SCIENTIFIC AMERICAN

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Vol. LXXXVII.—No. 2.
ESTABLISHED 1845.

NEW YORK, JULY 12, 1902.

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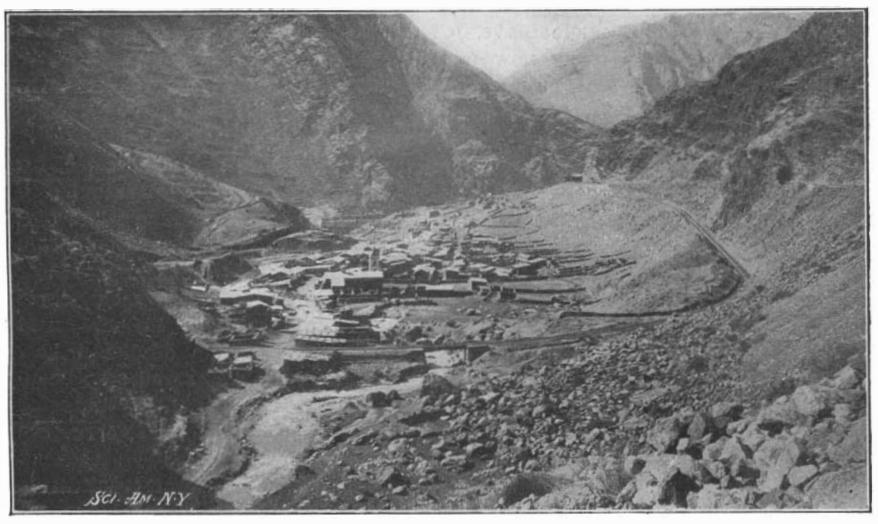
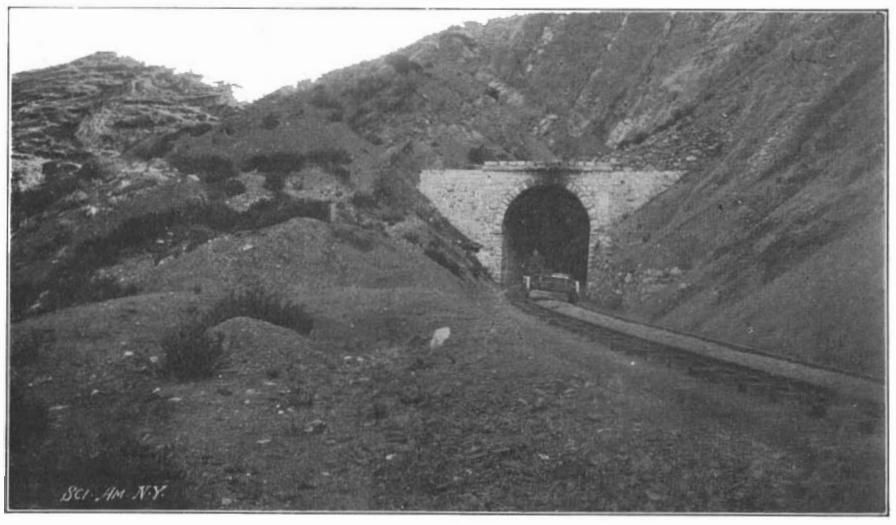
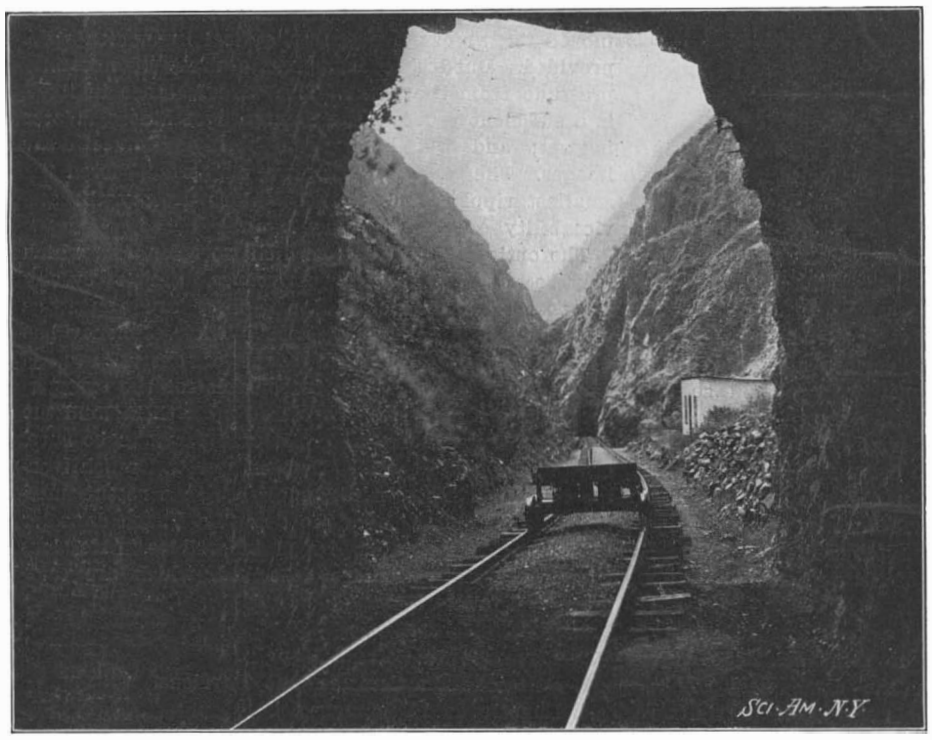


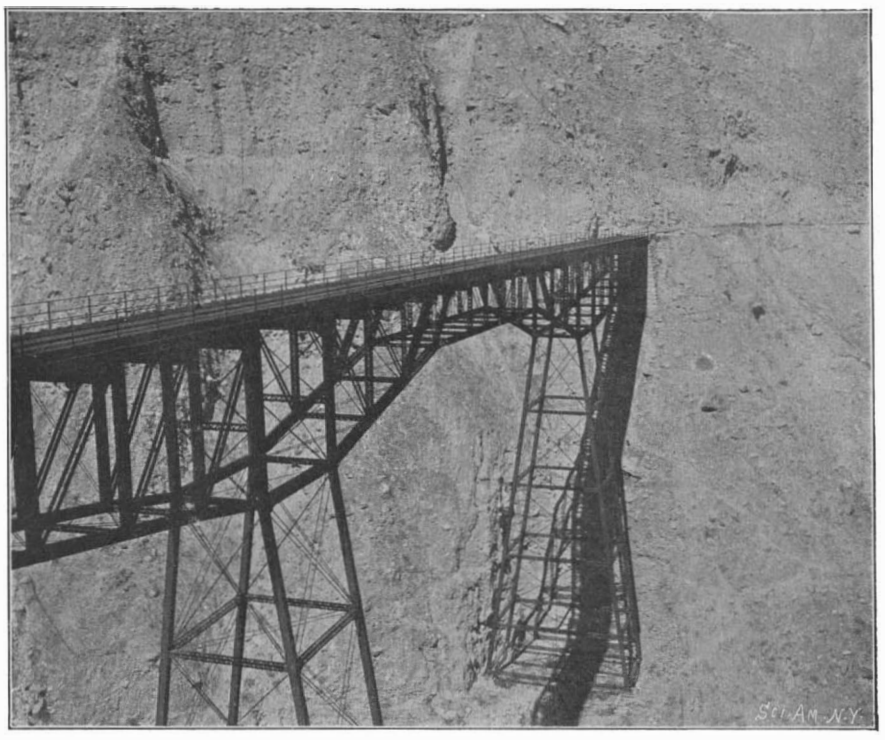
Chicla on Oroya Railroad, 12,697 Feet Above the Sea Level.



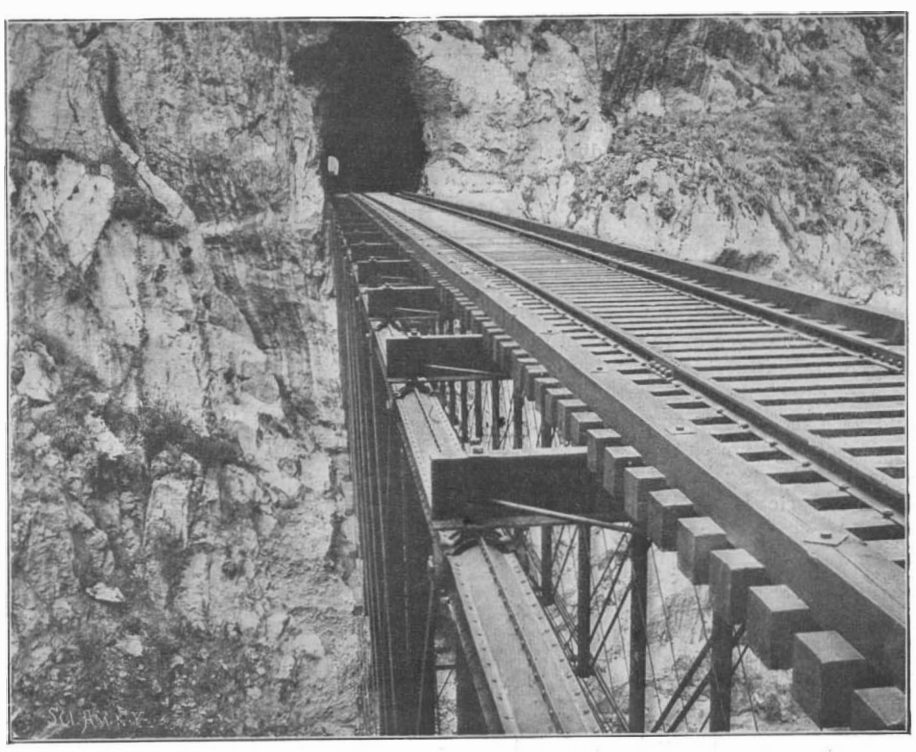
Galera Tunnel, 15,665 Feet Above the Sea Level. The Highest Point Ever Reached by a Railroad.



Tunnel Near Tamboraque on Oroya Railroad, 9,826 Feet Above the Sea Level.



Agua de Verrugas Bridge on Oroya Railroad, 5,839 Feet Above the Sea.



Infiernillo Bridge and Tunnel on Oroya Railroad, 10,919 Feet Altitude.

Cacray. Double V-Switch, 11,033 Feet Altitude.

