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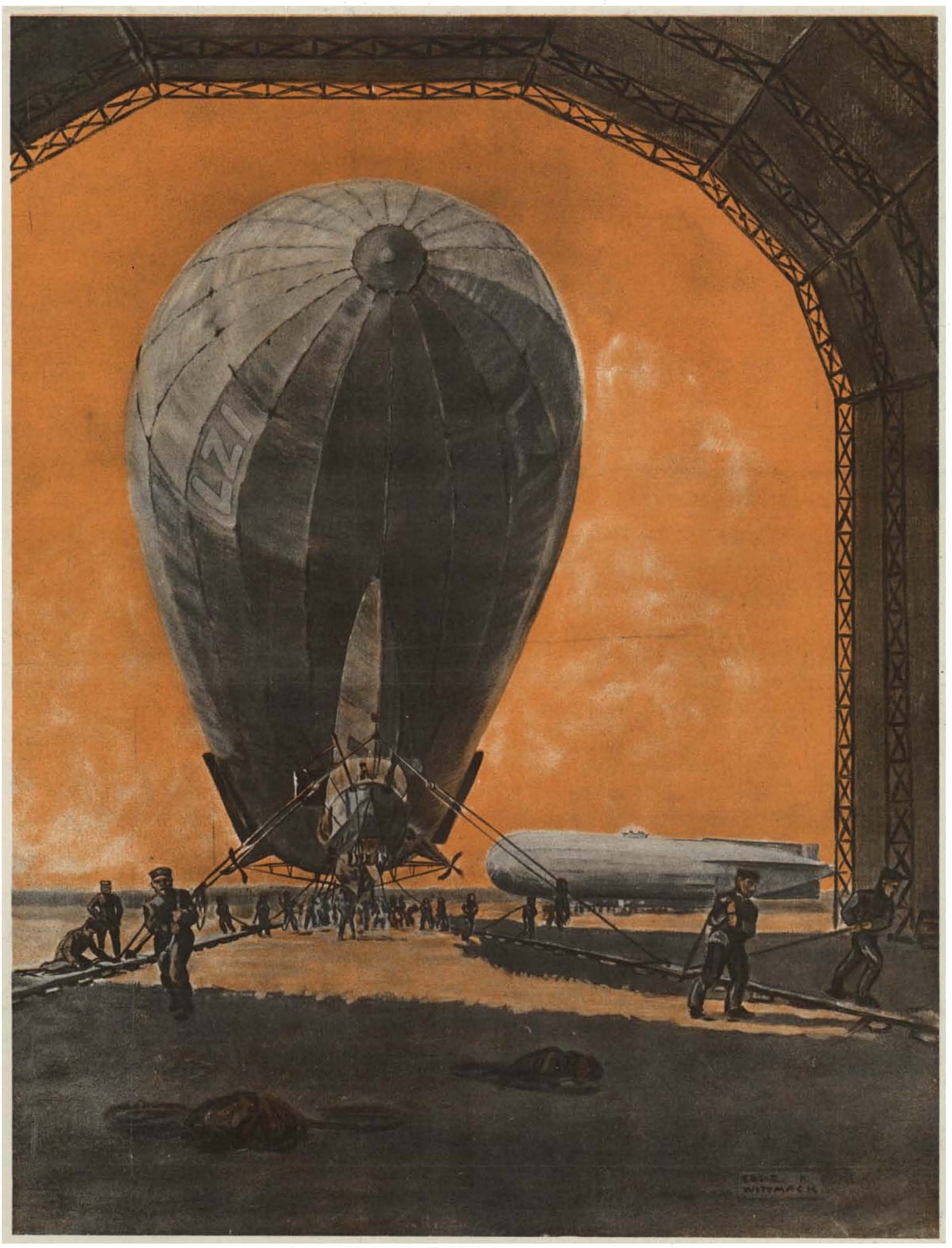

DOCKING A SUPER-ZEPPELIN.—[See page 55]

July 15, 1916

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

Price 10 Cents

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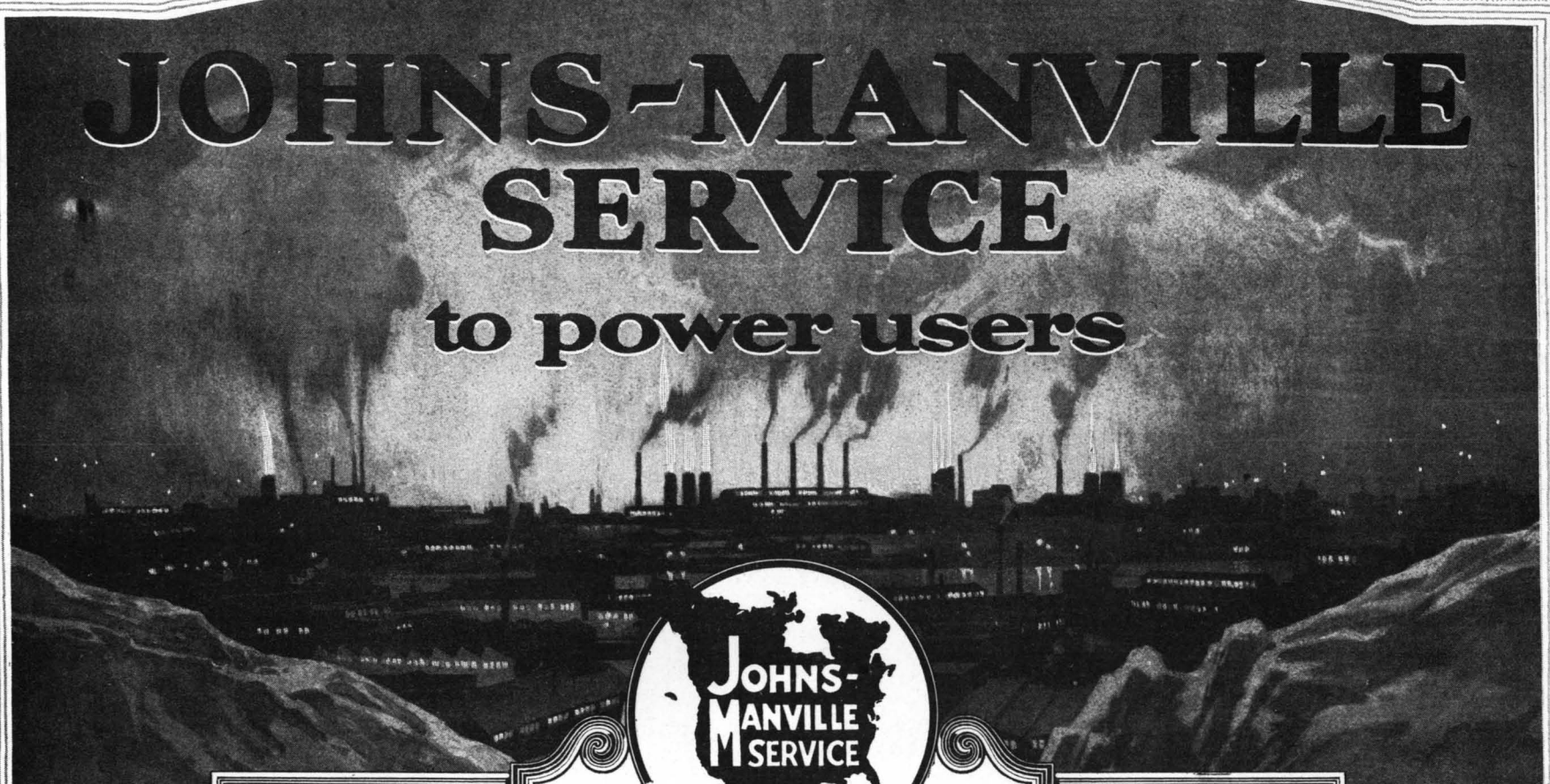
to power users



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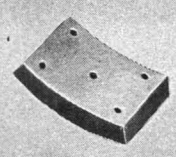

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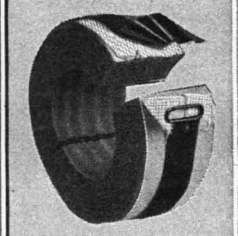

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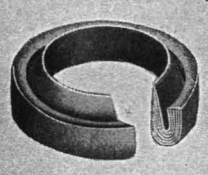
Built with circumferential channels, preventing air circulation. Will not crush, and withstands vibration. A most economical covering for Heating Systems.



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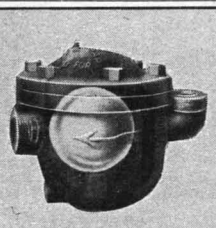

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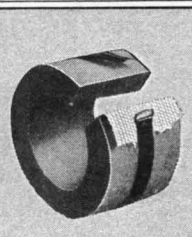

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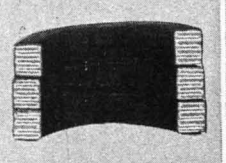

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SEVENTY-SECOND YEAR

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New Apparatus for Internal Diagnosis

By Jacques Boyer

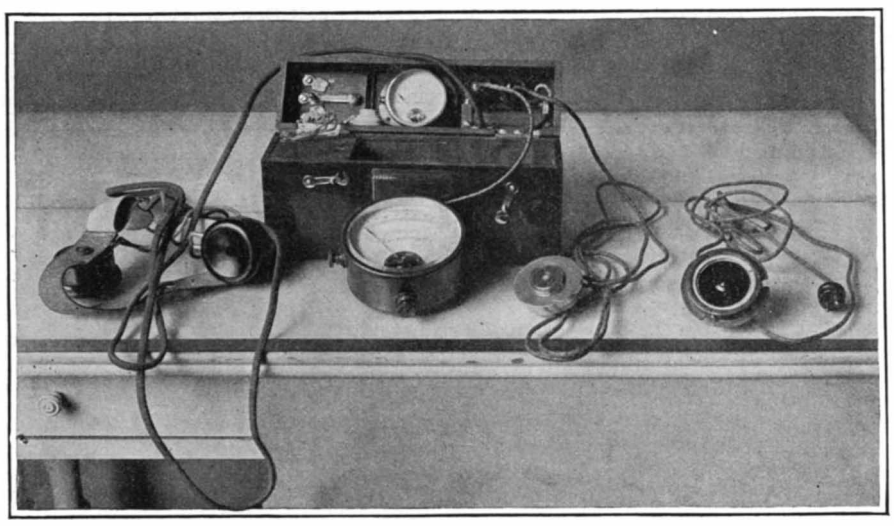
SOUND waves given out by our organs may be propagated either through the air in the ordinary manner of sound waves, or through the bone and tissues of our bodies. In the latter case the phenomena produced of vibrations in solid substance are of a very special character, and their study has such wide clinical and physiological applications as to warrant the exhaustion of all possible means for their effective reception and analysis.

A French physician, Dr. J. Glover, has recently devised a most elegant apparatus for the application of electrical methods to this matter. He places a galvanometer in circuit with a microphone, an induction spool primary, and a voltaic battery. A voltmeter is attached to measure the electro-motive force at the moment of experiment. For a given position of the microphone, this apparatus develops a certain intensity, which is indicated by the index of the galvanometer. When the microphone is exposed to the action of the organic sound vibrations from heart, lungs, etc., its membrane is subjected to periodic deformations, which are revealed to the eye of the observer by the galvanometer hand, the quotient of the voltage of the electric source by the resistance of the microphonic circuit being kept constant.

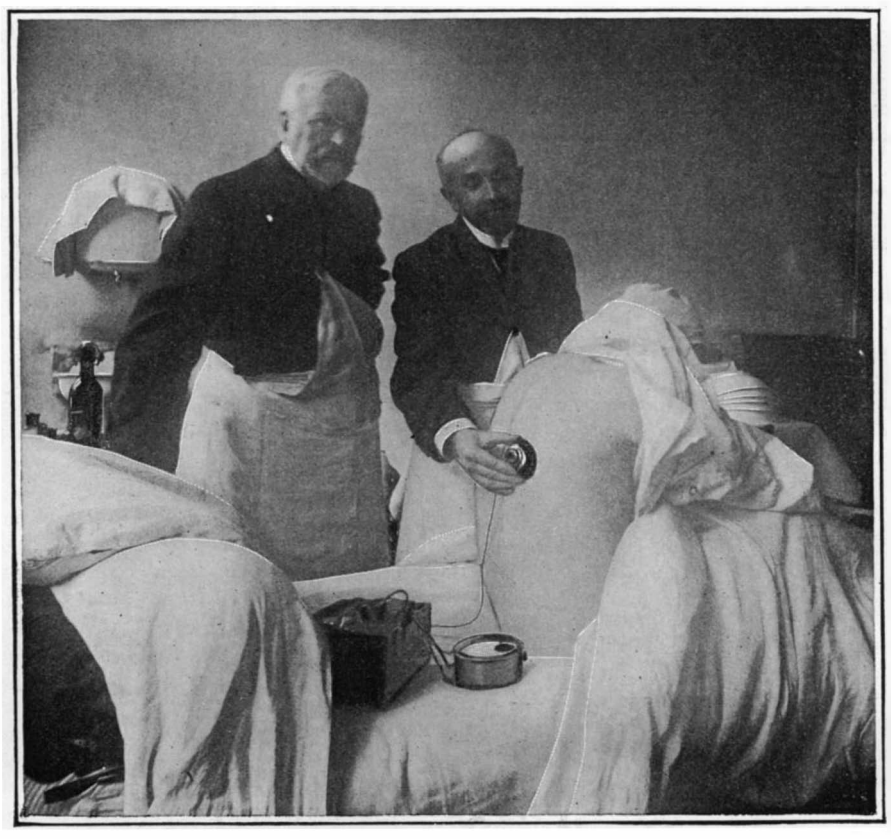
In order to test and check the visual record thus obtained of the patient's internal mechanisms, Dr. Glover has devised a system of two receivers inserted in the secondary coil of the induction spool. This is appropriately used in examining respiration and heart action. It is to be noted also that the galvanometer test is of value when associated with ordinary feeling of the pulse; for it reveals delicacies of the vascular vibrations which would not be sensible to the organs of touch. Finally, it is a simple enough step to attach a recording needle to the galvanometer, somewhat after the plan adopted for the testing of candidates for the French aviation service described in a previous issue of the SCIENTIFIC AMERICAN, thus obtaining a permanent graphical record, which may be studied at leisure under far more favorable conditions than those of the operating room or the clinic.

One of the advantages which this apparatus affords the practitioner is the possibility of a very early diagnosis of tuberculosis. In this case there is observed a slight trembling vibration of the breathing sounds, localized, and more or less marked, corresponding to incipient pulmonary congestion. A very close study of respiration is also made practicable. The movements of the thoracic shell may be accurately measured and recorded, and by applying the microphonic membrane successively to various regions of the patient's torso the type of respiration may be completely characterized. On this analysis is based a comprehensive individual prescription, and the subject, guided by the galvanometer, modifies voluntarily the defects of his respiration for the purpose of producing with minimum muscular effort the maximum effect.

The new apparatus makes a very efficient sphygmometer or even a sphygmograph—instruments, we remark for the benefit of the lay reader, designed to measure or record the blood-tension in an artery. The microphonic membrane does not possess sufficient sensitivity to register the oscillations produced by this phenomenon in such a way as to give an audible reproduction on the telephone circuit; but it is sufficiently agitated by the oscillations to give a very distinct variation in the galvanometer readings, under certain special conditions.



Apparatus for electric auscultation



Applying the respiratory test

Military Use of Sabadilla in the Manufacture of Tear-Producing Gases

RECENT press reports from England state that the asphyxiating and tear-producing gases used in the present war are made from sabadilla, a product exported only from Venezuela. In Caracas great interest has been displayed in these reports, and discussion has brought out several facts that throw light on its possible application to military operations.

Sabadilla (a diminutive of the Spanish *Cebada*, meaning barley) is a plant of the lily family, *Veratrum sabadilla Retztus*, occurring only in Venezuela and Mexico. The highly poisonous seeds have long been used in medicine. The substances produced from sabadilla seeds are cavadine, or crystallized veratric, veratric acid and sabadalline, a pleasant smelling alkaloid, that accelerates the beating of the heart.

While nothing is known in Venezuela as to its use in the production of war gases, it is a fact that sabadilla dust irritates the eyes, the throat, and especially the nose so much that laborers working with it are obliged to wear protecting masks. Sabadilla powder is used by cattle raisers in Venezuela as an insecticide with excellent results. It is stated that in Europe it is used in the manufacture of disinfectants, and that in the Balkan States and Russia it is employed in tanning fine leathers and as a mordant for dyes.

The first exportation of sabadilla from Venezuela was made to Hamburg 25 or 30 years ago. The foreign demand has never amounted to more than 5,000 sacks annually. Whenever the production passes beyond this point the price has fallen below the cost of gathering. It is not a cultivated crop, but might become such if new uses were discovered which would cause an increased and regular demand.

Docking Zeppelins

By C. Dienstbach

TO one schooled in present-day procedures, navigation by sailing vessels without the use of tugboats for guiding the craft through the tortuous waterways of our rivers and harbors seems difficult to imagine. The ease with which it could be docked by human labor unaided was perhaps not the least of the reasons why, side by side with craft propelled by sail, the oar-propelled Roman galley survived in the Mediterranean to the days of Lepanto. It is, then, not surprising that the true ship of the air, the dirigible, had at first, like the galley, to depend entirely on being docked by manual labor. But a really sheltered air harbor does not exist—all landing places are to the Zeppelin as as open shore to a ship. And to hold a big Zeppelin at the entrance to its shed, immovable against the wind which so vastly surpasses in velocity the currents of the sea, requires almost as many men as would suffice to hold a steamer against the tide. With galley slaves no longer available, and with modern prices for manual labor prevailing, it becomes necessary to find a way of docking the Zeppelin more in accord with the spirit of the present age.

The problem is solved by consideration of the fact that it is only the lateral air movement which imperils the Zeppelin by threatening to jam it against the shed. All that is necessary then is a means of anchoring it to the ground against any side pull while it is moved ahead. This is accomplished by laying a single rail on either side running up into the shed in the direction of the ship's course in entering, with four-wheeled clamps rolling easily along these rails and made fast to her sides with lines. Instead of a great crowd of men pulling at the ship direct, a handful pull at these clamps, and roll the ship into her harbor; and withal she is held more securely than she ever could have been before.

It should be noted that the running in and out of the shed is performed very expeditiously, two of the propellers even being used occasionally to speed the ship along. The purpose of this maneuver (seen by the writer at Fuhsbüttel, Hamburg) is to take advantage of any short lull in the wind. Captain Hacker relates that he once landed a party of French visitors before the shed in Baden-Baden during a storm severe enough to prevent him from entering. While these Frenchmen were spreading the news through the town that the Zeppelin was surely doomed, Hacker thus docked in a lull; and when his guests returned, to see the spectacular end of his airship, they found her safely harbored.

Potash in Texas

BORINGS in Texas to a depth of about 900 feet discovered potash salts in thick beds of salt. Some of the samples obtained were bright salmon red resembling the Stassfurt carnallite and analyzing about 14 per cent potassium chloride. This was in a bed overlying three other salt beds with a total thickness of several hundred feet. A large basin is indicated.

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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.

The Warrior at the Lathe

THE European war has taught us a great many lessons that we have not learned. Like the typical schoolboy, we let them go in one ear and come out of the other. We may accept the teaching and agree that it is correct; but until we profit by it we have not *learned* the lesson. For instance, we are taught that the modern war is a war of machinery; that other things being equal, ultimate success lies with the side which possesses the greatest industrial facilities. It matters not that these facilities lie without the borders of the country at war, provided they be available for purchase. However, the mere possession of industrial equipment is of little value unless this equipment is organized for use in emergency to supply the enormous demands of the modern army. This lesson we are really learning. The Naval Consulting Board is doing a wonderfully patriotic work in taking a census of American industries and organizing them for the defense of our land.

However, there is another lesson which the European war has been teaching which, as yet, we have failed to take in. We have before us the example of Great Britain, which has just learned the lesson at an enormous cost, namely, that certain men are too valuable to be placed on the battlefront. This may seem a startling statement to be made in a democracy, but we must realize that while all men are born free and equal in this land, certain men by their special training are more valuable for certain purposes than others, and the lesson of the European conflict is that the valuable men of war are not merely the ones who have graduated from military and naval schools or who have obtained their knowledge of military tactics and strategy from actual experience on the battlefield, but they are men whose peace-time occupations have fitted them for invaluable service in the preparation of the materials of war. A raw recruit may be turned into a fair soldier with ten weeks of rigorous training, but it takes ten years to develop a skilled machinist. The man at the lathe is indispensable in present-day fighting; for it is he who supplies the delicate machinery of modern warfare. We may think of a rifle as a comparatively simple piece of mechanism, but our own military rifle, the Springfield, which is one of the simplest of modern arms, requires *twelve hundred operations* in its manufacture. Every part has to be constructed most carefully to micrometer gage, so that it will be interchangeable with other parts. The time-fuse of a shell—and it is reported that in the latest great drive on the western front the Allies used a million shells per day—is a delicate piece of mechanism, comparable to the machinery of a watch. Our manufacturers have learned from the sad experience of many rejections that it requires much time and a deal of mechanical skill to produce this important part of a shell.

The European war has given us a taste of the industrial side of modern warfare. There has been such a scarcity of skilled machinists in meeting the limited demands of munitions for export, that we are beginning to be alarmed at the predicament in which we should be placed if we should have to supply munitions for our own use in a war with a first-class power.

