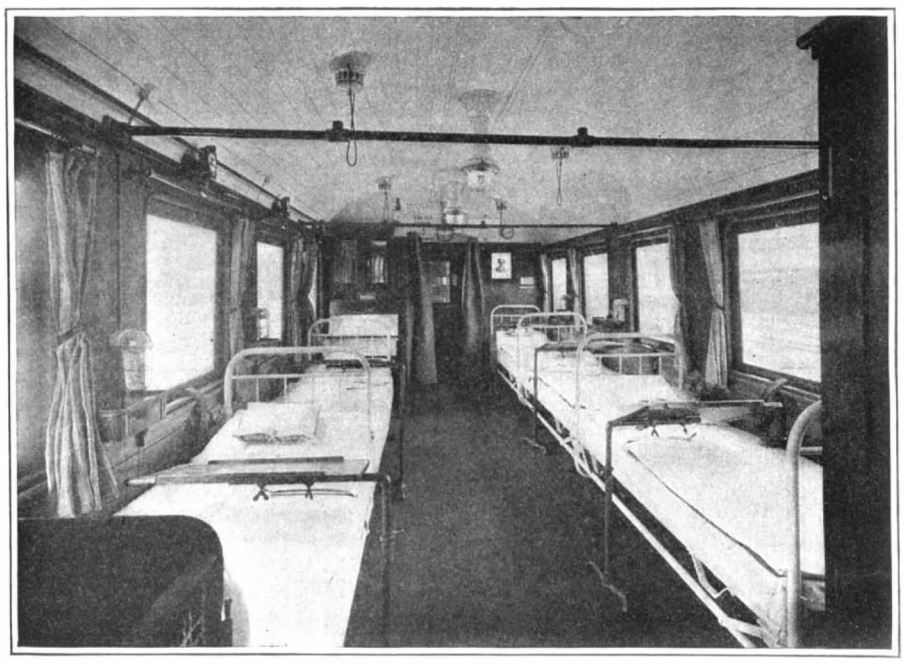
Incandescent Lamps. The largest made commercially is a 2,500 watt lamp. Larger ones of possibly 4,000 to 5,000 watts have been made but not commercially.

Telephony. The longest distance to which telephony over wires has been carried out is from New York to San Francisco by way of Boston, Buffalo, Chicago, Denver, Salt Lake City and Portland (Oregon), a total length of circuit of over 4,700 miles. About ten telephone relay or repeater stations were used.

Buildings. The highest office building in the world is the Woolworth Building in New York City, which is 750 feet high to the observation platform, the lantern being 42 feet higher. The largest in area is the Equitable Building in New York City, having a total floor space of 1,200,000 square feet, nearly one twentieth of a square mile, or nearly 27 acres.



Soldiers' hospital car, showing the arrangement of the combination stretcher-beds



Officers' hospital car, provided with white enameled iron beds and adjustable tables

A Model Hospital Train

Describing the Completeness of the Bavarian State Hospital Train

By Alfred Gradenwitz

SOME time ago the German Museum of Munich decided to place at the disposal of the King of Bavaria a considerable sum destined for the benefit of the wounded. The king ordered this contribution to be used for the equipment of a State Hospital Train, which was eventually attached to the Sixth German Army and placed under the orders of Crown Prince Rupert of Bavaria.

The task of the Museum consisted in availing itself of all the resources of science and engineering with a view to insuring as hygienical and comfortable transport conditions as possible. The Museum was eminently fitted to fulfill this task in so far as it had a number of the foremost experts at its disposal and because of its unparalleled connections with German industry, which greatly facilitated the obtaining of model arrangements in every respect.

The State Hospital Train is designed for transporting about 200 patients, and for accommodating in addition the personnel, which comprises 3 doctors, 3 managing officials, 2 clergymen, 3 female and 22 male nurses, 3 stokers and engineers, 2 male cooks, 4 soldiers and 3 railroad officials, a total of 45 persons.

Twenty-nine cars are provided for transporting and feeding the wounded and sick, as well as the personnel, viz., 14 soldiers' hospital cars, each comprising 14 berths; one officers' hospital car, comprising 7 berths; 1 operation and X-ray car; one disinfection car; one lighting car; 2 cars for doctors, female nurses and clergymen; 2 cars each for 10 male nurses; 1 manager's car; one kitchen car; one kitchen provision car; one linen storage car, and 3 baggage and materials cars.

Considering first the soldiers' hospital cars, these are found to be extra spacious, three-axle railroad cars, each comprising 14 berths, arranged on the two sides. These berths in reality are stretchers designed to be placed by pairs, one above the other in spring-supported frames. The upper stretcher, whenever desired, may be pulled upwards by day or hinged backwards, the lower stretcher then constituting a comfortable couch with its five-sectioned mattresses and bolsters. For the additional comfort of those seriously wounded, the upper stretcher may be removed and the mattresses of the upper berth used for the lower berth, so as to place the patient on double bedding and at a convenient height for the doctor.

Each berth of the soldiers' hospital car includes a little table, which is designed to be used both as a dining table and reading desk. Above each berth there is provided a string for the patient to raise himself by, while on one side there is a little case in which he may store his valuables and the like. Each hospital car for soldiers contains a washstand chest provided with drawers and a hinged lid, which may be used as a desk when so desired. Wearing apparel of patients is kept in a spacious cupboard. A lavatory and washstand complete the equipment.

In the officers' hospital car there are installed 7 separate beds made of white enameled iron pipe, which are spring-supported so as to damp any shocks and jerks incidental to railroad travel. The mattresses of the beds are designed to be used as stretchers. The beds are arranged at sufficient height for the doctors to examine and treat patients conveniently, and they can also be converted into couches for the use of the slightly wounded. The remaining equipment of the officers' car is the same as that of the soldiers' car.

In regard to the operation and X-ray car, it is of interest to note that there exists considerable divergence of opinions as to the desirability of surgical operations in a hospital train. Inasmuch as operations have been repeatedly made in cases of immediate danger to life, mainly during stoppages, it was decided in this instance to provide an operating car and to equip it as suitably as possibly with a view to rapid surgical work. The car is divided off into five separate compartments. In the middle one there is the spacious operating room proper, containing a modern five-sectioned operating table that can be readily adjusted by means of hand-wheels and screws. On the walls of the operating room, on either side of the operating table, are installed an instrument table, a narcosis table, a double irrigator stand, and a dressing pail arrangement on rotatable and adjustable arms so as to be placed within convenient reach of the operating surgeon. There are also provided two large washing basins with hot and cold water supply, and a double stand for hand disinfection. The instrument case contains a most complete set of instruments for any surgical operation likely to be undertaken, and four portable chests for medicaments, dressing, and other requisites to be carried by attendants during the doctors' visits through the hospital cars. A powerful electric lamp and mirror reflector are arranged above the operating table.

Adjoining the operating compartment is the sterilizing compartment, comprising a large sterilizer for dressing, another sterilizer for instruments, a salt sterilizer and a washing basin for instruments, with cold and hot water supply. The steam required for sterilizing is produced by a special boiler at a pressure of 1.5 atmospheres. A point was made of insuring the greatest possible cleanliness and sterility; accordingly, all metal parts likely to come in contact with the doctor and patients are made of polished

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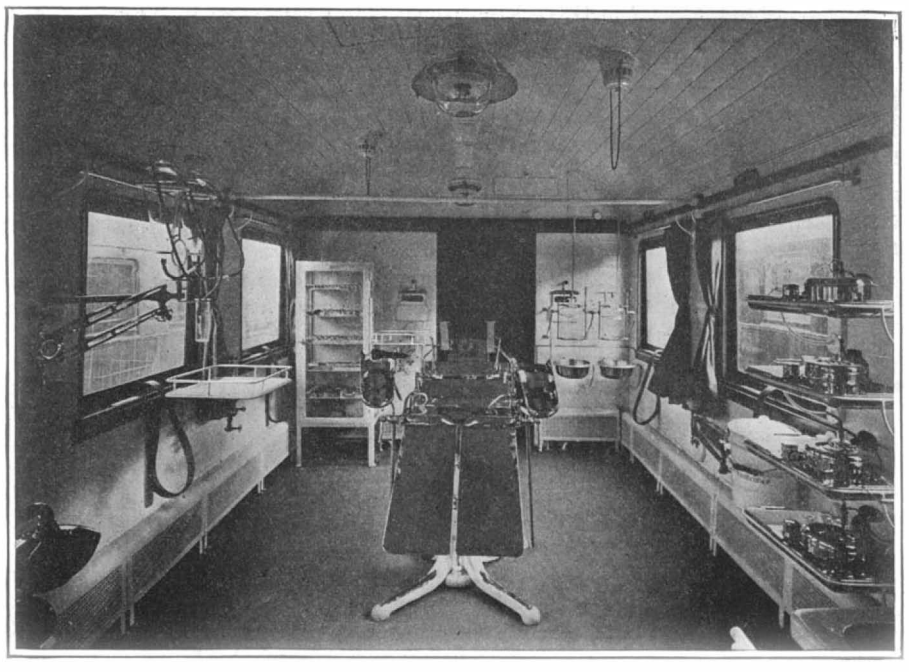
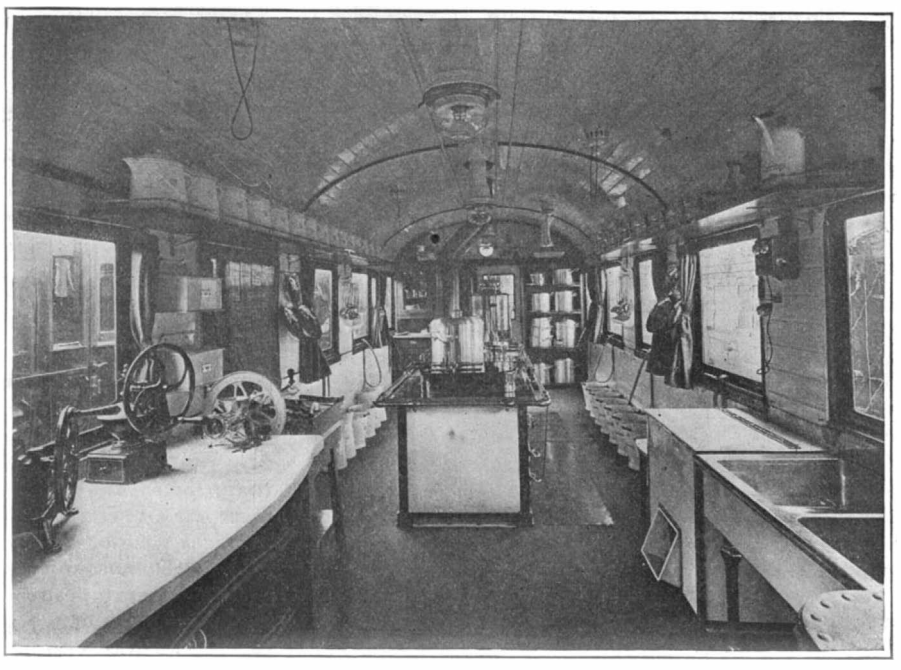


Operating room of the German hospital train, showing the elaborate equipment



Kitchen car, with the range in the center. The kitchen can cook for over 300 people

Newspapers That Are Printed Within Gun Range of the Enemy

By Jacques Boyer

IN the trenches in Belgium and France, which wind as a serpent from the North Sea to the Vosges mountains, the serious business of warfare has not succeeded in smothering the old-time French gaiety in the soldiers of France. Substantial evidence of this is found in the many humorous newspapers that are being published in the trenches, within sound and range of enemy fire.