THE FAMOUS OROYA RAILROAD OF PERU, WHICH CLIMBS HIGHER THAN ANY OTHER ON THE GLOBE.—[See page 22.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).....$3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885)..... 2.50 "
Scientific American Export Edition (Established 1878)..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 12, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

TITLE TO THE PANAMA CANAL.

We learn that the Cabinet of the President, at its weekly meeting on July 1, referred the matter of this government's securing a satisfactory affirmation of the sufficiency of title to the property of the New Panama Canal Company to the Attorney-General; and it is probable that he may endeavor to secure from the French government through the Chamber of Deputies a legislative resolution which shall effectually affirm the legality of the acquisition of the canal by the United States.

There is good reason to believe that informal preliminary assurances have been received from the French government that everything will be done that is necessary to assure a perfect title. It is also expected that the Attorney-General will have access to the records of the French courts bearing on the subject, and authorization from them to secure from a higher tribunal further evidence on the sufficiency of title. The continued friendly feeling between the two governments is certain to dispose of this vital question at an early date in a manner satisfactory to the President.

We trust that the treaty negotiations which are to be undertaken with Colombia will meet with such encouragement that the preliminary arrangements will be completed by the beginning of next year. The President and Cabinet are to be commended for acting so promptly in carrying out the provisions of the law on this most urgent question.

SOLUTION OF THE BRIDGE TERMINAL PROBLEM.

Among the many plans that have recently been submitted for overcoming the crowded conditions of street car and elevated railway travel at the Brooklyn Bridge terminal, by far the most simple and effective is that which has just been proposed by William Barclay Parsons, Chief Engineer of the Rapid Transit Commission, at a recent meeting of that body. The terrible congestion at the City Hall center is due to the fact that three great systems of railroad travel meet at the entrance to the Brooklyn Bridge, and unload their passengers to swell the crowds that find their way on foot during the rush hours to the same point; in other words, the congestion is traceable to the fact that at this most important point, instead of an unbroken system of travel, converging to the bridge and passing over it without any transfer of passengers, there is a terminus of extremely limited accommodations. Evidently, the way to relieve the congestion is to break it up by removing the cause.

We have recorded, from time to time, the various plans which have been offered as a relief to the present conditions. The first one, suggested by a special commission of engineers, proposed to extend the trolley tracks northward on Manhattan Island to the other new East River bridges which are under construction, and southward to important connections further downtown, and the plan proposed would certainly have relieved the crowding. But it was radically wrong in its suggestion to carry these tracks on elevated structures, and so add to the serious disfigurement and obstruction to traffic afforded by the present elevated railways.

Mr. Parsons is convinced that any future additions to the railway system of this city must be made underground, and he proposes to secure all the advantages and avoid the drawbacks of the plan just referred to, by making connections between the present bridge and the new bridges and with the district below City Hall Park by means of subways. The proposal, briefly stated, is as follows: Commencing at the Manhattan anchorage of the Brooklyn Bridge, he would depress the railroad tracks, carrying them down on a grade of 4.5 per cent, until they reached the level of the subway tracks which are now under construction. The tracks would enter a great central, underground station, which would be available for both the present subway tracks and those which it is now proposed to bring below ground from the bridge. Here the tracks would swing to the right and to the left, some of them passing in a subway below Center Street, to a junction with the Williamsburg and Manhattan bridges, while others would be carried in a subway below Nassau Street to Maiden Lane, where they would again swing to the left to pass in a tunnel beneath the East River to Brooklyn. By this arrangement it would be possible to maintain a constant circulation of cars from Brooklyn to Manhattan Island by the present bridge, and from Manhattan Island back to Brooklyn by way of the two new bridges and the proposed Maiden Lane Subway and tunnel. The present congestion would by this arrangement be entirely relieved. Incoming and outgoing passengers would no longer crowd to a single point; since the former would alight, some of them, at City Hall Park, and others at the various points in the new subway which are nearest to their destination; while the outgoing passengers would, a large proportion of them, take the Brooklyn cars at various points on Manhattan Island, and only a limited number would walk to the present bridge terminus.

The carrying of the tracks below grade will, of course, remove the necessity for the present Brooklyn Bridge terminal station, and this unsightly structure it is proposed to remove and erect in its place a large municipal building, whose architecture will harmonize with the buildings in the vicinity. We are glad to note that on the presentation of this scheme to the Rapid Transit Commission it was heartily indorsed by all the members of that body. The estimated cost of this work being only $2,752,000, it will be seen that because of the heavy damage costs which would be necessary if elevated structures were built, the proposed trolley subway would be a very much cheaper construction; while its advantages, because of the large union underground station which would be built at the bridge, and the absolute freedom from interference with traffic, to say nothing of the avoidance of any further encumbering of the streets with unsightly elevated structures, render it by far the most practicable scheme yet presented for the solution of this important problem.

SCIENCE IN AMERICA.

From time to time, the status of pure science in America is made the subject of more or less acrimonious discussion. One of the most trenchant opinions which has been delivered in some time on the subject, comes from the pen of Prof. Carl Barus, of Brown University, who writes in a recent number of Science with a candor that is refreshing.

Among other things, our self-distrust is sharply criticised. We are not quite certain that we have among us a great savant until we are told so by foreign scientists. Contrasting the reception accorded to a German scientist in Germany and a French scientist in France, it must be confessed that we treat our own men rather shabbily. Whenever he reads a scientific paper before some learned society, the German chemist or biologist, figuratively speaking, takes off his hat to the work of his countrymen. The Englishman waxes enthusiastic over results achieved by British men of science, and a Frenchman will pay many a graceful compliment to some scientific compatriot who has worked in the same field. That science should know little or nothing of patriotism may be true enough. The pessimistic Schopenhauer even went so far as to declare in his clever, bitter way that patriotism in science was but another form of bigotry.

But if American scientists should not flaunt the stars and stripes in the face of the foreigner, yet they should at least take a certain pride in what their countrymen have accomplished. For Americans the aristocracy of science resides in England, although it cannot be denied that the Continent too has its attractions. Prof. Barus tells us that our scientific men are apt to outgrow first the American Association, then the National Academy, and finally even their own country.

All this may seem to point to a well-devised scheme of gradation. But the question arises: Can we ever hope to reach intellectual maturity in the eyes of the world if we belittle the dignity of our own institutions? Self-confessed incompetency, says Prof. Barus, may be a virtue, but one should at least first be sure that the incompetency really exists. Although we cannot agree with the Professor in believing that if Europe were to close her gates to American scientific research, no greater blessing could befall us, we do believe that American achievements in scientific research should receive as full a meed of recognition in this country as they do in Europe.

THE "BLINDNESS" OF THE SUBMARINE.

In 1899, the largest of all submarine boats, the "Gustave Zédé," successfully withstood her first trial. The results were so satisfactory that French naval architects immediately and enthusiastically advocated the introduction of submarine craft in the French navy. Even the public showed unusual interest in the construction of these new vessels; for the Paris newspaper, Matin, received subscriptions sufficient in amount to pay for the two boats, "Français" and "Algérien." M. Lockroy, Minister of Marine, who traveled through Germany for the purpose of studying German industries, was one of the strongest advocates of the submarine boat after the "Gustave Zédé" had been placed in commission. In the Chamber of Deputies he advocated with all his ardor the building of submarines, maintaining that "once the submarine boat was blind, but now it can see." That statement must be taken with the proverbial grain of salt. Indeed, naval officers have time and again complained of the blindness of submarine boats. For that reason it is not to be wondered at that many attempts have been made to provide eyes for the new vessel.

The exact nature of the provisions that have been made have, of course, been kept secret. Indeed, every new piece of machinery that is introduced in the submarine boat is carefully concealed from the inquisitive intruder. At all events, it is quite certain that the first suggested plan of using searchlights, to dispel the submarine darkness, is not practicable, for the reason that the rays of light illuminate but a small portion of the vessel's course. Some years ago, during the diving experiments with the "Goubet," a French journalist was said to have been engaged for the purpose of bringing home to the French people the terrible efficiency of the new craft. He performed his task with startling success. He described how easily the boat sank beneath the water and rose again to the surface; how easily it was guided, and how comfortable were its accommodations. It is true that the boat never journeyed for any distance; that no torpedoes were launched, nor that any other offensive virtues were developed. But one phenomenon at least he described truthfully. He positively asserted that nothing could be seen from the interior—nothing but a mass of water.

Instead of using searchlights which would be of service only for such submarine vessels as are employed for wreckage purposes, optical instruments are provided. But these instruments must of necessity protrude from the water. That circumstance in itself is a sufficient proof of their untrustworthiness. Water is wet; and wet lenses can hardly produce clear images. The sea is almost always agitated. Even the smallest ripples may be sufficient to destroy the serviceability of the instruments used.

The optical apparatus to which we refer, and which may be generally termed "périscopes," are not by any means very recent inventions. They are almost as old as the submarine boat itself. Their efficiency has ever been doubted in all countries except France. The daily press is chiefly responsible for the exaggerated praise that has been lavished upon them; and the press accounts, in somewhat diluted form, to be sure, have filtered into the technical papers. A French technical journal, for example, publishes in a recent number an article that bears the title "La Vision dans les Bateaux Soumarins et les Submersibles." No less than six instruments are described, which are catalogued as follows:

1. Lunette de Drzewiecki.
2. Périscope du Colonel Mangin.
3. Périscope du Commandant Darrieus.
4. Lunette de M. Romazzotti.
5. Lunette de MM. Garnier et Romazzotti.
6. Lunette de Daveling et Violette.

Of these, the first is preferred; for the paper in question assures us that "this system is exceedingly simple, and is perhaps the best." In commenting on the apparatus, it may be skeptically remarked that the arrangement is certainly simple—so simple that its efficiency may well be doubted. The original description of this instrument reads: "Elle est composée d'un tube ayant à chaque extremité un prisme droit à reflexion totale. La lunette coulisse dans un presse-étoupe. On peut la faire rentrer ou sortir du navire et, de plus, en la faisant tourner autour de son axe, on parcourt tout l'horizon." The description is certainly meager enough. No sketches are given. It is furthermore stated that the instrument is only five centimeters in diameter, and that only one eye can be used in viewing an object. Even in France this "best" optical instrument for submarine boats has been criticised; for the article concludes: "We believe that the most practical instrument would be the two-prism apparatus of Drzewiecki, provided it could be given a length of 50 centimeters and a diameter of 15 centimeters. The angle of vision would then be about 18 degrees instead of the present 4 degrees." The images are said to be clear. The inventor, Drzewiecki, is a Russian who first made his appearance in France during the nineties.