At the beginning of the war Great Britain drew into her army of volunteers hundreds of skilled machinists. Not until they were lost was it realized they could not be replaced. Must we make a similar blunder before we learn our lesson? Why do we permit expert machinists to join the National Guard and be subject to a call to the firing line? Many plants in the eastern section of the country have been seriously crippled by the recent mobilization of the National Guard, because men who are most valuable at the machines, or in directing the operations of men at the machines, have been obliged to give up their work and join the colors. Is it not clear that a man may be a hundredfold more valuable at the bench then in the trench?

Volunteer Weather Observers

STATISTICS of climate are in constant demand for a great variety of purposes. They are a factor in innumerable investigations in pure and applied science. The requirements of agriculture, commerce, engineering—in short, most activities of the workaday world—combine to furnish a practical *raison d'être* for the great task of taking meteorological observations year after year at numerous stations scattered over the globe, and compiling the results in usable form.

Perhaps comparatively few persons who make use of climatic statistics realize the extent to which such statistics are based upon the work of volunteers—"amateur" observers, in the literal sense of the term, since their painstaking observations, extending in many cases over long periods of years, are entirely a labor of love. This is especially true in America, as compared with certain foreign countries where the taking of meteorological observations is one of the prescribed duties of various public functionaries, such as postmasters, school teachers, foresters, and the like.

In fact, American climatography would hardly exist but for the faithful labors of thousands of non-professional observers, past and present; and the valuable public service rendered by these persons certainly deserves more general recognition than it has hitherto received. At the present time about 4,500 unpaid observers are maintaining records of weather and climate under the direction of the United States Weather Bureau, and the number has been even greater in the past. Probably much more than nine tenths of the total raw material (in the shape of daily observations) from which the existing climatic statistics of the country were compiled has been supplied by volunteer observers having no special training as meteorologists. Yet so well have these "amateurs" done their work that its results are confidently accepted by scientific men on the one hand, and by farmers, lawyers, capitalists and the community at large on the other.

The farmer "lives by the weather," and the local records of the "coöperative observers" (as they are officially called) give him a far more definite idea of the normal atmospheric conditions of his locality than could be gained by inference from the most elaborate observations made at distant observatories. The same records are repeatedly produced in court in connection with lawsuits. They have often been the decisive factor in the consummation of big "deals" in land selected for town sites, irrigation projects, or whatnot.

The Government supplies to each of its coöperative observers a rain-gage, a pair of thermometers (maximum and minimum), and a thermometer-screen or "shelter." The observer reads his instruments once each day (generally about sunset), and enters the readings in his register, together with a record of the general weather of the day and of the occurrence of various special phenomena, such as frosts, thunderstorms, tornadoes, auroras, and optical meteors. The not very burdensome task of keeping a record of earthquakes has recently been added to his duties. A copy of the register is sent to the "section center," or state headquarters of the service, at the end of each month.

While the aggregate amount of time devoted to such observations is not great, the necessity of maintaining an unbroken record, day after day, year in and year out, is no slight test of the observer's fidelity.

The coöperative observer receives no remuneration from the Government for his work, except in the form of certain official publications. His chief reward consists in the consciousness of rendering a valuable service to the world in general and to his own community in particular, and in such local prestige as he may obtain as the keeper of the official weather record.

That these incentives are sufficient is shown by the fact that there are numerous cases in which unbroken records have been kept by a single observer or a single family for more than fifty years, while a few such records extend back more than seventy years.

Departures from the Fact

IN "The Brothers Karamazov" Dostoievsky, in a profound passage, puts into the mouth of one of his characters a singularly profound remark. The character in questions says that he has no wish to understand anything, for he wishes to stick to the fact. To what extent Dostoievsky was aware of the significance of his remark it is difficult to say, but it is certainly true that human intelligence, when confronted with a fact, has a constant tendency to depart from that fact. It is irresistably tempted to put the fact into a system; to express the fact by a formula of words which does not wholly express it; and presently to allow attention to be diverted from the fact to the words which imperfectly describe the fact. In this way, when the process has gone far enough, men come to live in a curiously unreal world of words and phrases which possess either no significance or a significance imperfectly understood. At the present time words which connote moral ideas are particularly cloudy. In every leading article we read such words as "patriotism," "humane," "duty to the State," and by comparing the different connections in which these words are used, we reach the conclusion that each word and phrase stands for several incompatible ideas having this in common, that none is clearly defined.

If it were admitted that we are here dealing with a world of ideas which has been suggested by, but has no direct contact with, the world of reality, then the use of these words and phrases would become an art resembling, in this respect, the art of mathematics. The basis of mathematics, the conception known as the mathematical continuum, cannot be derived from experiments. In the mathematical continuum we can pass from the number 1 to the number 2 by an infinite number of intermediate steps. But in the continuum known to us by experience, the physical continuum, this does not happen. It has, for instance, been observed that a weight A of 10 grammes cannot, in virtue of the muscular sensation produced by it, be distinguished from a weight B of 11 grammes. Similarly, if after weighing B in the hand, a weight C of 12 grammes be substituted, the observer cannot tell the weight C from the weight B. But if the weight C be substituted for the weight A, the observer does notice a difference. So that, going merely by this experiment, the observer would say that A was equal to B; that B was equal to C; and that C was greater than A. In other words, he would say that as the result of experiment, two things which were equal to the same thing were not equal to one another. We have here an intolerable disagreement with the law of contradiction, and the mind immediately rejects the conclusion. In other words, it abandons the physical continuum and constructs an ideal mathematical continuum where the law of contradiction is never violated. Even if we make our measurements with the most accurate instruments we possess, we experience the same contradiction. The differences which can be detected are much more minute, but the results obtained still present the characteristics of the physical continuum with the contradiction which is inherent in them.

When we pass from mathematics to the physical sciences, we find the same departure from the actual fact. Man makes the universe in his own image; he makes this world a reasonable world, willy-nilly; and he contradicts his experience if it is not in accordance with the laws of his mind. Whenever, in his works on physical science, he talks about a mirror, or a rod of sealing-wax, he never means an actual mirror or an actual rod of sealing-wax. He means a piece of glass or a piece of sealing-wax regarded from certain aspects.

He has become abstract—and in so far he has departed from the fact. When a chemist talks about a pint of sulphuric acid, he never means a pint of any actual sulphuric acid which has ever existed on this globe. He always refers to abstract ideas which are approximations to the fact; or perhaps it would be more correct to say, to which the fact is an approximation. As this procedure is inevitable, it is waste of time to discuss whether or not it is legitimate. Science remains valuable: all that occurs is that we understand more clearly what we mean by the "value" of science.

When, passing from the consideration of triangles, atmospheric waves, borax and beetles, we come to consider communities of men, the departure from the fact becomes so pronounced that it is doubtful whether results of much use have yet been achieved. Birth-rates and death-rates are pretty accurate, because to get these so little of what we mean by the term "man" is involved in our reasoning. We are concerned with man as an appearing and disappearing creature, and the same calculations would apply to a collection of reproductive and evanescent lamp-posts. But when we come to consider man from other aspects, when we fill in more of what the term "man" comprises, our difficulties increase. The factors become too numerous: we are forced to select and it is very questionable whether, in making our selection, we are not forced to omit too much.

In contemporary questions, as heated by politicians and leader-writers, the simplifying process reaches ridiculous limits. We read about "the working classes:" the phrase, expanded by those who use it, might reach a couple of sentences; it should reach a couple of volumes. We hear of "the labor question." What is the labor question? These simplifications are not only useless; they are unnecessary. There is another method of simplification. Let us describe men as creatures capable of love, pride, hate, loyalty, etc. These terms may not be simple terms, but they are at any rate, more simple than "the working classes." All classificatory terms depart from the fact, but the terms used in current political discussions depart so widely from the fact that their users, in most cases, have not the slightest realization of the fact they imagine themselves to be talking about.

Electricity

Shelling Nuts Electrically.—Out in California a centrifugal blower, driven by an electric motor, is being used in the shelling of almonds. Formerly the nuts could be shelled by hand only with the greatest difficulty. At the present time the almonds are fed into the suction side of the fan, where they are picked up by the runner and hurled against the fan casing, following which they are blown out of the discharge pipe into a box, already shelled.

Flood-Lighting Niagara Falls.—An expenditure of $10,000 for the illumination of Niagara Falls has been authorized by the City Council of Niagara Falls. This sum is to be expended in carrying out the flood-lighting scheme proposed by a Chicago concern, which promises to be so uniform as to eliminate dark spots in the center and wings. It is said that the projectors to be used will be so powerful that their rays will readily penetrate the densest mist, although the current consumption will be low.

Philadelphia's New Street-Lighting System.—On June 24 a new street-lighting system was placed in operation in Philadelphia, comprising 310 arc lamps mounted on ornamental poles on Broad Street. The present installation completes the uniform illumination of this thoroughfare, which now has 901 double arc lamps scattered over a distance of 10 miles, the total length of the street. The aggregate illumination of Broad Street is estimated at 642,000 candle-power, or an average of 8,000 candle-power to the block or square.

Hydrogen by Electrolysis.—One of the first commercial plants for decomposing water into hydrogen and oxygen was that at Waverley, Newark, N. J., according to *Metallurgical and Chemical Engineering*. The electrolyte used is an aqueous solution of caustic soda or potash. Each cell produces per kilowatt hour 8 cubic feet of hydrogen and 4 cubic feet of oxygen. The watts per cell are 800. The purity of the electrolytic hydrogen and oxygen is 99.8 and 99.6 per cent, respectively. The cost of hydrogen by this process is low.

Illuminating an Entire City by Flood-Lighting.—The city of Seal Beach, Cal., is now attracting attention because of the novel idea of illuminating the entire water front which has been carried out by the officials. A battery of 41 powerful searchlights, each being of more than 25,000 candle-power, has been placed on the outward edge of a long pier which extends out into the ocean from a point at the center of the waterfront. The illuminated waterfront may be seen far out at sea, while the searchlight beams are visible for miles inland.

Squeezing Lemons Electrically.—The latest novelty in electrical appliances is an electric lemon squeezer, which is especially intended for use in restaurants, hotels, soda fountains and other places where it is necessary to extract the juice from a large number of oranges or lemons. Briefly, the device may be described as consisting of a ribbed hemisphere which is rotated by a 1-10th horse-power motor. The lemon or orange is halved and held against the rotating member, with the result that the extracted juice is caught in a deflector at the back and carried down to a spout under which is placed a glass to receive it. The lemon squeezer is provided with a clamp for attaching it to a counter or shelf, while a ring is attached below it in order to accommodate a glass.

Electric Propulsion of Ships.—The efficiency and economy of the steamship "Mjölner," in which turbo-electric propulsion is adopted, were recently commented upon by the *Motor Ship*. The main machinery consists of two double-flow turbines, each driving a 400-k.w. generator and delivering power to a single motor, which drives the propeller shaft through reduction gearing at 90 revolutions per minute. It is reported in the *Electrician* that there are about 20 or 25 steamboats under construction in which similar machinery is to be installed, mostly of a low-powered type, usually of about 1,000 horse-power. The economy effected seems to be considerable as compared with reciprocating engines, although presumably the cost of installation is much higher.

Trackless-Trolley Battery Car.—In Bradford, England, the general manager of the municipal city tramways has shown not a little ingenuity in converting an old electric trackless-trolley car into an electric truck. At the present time the vehicle makes use of the overhead-trolley current supply while traveling along the tramway route, and by means of a storage battery which it carries it is enabled to leave the route and travel a distance of several miles on the stored up current. But one trolley wire is used, the return circuit being effected by a grounding device in the form of an extension of the steering arm, terminating in a contact shoe bearing on the track. The trolley supply voltage is 500, and that of the battery but 150. However, the latter is found sufficient to drive the car at a slow speed while journeying away from the tramway route.

Astronomy

Conjunctions of Venus and Jupiter.—Mr. B. H. Dawson has calculated the frequency of close conjunction of Jupiter and Venus, and finds that conjunctions as striking as that which formed so beautiful a spectacle last February occur at average intervals of from fifteen to twenty years.

The Great 72-inch Reflector, built for the Dominion Astronomical Observatory, Victoria, Canada, is complete, and was exhibited at the works of the makers in Cleveland on May 26. Invitations to attend the exhibition were sent to astronomers and other interested persons throughout the country.

Meteorological Causes of the Variation of Latitude—The motion of the terrestrial pole relative to the surface of the earth was shown by Chandler to consist mainly of two parts; viz., a circular motion, with a period of 430 days, and an annual motion in an ellipse. The former is considered to be identical with the free vibration called the polhode motion, or Eulerian nutation. The latter is generally attributed to meteorological causes. An elaborate analysis of these causes is published by Mr. H. Jeffreys in the *Monthly Notices*. The author examines separately the effects of atmospheric motion, oceanic movements, precipitation, vegetation, and polar ice. He concludes that "the known meteorological causes are apparently capable of giving a fairly good account of the observed annual motion of the pole, the errors found being perhaps within the range of uncertainty of the data."

Possible Planetary Magnetic Effects were discussed by Dr. L. A. Bauer at the New York meeting of the American Physical Society. It has been known for some time that there are certain irregularities in the motions of the moon too large to be satisfactorily accounted for by any known outstanding gravitation effects, and similar irregularities are also shown by the motions of Mercury, Venus and the Earth. Dr. Bauer raises the question whether these irregularities may be associated in any way with magnetic effects. As a first step in investigating this subject, a preliminary formula has been theoretically established for determining the field strength of possible magnetic fields enveloping those members of the solar system for which certain requisite constants are known. According to this formula, it appears that Jupiter and Saturn, and probably also Uranus and Neptune, may be enveloped by stronger magnetic fields than is the Earth.

Ptolemy's Star Catalogue.—A recent publication of the Carnegie Institution of Washington is a revision of the catalogue of stars found in Ptolemy's Almagest (138 A.D.), the earliest general list of star-places now extant, but generally supposed to be based upon that of Hipparchus, which gave the positions for the epoch 125 B.C. It includes 1,028 stars. The new revision is a work of great erudition, and its history is interesting. About 1876 the late Prof. C. H. F. Peters, of Hamilton College, conceived the idea of calculating, from modern observations, the latitude and longitude of all of Ptolemy's stars, embracing every probable star near Ptolemy's positions, corrected as far as possible for proper motion. About the same time Mr. E. B. Knobel, of London, undertook a similar project, without knowing of Peters's work. Later the two men worked in co-operation with each other, and after Peters's death in 1890 Knobel proceeded with the task alone. In the course of this work 21 Greek and 8 Latin codices of the Almagest were examined, besides 14 Arabic versions of the Almagest or of works based thereon.

A Proposed Machine for Computing Perturbation of the planets is described in a recent memoir by the Finnish mathematician, K. F. Sundmann, an extensive abstract of which has been published by Dr. H. D. Curtis, of the Lick Observatory. The machine which Sundmann hopes to construct will make the marvelous tide-predicting machines seem simple by contrast. Indeed, it is almost incredible that any one should think of solving by mechanical means the question of the perturbations of a planet over long periods of time; but on the other hand, as Dr. Curtis points out, with the ever-increasing list of asteroids (the number of which will probably pass the thousand mark in a few years), "if we are not to neglect any of these bodies, something in the nature of a 'perturbation machine' would seem to be absolutely necessary." Detailed plans of this "perturbograph" have been drawn, and it is believed that perturbations can be secured with it with an error of less than one per cent of their magnitude. The machine would have a speed of movement such that one revolution of Jupiter would take about seven minutes, so that an interval of ten days would correspond to one second. Two persons could set the instrument in about twenty-five minutes. "With the aid of proper auxiliary tables, it should be possible to determine the perturbations for all the oppositions during a revolution of Jupiter—*i.e.*, for about twelve years—in one hour."

Automobile Notes

Japan Now Building Cars.—Japan is now successfully building automobiles which are claimed to be well made and are produced at a low price. The output is not large, but is steadily growing, although the opportunities for using cars in Japan are extremely limited.

The British Embargo.—It is difficult to understand, under existing treaties, any justification of the British embargo on American motor vehicles. A further agitation is now on foot to extend this embargo after peace is declared until British manufacturers are able to take care of the home demand. In other words, the proposition is to stamp out the business that American manufacturers have spent so much time and money to develop. Such a procedure would be a plain abrogation of treaties, and if our Government were to make the action reciprocal, extending it to every kind of merchandise as would logically have to be done, the foreign schemers would probably gain a different point of view.

Testing of Tire Fabrics.—Because of confusion in interpreting the results of tests of automobile tire fabrics in the mills, the United States Bureau of Standards has made a study of the various methods employed and has assisted the fabric and tire makers in developing those best suited to produce accurate and reliable results. The conclusions reached have been published in Technologic Paper No. 68 of that bureau. This work was undertaken with the view to standardizing the more important methods of tests made upon 17¼-ounce cotton tire fabric. The chief causes of variation in test results were found to be differences in testing machines, size of test specimen, moisture in fabric at time of test, method of selecting samples, and in the fabric.

Rural Robbery.—Is there no way to limit the high-handed robbery that is regularly practiced on motorists by small town authorities in the neighborhood of large cities? A specimen case is that of a town in New Jersey, near New York. Funds were needed to pay for some local improvement, and it was decided to "put it on the motorists." There was a flower bed in one of the main streets, and although it made no difference on which side traffic passed, the authorities in secret session decreed that automobiles should take a certain side, and an officer was stationed to gather in the victims, who were summarily mulcted five dollars each. The loot of a single fine Sunday afternoon (for Sunday is the best day for this sort of pocket-picking) amounted to $375. These facts are on the authority of a resident; but the worst feature is that the prime movers in this discreditable undertaking were supposedly reputable business men of New York, who reside in this town, and many of whom are themselves automobile owners.

Needed Improvements.—Most of the so-called "improvements" on motor cars of late years have been in the form of catchy accessories that, while convenient, are essentially important for their advertising value, but to the really desirable mechanical features comparatively scant consideration has been given. Among these is one to which attention is loudly called almost every time a car is started by the discordant grinding of the gears whenever a change of speed is attempted; and even the most expert cannot always avoid these demonstrations of mechanical imperfection, for the methods of changing speeds on automobiles are unmechanical in the extreme. Of course, the public is used to this sort of thing and knows no better, and then again battered gears that cannot be made to run quietly foster the habit of buying a new car every year; but there is one factor looming up that is liable to compel a radical revision of the gear-changing mechanism, and that is the combined gasoline and electric drive, with its absolutely noiseless changes, that anyone can operate.

About Inner Tubes.—The great majority of automobile owners could save money by a better understanding and better treatment of their inner tubes. Because these tubes come packed in a cardboard box most people suppose this is a good way to preserve them when carried in a car; but the continued chafing caused by the motion of the car will sooner or later result in injury. Tubes should be carried in proper bags—and this suggests that the makers devise a more suitable method of packing, that affords protection whether on the shelf or in the car. Another point is using the right size of tube for the case. If too large a tube is inserted it wrinkles, and the tube chafes or splits at these points; while if the tube is too small it is constantly and unduly stretched, which is not conducive to long life. Tubes are so pliable that these points are apt to be overlooked by their users. As cases by different makers may differ in their interior dimensions, although nominally of the same size, it is best to use inner tubes supplied by the same makers as the case.

Spanish Moss

The Source of a Valuable Upholstering Material

By Samuel J. Record

SPANISH moss, also known as long moss, black moss, and Florida moss, is one of the most conspicuous and characteristic objects of a southern landscape. Massive live oaks owe much of their splendor as shade trees to the long gray festoons of moss that bedeck their branches, and whole forests may be similarly bearded. Its range is along the coast from Texas to Florida and eastern Virginia, extending southward to southern Brazil. In a part of its range it is more than a mere addition to the landscape, for in Louisiana alone it is the basis of a million-dollar industry.

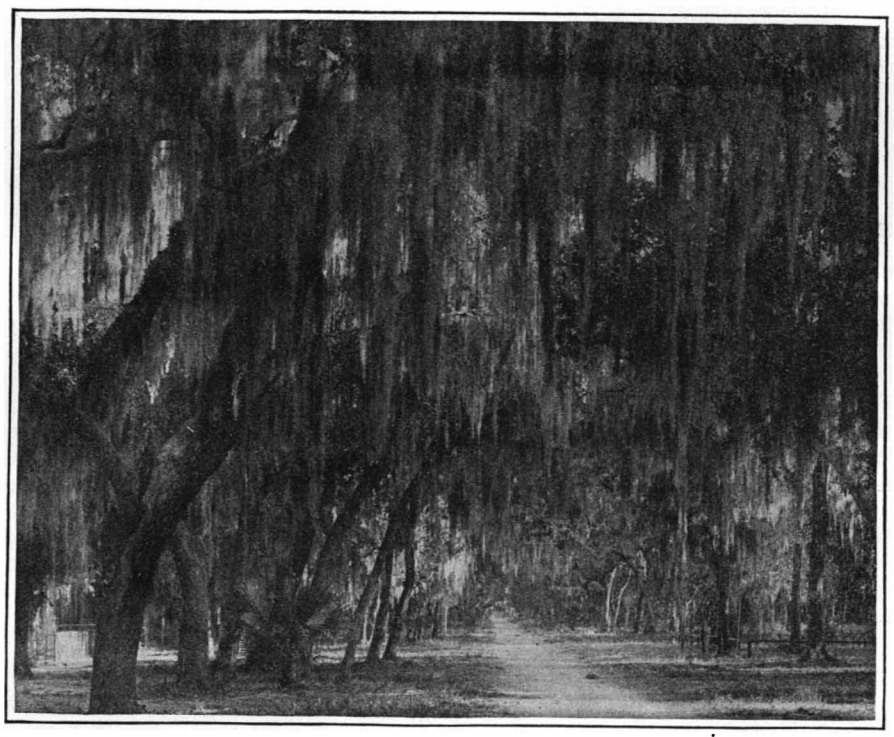
Spanish moss is a moss only by courtesy. It is a flowering plant of the pineapple family (*Bromeliaceae*), much higher in the scale of plant life than the true mosses. It is a true epiphyte and not a parasite; the trees furnish it lodging, but it derives its sustenance from the air. In ordinary terrestrial plants water is absorbed from the soil through the roots and makes its way to the leaves through conductive tissue; the food elaborated in the green leaves is then transmitted to all other parts of the plant through the sieve tubes of the phloem. In Spanish moss the vascular system has degenerated and there are no roots. The source of water supply is atmospheric; the plant absorbs moisture through the tiny scales that cover every part of the stem and leaves. The water also provides the necessary salts, dissolved from the dust in the air or from tiny particles lodged on the bark of the tree or collected under the scales of the plant itself. Since all of the living cells either contain chlorophyl capable of elaborating the necessary carbohydrate food or lie alongside other cells that do, there is no need for an extensive delivery system; hence the absence of functional phloem.