It is believed that *L'Echo de l'Argonne*, which commenced publication on October 26th, 1914, was the first of the French trench newspapers. Its first and second numbers were typewritten on thin paper; but beginning with the third number this interesting journal was, and has since been, printed from type. Aside from the latest news of the war, the newspaper contains much humor and even poetry.

Although other sections of the intrenched line have not been so fortunate as to have access to printing presses, the ingenuity of the French soldiers soon found a means of duplicating handwritten newspapers in quantity. A story is told of how Sergeant Bonneton, wishing to amuse his comrades of the 154th Territorial Regiment, resolved to publish a trench newspaper which would contain news, anecdotes, and even sketches representing the efforts of local talent. The captain of the company approved of the idea, and even went to the extent of furnishing the necessary paper and the copying ink. But the copying paste was still lacking, so the would-be publishers set about to find the all-important requisite. Ruined villages in back of the lines were searched, and after diligent pursuit of their task the searchers were rewarded by a find of gum, as well as several cake tins for holding it. But no sooner did they attempt to use the gum for copying purposes, they learned to their great dismay that it was of the variety suitable for confectioners and worthless for their purpose! Finally, they sent a corporal to a certain town several miles in back of them, who succeeded in bringing back the much desired gum.

The preparation of the gum into a successful reproducing device was soon accomplished, thanks not only to the ingenuity of the men, but also to a liberal collection of odds and ends gathered in the trenches. Yet just as the impressions were being made and the men were about to realize their ambitions, a German 77 mm. shell fell in the midst of the improvised print shop, putting the quietus on the publishing activities. Undaunted, however, the men recommenced their work; and in a short time the first number of the *Fanion* made its appearance in the form of over 100 copies.

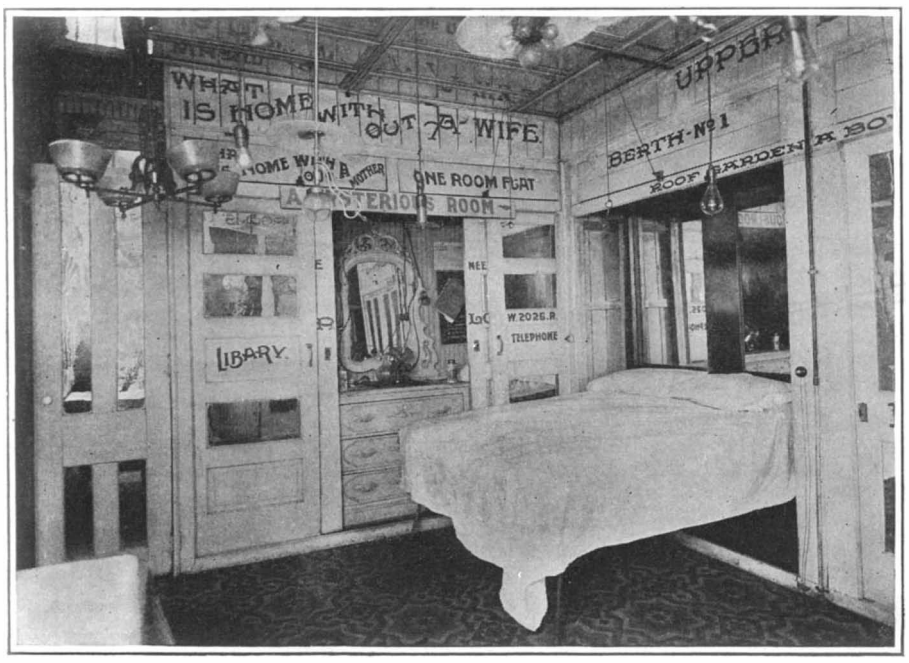
Aside from German shells and other forms of interference, the French journalists at the front have other problems to face which are no less disastrous to their equipment. It is not unusual for them to return from an engagement only to find that the trench rats have devoured their copying paste and paper. But even this obstacle has not prevented the multiplication of these original periodicals. So much interest has the French government taken in the trench newspapers that it has authorized M. Charles de La Roncière to collect copies of all of them, which are to be preserved in the National Library of Paris. The list of the publications alone is said to occupy over a page.

Following the *L'Echo de l'Argonne*, there have been numerous trench papers started by the fighting men. Among them *Le Petit Echo du 18e Régiment d'Infan-*

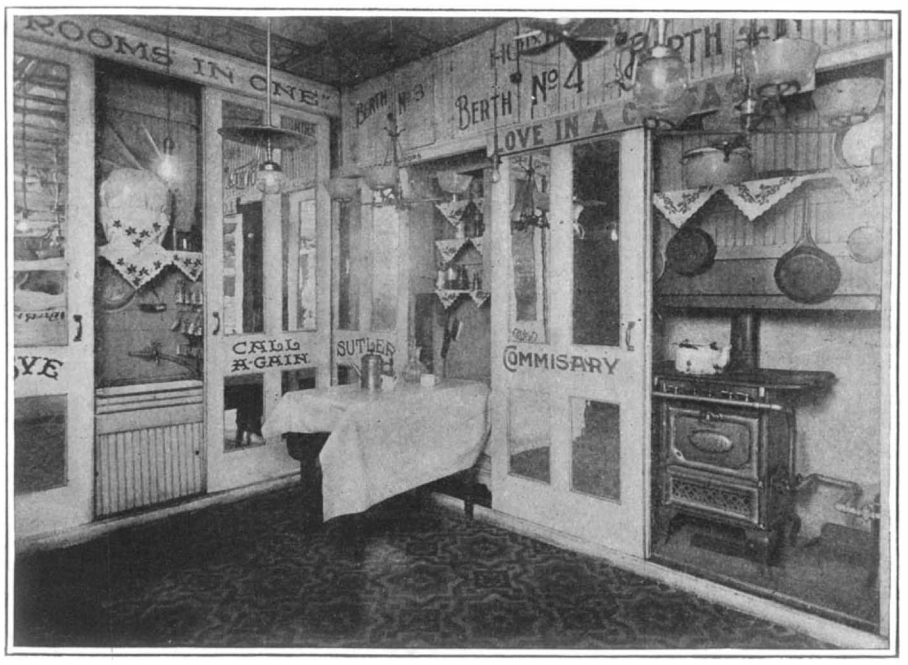
(*Concluded on page* 672)

FRENCH JOURNALISM IN THE TRENCHES

Above: Three representative trench newspapers published by French soldiers. Two are printed and the third is mimeographed. Below: At left, Alphonse Roux, editor of "Marmita," at the entrance to his bomb-proof. Center, editorial office of the "Marmita." Right, typical scene when the "Face a L'Est" "goes to press."



Library and bedroom corner of the four-in-one flat



Kitchen, dining room and pantry exposed to view

A Compact Apartment for the Man Who Does His Own Housework

IT would appear that E. J. Beall, of Cincinnati, Ohio, has solved the problem of running a womanless household. His success is due to the compactness of his living quarters, which makes for a high order of efficiency with the minimum of labor; in fact, the apartment consists of but one room which, by the sliding of various doors which comprise the walls, can be converted into a dining room, a sitting room, a kitchen or a bedroom.

The four-in-one flat, for such it truly is, measures 18 by 20 feet. When the owner desires to prepare a meal he has only to slide a few partitions aside, revealing a gas range, a kitchen table, chairs, sink with running water and every other convenience that goes to make an ideal kitchen. When the meal is ready to be served, a few partitions on the opposite side of the room are moved, bringing into use a dining table and the necessary tableware and chairs. The meal once disposed of, the doors or partitions are closed so as to remove all traces of the dining room and kitchen. Other partitions are then shifted, bringing to view a few easy chairs, a library, table, electric lamps and electric fans, all of which go to make a comfortable sitting room. Late in the evening, when the owner wishes to retire, he goes to the remaining or fourth side of the room and behind other sliding partitions finds his big, double bed folded up against the wall. He lowers the bed and moves aside a nearby partition, revealing a dresser. Still, no house is complete without a bath. But the designer of the four-in-one flat has not overlooked this fact, two other partitions concealing this very necessary adjunct.

Studying the Eyes of Wild Animals

TAXIDERMY has made wonderful strides of late. The grotesque "stuffed" horrors seen on exhibition a few years ago, when the defunct animal was actually stuffed, have gone. The skilled taxidermist of to-day mounts his animals on a frame that is built to follow the lines accurately, so that when finished the skin is stretched taut as in life.

But not content with the great strides made in the art Mr. Wilson Potter, a well-known hunter of big game who has set up his own taxidermal workshop in Philadelphia, has been following a new line of improvement that has brought the mounted specimen to a startlingly life-like appearance. Few taxidermists have given any thought to the appearance of the eyes of mounted specimens. The eyes have usually been selected at random from optical "various." But a study of the eyes of wild animals will show that one is quite different from another in color and expression. To put a camel's eyes in the mounted head of a lion is not true taxidermy, for the eyes of both are quite different.

Swiss watch which contains three separate movements to operate its manifold hands and dials

Working along these lines, Mr. Potter has commissioned an artist to visit the various Zoological Gardens and study the eyes of wild animals at close range. The result has been the preparation of a set of models of wild animals' eyes that are true to life and show the actual character of the stare of the animals. The work is still in progress, but most of the well-known animals of the forest and mountain have been studied and their eyes, true to color and conformation, added to the collection of models from which the artist can copy for use in the workshop. A comparison of the head of a wild animal that has been fitted with the eyes selected at random from the stock of a taxidermist with one provided with eyes that are true to life, shows the importance of this advance in the art of taxidermy. The idea also opens a new field for the artist who likes this branch of his art.

A Watch Which Performs a Score of Functions

WHAT is unquestionably a great masterpiece of both mechanical construction and artistic workmanship is presented in the form of a watch recently finished by a well-known Swiss watchmaker for James W. Packard, an American mechanical engineer whose name is a familiar one to Americans.

The watch is necessarily larger than the conventional pocket time piece, as may well be judged from the accompanying illustration which represents it in its actual size. In fact, it is intended to be kept in a highly finished wooden box which is fastened to a wall. From the box extends a silken cord which can be pulled when the owner wishes to know the time by the striking of the hours, quarter hours and minutes.