The other instruments of the list are similar in character. Mangin's périscope is 1 meter long, 30 centimeters in diameter and produces reduced distorted images. The instrument invented by Commandant Darrieus, who is said to have "commanded several (*sic*) submarine boats while he was still a lieutenant," is very similar to the Drzewiecki apparatus. The lenses are, however, somewhat differently

arranged. The angle of vision is only 4 degrees. The length of the instrument is 1 meter, and its diameter 30 centimeters.

Romazzotti designed the "Gustave Zédé." It may, therefore, be inferred that the boat is also provided with his telescope. But nothing definite is known. Romazzotti collaborated with Garnier in the invention of a telescope that may be deemed an improvement upon his own. Both apparatus are said to have an angle of vision of 20 degrees, and to have a length of 1 meter and a diameter of 30 centimeters. The contrivances of Daveling and Violette, about which no little ado was made in 1899, are merely modifications of the Garnier-Romazzotti instrument. The images are said to be small and the apparatus not easily manageable. The Italian engineers, Russo and Laurent, have also attempted to solve the problem of providing submarine boats with eyes. Their compatriot, Albrizzi, has succeeded in introducing his own instrument. Of this last contrivance nothing is known beyond the fact that it is an "improved périscope" of wide angle. Finally, the submarine telescope of Malachowski must be mentioned—an instrument which was primarily intended to reveal objects at the bottom of the sea, and which has never been practically used.

THE METRIC SYSTEM IN THE TEXTILE INDUSTRY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Prof. Roberts Beaumont, the well-known English textile technologist, is strenuously advocating the adaptation of the metric system to the textile industries, and the publication of an international list of definitions for the various technicalities in the trade to facilitate business. At the present moment great confusion exists upon this point, since mechanics in the textile industries in various parts of the United Kingdom have a variety of terms to indicate the same subject, while the terms in America are also different, thus increasing the perplexity of the complication. For instance, the Scotsman defines his yarns as "cut;" the West of England weaver, "snap;" the Yorkshireman, "skein;" and the American, "run." When the subject is that of the "setting" or fineness of the fabric, the words "set," "reed," and "sley" are respectively employed.

Again, confusion also exists in connection with the units of length and weight. For example, in two textile districts, although a similar unit of length is in existence, the unit of weight varies. Corresponding terms are used ("cuts" of 300 yards), but the weights are 24 ounces and 26 ounces respectively. No doubt the latter were fixed by some ingenious manufacturers when secrets of the trade existed, with the object of throwing dust in the eyes of each other; for if a man in one district, in speaking to a confrere in the other district about any cloth produced, referred to the yarn as a 20-cut, it would be different in diameter to the same counts of yarn in the latter center. Further, the term "set," which is quoted 40's, or any other workable number, implies very dissimilar results in different towns, on account of the units of widths being 24¼, 36 and 37 inches respectively.

To the average mind these are sufficiently heterogeneous conditions for the manufacturer to have to contend with, but they are intensified by the trade of to-day demanding that in the same fabric, yarns of wool, worsted, cotton, and silk should be combined. The unnecessary difficulties which ensue may be briefly elucidated by considering how the weight of fabric is determined; namely, by the diameter or thickness of the yarn, and by the length of the yarn in a given area.

Suppose that in the fabric there are compound threads, say of wool, worsted, and mercerized cotton. Here at once three systems of counting yarns have to be dealt with—the woolen by the yards per drachm, the worsted by the hanks of 840 yards per pound—resulting in several calculations before the actual counts of the three-fold thread can be ascertained. It is remarkable that the trade should for such a period have endured these unsatisfactory methods, and that firms of this country should hitherto have not only practised them, but rather enhanced their complexity by the coining of other words and equivalents, such as "runs" and "grains." Our experts are now, however, making a strong stand for the adoption of the metric system, and a standard unit of counts, whatever the kinds of yarn spun.

The committee appointed by Congress to examine into the systems of coinage, weights, and measures have recently issued their report, which embodies the views of the principals of the textile schools of this country. The decision of the International Congress, held at the Paris Exposition in 1900, on this very same subject is approved by the committee, namely, one universal system of counting yarns, the basis of which would be that a No. 1 yarn would be a length of 1 meter weighing 1 gramme; or in other words, a length of 1 kilometer weighing 1 kilogramme. This method is identical in principle to the Yorkshire "skein," in which a 1's yarn is equivalent to a length of 1 yard weighing 1 drachm.

In a statement which was read before the Associated Chambers of Commerce in London in 1895, Prof. Beaumont suggested that a fixed number of meters (1 kilometer) should be taken as a unit of length, and the kilogramme as the basis of weight. This is exactly the method that was subsequently recommended by the Paris Congress of 1900, and now advocated by the textile technologists of this country. An alternative system advanced in 1895 was the use of a constant length, say 10 or 100 meters, and a variable weight, the counts being indicated by the weight of the yarn in grammes. It is important to differentiate between these two bases on which yarns may be calculated; in one there is a variable length and constant weight, and in the other, a constant length and a variable weight. The latter suggestion has one element in its favor, for in calculating folded yarns it is only necessary to add them together, whereas in systems where the length varies and the weight is constant, the calculations have to be done by fractions.

The question as to which system should be utilized is one for the experts to determine when all technicalities have been adequately considered, but it is in the interests of the trade that the metric system should be practised, and that "counts" should have the same meaning of whatever fiber—cotton, flax, wool, silk, etc.—the threads may be composed. Such a standardization of lengths and weights would be of universal value, and would considerably facilitate business in this industry between America and England.

THE FRENCH ALCOHOL AUTOMOBILE ENDURANCE TEST.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

It will be remembered that the French Minister of Agriculture organized a series of official tests of alcohol automobiles, the route being laid out through the north of France, starting from Paris. The races were held under unusually trying circumstances, as it rained the whole time and the roads were in consequence very muddy. It was, in fact, an endurance test for the chauffeurs as well as for the machines. Notwithstanding the bad weather, the race was quite a success and the machines, all of which used alcohol as fuel, did remarkably well. This has been the first official test of alcohol automobiles and it will no doubt be followed by others. A speed and a consumption test were held. The route started from Paris, reaching the north coast at Boulogne, following along the coast to Dieppe, then returning to Paris, the total distance being 571 miles. This is the first great speed test of the year, and shows how the new racing machines behave on a long course. Last year the racing cars weighed from 2000 to 4000 pounds, but this year's models are lighter, and do not much exceed 2000 pounds. Maurice Farman carried off the honors of the race and made the record of 72.28 kilometers (44.8 miles) an hour on a Panhard & Levassor car. Marcellin came second (speed, 41.5 miles an hour) on a Darracq light machine, and Jarrot third on a Panhard. In the automobile class four Serpollet steam machines made the best time after Farman and Jarrot, using flash boilers heated by an alcohol flame. The consumption test followed a somewhat shorter route, a distance of 452 miles. Here the consumption of alcohol per ton-kilometer was the important point and speed was a secondary matter. The filling and measuring of the tanks was carried out by a commission headed by M. Famechon. The results are of interest as showing the amount of alcohol used; this amount varies considerably in the different types. The best performance belongs to the Chenard & Walcker automobile class car, which consumed but 65.3 cu. cm. of alcohol (50 per cent mixture) per ton-kilometer. In the light-weight class the Delahaye stood first at 92.2 cu. cm. per ton-kilometer.

THE SECOND PARIS AUTOMOBILE EXPOSITION.

The second exposition of automobiles and stationary motors was held in the vast Galerie des Machines and was even a greater success than the former show. On one side were the exhibits of automobiles and on the other the stationary motors. The center of the hall was occupied by an elliptical race track, on which the automobiles could be put through their evolutions. The racers which had made the north circuit test were all on exhibition, including the Delahaye which had three machines entered, the Gillet-Forest, Panhard and all the leading makes. The Gobron-Brillie Company had an immense ore-hauling wagon, built for a mining company of France. The Serpollet cars were on exhibition, including the famous "Easter Egg" racer which made the speed record at Nice. The alcohol-electric car of M. Krieger is among the novelties; it carries a De Dion motor, as well as an electric outfit with batteries. President Loubet, who is much interested in the subject of alcohol, made an official visit to the show. M. Dupuy, the Minister of Agriculture, is trying, by a series of tests and expositions, to develop the alcohol industry in France. In fact, nearly all the leading automobile firms have arranged their motors so as to use either alcohol or gasoline by a simple change in the carburetion, and the success of the alcohol motor has been strikingly brought out in the north circuit tests which were recently made.

ANALYSIS OF MONT PELEE'S VOLCANIC DUST.

The steamships that escaped from the ill-starred islands of Martinique and St. Vincent after the disastrous eruptions of Mont Pelée and La Souffrière, were literally deluged with the sand that spurted from the volcanoes. One of our correspondents, Mr. A. E. Outerbridge, Jr., of Philadelphia, Pa., assures us that the decks of the steamship "Korona" were covered with a layer of sand three inches in depth, some hours after she left Barbados on the 7th of May, at which time she was about ninety miles distant from St. Vincent.

As a partial recompense for the terrible destruction of their property, it was hoped by the planters that the volcanic dust might contain soil-enriching phosphates. Tradition says that after the dust-shower which accompanied the eruption of 1812 the sugar cane flourished in the West Indies as never before. The remarkable crops harvested in the years immediately following 1812 were attributed to the presence of phosphate and potash salts in the dust.

But the planters of the present day will be doomed to disappointment. Mr. Outerbridge furnishes us with a very full analysis of the sand discharged by the Martinique volcano, from which it appears that the Barbados soils will profit little by this most recent eruption. The sand contains but a small percentage of potash and phosphoric anhydride. In a hundred parts of the dust that fell on May 7, only 0.675 part of potash and 0.141 part of phosphoric anhydride were found. Other constituents of the dust (alumina, titanium oxide, iron oxide, lime, magnesia, soda, etc.) are already contained in abundance in West Indian soils. The planters have merely reason to congratulate themselves that the sand contains no injurious substances and that the texture of the soil may be somewhat improved by the incorporation of the dust with the surface layers.