Although the available water supply of Spanish moss is subject to considerable irregularity, the structure of the plant is such that it can readily tide over the periods of drought. Professor Billings of Louisiana State University hung a small festoon of moss in a closed dry room for 19 days without water. He states that it "lost 23 per cent in weight during the time, but when placed in water it absorbed as much as it had lost, and remained a healthy plant, showing that it had not really suffered injury by exposure to drought. There is occasionally, of course, a similar drying process in the open air when drought occurs. During the dry spell in the spring of 1902, moss plants were known to have been subjected to two months of rainless exposure without injury."

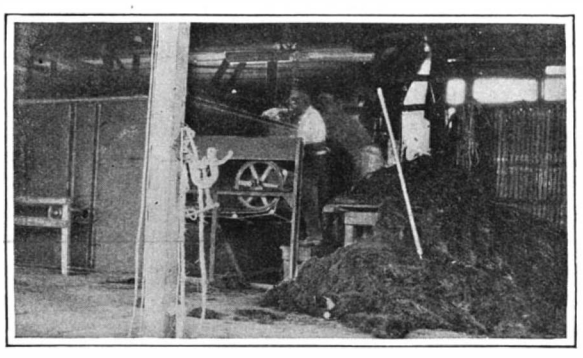
If one examines the festoons of moss he finds a tangled mass of string-like, spirally zigzag stems varying in length from a few inches to many feet. The narrow awl-shaped leaves are scattered along the stem and in their axils are borne the green flowers. The latter are small, inconspicuous, and fragrant, and appear in considerable quantity in May and June. The formation of the seeds is slow, and it is not until the following March that they are dispersed. Each seed is covered with delicate, barbed hairs, three-fourths of an inch long, which render it sufficiently buoyant to float long distances in the air, and assist it in finding lodgment in the bark of trees.

It seems, however, that the plant does not depend upon its seed for its distribution, as seedlings are uncommon. The most usual method of propagation is by fragments of festoons carried from one tree to another by high winds or by birds. When a fragment finds lodgment in a tree, the living portion of the stem passing over the limb dies and sloughs away, leaving the central fibrous portion to hold the plant in place for years. Trees with dense evergreen foliage tend to ward off the wind-blown pieces of moss. This accounts in part for the irregular local distribution of the plant and its apparent preference for certain kinds of trees as its host.

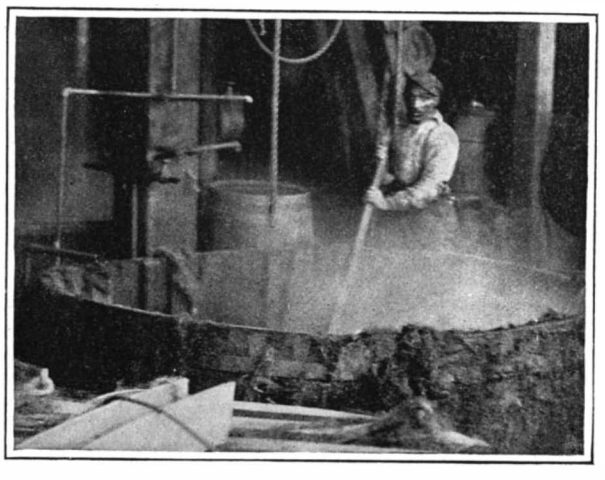
The ability of the dead central axis of the moss to sustain the weight of the living moss for a long time testifies to its durability and toughness, and it is to these characters that the plant owes its economic value. The local use of Spanish moss for bedding and upholstering material dates back many generations. The commercial exploitation of it is, however, comparatively recent, and is, for the most part, restricted to Louisiana. In 1878 the Government chemist made an investigation of Florida moss to see if its composition bore any resemblance to the reindeer moss which in Sweden is subjected to fermentation, producing alcohol. He found that, whereas reindeer moss contained 79.9 per cent of lichenin or moss starch, in Florida moss no starch or sugar in appreciable quantity existed. He further noted that 40.9 per cent of the Florida moss consisted of crude fiber, which comprised only 5.6 per cent of the reindeer moss. The problem of the moss industry is to recover this fiber and preserve its natural properties of pliability, strength and resilience.



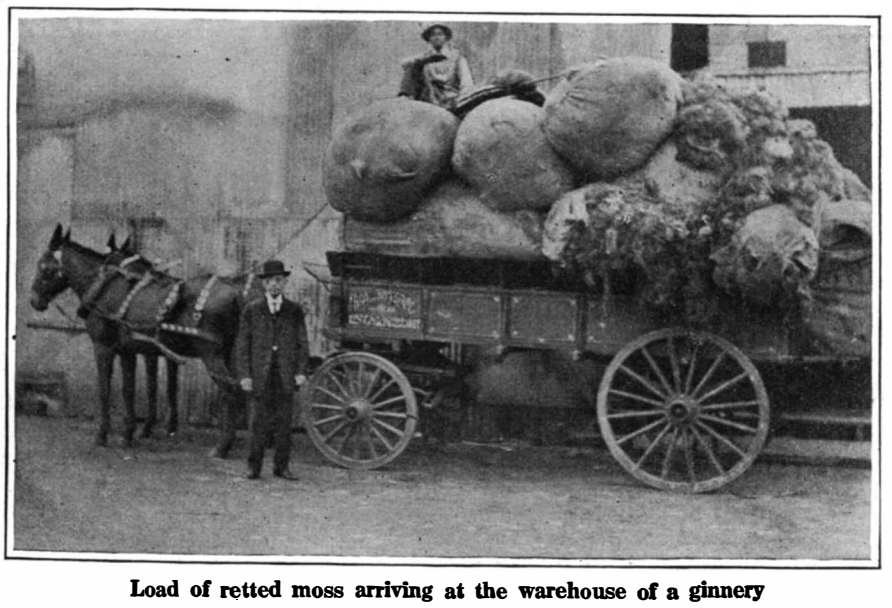
Spanish moss on trees in Florida, showing its characteristic habit of growth in festoons



Kiln-drying dyed moss in a southern plant



Dyeing of moss in a large vat



Load of retted moss arriving at the warehouse of a ginnery

The gathering of moss proceeds the year round. It is picked up from the ground, where it has blown from the trees, collected from felled trees, and picked or pulled from living trees. It is most abundant in marshy or swamp land or in localities where fogs are common. In deep swamps boats are used by the pickers, who pull down the moss with sickle-like hooks attached to long poles. The work is mostly done by negroes at odd times or when other employment is slack. The pickers receive about 20 cents per hundred pounds for the green moss.

The next step is the retting process, similar to the treatment of flax to obtain the fibers. The fresh moss is piled in ranks about four feet wide, four feet high and any length, and thoroughly wetted. In about a week the pile begins to get hot from the action of the water. The bark or outer covering loosens and disintegrates, leaving the inner hair-like strand, which becomes darker and darker as the process continues. It is customary to turn the moss two or three times during the heating in order to make the produce uniform.

Moss is marketable at the end of two or three weeks in the pile, but it is nothing more than dead moss and commands the lowest price, about a cent and a half a pound dry, at the ginnery. After the moss has been down in the pile for five or six weeks much of the gray coating has disappeared, while at the end of ten or twelve weeks little but the fiber remains. The bulk and weight diminish, of course, during this process, but the increase from a cent and a half to three and a quarter, or even four, cents a pound more than offsets the loss.

There is a limit, of course, to the profitable duration of the retting process. This is shown by the experience of an operator who, in the winter of 1914, picked 275,000 pounds of green moss, piled it without wetting, and left it in the pile until September, or about nine months. The yield of fiber in this case was only 12.75 per cent. Even after this length of treatment the moss was somewhat red in color, and brought only two and one-half cents a pound f.o.b. his place. The financial results of this operation were as follows:

Cost of gathering moss, 275,000 lbs.....	$550
Cost of retting and baling.....	200
Total cost of 34,000 lbs. retted moss.	$750
Sale value of same at 2½ cents per lb...	860
Net profit.....	$110

Last year this operator bought a force pump and 25 feet of rubber hose and wet his moss as soon as bedded. The material was turned three times while retting and allowed to remain in the pile 90 days. The yield in this case was 25 per cent of black moss worth 2¾ cents a pound at his place. Had these results been secured in 1914, the gross returns on 275,000 pounds of green moss would have been $1890 instead of $860, and the net profit about $1100, or ten times that of 1914. This operator plans to increase his output for 1916 very materially, as there is good money in the business when rightly conducted.

When the retting process is complete

the moss is dried, as the dealers prefer it in a dry condition and deduct liberally for dampness. In traveling through the moss-producing regions of the South it is not uncommon to see fences, racks, sheds and clothes-lines covered with moss exposed to the wind and sun. One or two days are sufficient for this purpose. It is then baled or bagged and hauled to the nearest store. The store-keepers ship it to the ginneries, some of it traveling 200 miles.

Up to a few years ago all moss was cleaned by hand, and this had one advantage of not breaking the fibers. The process is expensive, however, and is now largely replaced by special gins, which remove all the loose bark, sticks, dirt and various kinds of foreign matter, and leave only the dark-brown or nearly black fiber. These gins are of the same construction as hair pickers, only much larger. The loss in weight due to ginning is for the best grade of retted moss about 25 per cent.

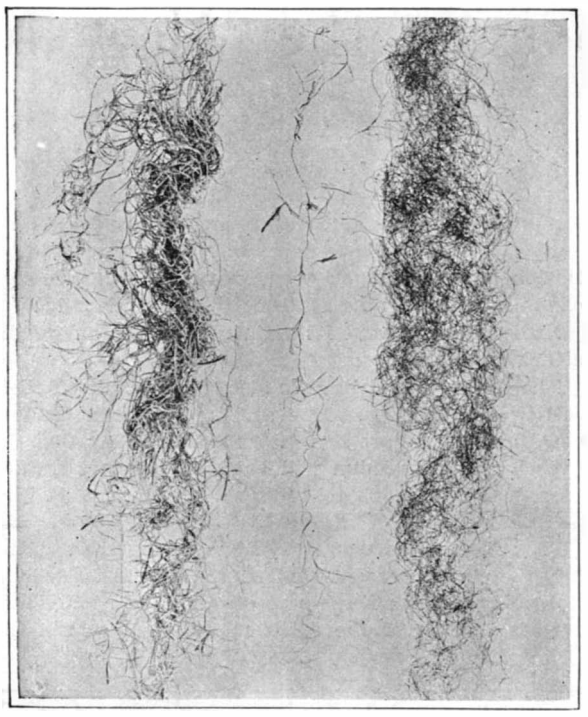
The equipment of a high-grade moss ginnery the writer recently visited consisted of a warehouse or storage shed for the moss both before and after ginning, a double gin, a baler or compress, two dyeing vats with crane and platforms for removing moss, a dry-kiln for drying the dyed moss, and the necessary boiler and engine for operating plant. The chaff from the gin is used for fuel under the boiler. The work of ginning is very dusty, but negroes seem not to mind it.

The dyeing vats hold about 1,000 pounds of dry moss, or 1,800 pounds of wet. The dyeing process employs sulphate of iron and requires about 20 minutes; the capacity of one vat and one kiln is from 35 to 40 bales per day. The moss is removed from the vat in about two minutes by means of a platform and crane as against an hour and a half when forked out by hand. It is fed into the drier by two operators. This kiln is 60 feet long and 6 feet wide, with 3 feet additional for the steam pipes, there being 5,300 feet of 1¼ inch pipes in a kiln. The temperature varies from 220 deg. to 240 deg. Fahr., and the time for the wet moss to pass through and come out at the other end thoroughly dry is 18 minutes. In this form it rather closely resembles horse hair, and is used for the same purpose. It is known to the trade as "Spanish hair," and sells for about 10 cents a pound. It can readily be distinguished from horse hair by pulling a strand between the thumb and finger and noting the numerous little knots or joints. Horse hair is smooth throughout its length.

Only the moss for the most exacting trade is dyed. Of the other there are the following grades: XX, worth, according to the best quotations available, 4½ cents a pound; XXX, 5½ cents; XXXX, 6½ cents. All ginned moss is put up into bales weighing from 175 to 200 pounds each, much like cotton, except that the edges of the bales are protected by wooden slats.

The force required to operate such a plant as described is about as follows: one fireman, two ginners, two kiln feeders, one dryer, one baler, and from three to five others for receiving, weighing, moving, and shipping the moss. All employees in the ginnery described are negroes, including three or four women.

Moss is not as good as hair for upholstery and padding, but it makes the best substitute known and costs only a fifth as much. It is very often used in mixture with hair and gives good results. The great development of the automobile industry affords an extensive market for the moss, and is stimulating the business materially. Although at present confined mostly to Louisiana, there seems to be no reason why it should not be extended over a very much wider portion of the South.

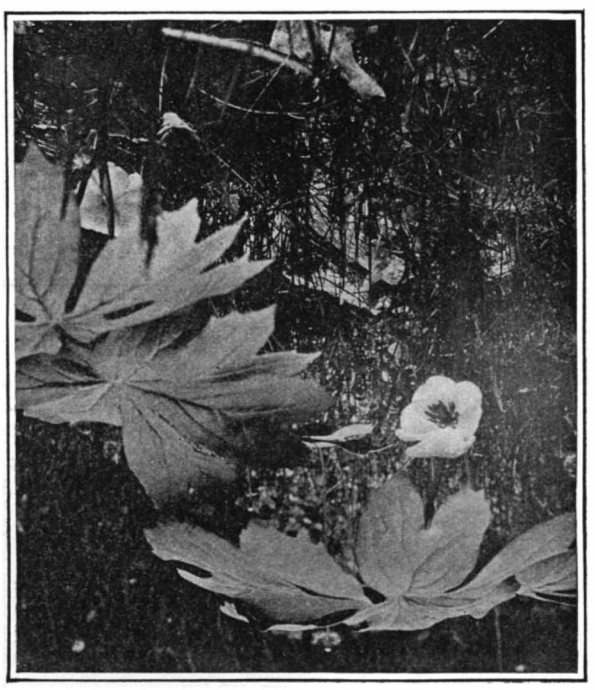


Spanish moss

At left: A festoon of live moss. In middle: A single strand of live moss in fruit. At right: Moss after retting, ginning and dyeing.

Mandrake Root as a Source of Income

THERE are several small opportunities which the American farmer often loses sight of in his general desire to grow and to harvest large crops, with the thought that there will be correspondingly large returns. He is apt to overlook the combined results which may be gained through the proper handling of many small crops of the field and forest. The European farmer keeps strict account of these and in the aggregate reaps a rich reward for his thrift. Americans still have far to go in intensive cropping before they will get the most from their land. For example, there are on most farms waste places, odd corners, or low areas which are generally considered unproductive of anything of value. It will be of interest, however, to owners of such land to know that a number of the so-called weeds and bushes which grow wild and often in great profusion along fences and in the woods have a commercial value, and can be collected and prepared for market with comparatively small expense. For example, the little plant which is the subject of this article, and is one of the ever-present weeds in all uncultivated areas of the farm and forest east of the Rocky Mountains, produces a root stalk so highly esteemed for its medicinal virtues that thousands of pounds are collected annually and sold to botanical druggists for domestic use and for export.



The mandrake plant, showing the characteristic leaf and flower

The main object of this article is to point out that there is ample opportunity for farmers in many sections of the country to add to their income by the collection of the root of this plant growing on waste land and in the forest. The mandrake is perhaps one of the best known plants east of the Mississippi River. It is popularly known also as May apple, duck's foot, hog apple, raccoon-berry, wild lemon, etc. Botanists refer to it under the name of *Podophyllum peltatum.* The generic term Podophyllum, which is also used as a trade name, is derived from the Greek *pous*, a foot, and from *phillon*, a leaf, from a fancied resemblance of the leaf to the web-foot or a duck. The plant has a simple, upright, round, smooth, yellowish-green stem about a foot in height, supporting two large, shield-like, deeply lobed leaves, with a single white flower in the fork formed by the junction of the two leaf stalks. The flower develops an egg-shaped fruit about the size of a small lemon. The latter is edible and is relished by some people. When fully mature, it is a lemon yellow color, indistinctly spotted with small brownish dots. The pulpy matter is said to be an excellent substitute for calomel, and may be eaten in considerable quantities without an unpleasant effect. The fruit has, however, no commercial value.

The leaves, stem and roots are poisonous and contain active medicinal properties. The active principle used in medicine resides in the underground parts. The part of the plant collected for the market consists of the creeping underground stem or rootstalk, which is, technically speaking, a rhizome. It is usually from 3 to 6 inches below the surface of the ground, and is from 2 to 5 feet in length and from ¼ to ½ of an inch in diameter. It is smooth, chocolate-brown in color, round, interrupted by nodes or joints, and gives use to a number of small fibrous roots which proceed from the joints of the rootstalk.

The mandrake is exclusively a native of North America. It grows in great profusion in moist and rich, shady woods from Canada southward to the Gulf of Mexico and westward to the Rocky Mountains. It is very common also along streams and along fences in cultivated fields, and not infrequently in open and exposed situations; but it is almost never found in permanently dry soil. Every one who is familiar with this plant knows that it delights in moist soil, being most luxuriant in permanently moist places covered with a leafy litter or green sod.

(*Concluded on page* 69)

A Curious Garden Trick Explained

A FEW years ago some of the leading English horticulturists were very much perplexed by certain experiments conducted by a French exhibitor. The demonstrations were conducted in a very open manner, every one was allowed to examine freely, and it was agreed that there was nothing of the ordinary conjuring trick about the plan.

This is what the observers saw. A plant, perhaps a geranium or a rose bush, was brought forward in a large deep box of soil. Sometimes the plant was just growing in the open border. Although the specimen was full of buds there were no expanded blooms to be seen. The demonstrator informed the onlookers that in about ten minutes he would have the plant covered with widely opened flowers. The procedure started with the watering of the soil over the roots. As soon as the ground was moist, the whole plant was at once covered with a glass shade. At the end of ten minutes the shade was removed, and the audience was amazed to see that the specimen

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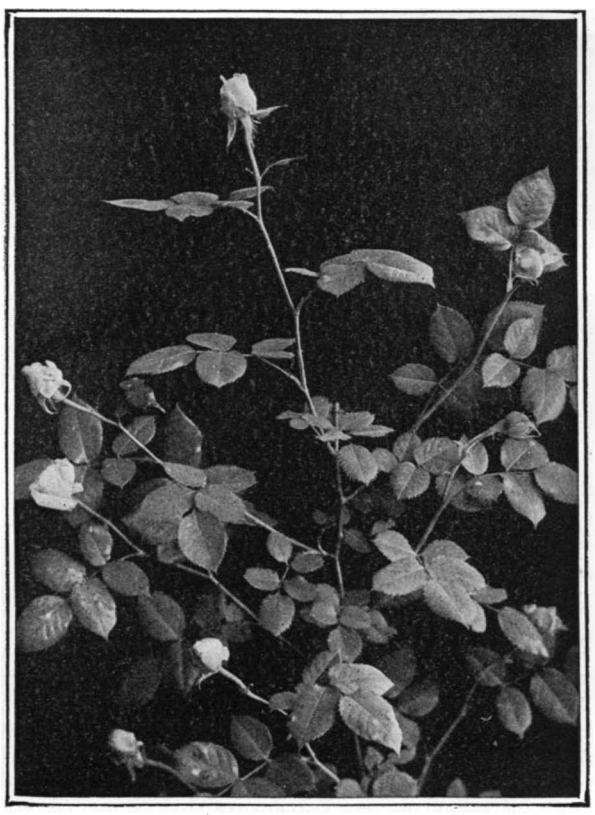
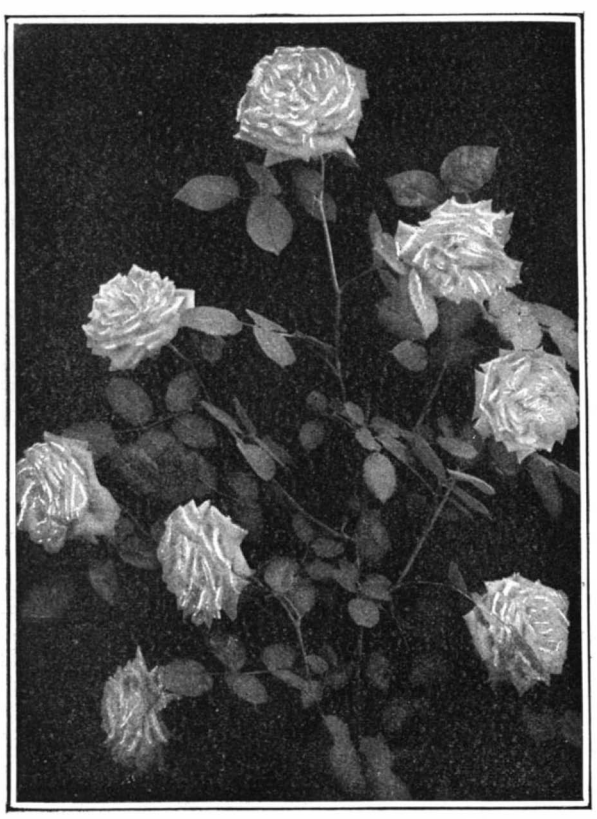


A rose bush before treatment



—and ten minutes after

Strategic Moves of the War, July 7th, 1916

By Our Military Expert

THE inevitable which has been foreshadowed for weeks, the only possible answer which could exist to the question of the long inaction of the English armies, has come at last and the great Entente offensive on the western front is in full blast. That the time for it was at hand was clearly indicated last week by the tremendous volume of artillery fire which was concentrated upon the German lines from the Somme to the sea.