Strictly speaking, the watch is more of the nature of a clock and is provided with a clock movement. Its mechanism automatically strikes the hours and the quarter hours, while the repeater mechanism, which is released by a spring, strikes the hours and quarter hours and exact minutes that are indicated on the dial by the hands. Aside from the usual hour, minute and second hands, the watch contains a movement suitable for timing an event or an operation to the fraction of a second, in the form of a split-second hand and a fifth-second hand. Two additional dials are also included to indicate respectively the number of minutes and the number of hours which have elapsed during the actual use of the split-second mechanism. Another interesting

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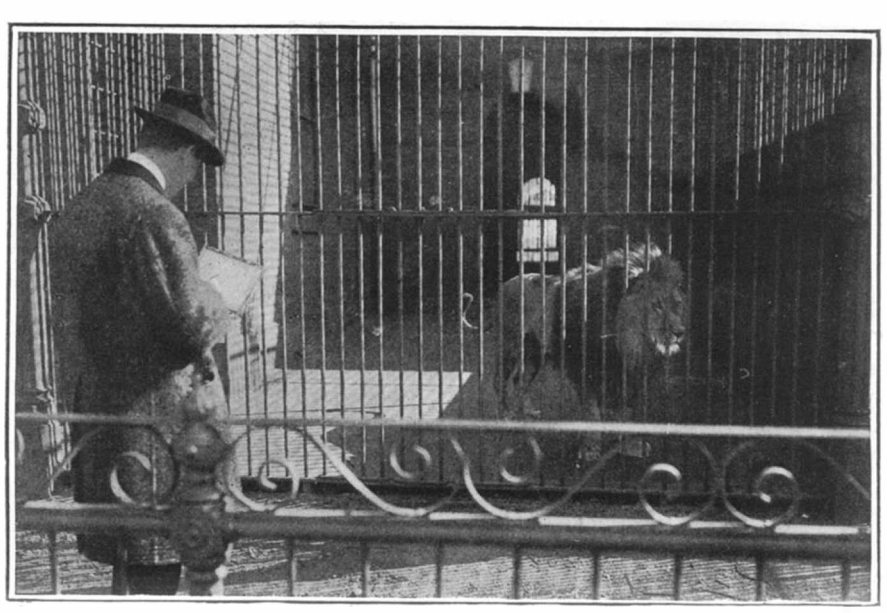
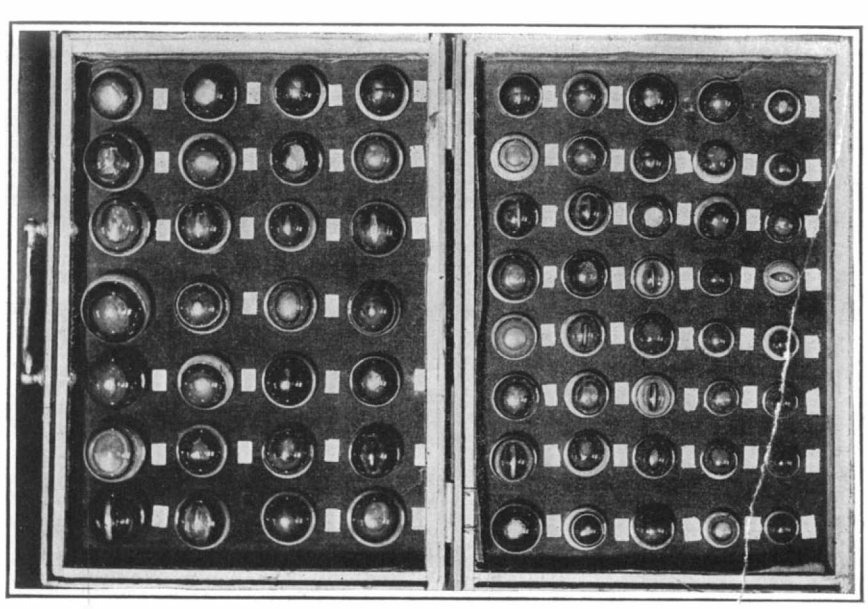
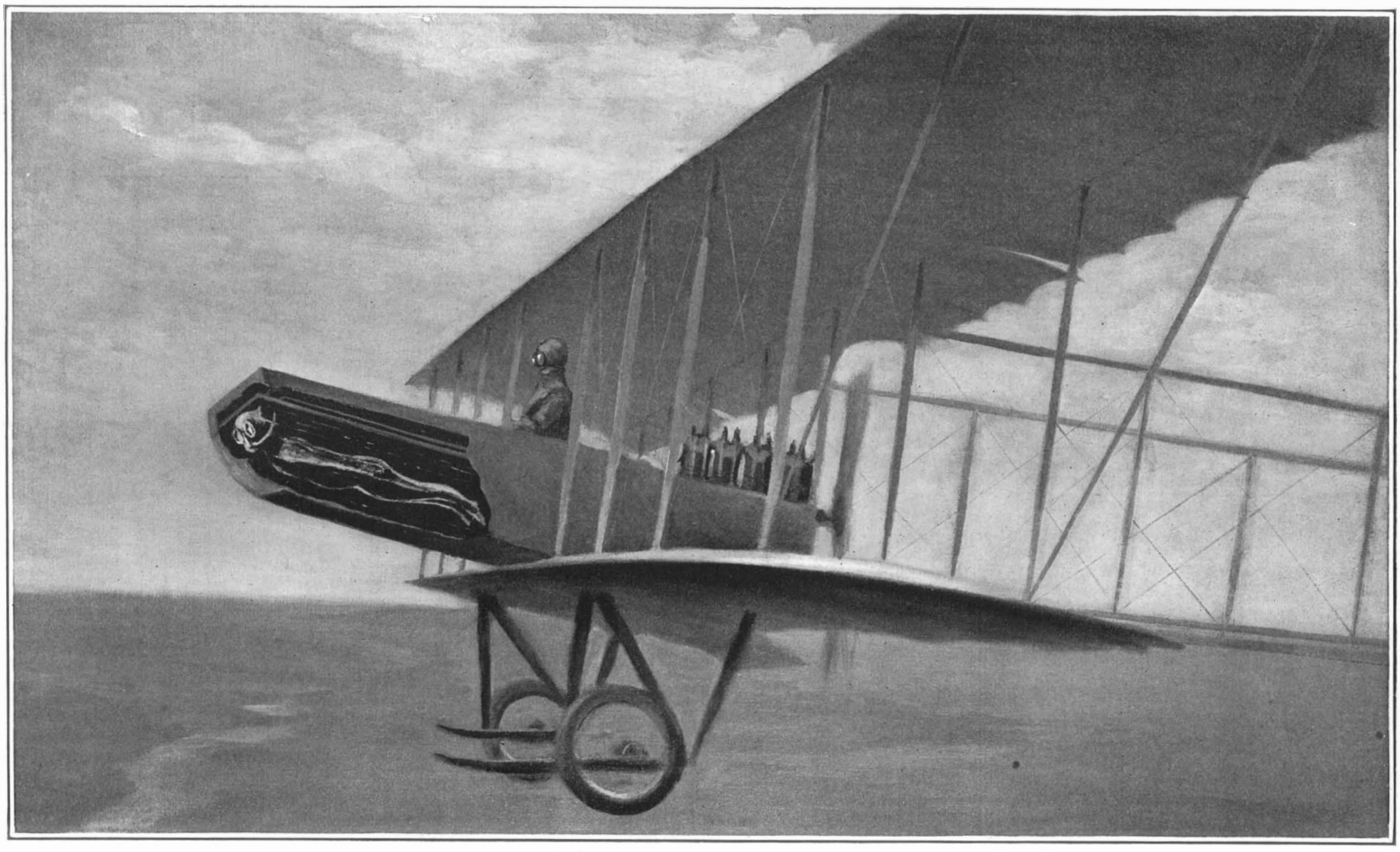


Artist engaged in painting the color and expression of a lion's eye from life



Specimen case of animal eyes, every one of which has been painted from life



Design for attaining the flying sensation by floating in fluid in a closed chamber

The Flying Sensation

Could It Be Realized?

By C. Dienstbach

MUCH has been written about the "Wonders of Modern Science," yet recent developments may well impart a truer meaning to this hackneyed phrase. With the artistic touches constantly being added by science to familiar achievements one may well ask whether the fairy tales hold promise of any magical powers that have failed of realization by man. Wireless telegraphy was abstractly wonderful; but speaking through space to the antipodes is concrete sorcery. Motion photography fell short of the true illusion of life; but "kinemacolor" may well be turned into the true magical mirror into which Faust gazed in the witch's kitchen.

Artistic staging—projecting from behind upon a transparent screen, with suggestive frame and surroundings — would work wonders, but the perfection of stereoscopic features and phonographic accompaniment might well furnish realistic effects to make the spectator shiver. Already sufficient steadiness has been achieved to make possible the perfect superposition of twin pictures through properly focussed telestereoscopes; and what promise of startling effects in distance-variation are held forth by the phonograph! In scanning all the treasures of dreamland presently to come true, but one thing appears missing, the most cherished of all — the privilege of superhuman beings, the sensation of flying. True, we have flight; but not yet the "flying sensation." Next the ground, an aeroplane passenger cannot say whether he is rolling or flying. In a Zeppelin, one feels as on a river steamer. The novelty is all in the view, yet even this is to be in large measure obtained from a railway trestle. That we are carried by the air does not alter the sensation of actually sitting as in a chair, and sensing the workings of gravity.

How different from flying as it feels in our dreams—that supreme pleasure of floating in a space freed from gravity, of effortless soaring at will whither we please. This is indeed the flight of fairies. Scant reason have we to envy even the birds for any supposedly similar sensation; they can hardly escape feeling the pull of gravity at their wing bases and in their bodies, suspended as between parallel bars. Still, it would seem interesting to probe whether, like the other wonders of the fairy world, the rare sensation of dreamflight might not be reproduced; and all the more so since this happens to lead us to a striking inspiration of a great poet.