That the eruption of 1812 was less violent than that of 1902 is indicated by the fact that the dust of the former is composed of much finer particles than that of the latter. The dust of 1902 is almost entirely volcanic glass.

A sample of sand sent to us by Mr. Outerbridge is of rare microscopic interest. Many of the nodules have long spider webs of volcanic glass radiating in spirals, closely resembling those of "mineral wool."

The amount of dust which fell upon the island of Barbados on May 7 and 8 is variously estimated at from one million to two million tons.

THE PARIS-VIENNA AUTOMOBILE RACE.

The automobile race from Paris to Vienna has been run at last, the event taking place on the 27th, 28th and 29th of last month. One hundred and thirty vehicles made the start, but a number of the best chauffeurs were obliged to quit the race after the first day's run, because of accidents. The total distance of 782 miles was divided into three stages, one of which was covered each day. The best time was made by Renault in a machine of his own manufacture, which weighed about 1000 pounds and which completed the journey in 15 hours, 22 minutes actual running time. This is an average speed of 51¼ miles per hour, or as fast as that of many of our express trains. When one considers that in order to maintain this average M. Renault had to go far faster at various times in order to make up for reduced speed in the more difficult places, one is struck with the speeding power of his automobile; but far more striking even than this were its enduring qualities. The roads traversed were some of the worst in Europe, and the route of the final stage of the journey passed directly over the Altberg, a mountain 5000 feet in height, with deep snow on the summit.

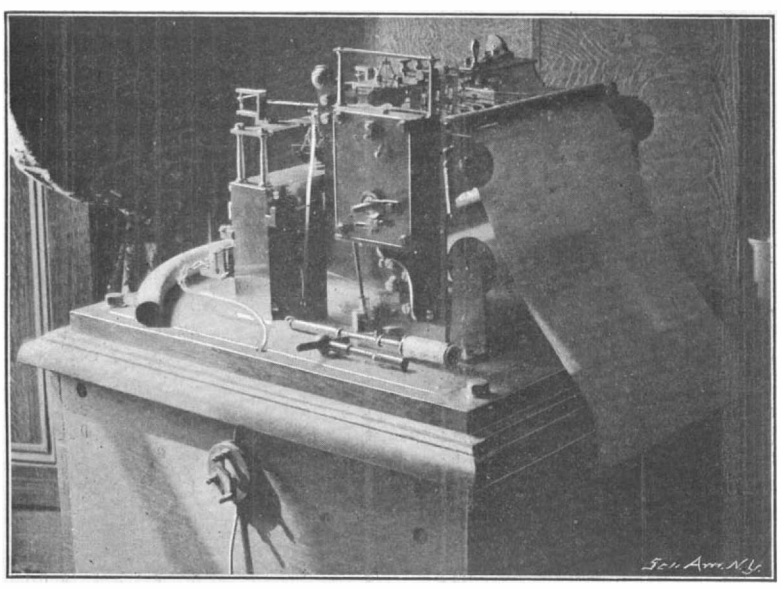
The prizes were awarded to the winners as follows: Marcel Renault (light weight class, Renault machine), first; Henri Farman (heavy weight class, Panhard), second; Edmond (light weight class, Darracq), third; Maurice Farman (heavy weight, Panhard), fourth; Zborowski (heavy weight, Mercedes), fifth. Mr. S. F. Edge, an Englishman, won the international cup, reaching Innsbruck, Austria, ahead of his French competitors.

The winning of the contest by a light weight machine was a surprise to many. It is said, however, that the framework of the heavy machines and other parts of their minor mechanism were too light to carry the heavy and powerful motors. As there was a limit of 2250 pounds in the heavy weight class, many of the manufacturers were obliged to sacrifice to weight in some parts that were thus not strong enough to carry the tremendous strains. The contest certainly proved that a light vehicle has as good or perhaps a better chance in long distance traveling over rough roads.

MEASURING THE RAINFALL—THE BRITISH RAINFALL ORGANIZATION AND ITS WORK.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The daily measuring of the rain throughout the British Isles constitutes one of the most important meteorological observations. The Royal Meteorological Society is generally supposed to carry out these surveys, but the records of this organization are neither exhaustive nor complete. The measuring of the rainfall is the sole function of a particular institution known as the British Rainfall Organization, with its headquarters at Camden Town, a northwestern suburb of London. This society was founded in the year 1859, by the late Mr. G. J. Symons, a Fellow of the Meteorological and Royal Societies.



THE BRONTOMETER FOR RECORDING WIND VELOCITY, BAROMETRIC PRESSURE, THUNDER, LIGHTNING, HAIL AND PRECIPITATION.

Although this society performs a valuable national work, it receives no State or public assistance. It is maintained entirely by private resources. When first inaugurated, the founder defrayed the expense of maintaining the institution himself; but as the organization attained larger proportions, several other equally interested gentlemen offered to contribute toward the expense of controlling the same.

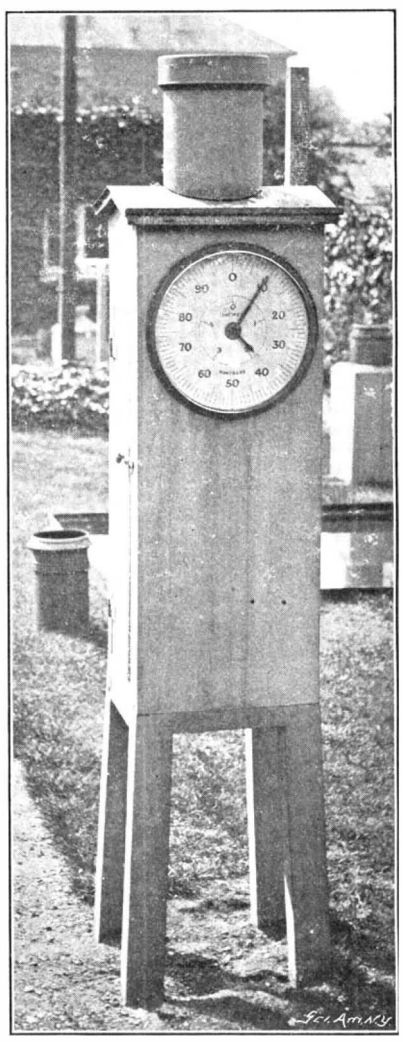
The work is carried out upon a most extensive and exhaustive scale. Scattered over the whole of the British Isles are over 3500 observers, comprising men in all positions of life, the majority performing the work gratuitously, while in some cases, where such complimentary assistance cannot be obtained, remunerated observers are employed. These observers are supplied with printed forms from the London headquarters, which have to be filled in regularly every day, and returned to London for publication in the Society's annual publication and magazine. The major portion of these returns are dispatched to London weekly, in other cases monthly; and in a few instances, owing to the inaccessible places in which the recording instruments are placed, either quarterly or half-yearly. A comprehensive idea of the manner in which this work is undertaken may be adequately realized from the fact that, on the average, there is a rain gage to every twenty square miles in England, one to every thirty square miles in Wales, one to every seventy square miles in Scotland, and one to every one hundred and seventy square miles in Ireland. The reason for the larger disproportion of instruments in Scotland and Ireland, is due to the dearth of observers in the Western Highlands of the former country, and the thinly populated districts in Ireland.

It must be explained that in using the term rainfall, snow, hail, and dew are also incorporated, since the three latter are only various forms of rain, and all tend to nourish and to water the earth.

The instruments employed at the London observing station are both numerous and ingenious for the fulfillment of the various functions for which they are required. The most common type of rain gage consists of a cylinder fitted with a wide-mouthed funnel and terminating in a bottle or other suitable receptacle. In measuring the rainfall, care has to be observed that no loss is incurred by the splashing of the drops, or by evaporation, and the vessels are consequently specially constructed with a view to overcoming these defects. The rain which falls into the bottle within the cylinder is subsequently measured in a graduated glass, and the amount of the rainfall thus obtained.

Although the foregoing constitutes the simplest form of rain gage and is infallible in its working, the institution utilizes one or two types of mechanical registering appliances. The drawback to this description of rain gage, however, is the liability of the instrument to become deranged as a result of the failure of a portion of the mechanism. One of these instruments, known as the Casella rain gage, however, is particularly ingenious. It consists of a large funnel, connected to a small receptacle called the "bucket," placed in the box below. This bucket is suspended upon one end of a lever, to the other end of which is fixed a pencil, which in turn glides over a continuous roll of paper tightly wound upon a drum, making a fine thin line in its progress. As the rain falls through the funnel into the bucket, the latter, owing to its gradually increasing weight, slowly depresses the lever, which movement in turn draws the pencil higher up the paper. The drum containing the paper is slowly forced forward by a clockwork mechanism, so that a pictorial representation of the rainfall similar to that recorded upon the barograph is obtained. This instrument performs its duties very efficiently, and is reliable in its working. Owing to the simplicity of its mechanism and the stoutness with which it is constructed, the possibility of its breaking down is very remote. When the bucket is filled with water it automatically tips over, so that its contents are emptied, and resumes its original position, at the same time returning the pencil to zero. The only attention that the instrument requires is the daily winding up of the clock and the adequate supply of paper upon the drum.

Another type of rain-registering apparatus is the float gage. The principle of this is that the rain falls through the funnel into a cylinder. In this cylinder is placed a float to which is attached a graduated measuring rod, which projects through the mouth of the funnel. As the rain falls into the receptacle below it raises the float, which lifts the measuring rod a height commensurate with the depth of water within the vessel. The snowfall may be recorded in a variety of ways. One process is to melt the snow in a previously ascertained quantity of hot water and then to measure the aggregate, the difference between the latter and the quantity of hot water utilized for melting purposes, representing the amount of the snowfall. The most salient disadvantage of this system is the liability of the observer to forget the amount of hot water that he employed with which to melt the snow. The method employed by the Rainfall Organization is much more satisfactory and infallible. The snow falls into a capacious receptacle, and drops into another vessel below. Round this latter circulates a constant stream of hot water which rapidly transforms the snow to water, and it then drops into a third receiver to be measured.