The result of the grand attack cannot be measured in terms of villages gained, miles won; whether it is to be a success or a failure cannot be determined until time shows that material strategic gain has been made or that such gain has failed to materialize, and the offensive is yet too young to permit any perspective.

There are, however, certain factors which should go far toward determining probabilities. The most important is that with practically two years of war behind them, the forces now on the general offensive for the first time should have the benefit of experience to their credit, as to the number of men it will be necessary to sacrifice to carry a given section of a hostile series of defenses, the number needed to carry through, the amount of all-important artillery ammunition necessary to blast a way through the lines and the probable time necessary to achieve a given distance. Germany, when she concluded to center her attacking activities upon certain points had nothing to go upon but theory, and theory has not consistently worked out:—witness, the attack upon Verdun. It is most reasonable to assume that Germany would never have given the tremendous effort she has to an attempt upon so powerful a military point without the promise of material gain in case of success; and unless she believed success possible, she would never have made the attempt. There has been a fly in the ointment somewhere.

With these lessons fresh in mind, with every aspect of the situation closely scanned for informative disclosures, Britain has devoted every effort to the completion of the vast forces which constitute the legacy of Lord Kitchener to his country, that they should be ready at the propitious moment for attack. The men have been organized into units and trained; their officers have been clothed with authority and, as far as possible, trained; almost incomprehensible quantities of munitions, rifles, equipment and shells, shells, shells, have been gathered for the mighty effort. And on top of the local preparation of British troops, for the first time since the war began the various elements of the Entente allies have managed to co-ordinate their movements so that simultaneous action is taken on all fronts but one—Saloniki—which will probably become engaged within a short time.

Every movement seems to have been carefully considered. So far there has been no repetition of the half-baked efforts which foredoomed to failure the sporadic efforts of the small local offensives launched on the western front at various times. One of the most significant items which has appeared in the dispatches, an obscure little item tucked away in an unobtrusive corner of the newspapers which have published it, is to the effect that no matter how quickly immediate objectives have been gained in the recent assaults and no matter how elated the stormers might be, there has not been the slightest effort to advance an inch beyond the point of advance called for in the schedule of attack. This means much. It means that there is to be no disunited action, no surging forward of the line here and there beyond flank support, and most of all, no attempt at progress until the concentrated fire of a thousand batteries has made the way feasible, thereby saving all important life that the price of advance be not too high to pay.

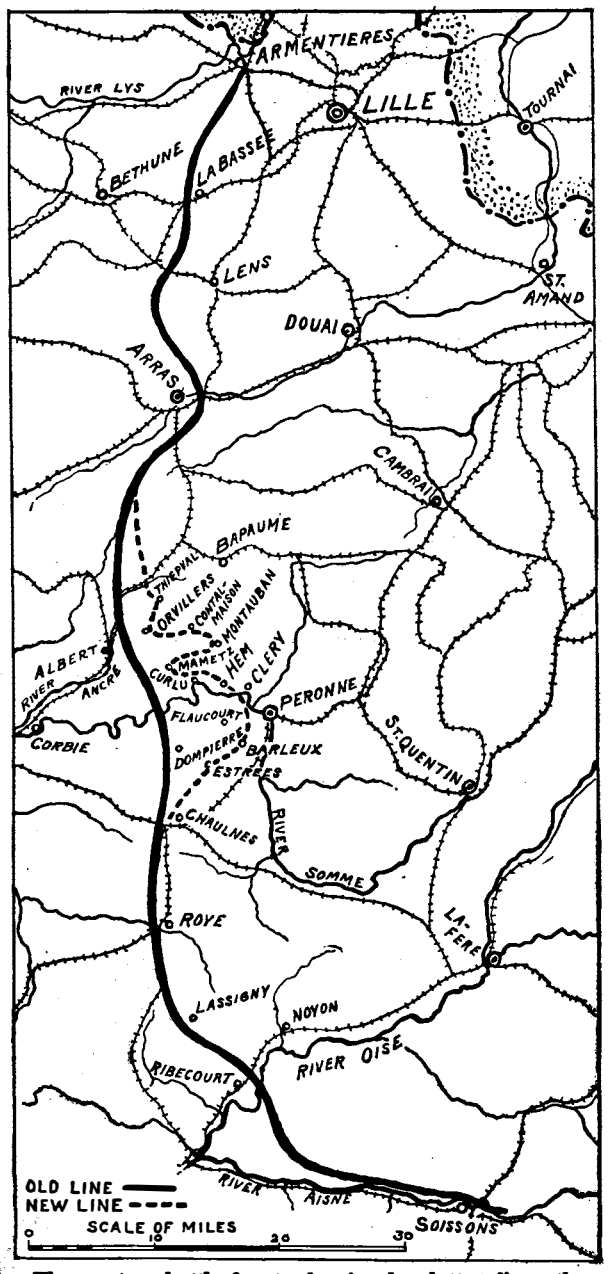
There was no secrecy about the launching of the attack, for with methods of modern trench warfare it was impossible to conceal the preparation for it. From the sea to the Somme the great artillery of the Entente pounded the opposing lines for six days, while the Germans massed troops and reserves to meet the assault. But there seems to have been a slip-up somewhere. Perhaps they were overconfident that the main attack would be launched by the English alone, they figuring that the French had all they could do at Verdun. It came as a total surprise when a powerful French offensive, flanking the English to the southward, straddled the Somme; and as the German reserves were gathered to the north of the river, there were fewer than normal to resist the French advance. The result has been that the French have made two feet of gain to one by the Englishmen and now, within less than three miles from the important railway center of Peronne, that point is strongly threatened with speedy capture.

It cannot be said that Peronne will fall immediately; this is contingent upon a successful carrying through of the attack. But the assault will make this gain:

Either Peronne and its vicinity will fall before the attack or:

The Germans will have to attempt to break off their activities at Verdun. Men are the important factors now, for reserves are scarce. It is safe to say that the French now at Verdun will bend every effort toward forcing the Germans to continue in strength at that place.

It is about time that the Allies got together. Thus far, they have seemed content to let the individual states of their membership go off on a little individual offensive whenever the spirit moved them—when the



The western battle-front, showing by dotted lines the advance of the French and British up to July 6th

state of the ammunition larder permitted. Now they appear to be working in unison, for in addition to the rather insignificant Italian offensive, which is merely following up the retirement of the Austrian lines, weakened to meet the thrust of the Russians in the south, Russian force seems surging up like a cataract. Not only is Bukovina practically cleared of Austrians, but it is reported that Cossacks have crossed the Carpathians and have raided into Hungary, the invariable prelude to an advance in force. But, more surprising yet, with all the force with which Russia has prosecuted her offensive south of the Pripet, she has nevertheless been able to find additional forces to throw along her northern line and seems to have made a sag in the enemy line near Baranovitchi.

Dispassionately, the moment appears a critical one for Germany, one not in the least belittled by the admissions and tone of the German press. Beyond a shadow of a doubt, it is possible for Germany to definitely check the Russian offensive, or to hold the Franco-British in the west—but it looms as a terrific task to check them both. With offensives battering at her lines east and west, the moment should be past when Germany can shuttle great masses of troops back and forth at will, striking a heavy blow here, consolidating gains, then another blow there. The constant local sorties which are reported on both lines by the various Entente forces have been merely tests, to determine whether the enemy was in force, whether reserves have been detached for service at other points. These sorties are so constant that they furnish a very sure indication of strength in front of them, and any weak point will be pounced upon.

If Germany has to retire on either line, it is a question as to which front she could give on with the least cost to herself. As matters now stand, Germany holds thousands of square miles of an enemy's territory on the east. Retirement here would cost her little but the releasing of conquered ground, not her own; and the distance separating her present line from her own territory is much greater on the east than on the west; she should therefore be more willing to give ground here than on the west—unless the High Command fears the momentum of the Russian armies should they once get under full swing. Russia is so much better organized now than at any other time in her existence as a power that it would be a very difficult matter to establish lines upon which she might be held farther west, once the present Teutonic line gives way.

If Germany should give way on the west, however, the moral effect to the Entente of clearing France and Belgium of invaders would be monumental. Germany, with her vastly superior military and political organization, has fought a most marvelous fight against tremendous odds in man-power and resources, and she has been sustained by a national confidence in the prowess of her arms; to her people, trained as a military people, Germany has typified the invincible, and every citizen has willingly given his all in the strength of his belief. But once this belief should become shaken, the very overpowering factor of resources massed against her must beat into the consciousness of her people; and a country with shaken morale cannot fight to the last ditch for—nothing.

Germany is by no means at the last ditch, or anywhere near it. It has been a conviction of the writer's that if Germany chooses to continue the struggle to the end, in the hypothetical case that her lines are definitely broken on one or more fronts, with her military ability and resources, coupled with the importance of the possession of ideal interior lines of strategy, the real battles will not begin until she is thoroughly on the defensive on or in rear of her own frontiers. But what would the gain be in a war of attrition, man given for man, the theoretical time come when, outnumbered in man-power two to one, she could not place another man on the line while her enemies possessed millions of reserves? At the beginning of the war the available man-power stood: Entente, 28,000,000; Teutonia, 14,000,000. Arithmetic cannot be denied.

The steps gained in the development of the French-British offensive are of little moment; the object of the succession is to carry the offensive far enough on a broad enough front, to break the line and the deadlock and again permit field maneuvering and fighting. The attack was launched on a front, after artillery preparation extending much farther, from about eight miles south of Arras to a point southwest of Chaulnes, a distance on an air line of about thirty miles. The British carried, after sanguinary encounters, the villages of Thiepval, Orvillers, Contalmaison and Montauban, with Mametz farther south. This thrust forced a deeply indented salient, the southern limit of which was formed by the French, who took Curlu, then, opposite Clery on the south bank of the Somme, thrust forward beyond Flaucourt to within three miles of Peronne, the right of the thrust sweeping to the southeast, bringing the main railway of supply to Chaulnes under such intense fire as to render it unavailable to the Germans. The line then sags back toward the original French front through Barleux and Estrees, after which it gradually joins the old positions to the southward.

By the time these lines go to the printer the situation should be materially changed, ancient history, for the fighting continues unabated. The first objective of the drive is Peronne, which is of local importance, being the railway junction which supplies the sector before it. Of far greater importance, however, is St. Quentin, scarcely eighteen miles to the southeast, for this point controls the supply of a more important and a broader field. Should Peronne fall, it would but establish a base for further operations against St. Quentin.

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.]

Dividing an Angle into Five Equal Parts

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 5th, Mr. William S. Chapin gave a method of trisecting an angle and asked for methods of dividing an angle into five, seven, or eleven equal parts. The following method of dividing an angle into five equal parts, like Mr. Chapin's method of trisection, is not a pure ruler and compass construction. It is, in fact, similar to his method, having been suggested thereby.

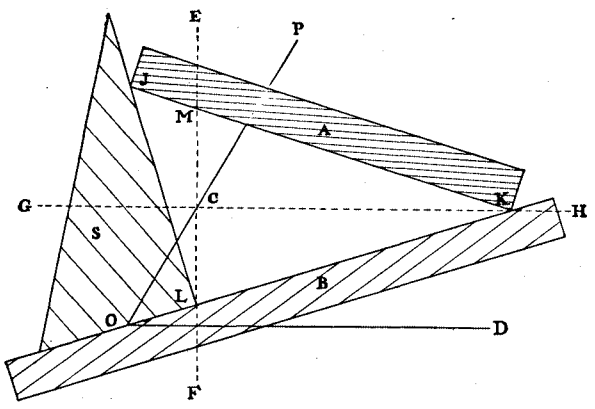


Fig. 1

Given angle POD, Fig. 1. Through any point C on OD draw EF perpendicular to OD and GH parallel to OD. On a card or ruler lay off JK = 4OC. Place a second straight edge B in some such position as indicated, just so it passes through O. Against B place a set square S with right angle L falling on line EF. Place A with K at intersection of GH and edge of B, and with J falling where it will on edge of S. Now shift the system A, B, S, maintaining *all* these conditions, till CL = MC. Then angle KOD is one fifth angle POD.

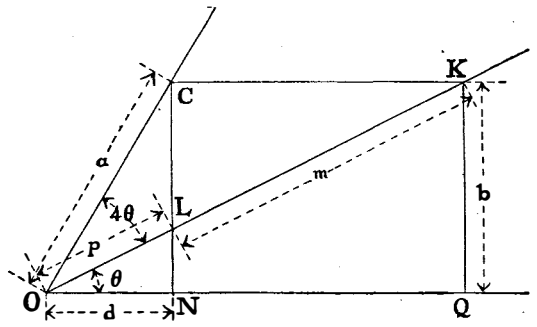


Fig. 2

Proof: In triangles OQK, ONC, Fig. 2,

(b =) a.sin5θ = (m + p)sinθ.....(1)

In triangles ONL, ONC,

(d =) a.cos5θ = p.cosθ.....(2)

Eliminating p from (1) and (2), and effecting a trigonometric transformation, we get

m = 4a.cos2θ .....(3)

On the other hand, in the equal triangles MCK, LCK, Fig. 1, angle MKC = angle CKL = θ.

Then in right triangle JLK,

LK = m = JKcos(MKL) = 4a.cos2θ.....(4)

And comparing (3) and (4), we see that angle POD is five times angle KOD.

A. T. JONES.

Northampton, Mass.

A Fight for Naval Fuel

To the Editor of the SCIENTIFIC AMERICAN:

In all the agitation over preparedness and in all the visible effort to that end, there is being overlooked a vital factor which, permanently ignored, will practically destroy the American navy. The Navy Department is confronted with no less a calamity than finding itself destitute of sources of liquid fuel upon which all its capital ships are now solely dependent. These ships —some actually in commission, some in process of construction or design, others in contemplation as units in the new five-year building programme—are intended to burn oil instead of coal, giving them the benefit of greater speed and endurance at sea, and placing them in a class comparable with war vessels of other nations.

The experts who are responsible for the development to a maximum of the fighting efficiency of our fleet realized some years ago the full value as a military asset of the substitution of oil for coal as a naval fuel. To meet the demand produced by the prompt recognition of the situation by our rivals the vessels burning oil exclusively were designed. At the same time, about 70,000 acres of oil lands in California were set aside as a naval petroleum reserve to insure a permanent and adequate fuel supply for these vessels. There was no doubt in any quarter of the necessity of these steps.

Some idea of the demand for oil as naval fuel may be gained by noting the increase in its consumption from 137,587 barrels in 1911 to 600,000 barrels in 1916. Every battleship added to the fleet will increase the yearly peace consumption by about 90,000 barrels, every destroyer by some 20,000 barrels; when the nine battleships and seventeen destroyers now authorized are added to the fleet the annual peace consumption will be about 1,750,000 barrels, exclusive of the oil used by the thirty-seven submarines and six auxiliaries authorized. In the event of war it is estimated that the consumption would be three times this amount, or over five million barrels. The necessity of a sure and adequate supply is obvious.

Moreover, in order to profit fully by the use of oil for fuel, ships are so constructed that the space which would be utilized for coal storage in coal burners is used for other purposes. Hence, when a ship is once built to use oil, she cannot be converted to use coal without practically rebuilding her at a cost comparable with that of a new vessel, and with a reduction in speed and cruising radius.

The Navy Department does not desire to produce oil from the Naval Petroleum Reserve at the present time and does not want the oil converted into money at any time. It does want the oil conserved underground where it may be stored without cost and free from loss by fire or evaporation until the decreased production and increased market price render its production and use desirable. This was the purpose in creating this reserve and it is still the desire of the Department to utilize these deposits as a reserve to be depended upon when an adequate supply of fuel oil is not available at a reasonable cost.

There is a difference of expert opinion as to the date when the supply of oil will be exhausted in this country. One view is that "the Navy Department may rely upon the reserves already existing for a supply of fuel oil for a period greater than the life of any battleship to be constructed within the next decade." Another view, entertained by the Geological Survey, is that, at the present rate of consumption, oil will be gone in about 25 years or hardly before the present five-year naval building programme is completed. The Interior Department has notified the Secretary of the Navy: "The failure of the oil supplies in the United States will not take place suddenly. The decline will be gradual and will tend constantly to be checked by rising prices. This is illustrated by the fact that in the oldest field in the United States, Pennsylvania, where production was important as early as 1861, recent increased prices have changed a former decline, sometimes as rapid as 15 per cent., into a slight increase for the year 1912. Production from fields abandoned earlier may be resumed when prices advance to a point which permits of more expensive extraction at a profit. Declining production and increased demand will be announced by rising prices, but there will be no sudden cessation of supply. Indeed, it is believed that the decrease in California will be much less rapid than the increase has been. The latter has risen from 24,000,000 to 81,000,000 barrels per annum during the last decade, and one of the older fields, that of Kern River, maintained a nearly constant production for nine years before decline began."

At the same time, the naval officials are apprehensive —and they have a right to be—that, unless the oil is conserved by the protection of certain oil lands to the Navy Department, the ships designed to burn oil will be found without that special fuel upon which they must depend, with consequences that are fatal to their availability and usefulness.

Precipitation of this very state of affairs is threatened by legislation now pending before Congress proposing to take from the Navy Department its rights in the Naval Petroleum Reserve and lease these lands to claimants whose rights in the matter are of the flimsiest character, being based for the most part on alleged placer operations conducted under the placer mining law which formerly applied to the petroleum lands. That these laws and any claim made under them are necessarily a misfit is clear from consideration of the fact that placer laws are drawn to cover the exploration for and discovery and production of precious metals which are discovered practically at the surface with expenditure of very little money, whereas to discover oil it is necessary to drill a well at cost of months of time and thousands of dollars. Of course, some few of the placer claims are legitimate—some good may be found in any company—but most are regarded by the Navy Department as deserving no consideration whatever. All, quite impartially, will come into the possession of valuable lands to the exclusion of the national needs if the legislation now before Congress is not checked.

The consequences are easily to be imagined. Lacking its own sources of supply which shall produce the fuel in quantity adequate to the needs of the service and at cost which is at least under control, our ships must obviously return to coal as fuel, with the loss in fighting power which such a sacrifice implies. Our navy would thus suffer a fatal deterioration as compared with any possible enemy, regardless of numerical strength. The proposed legislation, in plain language, is an invitation to defeat; and it is with knowledge of that disastrous sequel that the naval authorities are making this fight for the existence of the fleet.

JOHN E. JENKS,
Editor, *Army and Navy Register*, Washington, D. C.

The War Game

To the Editor of the SCIENTIFIC AMERICAN:

The use to which your War Game was put by Mr. H. S. Gladwin as outlined in your issue of the 10th is quite interesting. It is especially interesting to the writer as he has used your War Game in conducting sand table maneuvers with the non-commissioned officers of Company K, 3rd Reg., I. N. G. The practice has been to read the articles, then ask the questions and in answering them have the different men formulate their plans and issue orders down to the smallest unit.

It will be a disappointment to us to have the War Game end. It certainly has been an advantage to us to be able to follow it.

RALPH HINCHLIFF.

Rockford, Ill.

A Typewriter that Prints Advertising Copy for Printers

ADMITTING that the business of advertising has attained the standing of a science, to be impartial it is necessary also to admit that the planning or "laying out" of copy for printers has been a crude process until recently. It has been the practice roughly to sketch by hand the larger or display type lines, and indicate with pencil lines or squares the position and tentative extent of the smaller or body type lines. In some instances copy writers have typewritten the body type matter on the layout sheet; but, needless to say, in most cases the typewriting is out of all proportion with the printer's type.