There is one infallible way of producing a floating sensation—immersing the body in a fluid of equal specific weight. But this sensation of floating is inherently opposed to one of flying, because the very density of the medium hinders motion. Otherwise swimming might be more than exhilarating. How could we artificially circumvent this natural contradiction? Simply by moving not painfully *through* the fluid, but at will *with* the fluid. This principle chances to coincide with Goethe's strangest inspiration, the "Homunculus" in Faust, that chemically created human being endowed with magic powers, chiefly that of flying but always within its confining glass vessel. The sensation of flying is necessarily realized if the body is floating in a vessel carried by an aircraft, if the supporting fluid and part of the vessel are perfectly transparent and if the flight's direction is in a simple way under instant control. This involves a number of subsidiary

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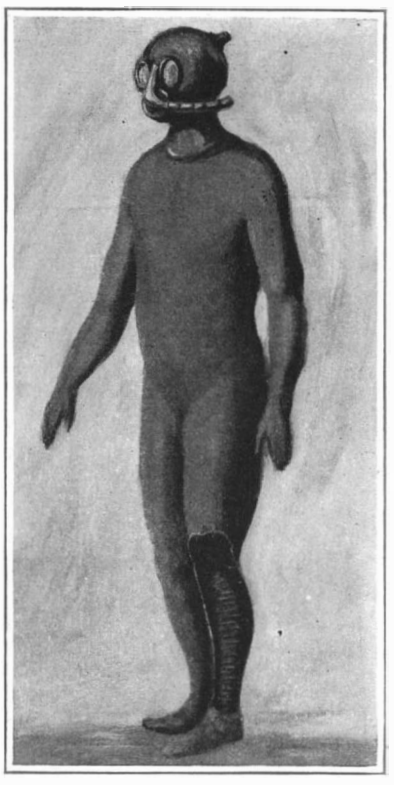
The sensation of flying, as we dream it and as Goethe pictured it



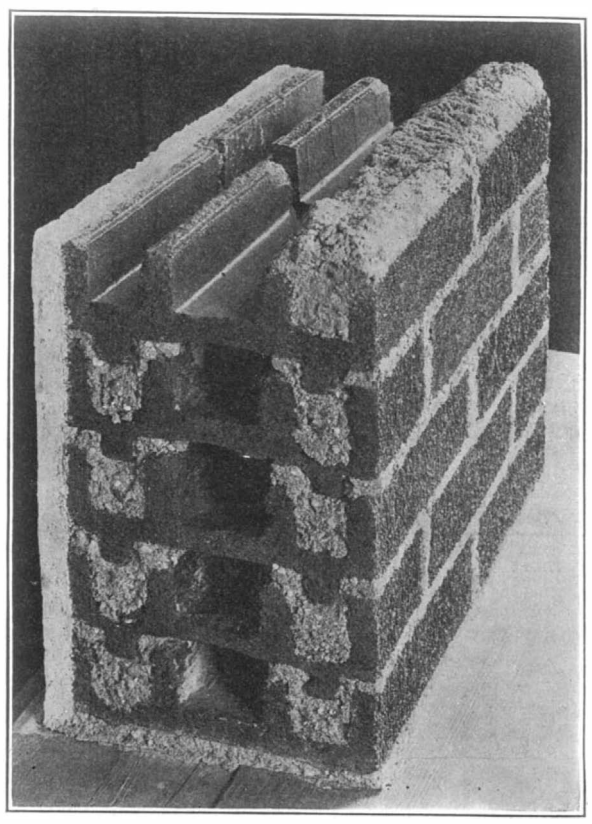
Suit designed for wear in the flying chamber

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Interlocking Channel Brick for Walls of Attractive Design

ALTHOUGH the numerous advantages of brick over other forms of construction in the building of country residences have long been recognized and fully appreciated by both the architects and home builders, they have continued to use wood profusely for no better reason than the fact that brick walls are usually unattractive and decidedly monotonous. It is difficult indeed to beautify the exterior of a brick home. Even



Section of a wall built of interlocking channel bricks, showing two-inch air space

stucco and concrete have been employed in place of brick, but since the former is not always satisfactory and the latter possesses the quality of being essentially unhomelike, it is evident that these substitutes rarely attain the ends for which they are intended.

With a view to overcoming the unattractiveness of brick walls and at the same time take advantage of the heat and cold insulation of hollow walls, there has recently been designed an interlocking channel brick of novel design. As will be noticed by referring to the accompanying illustration, the new brick provides a double, hollow wall with an attractive brick face. It consists of two solid masonry walls each 3 inches thick, which are calculated to withstand fire and water. The double walls, it will further be noticed, are separated by a 2-inch air space, yet are bound inseparably together by webs made integral with the brick itself.

It is claimed by the designers of the new brick that it possesses nearly double the strength of a solid wall made of common brick and is over 25 per cent stronger

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A Liquid Measuring Device

SIMPLICITY and accuracy have been the cardinal aims of W. C. Lindsay of Newport, Va., in designing a measuring device for tanks on which he has been granted a patent. While the measuring device can be used for liquids of all kinds, the inventor has found it particularly applicable to gasoline supply for automobiles, and in this connection he states that upward of 20,000 gallons of fuel were passed through such a meter last season with perfect results. And the very simplicity of the meter, which is illustrated in the accompanying picture, has caused it to be popular with the public.

In the cross-sectional view of the device it will be noted that a large, disk-like float is used in a metal cylinder. In one type of apparatus two upright rods are attached to the float. These pass upward through the top to a cross-piece. The latter is connected to a rod which passes downward through a tube placed in the center of the tank, and terminating at its lower end in a single or double pointer. In back of the pointer is placed the scale, graduated in gallons or any other suitable unit of measurement. A modification of the design just mentioned consists of a similar float to which is fastened a small chain that passes upward and around a pulley on top of the lid of the cylinder,

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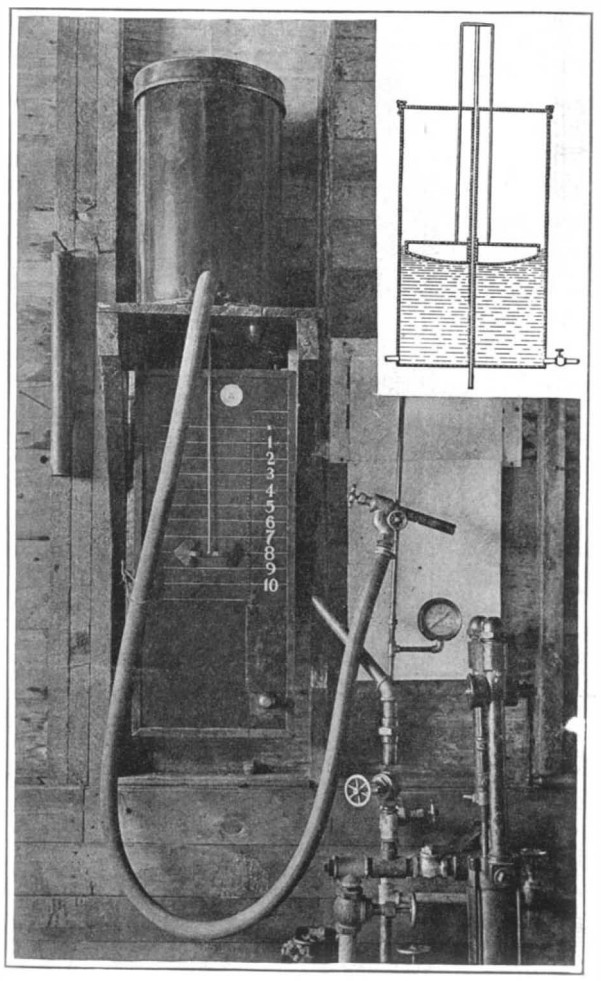
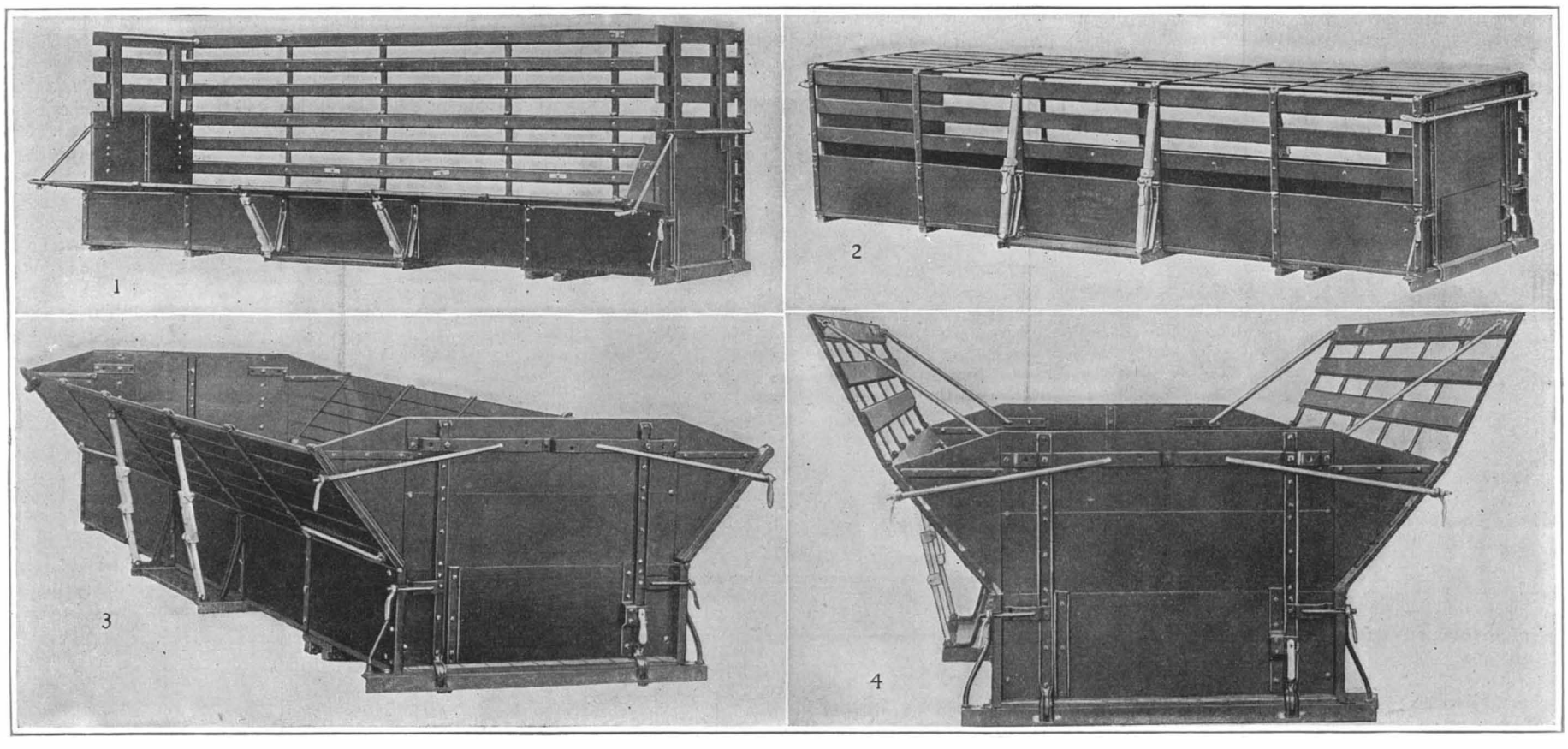


Measuring device for filtered gasoline and a cross-section of the operating members

Eight Wagon Bodies in One

DESIGNED particularly for use on farm wagons and motors which have to carry a great variety of goods throughout the year, the wagon body shown in the accompanying illustrations can be converted into eight different and distinct forms in a few minutes, without the addition of a single bolt or piece of wood. By the use of this body, the farmer is able to carry economically anything from hay, grain or produce to live stock. As shown in the pictures, the body is characterized by collapsible sides formed of slats, which may be folded close together to form a grain-tight box (as in Fig. 3) or extended to permit the carriage of larger quantities of light bulky goods.