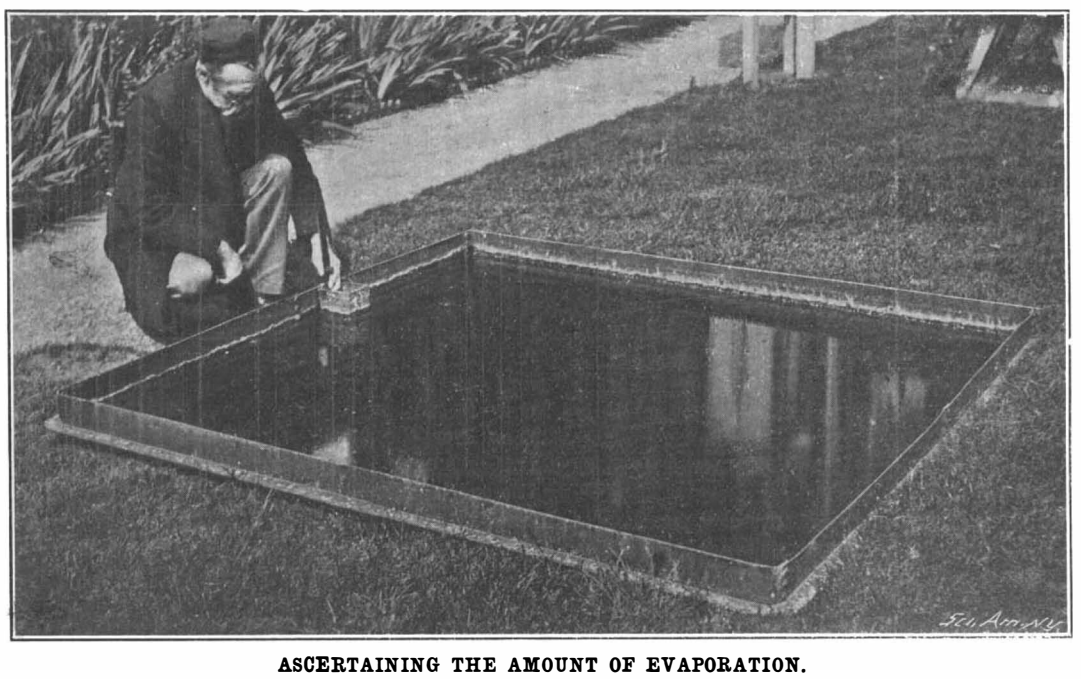


STORM GAGE FOR RECORDING ABNORMAL RAINFALLS.

The storm gage for recording abnormal rainfalls is another ingenious instrument. It consists of an elongated box supported on four legs, to the upper end of which is attached the conventional receiving funnel. Inside this box is a long cylinder equipped with a float, which is connected to the hands of a large dial placed on one side of the external box. As the rain falls through the funnel into the cylinder below, it forces up the float, which in turn actuates the hands of the clock. This dial is inscribed with the inches and tenths of inches, so that the rainfall can be gaged to a nicety.

Probably the most intricate and at the same time most delicate and beautiful machine ever devised for utilization in this ramification of meteorological survey, is that known as the "brontometer." It is the invention of the late Mr. G. J. Symons, the founder of the Rainfall Organization, and is the only one extant. It cost $2,000, and in reality is a combination of various instruments. A wide scroll of paper is wound tightly upon a large drum, which is slowly revolved by clockwork mechanism. Across the roll of paper extends a beam equipped with seven pens, each of which performs a particular function. The first pen is the time indicator. It defines a continuous thin line upon the paper, and at intervals of a minute deviates slightly from its course, so that minute periods are recorded. The second pen is connected by electricity with an anemometer placed on the roof of the building, and the wind velocity is recorded upon the paper. The third pen records the amount of the rain-

COMMON TYPES OF RAIN GAGES.



ASCERTAINING THE AMOUNT OF EVAPORATION.

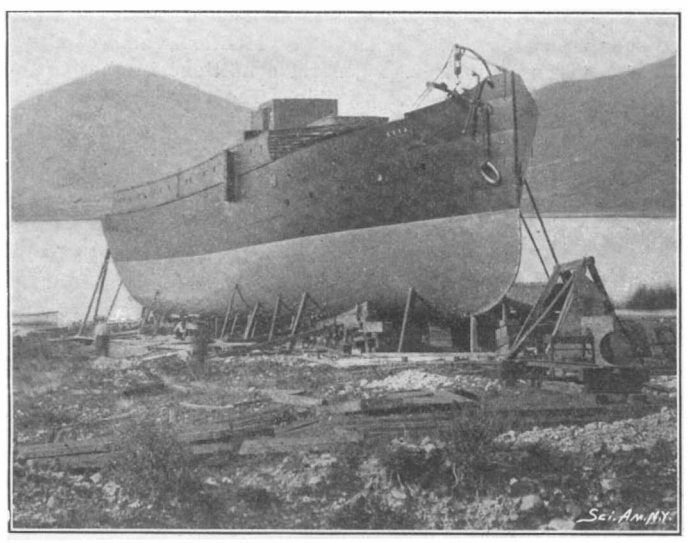
fall; the fourth and fifth pens, lightning and thunder respectively. The observer operates these two last pens by means of two small levers. Directly the lightning flash is observed, the first key is depressed, thus recording the lightning flash. When the thunder is heard, the next key is depressed, and the thunder duly recorded. By simple mathematical deductions between the records of these two keys, and the time indicator of the first pen, the distance of the lightning from the observing station may be gained. The sixth key records the fall of hail, and the seventh key the barometric pressure. The rainfall records from throughout the country are carefully collated at the end of the year, and published in the Society's annual volume, "British Rainfall." It is the standard work on the subject published in the United Kingdom. Through the work of this society a complete record of the daily rainfall in England, extending over a period of approximately forty years, has been gathered. Owing to the annual increment in the number of observers, the work is becoming more thoroughly and exhaustively performed.

These records are of inestimable benefit to the general public. Farmers, by the consultation of these surveys, can deduce the average rainfall within the year at any desired part of the country, and can thus calculate whether the moisture conditions of that section of the kingdom are suitable to the agricultural experiments contemplated. Local authorities who have to combat floods resulting from abnormal rainfalls, are also informed as to the best methods of averting any inconvenience from this source, and to cope with the difficulty when it arises. In view of the many public services thus rendered, the organization, which is the only one of its description in the world, would seem to deserve state assistance.

A REMARKABLE SHIPBUILDING FEAT, 13,000 FEET ABOVE THE SEA LEVEL.

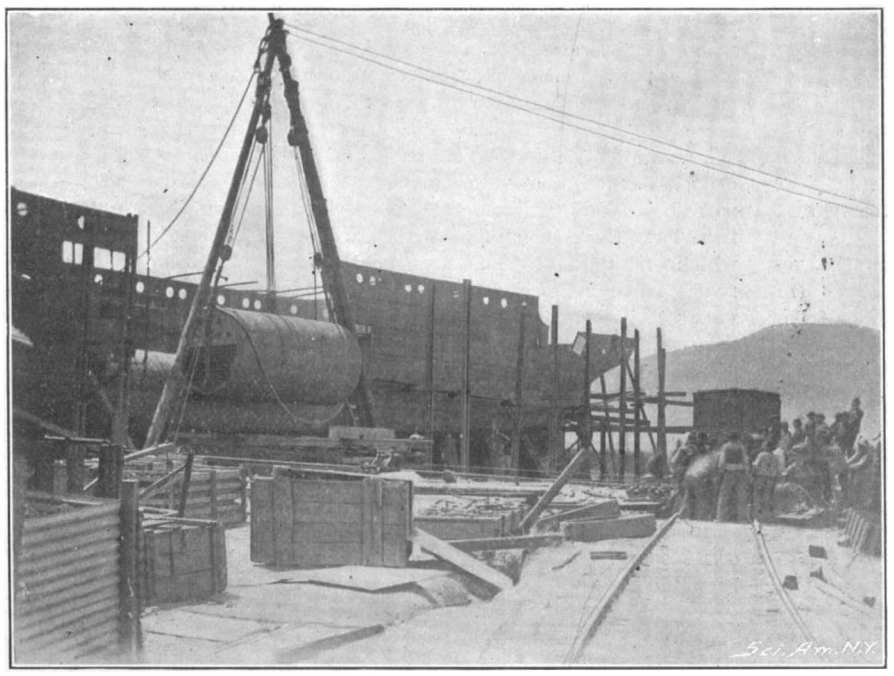
BY OUR ENGLISH CORRESPONDENT.

The Andes of Peru are remarkable on account of the railroad engineering achievements, especially on the section of the iron road stretching from the port of Mollendo on the Pacific coast to Lampa, and Puno on the banks of Lake Titicaca, the highest known sheet of water in the world (13,000 feet above sea level). This inland lake measures 120 miles in length, and varies from 25 to 40 miles in width. For many years communication was desired between the terminus of the railroad at Puno and the terminus of the railroad at Chiliaya in Bolivia on the opposite shore of the lake, some 100 miles away. The traffic between the two termini was maintained by means of the primitive native balsas, constructed out of the totora grass which thrives on the muddy banks of the lake. But the exigencies of the increased traffic necessitated a more expeditious and economical means of communication, and so the Peruvian corporation which controls the railroads resolved to establish a steamship upon the lake to ply between the two ports.



THE "COYA" READY FOR LAUNCHING.

The contract for the steamer was placed with Messrs. Denny Brothers, the celebrated shipbuilders of Dumbarton on the Clyde. The vessel is a twin-screw shallow-draught steamer, 170 feet in length, beam 26 feet, and 550 tons gross, with accommodation for 45 first-class and 30 second-class passengers. Owing to the lake shelving gradually from the shore, it was rendered expedient to have the craft of very shallow draught, in order to approach the landing stage. The vessel, named the "Coya," was temporarily erected upon the Clyde, but not launched. She was then dismembered and shipped at Glasgow to Mollendo. To facilitate transport, the parts of the vessel were made as small as possible. The boilers, however, owing to the great care that has to be exercised in riveting the plates together by hydraulic pressure, so that there can be no possibility of their exploding, were shipped intact, and that constituted the heaviest and most bulky portions of the cargo, since they weighed 15 tons each. The "Coya" was dispatched to Puno under the superintendence of Mr. John Wilson, F. R. G. S., a young engineer who had served his apprenticeship with the builders of the steamer. Considerable difficulty was experienced in disembarking the *material* of the "Coya" at the port of Mollendo. This port is the terror of all Pacific navigators, since it is exposed to the full fury of the Pacific Ocean. The surf is so heavy that it is only in the calmest weather that safe landing can be effected. After waiting a few days, the weather moderated sufficiently to permit the plates to be landed, by means of lighters. Apprehensive of the safety of the boilers, which from their unwieldiness and weight were more liable to accident, the engineer proceeded to Islay, a port ten miles north of Mollendo, where there is a magnificent anchorage. They were here transferred to lighters, and towed back to Mollendo. As an extra precaution, the engineer caused the boilers to be plugged, so that in the event of an accident to the lighters, the boilers would float and thus be recovered. The loss of a boiler would have been calamitous, involving several months' delay before it could have been replaced.