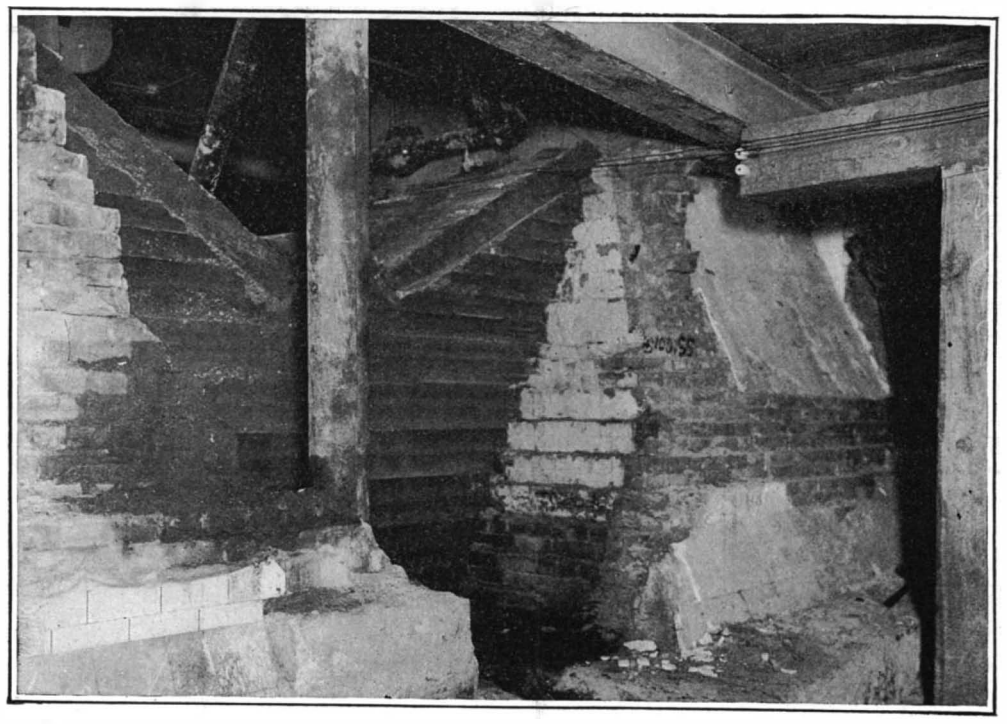
Thus it will be seen that the relation between the layout sheet and the printer's work has been a very loose one indeed, resulting in much misunderstanding and difficulties. For this reason there has been an urgent need for some form of typewriter that could be actually used to print the advertising copy and more or less closely match the work of the printer. Such a machine has been developed through the efforts of Mr. John R. Rogers, an inventor whose work on the linotype has been instrumental in the development of that machine. However, the groundwork was in the form of two machines made under the patent granted to James B. Hammond in 1908, and laid aside for several years.

A few months ago, without knowledge of the existence of the patent mentioned, Mr. Rogers and the typewriter experts started in on their work of developing a variable-spacing, multiple-type machine which has since taken the form of a display typewriter. The new machine can be used with any style of type, with twenty different fonts already manufactured to select from. The paramount feature of the machine is that the letter spacing used may be increased with the size of the letter, the adjustment for the varying sizes of type being arranged by a little lever right in the machine; thus, with a six-point body printer's type, or miniature Roman in typewriter type, not only eighteen characters may be written to the inch but at various other spacings as well if so desired. Larger type may be written in their respective or proportional spacings, practically if not quite in accordance with the spacing used in printing type. Finally, it is claimed that the aligning or "justifying" of the right hand endings may be brought to an even margin because of the variable spacing, this being a matter of skill on the part of the operator.

At the present time the new typewriter makes use of a large display type nearly one half inch high, together with nearly twenty other fonts of all shapes and sizes, with the typewriter spacing both between the letter and between the line adjustable to the wish or judgment of the operator.

The general appearance of any printed advertisement can be duplicated with the new typewriter, as can also any other class of printed matter. It is now possible to prepare advertising copy or other forms of copy in such a manner that not only the trend of thought embodied but also the typographical qualities of the work can be studied before being set up in type. Further, the individuality of the ideas of the advertising copy writer may be carried out in his own copy rather than leaving this individuality almost wholly to the typesetter as heretofore.

Pyramidal brick footings with crisscross-work of I-beams. Before concreting



Pyramidal brick footings showing form used for concreting the crisscross I-beams

Remarkable Underpinning Work

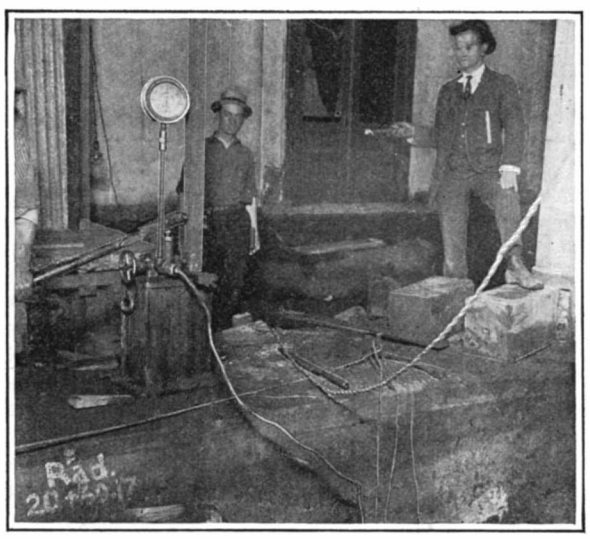
How the Foundations Are Safely Dug out from Underneath Large Buildings

THE new subway lines for Greater New York include an express section on William Street in the financial district of Manhattan. This street is narrow and crooked, with very sharp grades throughout. The excavation lines for the subway extend, at least for a large part of the way, from building line to building line. The profile of the subway subgrade follows the rise and fall of the surface profile, except for the first part of the half mile stretch from Beekman Street to Stone Street. The depth from curb of street to floor of excavation is accordingly a varying one. It is greatest at Beekman and at Pine Streets.

While rock is very plentiful on Manhattan, it is pretty well covered over in the southern part of the island. For example, it is so far down on part of the site of the tall Municipal Building that concrete piers carried to rock were used for only a part of the foundation. On William Street, in the section under consideration, the subway subgrade nowhere comes into contact with it. In fact, between Beekman and John Streets, nobody seems to know just where rock is. There is probably but one building in the whole section that was originally built on rock. This is the Royal Insurance Building at the corner of Maiden Lane. Rock at this point is only about 40 feet below the surface. In most cases, the original building foundations were footed *above* the subgrade of the subway. Everywhere the level of mean high water is above the subgrade and in general below the old footings. It may not be out of place to remark that "subgrade" indicates the extreme lower line of excavation necessary for laying the foundation of the subway.

Consideration of the foregoing facts will prepare us to understand that in general the heavy buildings of William Street required their supports along the street to be carried down beneath the floor of the subway prism. Otherwise, the excavation would undermine them. The difficulties of ordinary underpinning were here surpassed, largely because of the necessity of carrying the footings of many buildings not merely below mean high water level but considerably below the permanent water line.

The material underlying William Street consists largely of clay and sand mixtures. There is also a certain amount of quicksand. The footings had to be carried down through such material to the underlying stratum of gravel. In carrying on the underpinning operations, it was necessary that the ordinary use of the buildings be uninterrupted. That it has been found possible not only to do the work in a highly satisfactory manner, but to do it under such conditions marks this engineering and construction feat as perhaps the most noteworthy of all underpinning undertakings.



Hydraulic pump in operation. Pit excavation in plain view

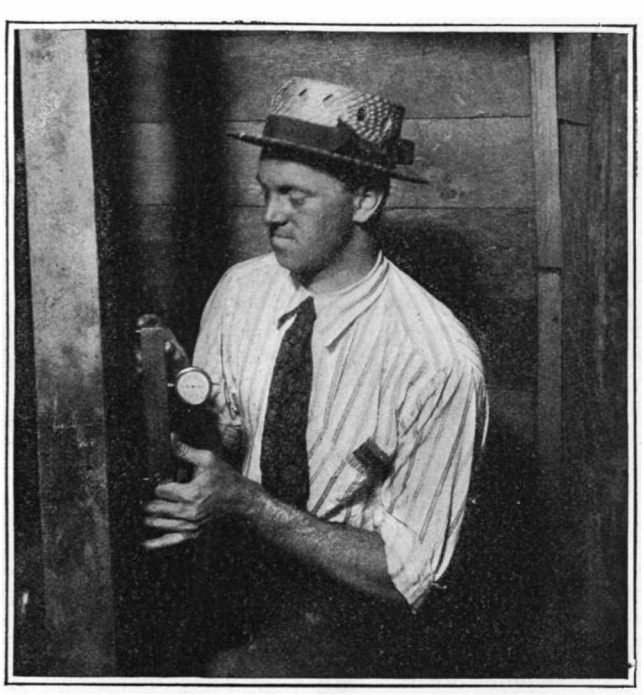
The Bank of America Building stands at the corner of Wall Street. The wall facing William Street corresponds to the longer dimension of the building. There are six old footings here, each being spread to secure an increased area of support. These were carried by a concrete slab, perhaps 2 feet in thickness, extending all along the side of the building. It was desired, as a beginning, to unite these footings into a single one. The object in view was to facilitate a piecemeal undermining of the slab. That is to say, when the line of footings was properly consolidated so as to increase their tendency to act together, it would be possible to withdraw temporarily a small portion of the support given by the soil and to replace it by a support going down to gravel without disastrous results. This procedure could then be repeated until the entire load should be transferred to the gravel. In carrying out this programme, the total support to be removed at any one stage was more or less distributed and small excavations made at separated points.

The pyramidal footings had a bearing area of about 10 x 13 feet, the longer dimension paralleling William Street. The slab was about 12 feet wide. The subway prism occupies the full width of the street at this location. In consequence, the old foundation described extended about 4 feet into it. This portion had to be cut off. The building itself is nine stories high, a granite office building. The load imposed by the William Street wall was and is about 3,000 tons. As the slab had an under surface of about 1,000 square feet, the average load carried by the fine-grained sand and clay was about three tons per square foot.

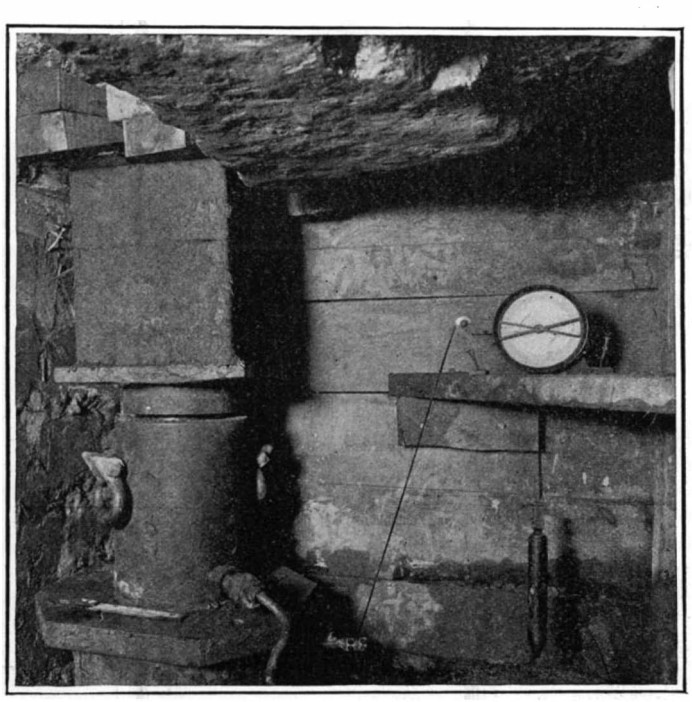
The bottom of the slab was about 11 feet beneath the curb. The subgrade of the subway was 21 feet farther down. Besides, ground water would be encountered when about one third of this distance should be penetrated. In fact, as it was necessary to go down some 8 feet below subgrade to get the support of a stratum of gravel and hardpan, the underpinning supports would have to reach down 29 feet, all but 6½ feet being below the water line.

The plan agreed upon provided for a heavy concrete wall located beneath the slab and directly beneath the columns of the building. This wall was to extend down to

(*Continued on page 67*)



Extensometer which determines amount of compression suffered by I-beams on taking load. Interval between two holes is measured before and after



Instrument for measuring settlement and rebound of pile. In the present case where line is disposed obliquely, result is given relatively, not absolutely

Facing Hazards for the Sake of Precision

Hardships Undergone and Results Achieved in Surveying for the Federal Government

By Robert G. Skerrett

WITHIN the past few months the U. S. Coast and Geodetic Survey has re-explored some of our most actively navigated waters by means of the wire drag, and has thus brought to light hidden dangers to shipping that would make a formidable list. It was commonly thought that these pathways of trade were completely charted, yet the searching sweep of the wire drag—the up-to-date substitute for the time-honored lead-line—has brought to light the peril of our ignorance. In a general way, the topographic, hydrographic, and geodetic characteristics of our continental domains are even less completely established. This in no way reflects upon the industry of the Bureau, but emphasizes, instead, the vastness of the tasks which fall within the cognizance of this, the oldest of the Government's scientific organizations.

There are great areas on the Atlantic, the Gulf, and the Pacific Coasts of the United States which are as yet unsurveyed, and probably 80 per cent of the coast of Alaska, the treasure house of the decades to come, may properly be regarded as unsurveyed. It must be remembered that the sea is restless and sands shift, and these changes will always have to be taken into consideration quite apart from what is yet to be disclosed of the permanent features of the subaqueous approaches to our coasts. But probably the largest measure of work ahead for the Survey is that concerned with the characteristics of the length and breadth of our land as well as the several aspects of our outlying possessions. The work ranges from the swamps and marshes of flooded lowlands to the peaks of our highest mountains and from the ice-gripped northland of Alaska to the sun-blistered areas of the tropics. Its prosecution demands the resourcefulness of the pioneer, the courage of the soldier, and that especial zeal for accuracy which is the hallmark of the undaunted scientist.

To the end that we may know more correctly, in terms of latitude and longitude, the position of any place within the national boundaries, and that we may be certain how high any point is above the surface of the sea, the Federal Government, through the Survey, is gradually laying a network of imaginary lines upon the maps of the States, a series of triangles that fix with the utmost precision thousands of points, each of which is sealed by a benchmark that constitutes a permanent base of reference. The work involved in this triangulation is upon a grander scale than that required in the civil engineer's ordinary undertaking.

Where distances are relatively short and areas comparatively small or unimportant, lines can be measured directly upon the ground by means of chain or tape and directions established by the use of a compass or a surveyor's transit. This is not the case when an extensive territory is to be covered or when great precision is demanded. Rivers, bays, mountains, forests, or some other natural obstruction may render direct measurements upon the ground impracticable. Instead of spanning intervals of feet or yards, scores of miles may be involved. To bridge these gaps accurately, and to measure distances without regard to the intervening contours, the surveyor employs a method called "triangulation." Base lines are established, distances determined and triangles measured by means of flashes of reflected sunlight or lamp signals shot from hilltop to hilltop, from crest to crest of mountain peaks, from improvised towers or the uppermost branches of the tallest available trees, and combined with telescopic instruments of exquisite accuracy.

To reach their points of observation, however, the Government's surveyors face all sorts of hazards and hardships.

The leveling net is the fruit of extremely toilsome work, because the surveyor must follow the contours of the ground and thus build up his record of heights by a process of cumulative measurements. Generally he must carry or continue lines reaching from the sea level upward. The instrument used consists essentially of a telescope so mounted with a delicate spirit level on a portable tripod that it may be quickly and readily placed in a horizontal position. Graduated rods are held at two points and the instrument placed midway between them. The telescope is sighted first on one rod and then on the other; and the difference between the readings gives the variation of height between the two points. The length of sight does not exceed a maximum of 150 meters, and the greatest discrepancy allowed between two measurements on a section one mile long is one-fifth of an inch! Circuits many miles in circumference are run around areas of leveling, and these are used to check up or test the accuracy of the enclosed work. There are eighty-five such circuits, varying in circumference from 100 to 4,700 miles, laid upon the network of precise leveling which now covers the United States. The greatest error indicated in any line of the whole system, involving nearly 31,000 miles of leveling, is about one-eighth of an inch per mile, while the average error is about one-fiftieth of an inch per mile. The leveling done in recent years by the Coast and Geodetic Survey has an average closing error of less than one five-millionth part of the distance involved. The

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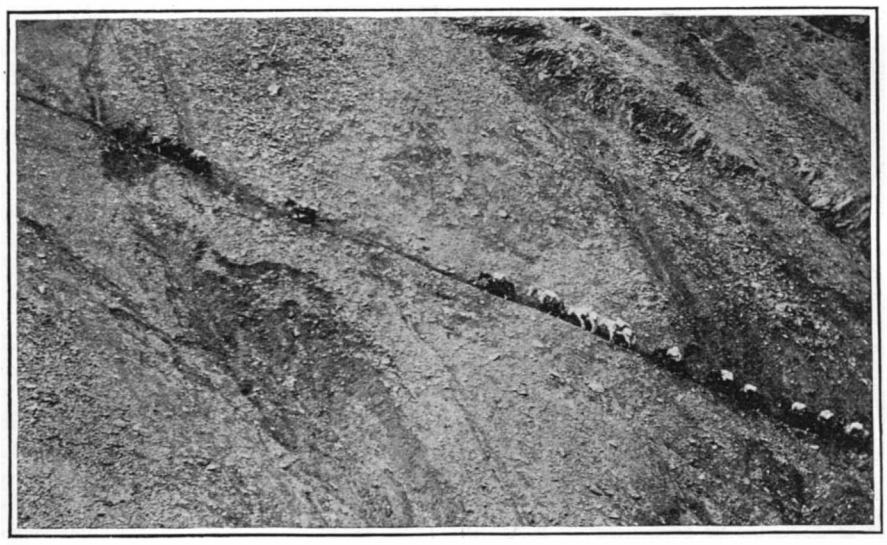
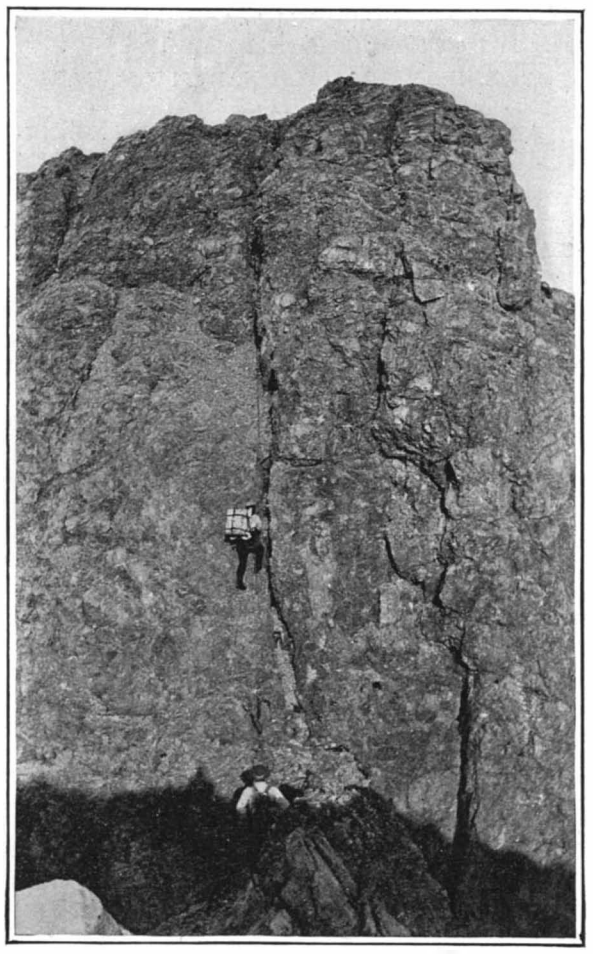
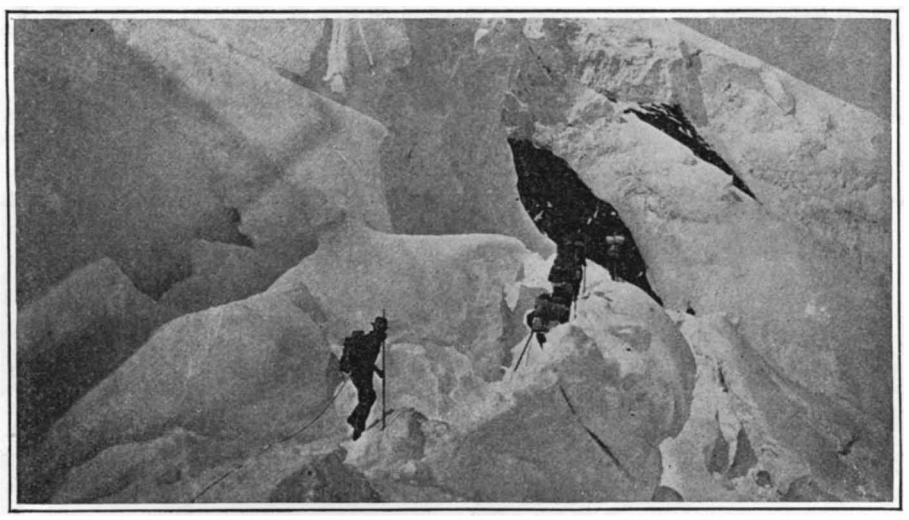