With the slats closed, the sides may be put in the position shown in Fig. 3, or may be turned straight up giving a rectangular box. With the slats open, we get a body as in Fig. 4, with great carrying capacity. In either event one or both sides may be turned down, as in Fig. 1, for convenience in loading or unloading, and for display and sale of goods. Various other dispositions of the sides are possible; but perhaps the most striking is that shown in Fig. 2, affording a closed cage for the transportation of live animals.



Wagon body adaptable to various purposes

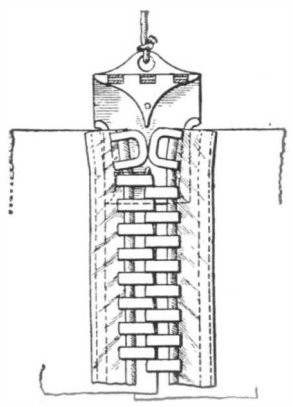
1. Showing side of body lowered for loading, marketing, etc. 2. Body folded together into cage for transportation of live stock. 3, 4. Two positions of body for ordinary loads.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

OPENING AND CLOSING DEVICE.—F. KRICH, 1015 Trinity Ave., Bronx, New York, N. Y. This invention provides a device for use on shoes, corsets, dresses and other articles of wear, and is arranged to enable the wearer to securely and conveniently open and close the article. Use is made of interlocking members arranged on the parts of the article to be fastened together, and a manually controlled slide adapted to engage the said interlocking members on moving the slide in one direction to unlock and open the said members, the slide on being moved in the opposite direction closing the said members.



OPENING AND CLOSING DEVICE FOR APPAREL.

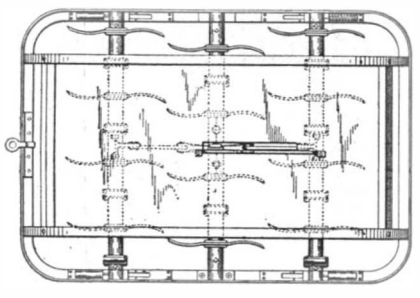
Electrical Devices

PORTABLE ELECTRICAL MEASURING INSTRUMENT.—M. B. KASSEL and A. FINKENBERG. Address the latter 619 E. 181st St., New York, N. Y. A specific object of the invention is the provision of a novel ammeter coil which, when traversed by current creates a magnetic field, the strength of which is indicated by a scale-carrying armature, whereby the strength of the current can be ascertained by a direct reading from the scale.

BACKING-UP DISTRIBUTOR. — E. KEEFE, care of *Collier's Weekly*, 416 W. 13th St., New York, N. Y. This invention provides means for uniformly distributing the molten metal forming the back of an electrotype; provides means for straining the molten metal as it is poured over the copper shell to form a support therefor; and provides such a device which is independent of the electrotype and the tray whereon it is placed for backing-up, thereby enabling an operator to place the same at any position on the tray.

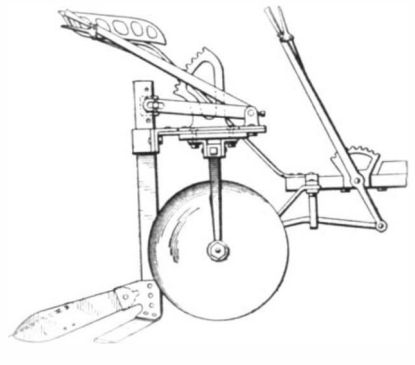
Of Interest to Farmers

HARROW.—E. W. BJORKMAN, Weldon, Sask, Canada. This invention enables the operator to control the general relative positions of certain revoluble shafts, provided with teeth, from a point approximating the middle portion of the harrow. It positions the revoluble shafts relatively to other parts as to balance the shafts as far as practicable, so that in shifting the relative positions of the movable shafts the tendency is to move both ends of the shaft equally.



HARROW.

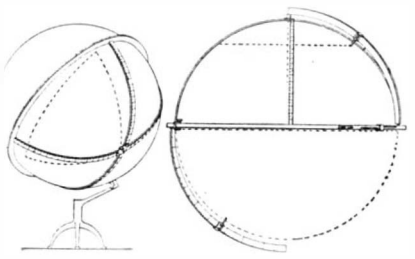
WEED CUTTING ATTACHMENT FOR DISK HARROWS.—J. T. BERTHELOTE, Havre, Mont. This inventor provides an attachment which may be readily applied to disk harrows of standard makes, and provides means to raise and lower the weed cutting blades, the whole to be bodily attachable to and detachable from the harrow frame. It also provides an attachment arranged to dispose the blades adjacent to individual disks at the base of the disks.



WEED CUTTING ATTACHMENT FOR DISK HARROWS.

Of General Interest

GLOBE RULER AND PROTRACTOR.—G. H. CRESSE, 38 South St., Middlebury, Vt. This invention provides an apparatus adapted especially for use upon globes for experimental or demonstrating purposes in classrooms, lecture halls, laboratories, or the like, for instruction along the lines of geography of the globe, spherical geometry and trigonometry, astronomy, and the like. By means of it circles of all sizes are drawn on a slated globe; spherical angles are measured and spherical triangles are drawn and graphically solved. The chief advantages of this device over its predecessors lie in the quickness with which the mechanism may be applied to the globe, the complete freedom from interruption, and breaks in the drawing of great and small circles.



GLOBE RULER AND PROTRACTOR

PROCESS FOR TREATING THE JUICES OF THE AGAVE PLANT.—L. LAVEDAN, 2522 Berlin St., New Orleans, La. An object in this case is to provide a process for treating the juices of the agave plant which will bring these juices to such a condition that the subsequent steps taken in the manufacture of the various products, such as alcohol, syrup, or molasses, are rendered extremely simple, thereby insuring an economical product.

PROCESS FOR TREATING ROCK CONTAINING ALKALI METALS.—F. L. FIREBAUGH, 106 Plaza Drive, Berkeley, Cal. The object of the present invention is the provision of a simple and economical process for converting the alkali contained in the rock into soluble sulfates, and then separating the potassium salt from the sodium salt generally present therewith.

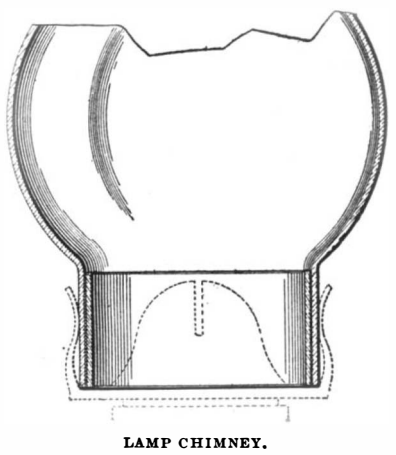
Hardware and Tools

JEWELER'S TOOL.—I. ROSENBAUM, Mount Vernon, Ind. This invention has reference to a tool for use by jewelers in re-sizing finger rings or like bands. An object is to improve a tool for the indicated purpose, in which one of a pair of ring-holding jaws is provided with grippers arranged as adjustable gage elements.

DOOR LOCK.—M. F. RICHARDSON, 107 E. 128th St., New York, N. Y. The purpose of the invention is the provision of a new and improved door lock in which the bolt automatically swings back into folded position within the door casing on opening the door, thus forming no undesirable projection when the door is open.

Heating and Lighting

LAMP CHIMNEY.—G. W. LINDSEY, Berrys, Va. The invention has for its object to provide a mechanism for use in connection with lamp chimneys of any character, for permitting the rays emitted at the base of the chimney to be utilized by reflecting the said rays and concentrating them with the rays given out above and at the flame, wherein the said means may be an integral part of the chimney or a separate article of manufacture permanently or temporarily attached to the chimney.



LAMP CHIMNEY.

ILLUMINATING DEVICE FOR LIFE LINES.—J. C. CERICOLA, 226 High St., Brooklyn, N. Y., N. Y. This invention relates to illuminating devices and particularly to devices for illuminating a life line as the same is projected from the gun toward a stranded ship, and has for an object the provision of an arrangement which will cause a light to be produced as soon as the line starts on its travel and to be maintained during the entire travel of the line.

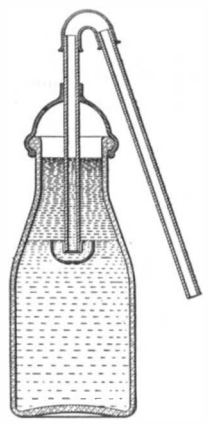
Household Utilities

WINDOW SASH ATTACHMENT.—G. W. POULTON, 5618 Larchwood Ave., West Philadelphia. The invention provides an attachment whereby an ordinary sliding sash can be transformed into a swinging sash. It provides an attachment whereby the swinging sashes can be utilized as ventilators; and provides an attachment whereby the sashes can be maintained at predetermined angles, thereby rendering the ventilation adjustable and also permitting the cleaning of the windows from within.

FLY TRAP.—H. M. MYERS, 220 4th St., San Rafael, Cal. This invention has reference to fly traps, and has for its general objects the provision of a fly trap of comparatively simple and inexpensive construction, of durable design, and having simple and effective means for enabling the trap to be readily cleaned out.

DUST COLLECTING BAG FOR VACUUM CLEANERS.—ALICE N. MUMMERT. Address, E. E. Mummert, 110 N. Main St., Goshen, Ind. This bag is constructed of a single blank section of paper or cloth capable of convenient attachment to and removal from a vacuum cleaning machine, the device being so inexpensively constructed that after it has been filled with dust and sweepings it may be destroyed or burned with the latter, thus obviating coming in contact with or inhaling the dust and dirt.

CREAM REMOVER.—F. S. DOUGANS, 30 Henry St., Clinton, Mass. The invention relates to a device for household use in siphoning cream from milk bottles. It provides a cream remover of the indicated character improved more especially from a sanitary point of view, and to the end that efficiency in operation may be relied upon. The siphon legs are designed for a single service to be then discarded in the interest of sanitation. Also, the other elements entering into the structure are of a character to be cleaned with thoroughness and facility.

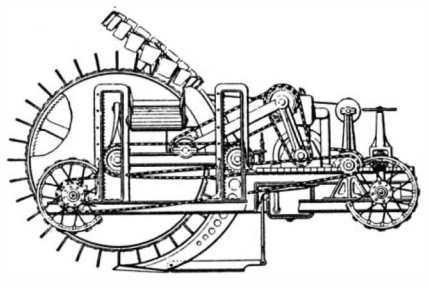


CREAM REMOVER.