THE "COYA" IN COURSE OF CONSTRUCTION.

The cargo was placed on a train of twenty-two freight cars. The boilers were carefully lashed down to obviate oscillation and collision with low bridges.

When Puno was reached, a primitive shipbuilding yard was improvised upon the potato patch of a Quichua Indian. Difficulties now confronted the engineer on every side. For some occult reason the railroad authorities at Arequipa had made no preparations for his arrival beyond giving him a pile of disused railway sleepers. Notwithstanding the fact that they had been fully instructed to provide necessary tools, Wilson was not even provided with a hammer. But he remained undaunted by this turn of affairs, and since sending to England for tools would have involved several weeks' delay, he set to work to fashion a few tools from some scrap iron that he discovered. The railway sleepers he cut up and used as keel dogs.

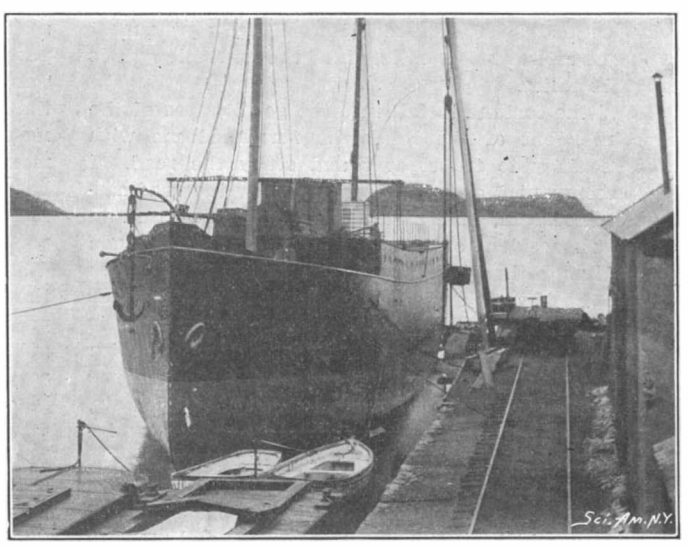
The railroad authorities supplied some riveters from the locomotive shops at Arequipa. The natives who assisted in the work, although slothful, possessed a certain amount of intelligence. Flush riveting was unknown to them, however, and some time elapsed before they became sufficiently expert to render much valuable assistance. Trouble was experienced with the "ne'er-do-wells" of the country, called Gringoes, who hastened to the scene from all parts of the country, not to work, but to see how much material they could appropriate for their own special use. Some idea of the arduous nature of the engineer's task may be gathered from the fact that in the forty laborers he employed, sixteen different nationalities from all parts of the world were represented.

In selecting the shipyard, care had to be exercised to select a suitable spot for launching. Under ordinary conditions the launching ways are laid at low tide, so that at high water the lower ends are sufficiently submerged. In this case, however, he had no assistance from tides. Fortunately, at the time of the year he arrived, the lake was low, so that when the rainy season raged, the water would rise a few feet. But even this would not have supplied a sufficient depth of water at the end of the ways, and they were further submerged by means of heavy weights attached to them. The stocks for the vessel consisted of the timber utilized by the railroad for the erection of their bridges, and they were placed as near the water's edge as possible. The construction of the vessel's hull progressed very rapidly after the laborers had been initiated into the work of flush riveting. The boilers were really the only difficult portion of the "Coya" to handle. As a rule, the machinery is not installed in a vessel until after launching, but this course in this instance was absolutely impracticable, owing to the absence of any kind of lifting appliances. The engineer was unable to obtain a crane, and also could not improvise a derrick, owing to absence of tall trees in that high altitude to furnish sufficiently long lengths of timber. He finally surmounted the difficulty by purchasing the spars from an old sailing vessel in Mollendo port, which the master of the craft only parted with at a high figure, since he had gained news of the engineer's difficulty. The boilers were each about 16 feet in length by about 8 feet in diameter, and were moved 40 yards from the freight cars to the vessel's side by sheer physical labor. The hauling of the boilers into the vessel by the primitive crane was an exacting operation. The condenser weighed five tons. The cylinders and the various parts of the machinery were not installed until after the launch.

Some idea of the rapidity with which the steamer was built may be gained from the fact that within six months of the arrival at Puno the "Coya" was ready for launching. The launch was an anxious operation to the engineer, because even in the best equipped shipyards a certain amount of uncertainty attends this operation. The engineer more than anticipated failure upon the first attempt, notwithstanding the infinite care he had exercised to avoid any hitch.

The launching ceremony was the occasion of great festivities in the city of Puno. About 5000 Indians also witnessed the function. The christening was performed by the Bishop of Puno. After the short religious service, holy water was sprinkled over the bows and a bottle of champagne broken in the conventional style. Immediately this was completed, the engineer pulled the trigger maintaining the cradle in position, and instantly the "Coya" glided with increasing momentum into the water. No launch in the most modern shipyard could have been attended with greater success than the launch of the "Coya."

With the launch of the vessel the most arduous part of the undertaking was completed. The "Coya" was towed to, and berthed alongside the mole at Puno, where the rest of her machinery and cabin fittings were installed. The sight of a steamship floating upon this lake occasioned considerable astonishment among the unsophisticated Indians, many of whom had never seen the sea, and consequently had never seen a steamship.



"COYA" LAUNCHED AND BERTHED BESIDE MOLE AT PUNO.

The trial trip of the steamer was the occasion of a general holiday in the city. The contract speed of the vessel was to be ten knots per hour, and she was to

cover the journey between Puno and Chiliaya in ten hours. The vessel was captained by a Peruvian, who had to be initiated into the work of the telegraph apparatus connecting the bridge with the engine room, while Mr. Wilson accompanied the vessel as engineer. One difficulty that was experienced was in connection with the stoking of the furnaces. Owing to the rarefaction of the atmosphere at this high altitude, there was a decreased supply of oxygen, which necessitated stoking the furnaces in small quantities, or else the fires were smothered. This required continual labor, which was exceedingly fatiguing. Forced draught was of course applied, but this did not alleviate the difficulty to any appreciable extent. The steamer was also supplied with the apparatus necessary for petroleum fuel. The engineer described the experience of traveling at such an altitude as peculiar. The air was extremely clear, with the clouds rolling thousands of feet below, while the throbs of the piston rods of the engines rang out clearly and distinctly upon the rarefied air.

The engineer suffered many privations as the result of working at such a high altitude. The blood would rush to his head and his eyes protrude from their sockets with painful results. He was also seized with one of the epidemical diseases indigenous to that region, and was troubled at times with soroche, the prevalent complaint. By conceiving a severe attack of *mal-de-mer* combined with a splitting headache, a quasi-asphyxiation, and land sickness, a tolerable idea may be obtained of the painfulness of this malady.

By the terms of the contract, the "Coya" was to be constructed and delivered over to the railroad authorities within twelve months from the signing of the document. The contract was fulfilled within the specified time by two days. The construction of a vessel of the dimensions of the "Coya" in such an isolated spot as the shores of Lake Titicaca is an engineering triumph. When one recollects the insuperable obstacles the engineer had to surmount, the absence of any of those appliances with which the modern shipyards are provided to facilitate work, the employment of unskilled labor, then some idea of the magnitude of the task may be gained.

THE FAMOUS OROYA RAILROAD OF PERU WHICH CLIMBS HIGHER THAN ANY OTHER ON THE GLOBE.

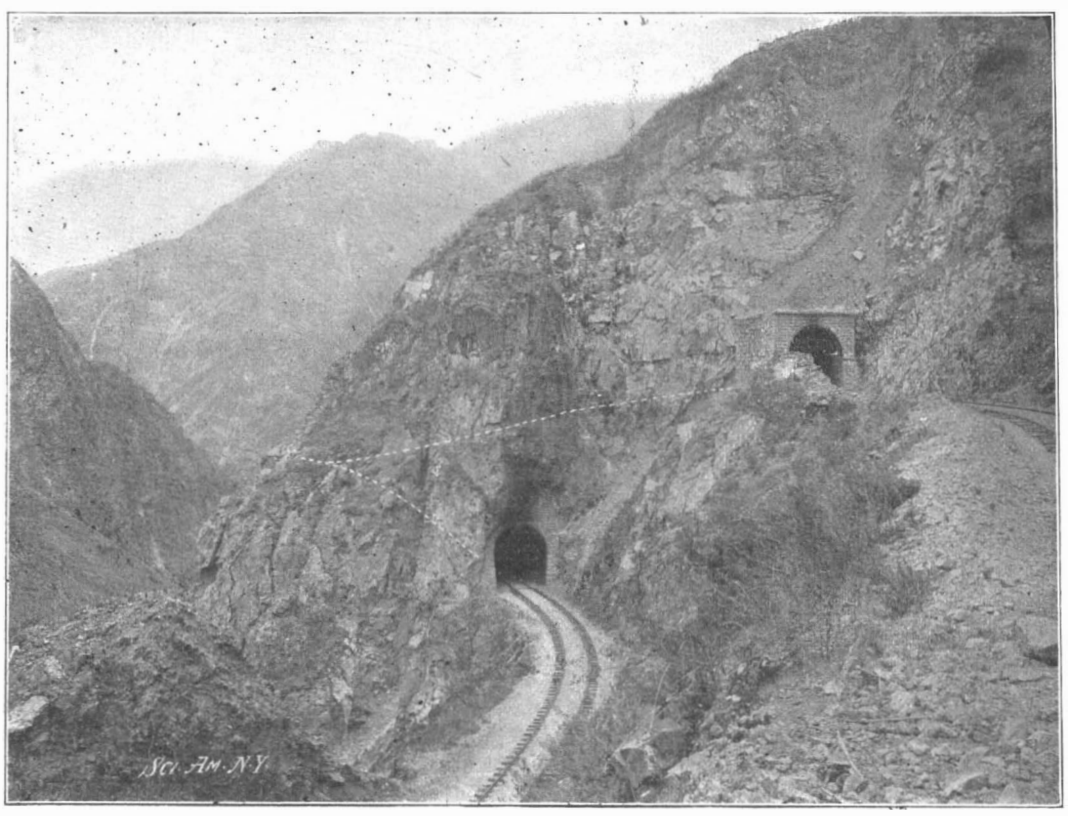
BY E. C. ROST.