Transport of supplies for Alaskan surveys

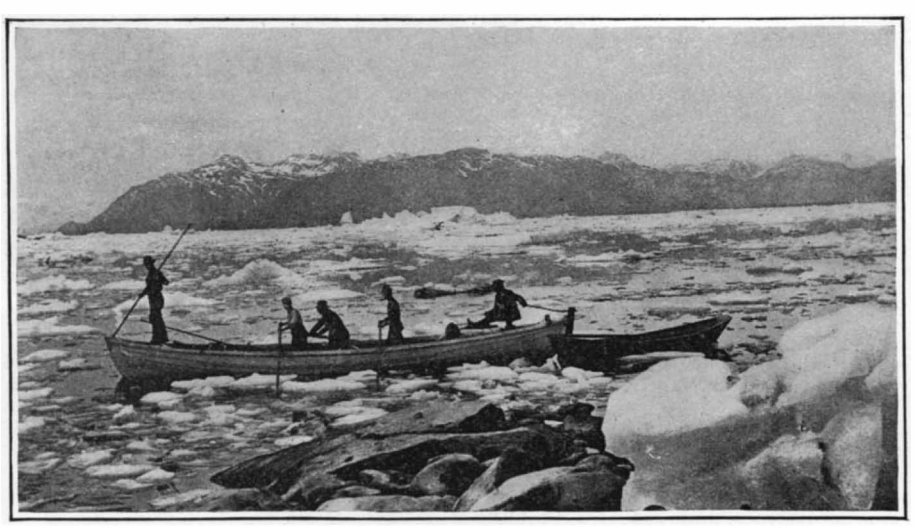


Coast survey at Glacier Bay



Triangulation on Mt. St. Elias

Shooting a level in the Philippines



Coast survey work in Alaska

Mediæval Machinery

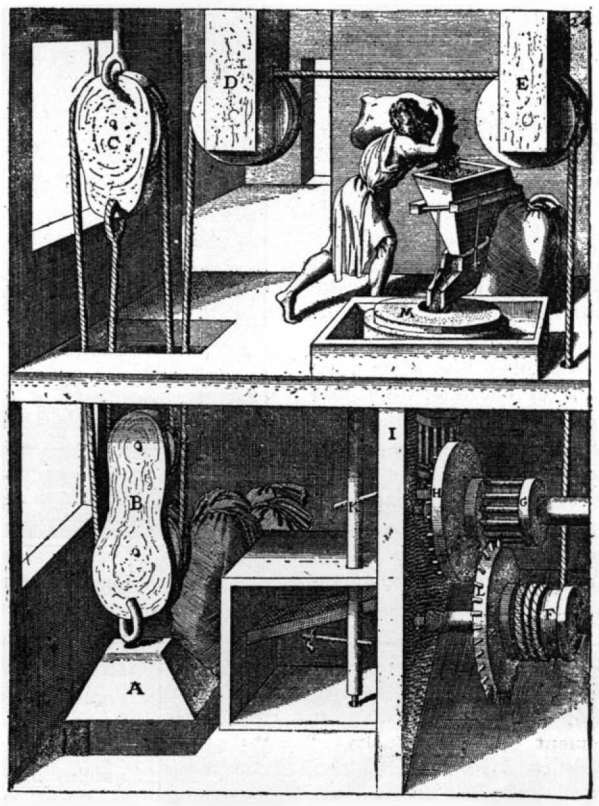
How the Germans of the Seventeenth Century Tried to Solve an Age-old Problem

A CURIOUS volume wandered into the editorial rooms of the SCIENTIFIC AMERICAN the other day. This quaint relic of the Middle Ages, printed in Nuremberg in 1686, bears the formidable title:

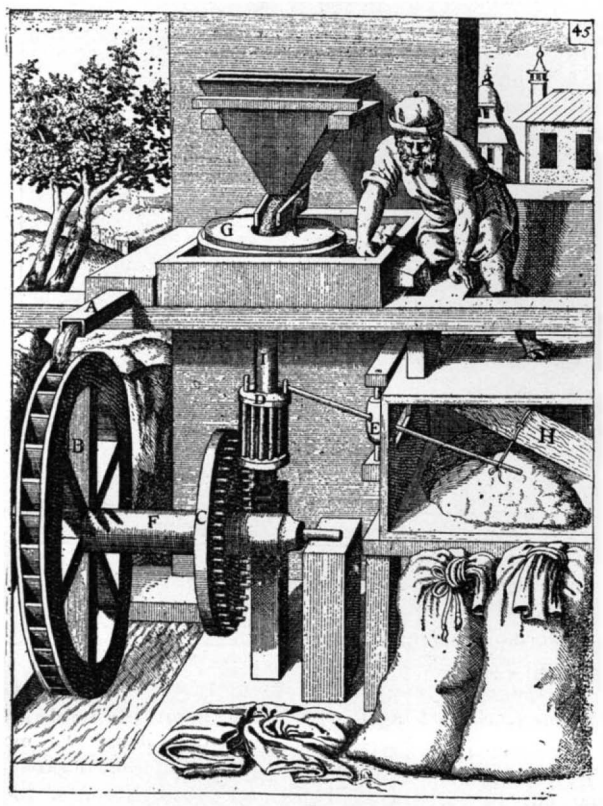
THEATRUM MACHINARUM NOVUM,
EXHIBENS
AQUARIAS, ALATAS, JUMENTARIIS, MANUARIAS, PEDIBUS, AC VERSATILES, PLURES ET DIVERSAS MOLAS.
Per
GEORGIUM ANDREAM BOCKLERUM, Architectum et Ingeniarium;

and it represents a pretty ambitious effort to describe and illustrate all the mechanical devices known, by observation or hearsay, to the author.

As might be inferred, not merely from the title, but upon consideration of the general conditions in Germany during the century after the Thirty Years War, Herr Bockler's acquaintance with machinery was restricted almost entirely to mills of one sort or another. In most of these, no matter what the motive power, is to be seen the precursor of the present-day geared transmission. The seventeenth century engineer had neither the theoretic knowledge nor the technical equipment to shape gear wheels, in the present sense of the term, that would mesh without ruinous friction loss; but he was well able to achieve the same result by means of a contrivance on his primary axle suggesting a bird-cage, and, on the secondary one, a wheel with a set of horizontally or vertically projecting pegs. In this way he could effect both parallel and perpendicular transmission of rotary motion. The clock-maker, as anyone will recall who has experienced the supreme joy of performing a capital operation upon a discarded time-peace, still employs this device to make his wheels go 'round.

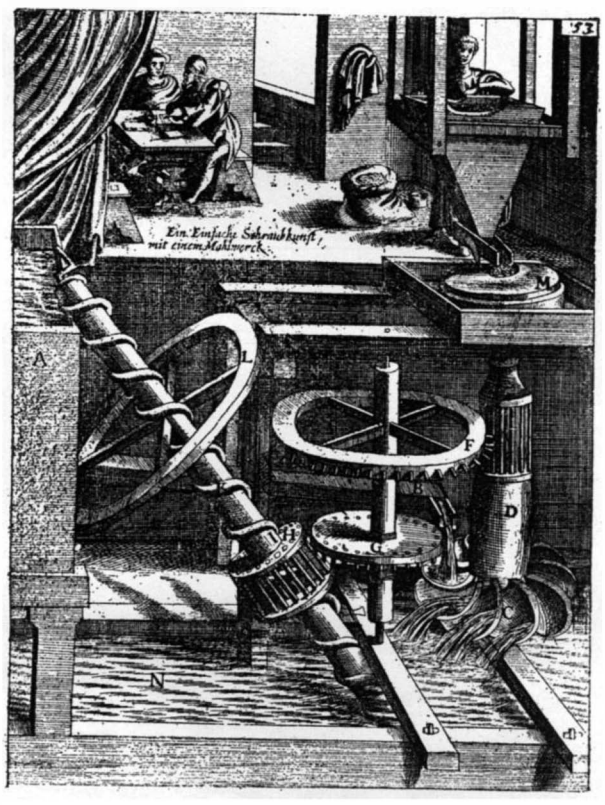


Mediaeval gear for parallel transmission

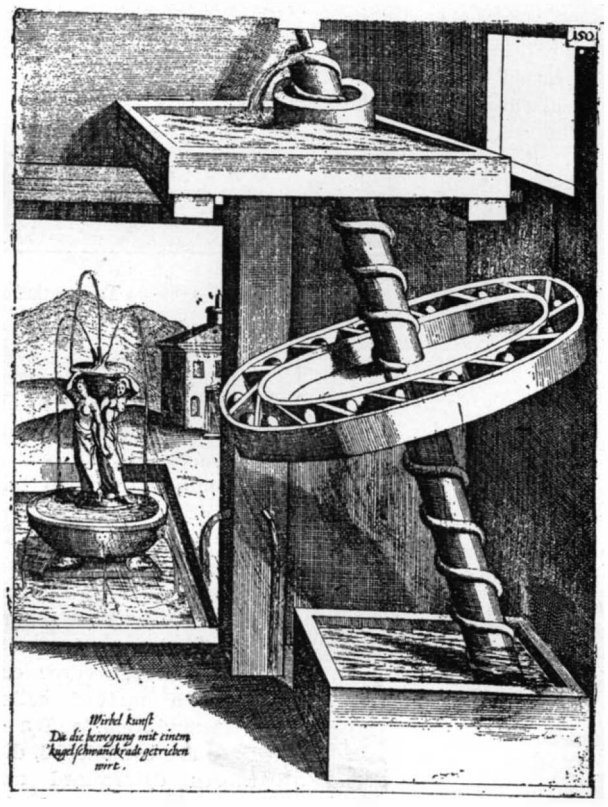


Similar device for perpendicular transmission

A far more striking feature of the illustrations of the Theatre of New Machines, however, is the constant recurrence of the germ of perpetual motion. The use of water-power seems peculiarly prone to implant this idea in the human mind. Perhaps it is because the water comes from nowhere and costs him nothing that the miller so often fails to grasp the fact that his power is bought and paid for in units of energy, and can be delivered but once. In any event, it seems that the proprietor of a water mill—especially of one whose driving stream is subject to seasonal diminutions of flow—is forever trying to make his water run back uphill and work for him again.



Perpetual motion by means of Archimedean screw



Perpetual motion by eccentric weights

Unfortunately for the peace of the mediæval mind, it knew of at least one highly plausible scheme for making the water do this very thing. If the end of a pipe, coiled like the thread of a screw, is immersed in water, and the whole pipe rotated like a screw, it has been known since the time of Archimedes that the water will climb in the pipe, and keep on climbing as long as the pipe keeps on rotating. We know that the pipe must be turned by some outside agency; our ancestors did not. What is more simple, they asked, than to connect such an Archimedean screw with the water wheel of a mill, and make the mill run the screw, the screw the mill? Nothing in the world, was the answer; and our author illustrates and describes enough mills worked, on this principle, by a tub-full of standing water, to make it quite certain that he was a theoretical genius first and a practical one last, if ever. Or perhaps he was like the perpetual motion crank of the present day, who complains bitterly that the dull and stupid mechanic is unable to understand his drawings and reproduce them so that the model will do what the sketch so plainly indicates.

One notable feature of the Archimedean perpetual motion machine which we have selected for our cut is the shape of the motive blades, clearly forecasting, as they do, the turbine.

Another means for making a mill raise the water for its own power in high favor with Herr Bockler consisted of a series of cups attached to an endless rope, after the fashion of certain present-day pumps. These cups were expected to re-deliver the water direct to the wheel.

But the type of perpetual motion machine which is really most plausible—the type which has deceived more capable people than any other, which even now is the hardest to explain away, which every little while is described anew by some present-day inventor, flushed with the confidence of having solved this problem of the ages—is the one worked by a balanced wheel, as in the cut. The claim made for the machine of this type is that there is always a preponderance of weight on one side of the wheel as it rotates, thus forcing it, once started, always to rotate in the same direction, without cessation. In the case covered by the cut, this claim takes the form that in any position of the wheel, as each of the little balls seek the lowest point in its compartment, there is always more leverage on the one side of the wheel than the other, because the balls are always further from the central pivot on that side. Hence that the wheel will commence to turn toward that side, and will go on turning forever. Even now, while we are perfectly sure that the force of gravity is not capable of performing such tricks, and while we can condemn this device in general terms, many of us will be puzzled, in looking at the cut, to put a finger on the precise point of fallacy; and many more, while realizing that it must be that the horizontal distances of the balls from the axis are such that the components in the one sense just balance those in the other sense, will be at a loss to demonstrate in just what fashion this balancing is effected. It is not at all surprising, then, to find that in the days of far less widely diffused knowledge of scientific fundamentals, well-informed men should have tried so persistently to achieve this particular type of perpetual motion.

Extension in Patent Cases

AFTER many months of consideration, the House of Representatives has passed the bill which provides for extensions of time, nine months, in which to pay fees, to file applications and take other actions in patent and trade-mark cases, and the bill is now before the Senate Committee on Patents. It is to be hoped that the Senate Committee will make an early and favorable report.

The importance of the amendment of the Patent Act, which is provided for in the bill, may be best understood when consideration is given to the difficulties and delays which arise in the transaction of normal business between the United States and Europe which have been the direct results of the war. However, even against this adverse current, the economic laws which make international trade of universal benefit press on, and one of the most persistent developments during this war period has been the activity of inventors interested in foreign industries, whose inventions, while primarily concerned with the production of war-making materials, may, nevertheless, in most cases be used to advantage when commercial rivalry succeeds the conflict of arms. This is fully re-

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Paper Pulp Balls for Fuel

AN accumulation of old newspapers may be converted into an excellent fuel, for use in stove, fireplace or furnace. The papers should be piled into a tub or other water-holding receptacle until it is about one third full, and the tub then filled to the brim with water. Left thus for two or three days, the papers will become thoroughly soaked. If at first they show an inclination to float, a heavy stone laid on top will weight them down until the water completely covers them.

When thoroughly soaked with water, the papers are taken from the water and squeezed into balls about the size of one's two fists and thrown onto the ground in the sun to dry. The papers have become so soft and pulpy that a perfectly compact ball is easily formed. It will dry, if left in the sun long enough, until it is almost as hard as wood. These balls, if made in the summer, will constitute excellent fuel for winter use, and will burn in the fireplace with a glow like carbon briquettes. Moreover, they will burn with comparative little ash, and they are clean to handle.

Old papers become a real nuisance about the home, and are rather difficult to dispose of even by burning on the trash heap. A summer's accumulation can be, in the manner above described, converted into a considerable supply of fuel, and the labor is easy and can be done at odd times.

Preparing for a hard winter

Measuring the Dust in the Air

New Types of Apparatus for the Measurement of Pollution of City Atmospheres

By John B. C. Kershaw

THAT the atmosphere of towns and cities is far dirtier than that of the country-side is known to all, especially to those of us who are able to live 30 or 40 miles away on the windward side of the cities, to which we rush up daily for business purposes. The state of our handkerchiefs and collars after a "day in town" bears witness to the dirtiness of town air, but only a few have realized the enormous amount of solid matter that in dry weather hangs suspended in the air over all large towns and busy centers of manufacturing industry, and in wet weather is carried down with the rainfall.

Recent experiments with a new standard type of soot- and dust-gage, carried out in 16 English and Scotch towns in the winter of 1914-1915, have shown that the rainfall of these cities, when calculated out on the basis of the square mile, in one year contained from 500 tons up to 1,000 tons of solid matter. As the rain does not fall on every day in the year, nor completely wash the air free from all impurity when it does fall, one may assume, therefore, that the air we breathe in towns contains an even larger proportion of impurity than is denoted by these totals.

The Mellon Institute of the University of Pittsburg carried out similar observations in 1912-13, and found that in certain districts of that city the soot- and dust-fall amounted to the huge total of 1,900 tons per square mile per annum. The Pittsburg observations were carried out with a rather small type of collecting funnel, and probably the results would have been still higher had the standard gage been used.

At the International Conference for the Prevention of Smoke, held in Pittsburg in September, 1913, a Committee was appointed to coöperate with the London Committee for the investigation of atmospheric pollution. Mr. E. P. Roberts, Chief Smoke Inspector of Cleveland, was elected Chairman of the American Committee, and the object in view was to arrange for the introduction of the standard method and gage into the United States. What progress has been made with the American investigations is not known to the writer.

The standard type of soot- and dust-gage used for these observations in English towns consists of a large cast-iron funnel enameled on the inside, and having a collecting area of four square feet. The funnel is supported by an iron frame and is surrounded at the top by a wire guard to prevent birds resting on the edge of the funnel and contaminating the deposit. Below is a wooden platform, on which rest the bottles that catch the collected rain-water with the solid deposit. The bottles are connected with one another by syphons, and will hold the whole of the collected rainfall for one month. The rain brings down the soot and other impurities in the air, and much of the insoluble portion of this impurity collects on the bottom of the first bottle. Before removing the bottles for examination of their contents, the funnel is washed down with some of the collected water, and a brush is used to remove any solid deposit that has adhered to the surface of the enamel.

In Fig. 1 appears the standardized pattern of soot- and dust-gage now being employed for the observations in English and Scotch towns.

The measurement of the intensity of sunlight is closely connected with the subject of air-pollution by solid matter, for the greater the number of soot and dust particles suspended in the atmosphere, the greater is the screening effect of the air upon sunlight, and the larger the proportion which is lost before the rays of sunlight reach the surface of the ground. Since sunlight is one of the most effective agents for destroying germ life and preventing disease, especially in crowded cities, the measurement of the intensity of light is of considerable importance, not only as a check upon the extent of the pollution of city atmospheres with dust particles, but also as a means for comparing the relative healthiness of town and country districts.

A new form of recording actinometer that is automatic in action, and makes a photographic record of the intensity of sunlight over 12 hours, has been devised by Professor Haldane Gee and Mr. W. C. Jenkins of the Manchester (England) School of Technology. This instrument, which is illustrated in Figs. 2 and 3, consists of a fixed metal cylinder 6 inches in diameter and 3½ inches long. The cylinder is open at the bottom. Its top is closed with a lid, which has on its circumference a scale of hours, and round its edge a scale of quarter hours. By the use of a clamping device, photographic paper can be secured evenly on the surface of the drum. The lid is fixed to a curved metal upright supported on the wooden base of the instrument. The top of the upright is graduated from 50 to 55 deg., corresponding to the local values of latitude. This enables the axis of the cylinder to be fixed at the required latitude by moving the curved arm until an index mark is at the right angle.

Concentric with the fixed cylinder is a movable one of a little larger size. On the bottom is a clock, with its driving axis passing through a hole in the metal bottom of the cylinder. This axis passes into a hole in a rod, and when the axis is held by turning a clamp-screw, the outer cylinder with its clock revolves round the inner cylinder once in 24 hours. The clock runs for seven days, and after adjustment keeps good time. It may be noted that in the actinometer the axis is held, and the clock rotates. This arrangement is the reverse of an ordinary clock. To keep the cylinders concentric, a central rod is fixed to the center of the upper cylinder, and pivots in a central hole in the top of the clock case. On the rotating drum are two fixed metal jaws provided with a slit between them. This slit is wider at the middle and tapers each way. When in use, the instrument must be placed with its axis in the geographical meridian, and the slit is brought opposite to the mark indicating solar time, when the motion of the slit will follow the sun, and the intensity of the light will be indicated by the degree of blackening of the paper. The type of paper best suited for the purpose has been the object of many experiments and inquiries. So far as the experimental work has been completed, it has been found that a gaslight paper that has been treated with a five per cent solution of resorcin, containing one half per cent of glycerin, is the most suitable paper for general use. The paper is sensitive to ultra-violet light, and to a certain extent toward the red end of the spectrum. It is proposed that all the exposed papers be sent to the School of Technology for examination and scaling. Much information can be obtained by the simple inspection of the records, but in order to obtain numerical values the surface brightness is measured by the aid of a portable photometer called a lumeter. The surface brightness is found to be, within certain limits, inversely proportional to the intensity of the received light. Where there is much variation in the daily record, the average value can be obtained by rotating the paper by means of an electric motor, and then reading off the resultant tint with the lumeter. The ideal position for the actinometer is close to the ground, and such that the light is not obstructed from sunrise to sunset. It is difficult to obtain such a situation, especially in the city and suburbs, and, although it is desirable, it is not absolutely necessary; for useful observations can be taken even when freedom from obstruction is only for a part of the day. It is essentially important to place the instruments in the charge of persons who are accustomed to the regular use of instruments. The actinometer gives the intensity of the light directly received from the sun.

The simplest method theoretically of measuring the solid impurities contained in the atmosphere is by an air-filter; a known volume of air being drawn through a porous paper and the collected solid matter then weighed or measured by aid of a colorimetric scale. Considerable difficulties, however, have been met with in applying this method practically, the

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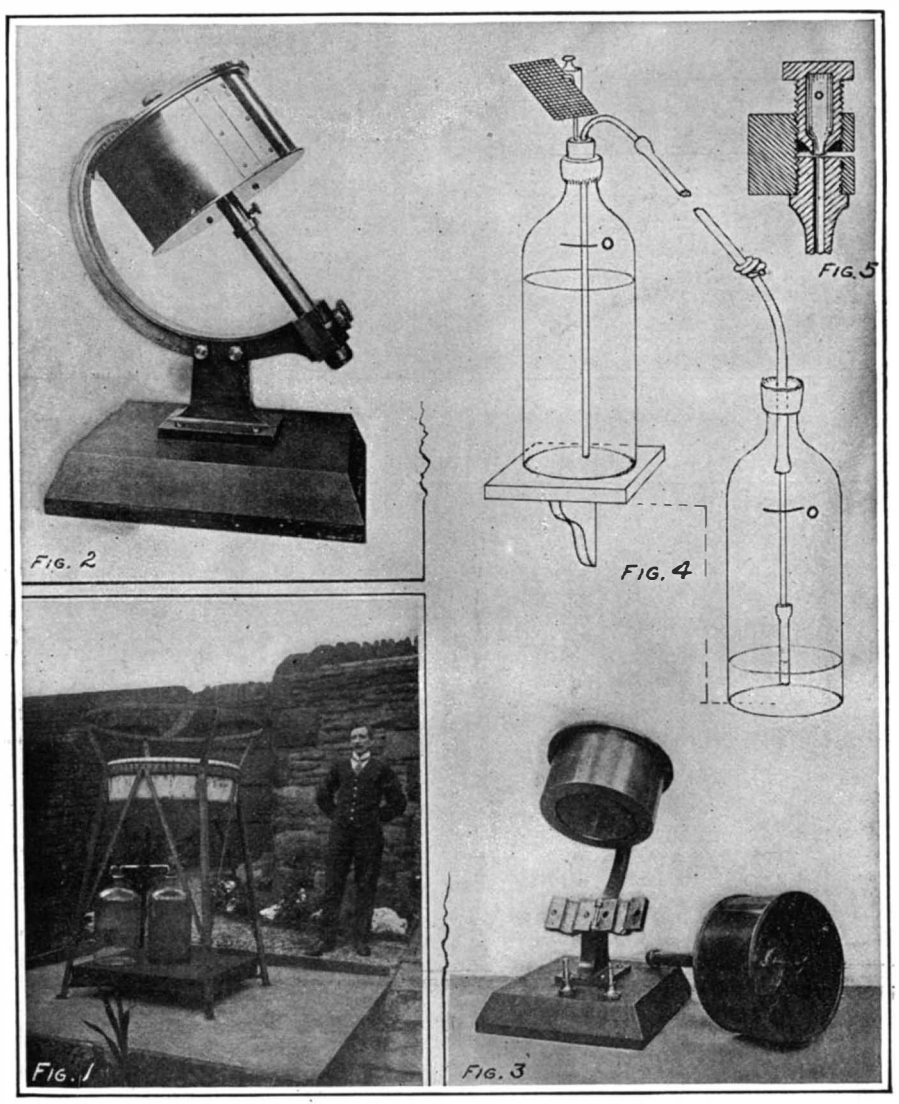


Various types of apparatus used for the measurement of pollution of city atmospheres

The apparatus shown are as follows: 1. Standard type of soot- and dust-gage employed for the observations in English and Scotch towns. 2. Exterior view of the recording actinometer. 3. Interior view of the recording actinometer. 4. The Owen air filter. 5. Details of the vise that holds the filter paper in the Owen air filter.