STOVE OR FURNACE FEED.—F. S. SEYMOUR, Manchester, Iowa. An object of the present invention is the provision of an automatic coal feeder particularly adapted for feeding coal to small heating stoves, ranges, house boilers, tank heaters, feed cookers, and the like, on which there is not a very large consumption of coal.

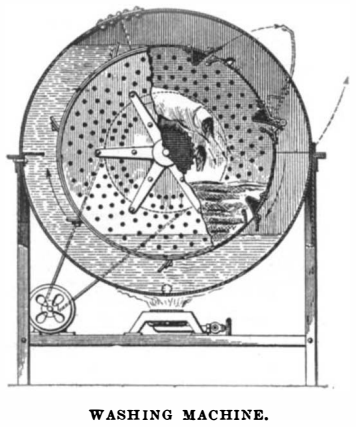
Machines and Mechanical Devices

DITCHING MACHINE.—J. L. CONROY and J. SHIMON, Pocahontas, Iowa. This invention relates to ditching machines of the tractor type, the more particular purpose being to provide a device having an excavating wheel driven from the source of power used for propelling the machine along. The efficiency of the machine is improved by arranging for its complete control by the operator, and especially with reference to the changing of the position of the excavating wheel while the machine is in action.



DITCHING MACHINE.

WASHING MACHINE.—A. C. COLLINS and J. E. YOUNG, Room 2, Dorman Block, Conneaut, Ohio. In this machine a rotatable container of cylindrical form is provided for the clothing, which is mounted to rotate in a second container and adapted to contain a liquid charged with a detergent, and wherein mechanism is provided for scooping up a portion of the liquid and passing it into the first named container, and forcing it through the clothing in the container, during the rotation of the first named container, and wherein heating mechanism is provided in connection with the second named container for heating the liquid during the operation of the machine.



WASHING MACHINE.

VARIABLE SPEED GEARING.—J. W. CAMPBELL, P. O. Box 87, Detroit, Mich. The invention provides a combination gearing by means of which various speeds may be imparted to the driven shaft, and in which the change from one speed to another is accomplished by means of clutch members, without the necessity of shafting gears out of or into mesh with certain other gears. Mr. Campbell has invented another variable speed gearing which provides a gearing wherein the driving shaft and the driven shaft are arranged to be connected directly or at varying speeds through the intermediary of a countershaft, and wherein a common means is provided for controlling the direct connection and the connection between the countershaft and the driven shaft in alternation in such manner that the driving and the driven shafts may not be connected directly without releasing the driven shaft from the counter shaft.

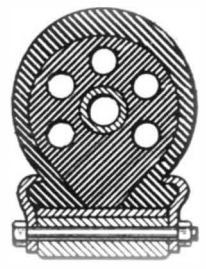
Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—E. C. GUNDELACH, 14 Union St., New Rochelle, N. Y. The engine is arranged to insure a thorough exhaust of the products of combustion, to prevent the incoming new charge from mixing with any products of combustion, to provide ample admission space for the explosive charge, and to prevent accumulation of the carbon deposits in the cylinder and fouling of the electrodes of the igniting device.

TOOL FOR REMOVING ENGINE VALVES.—C. M. WILKERSON, Middlefield, Ohio. The invention provides lever arms arranged to be given a separating movement by a cam lever whereby to compress the valve spring and relieve the usual cotter pin of spring pressure so that the pin may be readily removed. The arrangement of the cam lever relative to one of the lever arms is such that said lever arm will be rocked to compress the spring and will then be locked to maintain the spring under compression.

Pertaining to Vehicles

CUSHIONING BODY FOR CASINGS.—F. ZUBER, 210 Logan St., Brooklyn, New York, N. Y. This invention relates to cushioning bodies or fillers for tire casings, and an object is the provision of a construction which will produce a resilient effect while being sufficiently strong to support any reasonable load. It provides a hollowed-out filling or cushioning member for producing a resilient effect without the use of compressed air. It provides a cushioning filling body for tire casings arranged in sections with means for holding the same together, whereby any part may be readily renewed without it becoming necessary to renew the entire filling body.



CUSHIONING BODY FOR CASINGS.

Designs

DESIGN FOR A HOMESHRINE.—J. J. MCGRANE, 505 5th Ave., New York, N. Y. This invention comprises a facade-like panel or niche, an image of the Virgin Mary and Child set in the niche, a cross surmounting the panel, and a lamp at the foot and in front of the image.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—W. E. HUNTER, care of Economy Tumbler Co., Morgantown, W. Va. This design comprises a vase with handles at its sides, and with a leaf design at its bottom and feathers at its top. At each side is a rosette, the rosettes being connected with the vase by chains of pearls, and above each rosette there is a flame, and below, a floriated pendant.

DESIGN FOR A CANOPY FOR GAS AND ELECTRIC FIXTURES.—C. J. ALCAN, address Reliance Metal Spinning Co., 15 Laight St., New York, N. Y. This ornamental design for a canopy for gas and electric fixtures is No. 49,104. Mr. Alcan has also invented four other designs for gas and electric fixtures, as follows: DESIGN FOR A SHOWER PLATE FOR GAS AND ELECTRIC FIXTURES. This is No. 49,105. DESIGN FOR AN OVAL BACK FOR GAS AND ELECTRIC FIXTURES. This is No. 49,106. DESIGN FOR A SOCKET COVER FOR GAS AND ELECTRIC FIXTURES. This is No. 49,107.

DESIGN FOR A LIGHTING BOWL.—M. D. BLITZER, Gas and Electric Appliance Co., 569 Broadway, New York, N. Y. This ornamental design for a lighting bowl is No. 49,109.

DESIGN FOR A REFLECTOR.—P. SIMPSON, 138 W. 116th St., New York, N. Y. This ornamental design for a reflector is No. 49,129.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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The Spruce Gum Industry

(*Concluded from page* 660)

bottom of the box and the funnel is stretched fine cheese cloth, while the top is covered with burlap upon which the chip gum is spread in a thin layer. Steam is admitted to the box through an opening in the side and passes out through the burlap. The gum melts and runs through the burlap and cheese cloth strainers and into a tin receptacle below the mouth of the funnel.

While the gum is still warm it is taken out of the receptacle and worked or pulled. This makes it more uniform in density and lightens the color. It is next laid on a bench and rolled flat with heavy rollers, the last one having heavy dies cut into it to separate the gum into small sticks or squares. These are wrapped in tissue paper and sell in the retail market for about one cent apiece.

Some makers adulterate their steamed gum by introducing rosin. Others mix it with chicle. One formula for the latter calls for 20 parts each of spruce gum and chicle and 60 parts powdered sugar. The gums are melted separately, mixed while hot, and the sugar immediately added, a small portion at a time, and kneaded in on a hot slab. When the sugar is completely incorporated the mass is removed to a cold slab, previously dusted with sugar, rolled out at once into sheets and cut into sticks.

The true lover of spruce gum is not attracted by such hybrids. His test of good gum is first in the taste and then in the color. When the lump is first crushed in the mouth there should be an agreeable bitterness, but no trace of turpentine. The particles should soon adhere together in proper consistency, turn to a light lavender shade, and retain the characteristic flavor indefinitely.

A Model Hospital Train

(*Continued from page* 664)

nickel, and all other parts are white enameled. The walls and ceilings of the sterilizing compartment are white varnished, and in their lower portions are covered with a varnished cloth that is readily washed.

The chemist's compartment is situated beside the sterilizing room, and comprises all medicaments and provisions in two spacious cupboards. In another compartment of the car there have been installed X-ray outfits, enabling the wounded to be rapidly inspected before being operated upon. The apparatus is also used in inspecting plaster dressings. The induction coil of the X-ray apparatus receives its primary energy from the train-lighting circuit, and the bulb is readily adjusted along the radioscopic table.

Since the possibility of conveying soldiers suffering from infectious diseases had to be accounted for, a special disinfection car has been included in the hospital train. This car is fitted with every possible facility to reduce the risk of infection to a minimum. The disinfector is designed for disinfecting the body and bed linen of patients, their mattresses, pillows, etc., in a stream of live steam at a temperature of 108 to 110 degrees. In order to enable even clothes, leather and other articles to be sterilized, the same apparatus has been designed for formaline disinfection. Furthermore, with a view to destroying vermin, so dangerous in time of war, physical disinfection with carbonic acid and hot air has likewise been provided for. A steam washing machine insures a preliminary cleaning of blood-stained and dirty linen. Steam for this machine and the disinfector is supplied from a steam boiler installed in the car. Two spacious receptacles lined with sheet metal serve to store dirty linen not infected and disinfected linen, respectively. In a cabinet there is a shower bath for the doctors and the attendants.

The lighting car is in reality a power plant on wheels, and supplies electrical illumination to all the cars. The latter are equipped with compressed gas apparatus to be resorted to in case of emergency. Electricity is generated by a generator direct-coupled to a 12-horsepower four-cylinder gasoline motor. The load

consists of about 380 lamps. A storage battery of 60 cells supplies current while the generator is at rest.

The two cars reserved for the doctors, female nurses and clergymen each comprise nine separate compartments, containg a convertible bed-sofa, a wardrobe, a washstand containing a set of drawers and also available as a writing desk, and a spacious chest for personal belongings. In a special compartment of the doctors' car there is the chief surgeon's office. The attendants' cars are fitted out in a similar manner to the soldiers' cars, each containing 10 berths in addition to a dining table and chairs. The manager's car comprises three compartments, the dwelling room and office of the superintendent being installed in the central one.

The kitchen car is provided with a range of about 10 feet in length, designed for the needs of 300 persons. The cooking utensils are partly of aluminum and partly of pure nickel. Enameled crockery is used for dishes, insuring the greatest possible cleanliness. A portable, closed chest is used for transporting the food from the kitchen to the other cars, thus keeping it to the desired temperature. The kitchen storage car contains ample provisions for one or two weeks, as well as a water tank of about 2,700 gallons' capacity. The linen car contains 650 blankets, 600 sheets, 1,000 tablecloths, 1,000 towels, napkins, etc., 1,000 arm bands, neck cloths, handkerchiefs, etc., 300 "sick" suits, and a large number of other pieces of linen.

One of the baggage cars provides sleeping accommodations for the railroad personnel, and carries a large water tank. Another car carries a large provision of coal for heating. A further supply of coal is carried in a special car at the end of the train.

Each car of the train carries a telephone, thus permitting of ready communication between the different departments of this hospital on wheels. Water tanks of an aggregate capacity of over 21,000 gallons are installed in the various cars. The train is made more pleasant by a number of paintings, and a small organ, phonograph, and library are provided to make the days of the convalescing patients most agreeable.

The Flying Sensation

(*Concluded from page* 667)

problems—respiration while immersed, perfect vision, elimination of the wetness and saltness of a concentrated solution by comfortable watertight clothing, maintenance of the fluid at a pleasant temperature.