To ride in American cars, drawn by an American locomotive, over an American-built railroad of standard gage, to an altitude of 1445 feet higher than the summit of Pike's Peak in Colorado, is a feat than can be accomplished only on the Oroya Railroad, or Ferrocarril Central del Peru. Messrs. Meiggs and Thorndike, the famous American railroad magnates, constructed and completed the line at a total cost of $43,000,000, which places it among the most costly of railroads per mile, since the entire length is only 138 miles.

I had the fortune to fall into the good graces of the superintendent of the line, who furnished me with every facility to travel over and study the road. I was accompanied on my various trips by the roadmaster, an American, who, by the way, lost an arm and an eye in an accident on this line. Our start was made from Lima, although the road runs to the very shores of the Pacific at Callao. The road is of four per cent grade, the running time, including stops, is about fifteen miles per hour. It was therefore with some misgivings that I started on the trip, because we ascended so rapidly from sea level into the rarefied air, and in nearly every instance the passenger suffers intensely from the effects of this sudden change.

As Lima, the queen city of the Pacific, fades into the distance, we see naught but low hills and scant vegetation, which confine themselves more and more to the banks of the Rio Remac, and after a few miles we see no sign of vegetation, not even a scraggy cactus. These low hills are only the foothills of the Andes. A 33-mile run brings us to Chosica, 2800 feet altitude, where are several side tracks to permit trains to pass; for the Oroya is a single-track road. Here are some fine mansions, occupied by wealthy citizens of Lima, and we find a good hotel. Fourteen miles more brings us to San Bartolome, 4959 feet altitude, another point where trains pass.

From San Bartolomé we begin our zigzag journey over the famous switch system, here introduced by Henry Meiggs, called the "V switch," and known by us as the "switchback." This system saves cost of construction, difficult development round the mountains, wear and tear of rolling stock, etc. Four miles farther on, and at an altitude of 5839 feet, we cross the world-famous Agua de Verrugas bridge (built in Philadelphia), the loftiest viaduct on the globe, which spans the valley of like name. Many lives were lost during the construction of this wonderful bridge, from the dread and always fatal disease, also called the Verrugas, which is due to the mineral gases and dust peculiar to this locality. It is claimed that one American died from this malady, having crossed this bridge but once. It may be proper to state here that the Andes present a mass of various kinds of minerals, and to remind the reader that the word Andes means mountains of copper, so named by the Indians. After passing an unimportant station, having traveled 12 miles more, we arrive at Matucana, which is loftier than the summit of Mount Washington, in New Hampshire, or 7708 feet above sea level. This is a resort patronized by those afflicted with pulmonary troubles. Here commences the wonderful scenery, which is one of the celebrated features of the road. Nowhere else are such weird, rugged mountain vistas to be found. As we proceed, now forward, now backward, over the zigzag V-system (for the locomotive pulls the cars over one section, then runs onto a switch and backs the cars over the next), as we pass through dark tunnels and over substantial iron and steel bridges, now crawl along the flank of a mountain whose perpendicular walls reach above the clouds, the effect is awe-inspiring. No brush or pen can describe the grandeur of nature as created here. Our own Rocky Mountains are grand, nay sublime, and have been more or less described; but the Andes must be seen to be appreciated. After leaving Matucana, we pass over three more important bridges, and arrive at Tamboraque, where in one view we see five sections of the line below us, over which we have passed in making the ascent. Here are extensive works for the manufacture of carbide for acetylene gas purposes, lime being found in very large quantities. Next we come to Aruri, 76 miles from Callao and 10,094 feet altitude, where we find another of the remarkable engineering difficulties for which this road is celebrated, the famous double tunnels, where the train passes into the lower tunnel, drawn by the engine, and is backed out of the upper tunnel almost exactly above. Two miles from here we come to San Mateo, an old mining town, just beyond which is another of the engineering features of the Oroya, combined with scenic wonders—the Infiernillo bridge and tunnels, where a substantial steel bridge hangs suspended between the mouths of two tunnels, with the mad torrents of the Remac rushing far below.



SWITCH-BACK TUNNELS ON THE OROYA RAILROAD, 10,094 FEET ABOVE THE SEA LEVEL.

At 88 miles from the shores of the Pacific we find ourselves at Chicla, which is 12,697 feet above old ocean. This is another mining town of some importance. Fifteen miles more, and we arrive at Casapalca, of 13,606 feet altitude, where are located the silver-smelting works of an American company, and here it is that the soroche, the dread disease feared so much, and rightly, by the mountain climber has taken a firm hold on all but a very few. If your courage permits—and it takes considerable—you proceed on the upward journey; for we have still a hard climb ahead to reach the summit. Otherwise, avail yourself of the hotel, a very poor one, or the kind hospitality of the superintendent of the smelting works, and return to a lower level.

From Casapalca we have 11 miles more to Galera tunnel, the highest point of the road and the highest point in the world ever reached by any railroad; in fact, the highest point at which the piston rod was ever used. This tunnel is one and one-half miles in length, and when half way through it we are on the very highest point of the road, for the waters running from the eastern mouth of the tunnel find their way into the Atlantic, while those running out of the western mouth run into the Pacific Ocean.

At the tunnel we are 15,665 feet in height above our starting point, or 1445 feet higher than the summit of Pike's Peak in Colorado. Here we are in the region of everlasting snow and ice. From this point there are still 32 miles more of road to Oroya, the terminus, over a down grade, for Oroya itself is only 12,178 feet above sea level. This latter section is not so interesting, although there are considerable mining interests which, with produce from the eastern slopes of the Andes, provide a good, paying profit.

From Oroya travel is continued on donkey to Cerro de Pasco, some 80 miles away and some 6000 feet higher up, where extensive mining is carried on, and to which point a railroad has been surveyed and a concession granted for the construction of the same. On my return to Galera tunnel I found a handcar in waiting, owing to the kindness, as already mentioned, of the superintendent, in which we traveled to the shores of the Pacific. The handcar travels down the four per cent grade by its own momentum for 106 miles to Callao.

Arsenical Beer and Rats.

When the arsenical poisoning from beer caused such a sensation in Manchester a few months ago, the British government appointed a Royal Commission to investigate the subject. One of the most interesting outcomes of this investigation has been the experiments by Prof. Delepine, of Manchester, to ascertain the action of arsenical beer and other arsenical solutions administered in large quantities to rats. According to the scientist who carried out the researches, he selected these rodents, since they are specially suitable for the experiments, and because they take beer and weak watery solutions of alcohol and arsenious acid very readily, and can adapt themselves to considerable variations in their diet. They are less affected by arsenic than man and many other mammals, and to estimate the probable effects of certain quantities of arsenical beer upon man, solutions containing at least four times more arsenic than had been found in the most contaminated beers examined during the outbreak were administered to a certain number of rats. The experiments were conducted in sets. In each set a certain number of rats were placed under conditions absolutely identical, and care was taken to make the general conditions in the various sets as similar as possible. The stoppage of the arsenical beer to the rats was followed by marked disorder of health, manifested by a marked disinclination to take food and drink, which had been well taken up to then, and a marked loss of weight. This was after beer sampled from one of the districts in which the scare had occurred had been administered, diluted or undiluted, arsenical beer being less injurious when undiluted than when diluted with water. Those rats which were well fed were less seriously affected than those which had not been well fed. The result of the second set of experiments apparently proved that arsenical beer containing only a trace of arsenic, even in presence of an amount of alcohol above the average, was not injurious to health so long as a large amount of food was taken; and the presence of a large amount of arsenic was clearly injurious, whether the amount of alcohol was small or large, but the presence of a large amount of alcohol seemed to precipitate a fatal issue. The other experiments showed that it mattered little whether arsenical glucose or arsenious acid were used in making beer, but laboratory beer was more deadly than brewers' beer. One experiment showed that beer brewed at a low temperature was more wholesome than beer brewed at a high temperature.

Frank Linde, a wealthy resident of Bridgeport, Conn., has been sued by a local lumber firm for supplies furnished to Gustave Whitehead, the alleged inventor of a flying machine, who had secured the interest of Mr. Linde in his work.

Correspondence.

Explosion of Stars Into Nebulæ.

To the Editor of the SCIENTIFIC AMERICAN:

In the various numbers of your journal you have referred to the extraordinary fact that Nova Persei had expanded into a nebula which was growing at the rate of some thousands of miles a second; you also referred to the fact that it seems as though it was the result of a violent explosion. Here in New Zealand the idea of an explosion of a star into a nebula is no new thing. More than a score of years ago it was shown by Prof. Bickerton, of Canterbury College, New Zealand, that if two stars grazed, the velocity with which they would graze, due to mutual attraction, would be hundreds of miles a second; and it was shown that the explosive force developed by the energy of the collision would be thousands of times greater than that of dynamite. Dr. Johnstone Stoney some thirty years ago discussed the grazing impact of stars, and Prof. Bickerton showed that the parts that lay in one another's way would both be grazed from the stars and form a third body, while the two stars would not be greatly affected by the encounter. He showed that this grazed portion would have the same temperature, no matter how much was cut off, and if only a very little were cut off, the gravitating power of the mass would be altogether too small to hold it together; every one of the molecules would be above the critical velocity, and it would expand first into a nebula, and then, if the mass grazed off were small in proportion to the bodies, the nebula would continue to expand until it was dissipated into space. Prof. Bickerton has followed this action, and has shown that most varied results follow from variety in the amount of impact. He has embodied the whole in a book called the "Romance of the Heavens," published by Macmillan & Company, New York. Should any of your readers be interested in the problems presented by Nova Persei they will find every detail of its character has been anticipated in the "Romance of the Heavens."

JAMES R. WILKINSON, M. A., Cant. Coll., N. Z.
Wainoni, Christchurch, May 28, 1902.

A Folding Range Finder.