The Motor-driven Commercial Vehicle

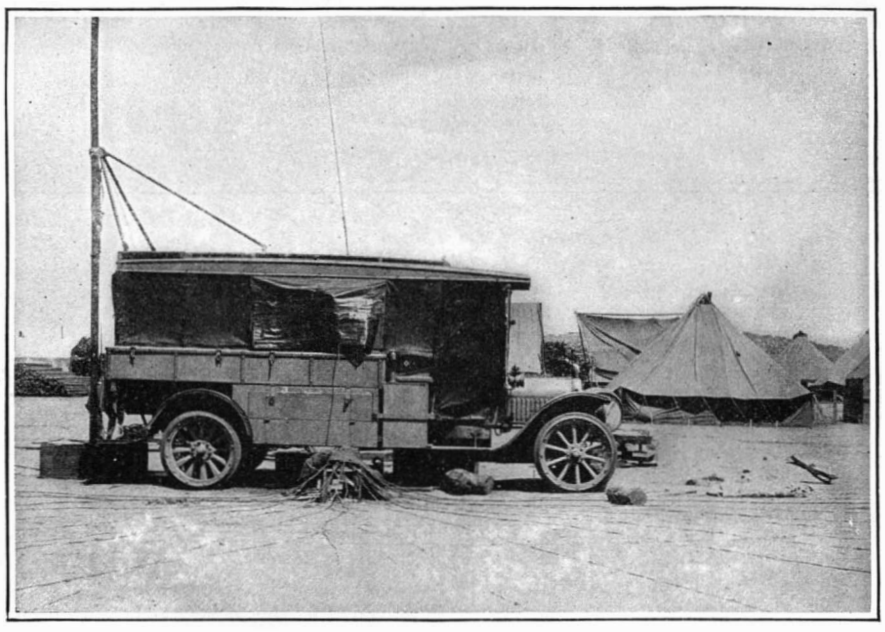
Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

Motor Truck Wireless Station

THE recent operation of our troops in Mexico has brought home the importance of modern equipment for warfare. The small portable wireless sets designed to be carried on mule back were found to be practical for only short distances and in some cases could not be used at all owing to peculiar atmospheric conditions prevailing on our southern border. A marked advance in the construction of portable wireless sets for the field service of our army has been made through the coöperation of a leading truck manufacturer with the Signal Corps. There is now available a truck carrying a complete wireless equipment which can be set up for use in twelve minutes and which will send messages within a radius of 800 miles under favorable conditions. The truck which is illustrated has received thorough tests. Messages have been received from points 2,500 miles distant. The electrical pressure reaches 90,000 volts at the top of the antennæ. The great range of the new equipment and the speed with which it may be put into service is due to the employment of a powerful dynamo to generate current which is driven by connecting gearing directly from the 30 H. P. gasolene engine otherwise used to propel the truck. The generator supplies electric current of 500 cycles at 110 volts and 18 to 32 amperes. This current is transformed by the usual equipment so that it leaves the transformer at a pressure of 22,000 volts which is greatly increased as the current rises to the top of the antennæ. This produces a wave intensity that gives a sending ability of at least 200 miles under the worst conditions obtaining in daytime up to 800 miles obtained in the early hours of the morning when there is less electrical disturbance due to electrical plants of various kinds.

The antennæ are of the umbrella type mounted at the top of an 85-foot mast, which is built in 9 sections to make it easily portable. The first or top section is raised by manual power, but the other sections are lifted with the aid of a block and tackle suspended from struts mounted on a platform on the roof of the truck. These struts are quickly detachable when not in use. The guy wires are attached to the fifth section of the mast. When dismantled the various sections comprising the mast are carried in compartments built on both sides of the truck. The counter poise, or artificial ground, is composed of heavy insulated wires radiating from a common center to which the ground wire of the wireless set is connected. For convenience in grounding there is a socket on the outside of the truck body into which the ground wire plug fits. The electrical equipment is of the latest approved type and the substantial design of the truck and large capacity make it an ideal wireless plant for practical army service.



Wireless equipment for United States Signal Corps mounted on a motor truck for ready transportation

Motor-Driven Squeegees in Street Cleaning Service

ONE of the first American cities to adopt squeegee street cleaning was the home town of the inventor, Louis Kindling, a resident of Milwaukee, where the horse-drawn type was first put in service in 1905. Ten years later a motor-driven squeegee was built and turned over to the Municipal Research Bureau for experimental purposes. The machine proved so satisfactory in service that it was purchased by the city and in carefully recorded data it has demonstrated its ability to replace six horse-drawn machines and at the same time effecting an operating economy of 35 per cent. The illustration shows the final design which has been recently perfected from the fund of experience gained with the first machine. The motor truck chassis is a special worm gear driven type on which is mounted a large oval-shaped water tank of 900 gallons capacity. Immediately ahead of the front fenders of the chassis are placed two flusher nozzles controlled by a lever convenient to the driver's seat. These nozzles, by sprinkling the surface of the street, prevent the agitation of dust and also moisten the attached matter so that the roller can more easily force the dirt from the pavement and wash the surface clean. A pair of heavy pavement sweeping brooms is fitted immediately behind the front nozzles to supplement the function of these members in loosening the dirt and also to prevent the squeegee from handling too large masses of material. The roller is 8 feet wide by 19 inches in diameter and is fitted with heavy special composition rubber strips which are adjustable for presenting a fresh surface as the strips wear. These are arranged spirally on the surface of the roller. It is claimed that this machine washes 125,000 square yards of pavement per day at a cost ranging from 12½ to 16½ cents per thousand square yards, depending upon the condition of the pavement, the amount of debris to be removed and traffic factors. The machine works more economically in those sections where the speed is not impeded by traffic and where the machine can be operated at its maximum rated speed of seven miles per hour.

Motor-driven squeegee for street cleaning

Loading machine transferring crushed stone to a motor truck

Motor Truck Queries and Answers

P. W. W. writes: We are in a general contracting business and have recently taken a contract to haul a large quantity of crushed stone for some distance. Unfortunately, the stone has been dumped in large piles from the cars along the roadside so we cannot load economically and must use hand shovellers. Can you describe the construction of a mechanical wagon loader and advise us if this machine is practical to be used in connection with a motor truck? How does a mechanical loader compare with laborers, regarding capacity? What is the approximate cost of operation?

Ans. Wagon loaders are just as practical and economical for loading crushed stone and similar materials from piles to trucks as they are for loading horse-drawn vehicles. A typical machine of this character is shown at work in accompanying illustration which clearly outlines the general construction. This machine is a conveyor that can dig sand and stone as well as elevate it. It will dig firmly into piles composed of 1½-inch and 2-inch broken stone. After the loader is pushed against the pile, in the electrically operated form, a switch lever applies the power and the material is transferred from the pile to the truck at the rate of 1 cubic yard per minute and at a cost of about 1 cent for electric current per cubic yard lifted. A comparison of the cost of loading 5 cubic yards of broken stone, coal or similar material by the machine and by hand shows a cost of about $1.80 for hand labor and 38 cents by machine. As will be apparent, the saving is of some consequence and in general contracting work it will soon pay for the machine. A truck loaded by hand took 75 minutes per round trip, the same machine loaded by power made round trips in an average of 38 minutes, thus practically doubling the amount of work done by the truck.

The construction is entirely of steel, as no other material will withstand the severe use that the machine receives. A dust-proof compartment houses a special high torque electric motor of 10 H. P. Machines of this kind have also been built using gasoline engine power. In the electrical form the control is very simple. Closing a switch starts the motor and elevator together. The truck wheels are of large diameter and are equipped with anti-friction bearings to make it possible for two laborers to move the loader. The front wheels are 24" in diameter and the rear 54" in diameter. A steering shaft is hooked on the front axle. The elevator consists of 20 carbon steel buckets, size 18 inches by 12 inches and with a capacity of ½ cubic foot each which are bolted across two steel pin chains at intervals of

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Remarkable Underpinning Work

(*Continued from page* 62)

about the water level. It was to rest upon a double colonnade of steel-incased concrete piles reaching down to the solid stratum. The line of piles, two abreast, was to be so located as to support the columns non-eccentrically. It was, of course, necessary that wall and piles should be so placed as not to encroach upon the subway prism. As originally planned, the individual piles were to support an average load of 33 tons. However, in carrying out the scheme, ten additional piles were put down and the average load in consequence reduced to 30 tons.

The unification of the brick footings was accomplished by crisscrossing six short lengths of 15-inch I-beams in the intervals between footings. Niches were cut in the brickwork to facilitate the placing of these beams. The steel work in each interval was then inclosed in a mass of concrete. The result in each case was to create a steel-and-concrete inverted arch. The upward reaction of soil and slab against these arches tended to produce a uniform distribution of the column loads over the entire under surface of the slab. Doubtless, there were still concentrations of loads immediately beneath columns, but their severity was reduced.

The next step was to get under the slab. Three pits were sunk of a very constricted sectional size. One was located beneath a toe of the first footing, counting from Wall Street, another beneath a toe of the third, and the last beneath a toe of the fifth. They were thus widely distributed and avoided the locations immediately beneath columns. Altogether 23 pits were sunk, the remaining 20 in groups of 4 at a time. Except for details, the procedure of utilizing the pits was much the same throughout the work; so that we may consider one representative pit.

The pit was carried down to water level—that is, to a point about 6½ feet below the slab. The pit was dug beneath the foundation overhead back to about the building line. Some 25 square feet of bearing area was thus disturbed. The consequent loss of 75 tons of support resulted in a redistribution of the load and, eventually, in a small settlement of the building itself. The pit walls were supported by wooden planks. Before extending the excavation farther back under the foundation, it was deemed advisable to replace the support already withdrawn by means of a pile, necessarily temporary because its location had to be in the subway prism.

The piles used in a large part of the underpinning operations along William Street are of a special character. When complete and in place, they consist each of a vertical column of short sections of sheet-steel shells, connected by bell-and-spigot joints and filled with concrete. The shells are 14 inches in diameter and have a wall thickness of 7-64 inch. There is one vertical lap joint. The bell and spigot ends are reinforced by external and internal bands, respectively. A normal section is 2 feet long. A bottom section is set in place where the pile is wanted and forced down into the soil by means of a hydraulic jack, which takes a resistance surface from the under surface of the foundation overhead. When one section has been forced down, another is put in place, the spigot end of one and the bell end of the other being fitted together. The hydraulic ram is again operated and both shells forced down until the top of the last shell is about even with the soil. In this way, the vertical column of shells is built up and the whole forced down. It may be advisable to clear the interior as the driving goes on. One method of doing this is by means of a miniature orange-peel bucket. When the stratum of gravel and hardpan has been reached and perhaps fairly penetrated, the interior is, in some cases, bailed out and then concreted. In other cases, a bottom-dump bucket is employed and the concrete placed through the water.

It is necessary to test the supporting

power of the pile, and to transfer load from the foundation to it. A very recent method proceeds by using a metal plate or cap, whose under surface is so formed as to have contact with the concrete and not with the steel casing. The ram is applied to the top of the plate with the result that the concrete is forced down and consolidated and then the pile as a whole is subjected to the full testing load —about 80 tons. It is very undesirable to release this load (except perhaps in part), since the driving of a pile under such conditions as are found on William Street will create in the soil at its foot a sphere of resistance. If the pile is released and allowed to rise under the upward thrust of this resistance, there will follow a loosening of the soil, breaking up to some extent the resistance field. If the load is now reapplied, the pile will settle to a lower point than before. To accomplish the transference of foundation load to pile before the ram is taken out, two I-beams are cut to proper lengths and set up vertically in such way as to rest on the plate. At the upper ends, metal wedges are used to bring about the transfer of load to beams and then to pile. When the wedges have been forced in between beam ends and foundation, the ram is removed. The pile will react somewhat for the reason that the original wedging did not transfer the entire load. Nevertheless, this reaction is sufficiently checked to make the operation safe.

The pit can now be excavated farther back and other piles put in and wedged to the foundation. When all are in, the permanent piles are shut in by a form and concrete is placed to envelop the whole space from the building line back. However, the concrete is not brought up quite to the under surface of the slab or foundation. Cement grout is put into the final space. In this way, a section of the wall beneath the slab is constructed.

Not all the underpinning on William Street is done in the foregoing manner; but what has been described is typical of the most advanced practice for the most difficult conditions.

Measuring the Dust in the Air

(*Concluded from page* 65)

smallness of the weight of collected matter, and the varying color of the deposit, in different localities, being two of the chief of these.

Dr. J. S. Owens, Hon. Sec. of the London Committee for the investigation of atmospheric pollution, has devised an air-filter which overcomes the first difficulty by reducing the area of tbe filter paper, used for retaining the deposit, to such a small size that a distinct coloration is obtained even when aspiring only a small volume of air. With this apparatus it is possible to obtain a number of comparative records of the state of the air in rooms and buildings within a comparatively short space of time; a permanent record being obtained with a test lasting but 10 minutes.

The second difficulty, namely, that due to the variation in the color of the deposit in different localities and places, is, of course, not overcome by the reduction in size of the area of the filter paper, and therefore the intensity of the discoloration of the paper is no guide to the absolute amount of solid matter suspended in the atmosphere.

The apparatus is illustrated in Figs. 4 and 5, and consists of the filter proper, two bottles, a rubber-bung with glass and rubber tubing, and a screw on the rubber tube. Record papers are provided for taking observations. The Winchester-quart bottles, each holding about 2,500 cc. water, are marked as shown in the sketch. These bottles are connected by the glass and rubber syphon tube provided with a screw-clip, and the water can thus be syphoned from the upper to the lower bottle at any desired speed by regulating the screw clip and the height of the fall. The filter itself is shown in the larger drawing with the paper in position, while in Fig. 5 it is shown in detail with the paper withdrawn. It consists of three screwed sections of solid brass, carefully turned and jointed, as shown. The middle sleeve is provided with a slot for reception of the filter paper, while the upper and lower sections are provided with carefully centered round openings ⅛ inch in diameter. The upper part of the filter is closed, and has a milled head. Air enters by the lateral opening in the side, which is shown in the sketch. To use the apparatus, a slip of white blotting or thick white filter paper is placed in the slot by slightly unscrewing the milled head section and then screwing it down again firmly on the paper. The screw clip is then opened and 2,000 cc. of air are drawn through the paper by allowing the full bottle of water to syphon into the empty one; the rate of flow and therefore time of the test being regulated by the head of water, and by the screw clip on the rubber connecting tube between the two bottles. When one test is completed, the position of the bottles is changed, and the rubber cork with the filter is placed in the second bottle, thus making the apparatus ready for a new test.

An observation can be made in about ten minutes. The apparatus is very simple and requires no technical knowledge for its use. A specially prepared and numbered scale of shades is supplied, for comparing the degree of impurity of the air of different cities; but as already stated, owing to the differences in the composition of the smoke in various towns and cities, the shade is no safe guide to the amount of impurity.

Extensions in Patent Cases

(*Concluded from page* 64)

alized by foreign financiers and statesmen, as well as by inventors abroad, and American inventors have not been slow to see the tremendous possibilities which will be presented with the awakening of commercial life, when the cobwebs of conservatism will be brushed away, and the forces of tradition will be limited to the legitimate test of experience. But, while inventors in this country realize their present opportunities abroad, and especially in Europe, they have in many cases found that the delays occasioned by the censorship and other war measures abroad have made it impossible to comply with the prescribed formalities in time. This situation has been met in most of the European countries by the passage of laws granting extensions of time in which to file patent applications, but in each foreign enactment there is a provision requiring foreign countries to reciprocate in order that their citizens may enjoy the benefits of the extended periods granted.

It will, therefore, be seen that it is important that the bill under consideration by the Senate Committee on Patents, which is similar to the war provisions concerning patents which have been enacted by the principal foreign countries, be made a law in this country. But, apart from the great benefits that American inventors will receive if the bill is enacted, there must be considered the justice of the measure to the inventors in Europe, where men in the prime of life are mobilized, and are deprived of the opportunity to attend promptly to their personal affairs.

In view of the great delay in the passage of the bill, with the resulting losses to American, as well as to foreign inventors, the Senate Committee on Patents should not only report the bill promptly, but give it support in the Senate.

Motor Truck Queries and Answers

(*Concluded from page* 66)

18 inches. The steel chains carry the loaded buckets over steel sprockets at the upper and lower ends of the elevator. A crowding device similar to that of a steam shovel pushes the elevator along the frame of the truck to produce the digging effect of the machine. When overhead obstruction interferes with the movement of the loader, it is possible to release a hook and pull the elevator down so that it rests in a horizontal position on the truck. When in working position the over-all dimensions are: Height, 13′; width, 6′; length, 12′. The over-all height with the elevator collapsed is 8 feet.

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

FLEXIBLE SUPPORT FOR HAT TRIMMINGS.—PAULINE ROSENFIELD, 637 Broadway, New York, N. Y. This invention provides a ribbonlike support which is reinforced or strengthened at the longitudinal edges so that when the same is shaped, with any suitable material, into a bow or similar ornament it will prevent the material from sagging at the edges and will allow sufficient deformation to adjust the shape of the ornament.

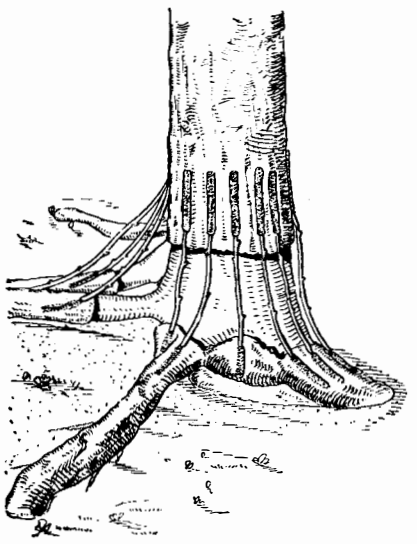
SHIRT.—W. K. JONES, 1501 Holyoke St., Wichita, Kan. This improvement provides a shirt more especially designed for use as an outer shirt for mechanics, workmen and other persons, and arranged to insure proper fitting, to allow the desired freedom of the arms, to prevent tearing at the shoulder seams and at the elbow portion, and to reduce the cost of manufacturing.

Pertaining to Aviation

HYDROPLANE BOAT.—GAETANO A. CROCCO, Rome, Italy. The invention relates to improvements in the arrangement of the fins or blades of the hydroplane boats, the object of which is to secure a greater stability in the first phase of the run, viz.: when the body of the boat is gradually emerging from the water, at the same time considerably reducing the number of the fins as well as their size.

Of General Interest

PROCESS OF BRIDGE GRAFTING.—N. J. WIGGINTON, Winchester, Va. This invention provides a process of bridge grafting by means of which trees which have been completely girdled by mice, borers, rabbits, etc., can be restored to substantially their original condition as far as growth is concerned. It provides a process by means of which crown galls may be bridged over or cut away and the bridge made over the wound. If a tree loses its roots on one side connections can be made from the roots on the other side of the trunk so the sap will be carried from healthy roots and evenly distributed through the trunk.

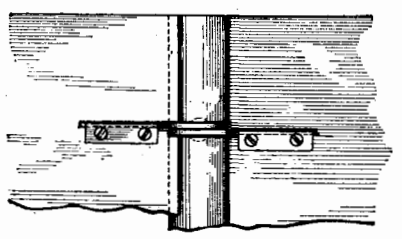


PROCESS OF BRIDGE GRAFTING

Hardware and Tools

CIGAR CUTTER.—F. W. DAVIS, care of Pierce Arrow Motor Car Co., 1695 Elmwood Ave., Buffalo, N. Y. The invention relates to cigar cutters characterized by a removable cutting blade mounted to swing between a pair of plates, with means for locking said blade between the plates. It provides a cutter the removable cutting blade of which has four cutting lengths easily interchangeable, whereby a sharp edge can always be provided in the cigar cutter.