How delightful such flying must be is realized if we consider that a perfect illusion of emancipation from gravity and the fear of falling automatically renders dizziness impossible. A self-adjusting safety valve could maintain a constant normal air pressure within a closed vessel and do away with the hardships and dangers incident to changing altitude. How different from previous altitude flights—from the supreme efforts and chastisements of the toughest athletes! That the mere exposure to the icy blast which supports the machine and the need of bundling up like an arctic explorer in itself annihilates any likeness to a flying sensation has been realized by designers who placed the fliers in glass enclosures. It might be advisable to add some details in contradiction of any vision of a "flying bathtub." The device suggested by the logic of physical and physiological facts is not unlike the current practice of strapping fliers into deep cockpits. The first Wright aeroplane carried for years an operator lying prone. A layman will frequently not realize what flotation means and why an ounce of water could be made to float a ton of wood in the form of a cube closely fitting a tank. This water should be compared to a quantity of lubricated fine shot; and if the wooden block is likewise imagined extremely slippery, the heavier shot will obviously slip under the wood and raise it. "Floating" a flier prone on his stomach in a long, narrow, closed cockpit could be done by a few pounds of salt water. If this thin film were found to interfere with a perfect view of the outside world through goggles and 2 square feet of glass, a short distended hose could be inserted to give the flier a path of vision through air. A pleasant sensation would be insured, and the submerged glasses kept clear by circulating the water through a heater to keep it lukewarm. The cockpit's rubber sides and bottom, closely fitting the flier's body, might be upholstered, although accelerations and centrifugal force are neutralized the same as gravity if the whole pit is flooded. Balancing and other technical cares of flight must of course be left to an aerial chauffeur and only direction and speed be controlled through a simple device.

The novel subject may be brought home by remembering the part played in medical treatment by permanent partial floating of a body incapacitated from supporting its own weight. For artistic illusion, of course, flotation must be more complete than this. The effort it takes to keep sustained even in the ocean, and the sensation of being wetted by cold water, add to breaking the spell in bathing. For a flying illusion, not only must the brine be heavier than sea water and the head submerged, with ventilation and temperature such as to give a sensation of immersion in the atmosphere alone, but a peculiar diving suit must eliminate wetness and irritation to the eyes, ears and nose in breathing. This garment has little resemblance to the familiar suit for deep-water diving. The thinnest fabric suffices; and the head covering must be uniform with the rest of the suit, because any rigid helmet would feel like a material support.

A short, flexible, ventilated hose, extended by rings, makes breathing easy. Glasses inserted before the eyes give the illusion of looking through air. The real problem consists in so ventilating this suit that the sensation is like that of being surrounded by air and yet afloat. It could be solved by a fine spongy lining built up of perforated rubber tubes branching out like veins. Air is continuously forced in and sucked out through interlacing systems of tubes, the lining absorbing and distributing it. The quantity is too small to feel like any outside support, and the suit is too light and flexible to interfere with the floating sensation.

Conversation between the passengers in adjoining cockpits could easily be made possible, thus permitting better enjoyment of flight by a company of soarers. For this purpose a sound-conducting covering over the ears would be necessary; and the breathing tubes, which would carry the conversation, would have to issue into a common air-space, with continuous infeed and escape of air under constant normal pressure. Also, in the ceiling confining the fluid against inclination, centrifugal force and acceleration, a sound-conducting diaphragm would be necessary.

This seems all a striking illustration to Homunculus' words:

"For what is natural scarce the world has place,
What's artificial needs restricted space."

Newspapers That Are Printed Within Gun Range of the Enemy

(*Concluded from page* 665)

terie Territoriale, which is conducted under the editorship of Corporal Huguet and autographed in different colored ink for each issue; *L'Echo des Tranchées*, edited by the well-known French author, Paul Reboux, and containing articles and poems from the pens of such celebrities as Poincaré and Rostand, Théodore Botrel and Henri de Régnier; *L'Echo du Carrefour*, which is written on a typewriter; *L'Echo du Ravin* of the 41st Battalion of Chasseurs, and many other *Echos* which are characterized by their interesting and brilliant contents. Strange enough, there is little reference made in these novel periodicals to matters of warfare; rather, they are replete with local gossip, jokes, cartoons and similar matter tending temporarily to remove the thoughts of the readers from the horrors of conflict.

Continuing our survey of the trench newspapers, we come to the illustrious *Face à l'Est*, the organ of the 91st Territorial, which has been printed on a copying machine in the Argonne region since August 1st, 1915. It is issued every Sunday—provided the opposing Germans do not seriously object; the fourth number of the journal, for instance, was withheld for several weeks because the editors and printers were rather busily occupied in settling a little dispute with the Germans.

Aside from the word *Echo* in their titles, the trench papers appear to be most partial to *Poilus*, hence there is a wide assortment of titles making use of that name. For instance, among others there are the *Poilu Déchainé;* the *Poilu Grognard; Les Poilus de la 9e* founded in March, 1915 and *Le Poilu*, directed by Dr. Vève. Printed at Châlons-sur-Marne, the last-named is one of the most important of the trench newspapers since it circulates more than 13,000 copies.

Prominent is the *Marmita*, which is, according to its publishers, an "anecdotic, humorous and fantastic" review. It came into existence on the banks of the Aisne at the beginning of 1915. It is directed by Adjutant Paul Clerouc, aided by several collaborators, among them Engraver A. Desligniéres, and Second Lieutenant of the Reserves A. Roux, professor of a university. Although elaborately printed in Paris, the *Marmita* is edited in a modest dugout which is quite devoid of the usual comforts of an editorial sanctum.

Still other journals are the *Cri de Vaux*, *La Voix du 75* and the *Woevre Joyeuse*. *Rigolboche* is another journal which is entirely devoted to poetry of the most humorous sort, with occasional contributions from Emile Faguet and Henri de Régnier.

Perhaps the most unique of the journals is *L'Echo des Marmites*, which is worded entirely in the strange, new terms of the trenches. Its laugh-compelling articles are rendered still more humorous by the peculiar expressions and words which the soldiers have come to use both for military and everyday terms.

L'Echo de Guitounes, *L'Echo de Gourbis*, *La Chechia*, *Diable au Cor*, the *Boyau* and the *Hareng Verni* are among the most conspicuous trench papers that have not been mentioned before.

A Watch Containing Every Refinement Known to Horologists

(*Concluded from page* 666)

feature of the watch is the perpetual calendar which makes allowances for the 31-, 30- and 28-day months and even the 29 days of February each Leap Year. The phases of the moon can be instantly determined by referring to a crescent shaped opening in the upper center of the dial. Lastly, a most useful attachment is incorporated in the watch to indicate when the gong movement and the watch movement were last wound.

The gold used in the case of the watch is 18-carat and weighs nearly seven ounces. Three separate mechanisms are required to perform the various functions of the watch; two of them are wound by turning the winding stem in one direction and the remaining movement wound by turning the winding stem in the opposite direction.

Peculiar interest is attached to the watch at the present moment when the greater part of Europe is involved in a gigantic conflict which is retarding the progress of hand work and artistic creations. It is noteworthy that Swiss workmen, surrounded on all sides by fighting millions, should continue in their normal occupations.

A Liquid Measuring Device

(*Concluded from page* 668)

and then down through a tube in the center of the reservoir, terminating in a single or double pointer. To prevent the float from turning, it is provided with a single projection which slides between guides running down the inside wall of the cylinder.

By opening an ordinary valve the measuring device is quickly filled, and the quantity of liquid entering into the tank is absolutely controlled. By a similar valve in the nozzle at the end of the outlet tube, the escape of the liquid is similarly controlled, discharging its contents as fast or as slow as desired. Gasoline, for instance, may be elevated to the measuring device from a storage tank in the ground by hand or power pump, air pressure, hydraulic pressure, or by gravity fall.

Interlocking Channel Brick for Walls of Attractive Design

(*Concluded from page* 668)

than a hollow-tile wall. Owing to the channel feature of the new brick, there is no possibility of moisture traversing through a wall built in this manner. The solid double walls, separated by closed air cells, provide maximum heat and cold insulation; hence there is a considerable saving effected in the heating expenses of a home built in this manner.

As for exterior appearance, the interlocking channel brick is made in such a variety of shapes, sizes, textures and colors that almost any variety of effects can be secured in the walls built of it.

Rock Tunneling Without the Use of Explosives

(*Concluded from page* 657)

is slowly carried over the face of the tunnel. The line pressure of 80 pounds per square inch exerts a constant force on the tool holder of each hammer, keeping the tool out. When the tool comes in contact with some obstruction in its path, however, the hammer is automatically and independently operated, delivering a blow of from 7 to 10 tons pressure on the chipping tool. If the obstruction has now been chipped off the face—and it almost invariably is—the hammer remains passive until the next obstruction is encountered.

Each cutting tool chips away a circular path or track of its own, the work of all the tools giving the face of the tunnel the appearance of a rifle-practice target because of the large number of concentric rings. Each hammer may deliver as many as 1,000 blows per minute. In soft material the hammers do not function; instead, the tools, carried around by the rotary head, act as gouges until hard material is again encountered.

The compressed air which operates the hammer drills also supplies the necessary motive power to rotate the head and turn the screw jacks that push the front member steadily up into the work. A simple form of double-acting engine, operated by compressed air, is used for driving the rotating-head shaft and for turning the screw jacks, as well as for operating the muck shovels and conveyor. The rock that is chipped off by the hammers is in the form of fairly large pieces which run as high as 10 pounds in weight. As the muck accumulates beneath the rotating head, it is scooped up by shovels that are rigidly mounted on either side of the former member, and unloaded on a conveyor belt that carries it to the rear of the machine, where it is dumped into small cars.

To those who have read the description of the rock excavator that appeared in a previous issue of the SCIENTIFIC AMERICAN the foregoing description fails to reveal new points regarding the rock excavator. Yet Mr. App has been constantly working on the details of his intricate machine in a manner that only fellow inventors can appreciate. As a result of this important if not manifest work, the machine has been brought to a state of development where it has successfully bored through over 70 feet of rock in connection with the work on the new subways of New York. Here it has encountered not only quartz rock, but also strata of gneiss, which is perhaps as hard a formation as is ever encountered in tunnel work. Runs of over one hour duration have been made without shutting down once, and the tools have stood up for a distance of twelve feet without dressing or renewal.

Among recent performances to its credit the rock excavator has cut 15 inches of 8-foot tunnel in 95 minutes, and 8 inches in 35 minutes, the latter being a non-stop run. On June 9 tests were conducted in the presence of the Interborough and

Rapid Transit Subway engineers, in which the machine cut 2½ feet in 3¾ hours' operating time. At the end of the run the machine was in good condition and cutting faster than at the beginning, and the tools did not require any dressing or renewal, according to Mr. App. At the time of the previous description in these columns the machine was still in its experimental state and had not yet encountered the severe conditions of actual use.

Among the recent refinements has been the redesigning of the rock-chipping hammers, resulting doubtless in the doubling of the weight of the piston, strengthening the tool and its holder, and making the mechanism simple and dependable in operation and less liable to breakage. The angles at which the tools are held in relation to the work has been solved after much study and experiment, and now the concentric cuts assume such a form as to have each tool cut a clearance for the tool proceeding it. Each rotation of the head chips off the rock face to a depth of one inch, advancing the tunnel that distance forward. A future development of the machine will be the elimination of the tracks and the use of herring-bone tired wheels especially shaped to take the curved tunnel floor. Thus considerable time will be saved in the driving of long tunnels, for there will be no tracks to shift forward as at present.

While the rock excavator is primarily intended for tunneling work, its inventor purposes using the same principle for excavation work in rock in city building operations. At the present time contractors find it difficult to remove rock in excavating sites surrounding by other buildings. Blasting often proves a serious menace to adjacent buildings because of their proximity. Mr. App proposes using a rock excavator for removing the rock adjacent to the foundations of neighboring buildings, and then blasting away the remaining rock in the usual way. In this way, it is believed, practically all danger will be eliminated.

NOTES AND QUERIES

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14111) E. A. V. asks: Will you kindly tell me if there is any way of drilling or making holes in glass other than drilling them with steel bits? A. The only way for drilling a hole in glass is by the use of a fluid to make the drill bite the glass. The best fluid we have found consists of one and one half ounces of spirits of turpentine, one ounce of camphor gum, and three drachms of ether. Keep the tip of the drill wet with this fluid and it will cut the glass very rapidly. Of course there is always a risk of breaking the glass when the tip of the drill cuts through.

(14112) F. H. W. asks: 1. What change actually takes place when the element phosphorous is changed from one of its allotropic forms to another? 2. Why are air waves sometimes visible over a body of water? This phenomenon has been observed over frozen bodies as well as open. 3. How is the sun's heat radiated to the earth? 4. It is said that water is leaving the earth. If so, where is it going? 5. What causes calcium sulphide, after being exposed to the sunlight, to glow when taken into the dark? A. 1. Allotropic forms of an element, such as phosphorus, are understood by chemists to be due to a modification of the constitution of the molecule. 2. The air waves, as you term them, are due to an inequality of temperature over the space where they are to be seen, thus producing an inequality of refraction of the light which passes through the space. They are more easily seen with heated air than in air which is being chilled. 3. The radiation from the sun is a wave motion in the ether of space. A portion becomes light when it strikes an eye; another portion becomes heat when it strikes a material which can absorb it. 4. Water is not leaving the earth in the sense that it is going away to any other place. It is being transformed into plant and animal matter, and into rocks and minerals, now as in the past. Some of this is returned to the earth again, some is not returned again as water. Rocks contain water in their composition. 5. The name phosphorescence is given to the gradual giving off of light by such substances as luminous calcium sulphide. We do not know the reason why these substances are able to thus absorb energy and later give it off as light.

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Note.—Illustrated articles are marked with an asterisk (*). Look for the general subject rather than the supposed specific titles of articles. Thus: "Aeronautics," "Automobiles," "Meteorology," "Panama Canal," etc., will give related articles much more quickly than by reference to the title.

(*Concluded from page* 673)

(14113) B. S. asks: Can water be compressed? If so, to what extent? A. Water is slightly compressible. At the freezing point and 1-25 atmospheres the compressibility is 525 ten-millionths, and at the freezing point and 2500-3000 atmospheres it is 261 ten-millionths. This gives as a result that the water at the bottom of the ocean in the deepest places, say 6 miles, is about 1-20 denser than at the surface. The data for various temperatures and pressures are given in the Smithsonian Physical Tables which we send for $2.00 prepaid.

(14114) W. J. S. asks: 1. To what degree does fused quartz polarize light? 2. The titles of good books on Polarization of Light. A. Fused quartz does not affect polarized light to any degree. The reason is that by the melting the three axes of the crystal are rendered equal, that is the crystaline structure is destroyed. The expansions by heat become equal in all directions and very small. For this reason the crucibles made of quartz can be set on a fire and put red hot into cold water. The quartz is nearly amorphous, and does not affect light any more than glass does. 2. We can supply you with R. W. Wood's Physical Optics, price $5.25, and Preston's Theory of Light, price $4.75.

(14115) W. S. asks: I would like to learn through the columns of your paper if there is anything like electricity or magnetism that affects a locomotive after a long continuous run? If so, in what way? I have heard engineers talk of engines getting tired. A little information on the subject will be appreciated. A. We have never known anything to lead us to think a locomotive could become magnetized or charged with electricity. We have heard workmen say that the machine which they were running had become tired. It would seem to mean that it was not running or doing its work so well as it should and needed tuning up. Any machine needs going over and putting in shape after a long run.

(14116) J. S. B. asks: Will you kindly answer this question for me? I have always understood that any substance heavier than water would go to the bottom, regardless the depth. In answer to question No. 14,027, J. H. G., Jan. 22, you claim not. To what depth will a submarine sink, not in motion, if one pound, or say ten pounds, more of water is pumped into the submersion tanks than the boat displaces? A. The old toy called the Cartesian Diver showed that an adjustment of the bulk of a floating body might be made by forcing water into it so that it would be just as heavy as water or a very little heavier, and thus it would sink below the surface to any desired depth. The diver was a little, hollow image of glass, with a small hole in the tip of its tail. It was placed in a tube, which contained water, and adjusted till it had enough water in it so that it barely floated. A piece of sheet rubber was then tied over the top of the tube. If now the finger was pressed into the rubber cover, the increased pressure forced more water into the image, and it sank quite to the bottom if the pressure was maintained. But by careful adjustment of the quantity of water, the image could be made to float at any desired depth. This is the mode in a small way of manipulating the submarine so that it is submerged to a desired depth. We do not know how many feet a few pounds of water would make it sink, but probably it would send it to the bottom if it were allowed to act unhindered by any motion of the boat. The Cartesian can be had from dealers in physical apparatus for schools.

(14117) E. B. asks: Can you give me any information as to the heating qualities of different cloths? If so, please advise me, which is the hottest cloth (one that consumes the most heat—and thereby heats the body) *white* cloth or *black* cloth. Please designate which of the two is the coolest or hottest. A. In the sun white cloth will probably not get so hot as black cloth. This can be tested by wrapping two thermometers, one in white and the other in the same cloth thoroughly blackened with ink, in exactly the same manner, and leaving them in the sun for an hour. The one which rises the highest has absorbed the most heat. This is, however, a different question from that of keeping the surface of the body at a desired temperature by clothing. The interior of the body in health is always 98.4° Fahr., while we feel most comfortable when the air around us is about 68° Fahr. We adjust our clothing so as to radiate our too great heat and get rid of it the best we can. In summer we wear thin clothes to hasten the escape of heat. In winter we wear thick clothing to retard the escape of heat from the body; or as we say to keep us warm. Thick clothing prevents heat from passing through it. It keeps out heat from the outside, it keeps the heat in the body, which is already there. It does this largely by the air which it holds within its meshes. Air is a non-conductor of heat, and if the air cannot move away from the body, the heat cannot be conveyed away from the body. Fur imprisons the most air and hence is the warmest of any materials worn for clothing. Any material made thick and fluffy, so as to contain much air, will be a warm material. It is neither a matter of color nor kind of material, the warmth of a material, but simply a matter of thickness and looseness of structure.

" * * * * what to him
Are Plato and the swing of Pleiades?
What the long reaches of the peaks of song,
The rift of dawn, the reddening of the rose?"

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By JOHN TYNDALL
(*ILLUSTRATED*)

Prof. Francis B. Crocker, Past President of the American Institute of Electrical Engineers, has contributed a very interesting introduction to Prof. Tyndall's "Lessons in Electricity" in which he sketches the history of the science of electricity and magnetism, and the development of their practical application, from the earliest recorded dates of their discovery down to the present day.

Prof. Lombroso's Book on Criminology

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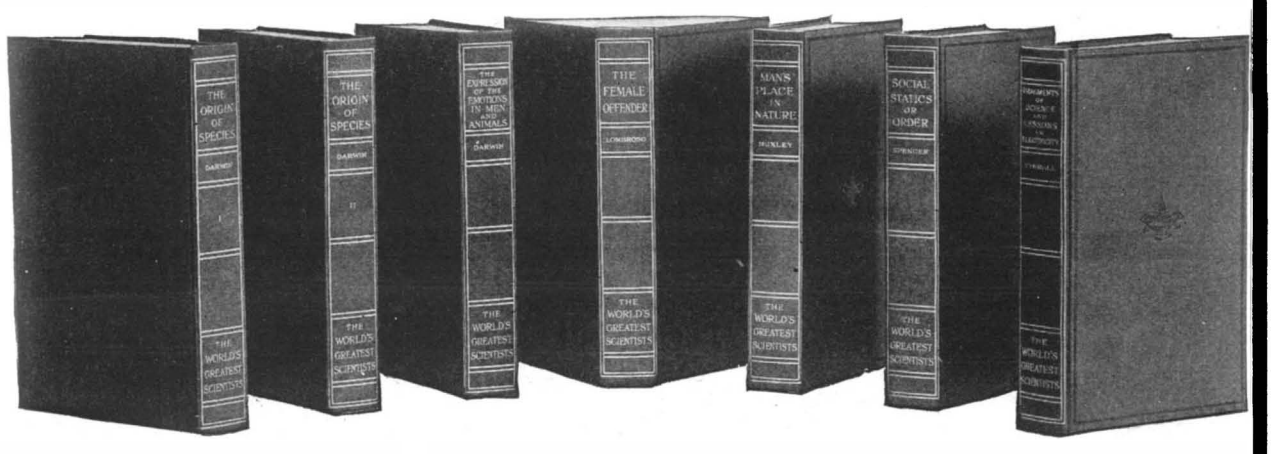

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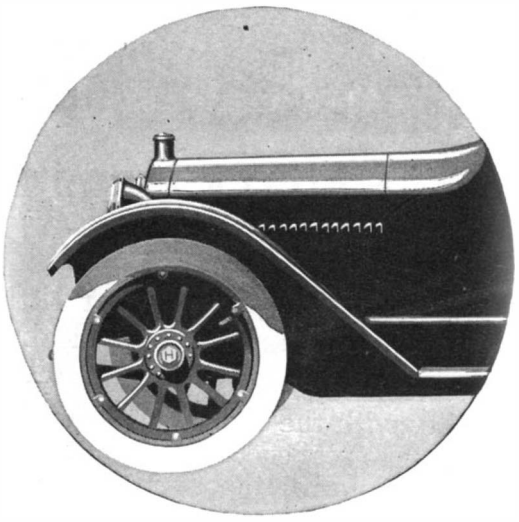

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