DOOR HINGE.—M. B. CUNNINGHAM, 1509 South Lake St., Fort Worth, Texas. This invention pertains to that type of door hinges in which the leaves lie in parallel planes and overlap and are pivoted together. The hinge comprises metal plates having flat circular heads, and broad flat shanks each having opposite parallel flanges arranged at right angles to the backs of the shanks, and provided with screw-holes. The engraving shows a face or side view of a portion of a jamb and swinging door connected to the hinge.



DOOR HINGE.

SUITCASE SNAP BOLT.—C. ROSENBLUM, 186 Lewis St., New York, N. Y. An object here is to construct a fastener or hasp comprising a stud for attachment to one part of the receptacle and a tongue part carried by another part of the receptacle movable relatively to the first part mentioned and corresponding with said stud, a peculiar form of spring provided to make the coöperation between the stud and tongue more secure.

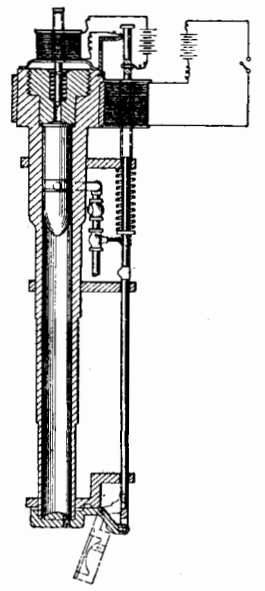
Heating and Lighting

PROJECTING LAMP.—C. A. MATISSE and A. C. MATISSE. Address the latter, 551 E. 116th St., New York, N. Y. This improvement has reference more particularly to means for concentrating the major part of the light from the lamp in the lower part of the reflector of the lamp. It provides a lamp which will comply with the various ordinances of large cities without materially impairing the light beam of the lamp.

DRAFT REGULATOR.—G. FROST, Westfield St., Thurston Road, Rochester, N. Y. The main object of this improvement is to provide a device of simple and durable construction which may be readily attached to the pipe or stove of a furnace, to prevent the too rapid burning of the fire should a strong wind causing an excessive draft rise during the absence of an attendant.

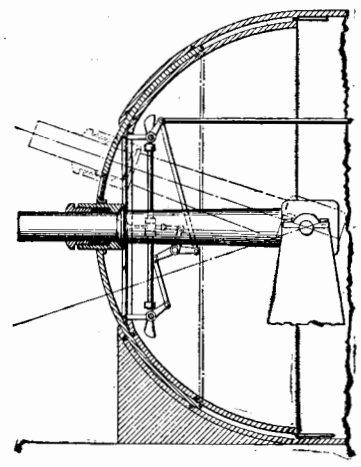
Machines and Mechanical Devices

GUN TAMPION AND MEANS FOR ACTUATING THE SAME.—W. V. MOORE, 750 7th Ave., New York, N. Y. This invention relates to attachments for guns and particularly to a gun tampion or plug and means for actuating the same, and provides a construction whereby the muzzle of the gun is normally closed but is opened immediately before the charge is exploded. It provides a mechanism for actuating the tampion of a gun whereby the same is quickly opened immediately before the discharge and closed immediately after the discharge, thereby preventing the inflow of water in case the gun is near the water line.



GUN TAMPION.

MOVABLE GUN PORT COVER.—W. V. MOORE, 750 7th Ave., New York, N. Y. This invention relates to covering means for ports and particularly to a covering member for a gun port, and provides a construction whereby the entrance of water through the gun port is prevented without interfering with the proper manipulation of the gun. It provides a cover for a gun port which may act in the double capacity of a shield against bullets and a shield for preventing the entrance of water.



MOVABLE GUN PORT COVER.

Musical Devices

BRIDGE FOR STRINGED MUSICAL INSTRUMENTS.—D. C. RICHARDS, 724 Central Ave., Hot Springs, Ark. The inventor provides a bridge adapted for use with any character of stringed instruments as for instance violins, cellos, violas, and the like, wherein the bridge is in the form of a hollow casing having open ends, one of which is adapted to rest upon the sounding board of the instrument, and the other end is adapted to receive and support the strings.

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.

The Current Supplement

A VALUABLE article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2115, for July 15th, 1916, is on *The Specific Characteristics of Vitality* which discusses attempts to identify life with "mechanism." *Gun Emplacements*, which deals with considerations that determine the selection of battery positions, and *Campaigning in the Snow*, which is a short account of the use of the Norwegian ski, are two illustrated articles drawn from the operations in Europe. *The Elephant Butte Dam* illustrates and gives pertinent facts relating to a great irrigating project of the United States Reclamation Service, which is said to be the largest enterprise of its kind in the world. The valuable article on *Color Vision* is concluded. A story of extreme interest to many industrial enterprises is that on *An Electric Haulage System*, which describes the application of a method of controlling many individual cars, operating over an extended system of tracks, from a single central operating station. It is illustrated by a number of photographs. *Shrapnel Shells* tells how these projectiles are designed and tested, and is from the pen of a recognized authority. It is illustrated by several cuts. *The Cosmological Ideas of the Greeks* is an interesting survey of the history of a phase of Greek learning and philosophy. *Aurora* discusses theories and facts relating to this mysterious manifestation and its relation to earth currents and magnetic disturbances. Other articles of value include *Solid Solutions*, relating to the annealing properties of metals, *Vitamine Solution of the Pellagra Problem* and *The Microscope Fine Adjustment*.

A Curious Garden Trick Explained

(*Concluded from page* 59)

was covered with blooms fully open. Everybody was asked to come forward and look at the plant closely, and also to gather the flowers. These were, of course, closely examined, and the most severe critic was bound to admit that there was nothing faked about the blooms.

The manner in which this instantaneous blooming of plants was brought about has been recently explained. In the first case care was taken to secure specimens in which the buds were as far developed as possible without having actually started to expand. Shortly before the time when it was intended to give the exhibition a shallow trench was dug out all round the plant. This was not quite deep enough to expose the main roots. Then all around this trench small lumps of quicklime were placed, with care not to put them actually in contact with the roots. When the quicklime was in position the soil was filled into the trench, and all was now ready for the experiment.

Sometimes it was declared that the liquid used was a magical concoction; as a matter of fact it was plain water. After a thorough soaking of the soil the moisture quickly penetrates to the quicklime, and there is a great generation of heat. A certain amount of vapor arises, and this is kept round the plant by the glass shade. The heat in the soil and this warm vapor have an extraordinarily stimulating effect upon the plant, with the result that the flowers' buds are forced open. The opening is quite genuine, so that the blossoms will stand the closest examination.

The idea is an extension of a plan commonly followed by florists when it is desired to induce flowers to open fully, of placing the stalks for five minutes or so in almost boiling water. This has an amazing effect, for in a very short while the buds, previously tightly closed, are fully open. In the same way wild flowers which have wilted after picking may frequently be revived.

Mandrake Root as a Source of Income

(*Concluded from page* 59)

The proper time for collecting these rootstalks for the market is during the latter part of August or middle of September, when the leaves begin to turn yellow and fall off. These rootstalks are generally not over six inches below the

Notice of Receiver's Sale of Patent

Notice is hereby given, that pursuant to an order of the Sullivan Circuit Court of Sullivan County, Indiana, the Citizens Trust Company of Sullivan, Indiana, Receiver of the Tishmingo Tie & Stone Company, will until noon on Tuesday, July 25, 1916, receive sealed bids for the private sale of a certain patent for concrete railroad ties issued by the United States Patent Office on July 6, 1909, being No. 927324. Said sale will be made subject to the approval of the court and said Receiver reserves the right to reject any and all bids. Terms of sale are, all cash in hand.

Citizens Trust Company of Sullivan, Indiana,
By J. M. LANG, Secretary, Receiver.
HAYS & HAYS,
Attorneys for Receiver.

surface, and can be readily removed from the ground by means of spade or grubbing hoe. They should not be exposed for any length of time to the sun, but should be cleaned by washing in cold water and then dried in the shade. It will be found that they will shrink considerably in drying, often losing one-third of their bulk and weight. When thoroughly dry they have a strong and disagreeable odor, and the taste is very acrid and bitter. In this condition the rootstalks sell for about nine cents per pound. There is always a ready market for them, for there is scarcely a plant in this country whose medicinal virtues are better known and more generally appreciated as an emetic than the mandrake. It was ranked at one time among the most safe and active of this class of medicines. Any druggist will be able to supply a list of dealers who buy crude drugs.

Facing Hazards for the Sake of Precision

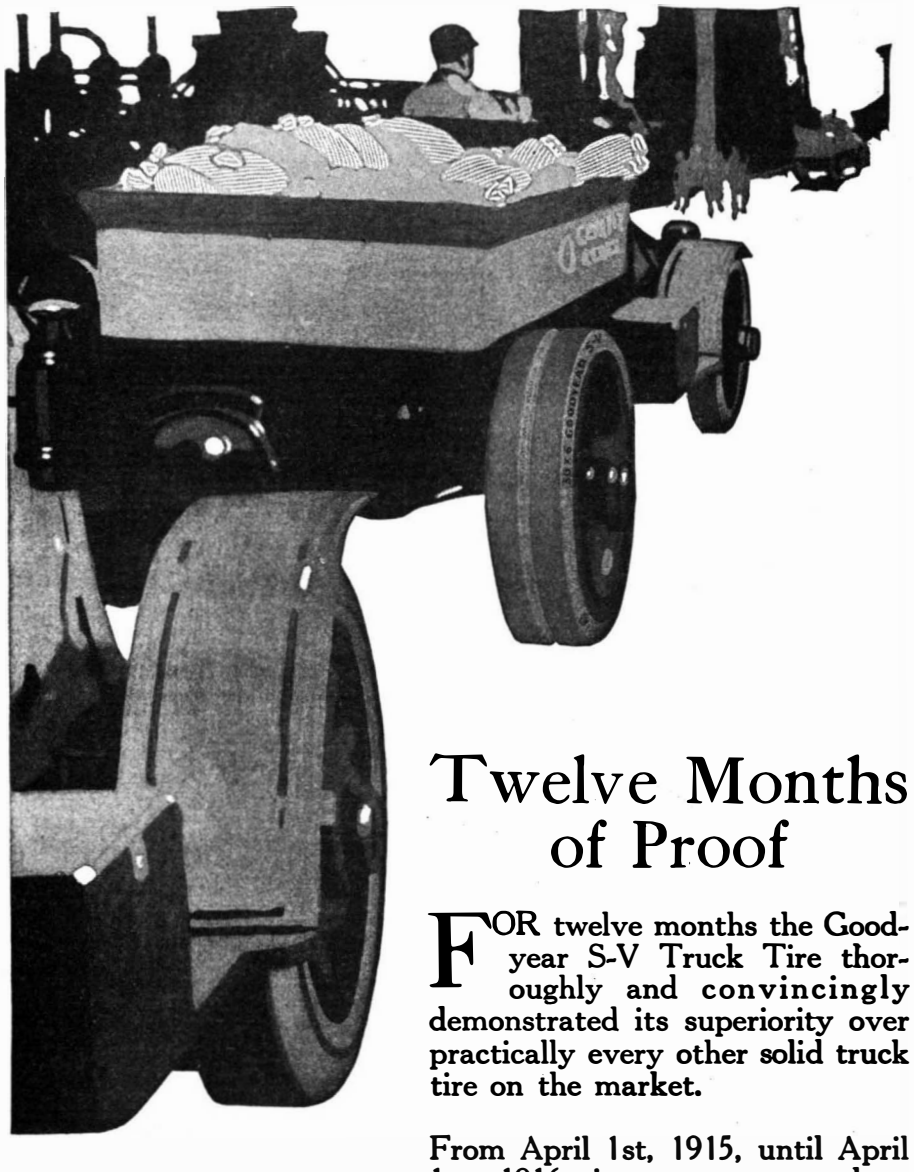
(*Concluded from page* 63)

question of levels or elevations is one of the utmost importance in water-power or irrigation projects, and scarcely less so in railroad construction.

In a larger way, the triangulation of the United States concerns the whole world because it has given us data from which it has been possible to establish with the closest accuracy the probable form and size of this globe of ours. Among other general problems that have occupied the scientists of the U. S. Coast and Geodetic Survey, and still continue to do so, are those of terrestrial magnetism and gravity. These have required the taking of exquisitely exact observations at widely scattered points, not only within our continental limits, but at distant foreign bases.

The Coast and Geodetic Survey has carefully and exhaustively analyzed and compiled all available data for the past three centuries relating to secular changes of the magnetic declination in the United States. The mariner is not alone concerned in the variations of the compass needle thus brought about. Public authorities and land owners are affected through the settlement of controversies over boundary lines where the original marks have been lost. The question is a vital one of how far the present readings of the compass can be accepted as a guide in rerunning lines indicated only by compass bearings. The needle does not point due north and the amount of its departure changes continually from hour to hour, from day to day, and from year to year. For instance, in 1670, at Baltimore, the needle pointed 6° 6′ west; in 1802 it pointed 39′ west, and 98 years later it pointed 5° west. A street a mile long laid out in that city in 1670, would have varied one-tenth of a mile at its northern terminus in 1802.

The Survey's nautical charts, its oceanographic records, and its data relating to the rise and fall of the tides and the force of tidal currents are of the utmost daily importance. Maps of the whole country are equally helpful, and, as has been said, the accurate surveys made through this Bureau of the Government and the maps published by it are national assets that aid materially in the industrial development of the entire country. To the end that the office force of the Survey may do its work well, the field parties must labor without thought of personal comforts. They are ever ready to perform any duty imposed upon them, whether that be to command a ship or to pack a mule train; to climb a glacier or to break a way through a tropical jungle; to raft down hundreds of miles of treacherous uncharted rivers or to blaze a trail over snow-clad mountains or through well-nigh impenetrable forests; to establish bases of supply in veritable wildernesses, and then to reach afar into the unknown region beyond. All that the soldier faces of Nature's perils these men bear without thought of praise that the nation may know better the character of its possessions.



Twelve Months of Proof

FOR twelve months the Goodyear S-V Truck Tire thoroughly and convincingly demonstrated its superiority over practically every other solid truck tire on the market.

From April 1st, 1915, until April 1st, 1916, it was guaranteed to give a lower cost per mile than any other truck tire—on an opposite wheel of the same truck. If the Goodyear S-V failed—its cost was to be refunded.

We wanted to prove to the truck tire buyers of the country that the Goodyear S-V would outwear and outrun any other truck tire made.

We proved it—again, and again, and again.

Side by side with practically every known make of solid truck tire, subjected to the same identical wear—the Goodyear S-V actually gave a lower cost per mile.

The test lasted twelve long months.

Thousands of Goodyear S-Vs were bought on this "make-good" basis and 98% **made good.**

All over the country, throughout one entire year, the S-V gave truck tire buyers the characteristic Goodyear result—better service, longer mileage, and lower cost.

The question of truck tire superiority has been settled once for all.

Get the actual service records from the nearest Goodyear Branch.

The Goodyear Tire & Rubber Company
Akron, Ohio

S-V

GOODYEAR
AKRON
TRUCK TIRES

Oil Folly

How gasoline dollars blow through the exhaust

Gasoline is higher this year.

Motorists will now see more than ever the folly of using incorrect oils. The saving in low-priced oil is lost time and again in gasoline-waste.

Correct lubrication is a controlling factor in low gasoline consumption.

With an oil of high lubricating efficiency and correct *body* the motorist is assured an oil film which thoroughly seals the piston rings.

Gas cannot then escape past the piston rings on the compression stroke.

Nor can the force of the exploding gas blow past the piston rings on each power stroke.

The power of the exploding fuel charge therefore acts with full force on the piston head. Full power results with consequent gasoline economy.

Gas wastage through oil of incorrect body is more common than most motorists realize.

True, the loss per piston stroke is small. But piston strokes quickly mount up into the millions. Then the gasoline waste is measured not by the thimbleful but by the gallon.

The grade of Gargoyle Mobiloils specified for your car in the Chart at the right represents our professional advice.

A year's supply will probably cost you less than a year's supply of the cheapest oil on the market. The higher per gallon price is usually more than an offset by the greater mileage, to say nothing of the saving in gasoline.

If your car is not listed in the partial Chart at the right a copy of our complete Lubrication Chart will be sent you on request.

Correct Automobile Lubrication

Explanation:—The four grades of Gargoyle Mobiloils, for gasoline motor lubrication, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example "A" means Gargoyle Mobiloil "A." "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

MODEL OF CARS	1916 Summer	1916 Winter	1915 Summer	1915 Winter	1914 Summer	1914 Winter	1913 Summer	1913 Winter	1912 Summer	1912 Winter
Abbott Detroit	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
" (8 cyl)	A	A	A	A						
Apperson	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (8 cyl)	A	A								
Auburn (4 cyl)	A	Arc.	A	Arc.	A	A	A	A	A	A
" (6 cyl)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Autocar	A	Arc.	A	Arc.	A	A	A	Arc.	A	Arc.
Avery	A	A	A	A	A	A	A	A	A	A
" (Mod. 5 & C, 1 Ton)	Arc.	Arc.	Arc.	Arc.	Arc.					
Briscoe	A	Arc.	A	Arc.	A	Arc.				
" (8 cyl)	A	A								
Buick	Arc.	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (8 cyl)	A	A	Arc.	Arc.						
Cartercar			Arc.	Arc.	Arc.	Arc.	A	E	A	E
" Com'l							A	Arc.	A	Arc.
Case	A	A	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	Arc.	Arc.	A	A	Arc.	Arc.	Arc.	Arc.
" (Model 6-40)	A	Arc.								
" (Model 6-30)	A	A								
Chandler Six	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Chase (air)	B	B	B	B	B	B	B	B	B	B
" (water)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Chevrolet	Arc.	Arc.	Arc.	Arc.	A	Arc.	A	A		
Cole	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (8 cyl)	A	A	A	A						
Cunningham			Arc.	Arc.	Arc.	Arc.	A	A	A	A
Delaunay-Belleville					B	A	B	A	B	A
Detroiter	Arc.	Arc.	A	Arc.	A	A	A	Arc.	A	Arc.
" (8 cyl)			Arc.	Arc.						
Dodge	A	Arc.	E	E						
Empire			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Federal	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Flat	B	A	B	A	B	A	B	A	A	A
Ford	E	E	E	A	E	A	E	A	E	E
Franklin	A	A	A	A	A	A	Arc.	A	Arc.	
Grant	A	Arc.	Arc.	Arc.	Arc.	Arc.				
Haynes	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (12 cyl)	A	A								
Hudson	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
" Super Six	A	A								
Hupmobile	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
I. H. C. (air)			B	A	B	A	A			
" (water, 2 cycle)	A	A	A	A	A	A				
" (water, 4 cycle)	A	Arc.								
Interstate					A	Arc.	A	Arc.	A	Arc.
Jackson	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
" (8 cyl)	A	A								
Jeffery	A	Arc.	A	Arc.	A	A				
" (Chesterfield)	A	Arc.	A	Arc.						
" Com'l	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Kearns	E	E	E	E						
" Com'l	A	Arc.	A	Arc.						
Kelly Springfield	A	A	A	A	A	A	Arc.	Arc.	Arc.	Arc.
King			A	Arc.	A	A	A	E	A	E
" (8 cyl)	A	A	Arc.	Arc.						
" Com'l	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
Kissel Kar	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" " Com'l	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" " (Model 48)	A	A	A	A	A	A				
Kline Kar	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
" (Model 35)	A	A	A	A						
Locomobile	E	E	E	E	E	E	Arc.	Arc.	Arc.	Arc.
Lozier	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Marion	A	Arc.	Arc.	Arc.	Arc.	Arc.	A	A	A	Arc.
Marmon	A	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.
Maxwell	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Mercer			A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (22-70)			Arc.	Arc.						
" (22-72)	A	A								
Metz	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Mitchell	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (8 cyl)	A	A								
Moline							A	Arc.	A	Arc.
" Knight	A	A	A	A	A	A				
Moon (4 cyl)			Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
National	A	Arc.	A	Arc.	A	A	A	A	A	A
" (12 cyl)	A	A								
Oakland	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
" (8 cyl)	A	A								
Oldsmobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.	
" (8 cyl)	A	A								
Overland	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard			A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" (12 cyl)	A	A								
" Com'l	A	A	A	A						
Paige			A	Arc.	A	A	A	E	A	E
" (6-46)	Arc.	Arc.	Arc.	Arc.						
" (6-36 & 38)	A	Arc.	A	Arc.						
Pathfinder	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.		
" (12 cyl)	A	A								
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (8 cyl)	A	A								
Pierce Arrow	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
" " Com'l	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Pullman	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Regal	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (8 cyl)	A	A	Arc.	Arc.						
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Richmond	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.		
S. G. V.			A	Arc.	A	Arc.	B	Arc.	B	Arc.
Saxon	E	E	E	E	E	E				
Scripps Booth (air)					B	A				
" " (water)	A	Arc.	E	E						
" " (8-cyl)	A	A								
Selden	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Simplex	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stearns Knight	B	A	B	A	B	A	A	A	A	A
" (8 cyl)	B	A								
Stevens Duryea			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Studebaker	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Stutz	A	A	A	A	A	A	Arc.	Arc.	Arc.	Arc.
Velie (4 cyl)			A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (6 cyl)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.				
White	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Willys Knight	B	A	B	A	A	A				
Winton	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

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