The officers of the British army have been experimenting with a new range finder, the invention of Prof. G. Forbes, Fellow of the Royal Society. The official range finder at present in use by the infantry is the mekometer; but so inaccurate is this instrument, and so exposed are the two men necessary for its working, that it has never been used in action. Prof. Forbes in his invention has overcome this great drawback, and has devised a folding range finder, which only requires one man to operate it. The Forbes range finder consists of a six-foot folding base, and a pair of binoculars, magnifying twelve diameters. The whole instrument weighs three and a half pounds. On looking through the binoculars, the image of a balloon fitted with a trail rope is shown projected on the landscape. By moving a graduated wheel, the balloon appears to advance or recede, so that the trail rope can be brought over any part or point desired. This done, the range is read direct off the graduation. The great point about the Forbes range finder is that the man who takes the range need not expose himself, as he can do his work hidden behind a tree or cover of any kind. Prof. Forbes demonstrated the portability, practicability and the accuracy of his instrument while in South Africa, for he took part in several engagements, and the officers expressed a high opinion of its qualities, so that its adoption by the War Office appears imminent.

The Current Supplement.

The leading article of the current SUPPLEMENT is a fully-illustrated account of the making of the huge 50-ton anchor chains which are to be used by the Great Northern Steamship Company. The chains are probably the largest that have ever been made. Mr. H. W. Buck discourses on the education of the electrical engineer. The paper read by Messrs. B. J. Arnold and W. B. Potter before the American Institute of Electrical Engineers on "Comparative Acceleration Tests with Steam Locomotives and Electric Motor-Cars" is published in full. In contrast to this paper stands Mr. J. Swinburne's article on the electric problem of railways. The reconstruction of the underground foundations for the Paris metropolitan railway is a topic which is interestingly discussed and graphically illustrated. Mr. Havelock Ellis concludes his entertaining study of mescal. A brief illustrated article on magnetic separators should prove of interest. Mr. D. B. Dixon comes to the fore with a valuable article on boiler scale solvents. Of practical interest is an article on how to make and use lead-burning apparatus. Minor articles and the usual Trade Notes and Consular abstracts will be found in their usual places.

Electrical Notes.

A new method of making carbide and carbon and carbide filaments has been invented by an electrical engineer of London. The filament is soaked, previously to its being heated electrically, in a salt of the metal or metals of which the carbide is desired. If the salt in its decomposition by heat damages the filament it is reduced to oxide by means of ammonia. During carbonization of the impregnated filaments, carbonaceous gas is passed through the crucible. The filament is first treated electrically in an atmosphere of the metal or metals, or of a salt of the metal or metals to be comprised in the carbide, this heating being carried to such an extreme as will form the carbide desired.

Many devices have been proposed to prolong the life of electric arc lamps. The most effective arrangement consists of a chamber or cylindrical body around the pencil ends, which prevents access of air and thus secures longer life. But the use of such a chamber is objectionable by reason of the fact that it decreases the light ignition. While it raises the temperature of a luminous arc, no means are provided by which this increase of temperature is utilized. A German inventor believes that he has devised an improvement in such arc lamps by providing them with pencils containing an addition of metallic salts or substances having a higher temperature of combustion than the carbon itself. Such carbon pencils, it is claimed, will produce a highly luminous arc. The temperature of incandescence and the power of emission of light possessed by the metallic salts used, will be intensified in proportion to the heat generated by the combustion of the carbon. With pure carbon pencils the reflectors are disadvantageous as regards the yield of light, by reason of the higher temperature for reduced luminosity of the arc. With the use of this especial carbon, it is claimed that the very cause of this disadvantage is utilized in realizing a distinct improvement.

One of the most powerful engines ever built for driving a dynamo has been completed by an engineering firm of Leeds, England, and is to be utilized in connection with the municipal electric lighting plant of that city. It is of the vertical double-acting triple-expansion type, and every part is inclosed. The three cylinders are at the top of the structure and have respectively diameters of 23 inches (high pressure), 35 inches (intermediate) and 55 inches (low pressure). The length of the stroke is 30 inches, the shaft on which the cranks are set at 120 deg. is 12 inches in diameter, while the total height from bedplate to top is 22 feet, and it is designed to make from 200 to 250 revolutions of the crankshaft per minute. Some fine castings have been employed in its construction, notably the bedplate, which measures 21 feet by 8 feet and weighs 16 tons. The casing is cast in two pieces and weighs 22 tons, while the low-pressure cylinder weighs 9¼ tons. The total weight of the complete engine is 105 tons. The cylinders are fitted with slide valves, and are self-draining. The forced system of lubrication is employed. The oil is supplied to all the working parts by a pump without valves or packing, driven from the crankshaft, which discharges the oil at a pressure of 10 pounds to 25 pounds per square inch through specially designed oil channels. The oil that escapes from the bearings drains into the crankpit, and is used again. The engine is coupled direct to a dynamo with a normal output of 1400 kilowatts, but capable of generating 1540 kilowatts. The steam pressure of the engine is 200 pounds maximum per square inch, developing 2500 indicated horse power.

C. B. Jacobs has described a new application of the electric furnace, which may prove to be of great practical importance, before the New York section of the Society of Chemical Industry. Barytes, the natural barium sulphate, is usually converted into other barium compounds by treating it with coal or coke in a reverberatory furnace and then working up the crude barium sulphide thus obtained; but it has been found that when barium sulphate and sulphide are heated together in suitable proportions, at the temperature of the electric furnace, the sulphur is completely eliminated as sulphur dioxide and barium oxide remains, the conversion being so complete that only 2 to 3 per cent of barytes remains unacted upon, as against 25 to 45 per cent by the older process. By lixiviating with water and crystallizing out, almost pure barium hydroxide is obtained, and from that compound all the barium salts are readily obtained. The electrical energy required for the process is got from the Niagara Falls, and the plant in use at the present time is turning out sixty tons of barium hydroxide per day. The compound is largely used in the tanning industry, the white pigment and dry color trades, the purification of water for industrial purposes, and general manufacturing chemistry, the largest consumption being the beet-sugar industry, for the recovery of the sugar remaining uncrystallized in the molasses. Barium hydroxide is also an ideal substance for the softening of water for boiler purposes, and its general introduction in place of the methods at present in use is said to be only a question of price.

Engineering Notes.

The Norwegian government has voted a sum of $90,000 to provide a submarine boat for the Norwegian navy. Capt. Geelmuyden, of the Norwegian navy, was commissioned to visit this country to examine the various types of this class of craft, and has recommended the Holland submarine, the construction of which will be commenced immediately. The British government has also notified the company controlling the Holland patents of its acceptance of this type of boat for the British navy, the experiments with the first of the vessels built by the Vickers-Maxim Company, of Barrow, upon the Holland designs, having proved highly satisfactory.

While shipbuilding is flourishing all along the coast of Maine this year, Bath is particularly prosperous, and the new fleet turned out there in 1901 will be notable both for aggregate of tonnage and for character of the vessels. There are now under construction in the Bath yards naval vessels aggregating 21,435 tons, to cost $5,637,650, and merchant vessels aggregating 27,400 tons, to cost $1,503,000, a total of 48,835 tons, costing $7,140,650. Since January 1 this year there have been completed at Bath naval vessels aggregating 501 tons, costing $510,000, and 24,878 tons of merchantmen, costing $1,260,500, a total of 25,379 tons, costing $1,770,500. The grand total of vessels launched thus far this year and now under construction represents 74,214 tons, and, with ship machinery contracts now in hand, a value of $9,510,150. These figures establish a new record for Bath both in tonnage and in value. Wood still outranks steel in importance, the steel tonnage launched this year amounting to 4400 tons, valued at $770,000, while the wooden vessels aggregate 20,979 tons, valued at $1,000,500.

The Administration of Public Works in France has issued a report dealing with the history of French railways during the past ten years. During the great drop in French trade from 1889 to 1894, the railways suffered severely, and large demands were made on the French treasury to make good the interest guaranteed to the shareholders by the state. In 1889, 29,000,000 francs were required to make good this guarantee, but in 1892 the amount required was 60,000,000, and in 1894, 62,000,000 francs. The falling off in net receipts leading to this state of affairs caused the companies to cut down, so far as possible, the working expenses. In 1894 these amounted to 688,000,000 francs per year, but in 1896 they were but 686,000,000 francs, although the amount of traffic handled had considerably increased. Since then the exigencies of the growing traffic have rendered necessary considerable increases in the working expenses, but these have been only about one-fourth the increase in the receipts. It has, however, to be observed that during the period of rigid economy inaugurated in the early nineties, the expenditure on new plant and works was kept down as much as possible, so that the railways were not fully prepared to meet the boom of the closing years of the century, and much heavy work is now desirable. During the period from 1890 to 1894 the number of passengers per year averaged 288,000,000, while between 1895 and 1899 it was 375,000,000. Similarly the goods traffic over the lines in question averaged 962,000,000 tons per year for the period 1890-4, and 1,095,000,000 tons for the years 1895-9.

From the rate at which the timber in the United States is now being used, says the Railway Age, it is apparent that within a few years a question of some weight will be that of securing a suitable supply for those industries using this material in large quantities. Railroads will be affected because of the large demands made by them for timber for tie purposes. It is true that great tracts of timber yet remain, but these for the most part are located in such remote districts that the necessary freight charges practically prohibit their use. The most natural remedy to propose is that of so treating the tie as to lengthen its life. Various successful methods of treatment are now being used, but in practically all cases the tie with treatment is just about as expensive in the end as the untreated tie. Among the other speculations that have arisen since the discovery of oil in Texas is that of determining its preservative properties in the treatment of ties. To this end extensive experiments are now being made by the Atchison, Topeka & Santa Fe. A tank has been built by that company at its creosoting plant at Summerville, Tex., where ties are being soaked with crude oil. These will be placed in the track together with others treated by various creosoting processes and the comparative value of the treatments determined. Different localities have been chosen for the tests where the ties will be subjected to extreme conditions of weather and climate. The comparative cheapness of crude oil, together with the fact that the ties are merely to be soaked—a process attended by little expense—makes the present tests of considerable moment. Oil is one of the principal constituents in many of the preparations that are being used for this purpose, and though as yet undetermined, it is not improbable that the crude oil of Texas will prove of value in this regard.

TESTING THE NEW BERMUDA DOCK.

BY HAROLD J. SHEPSTONE.

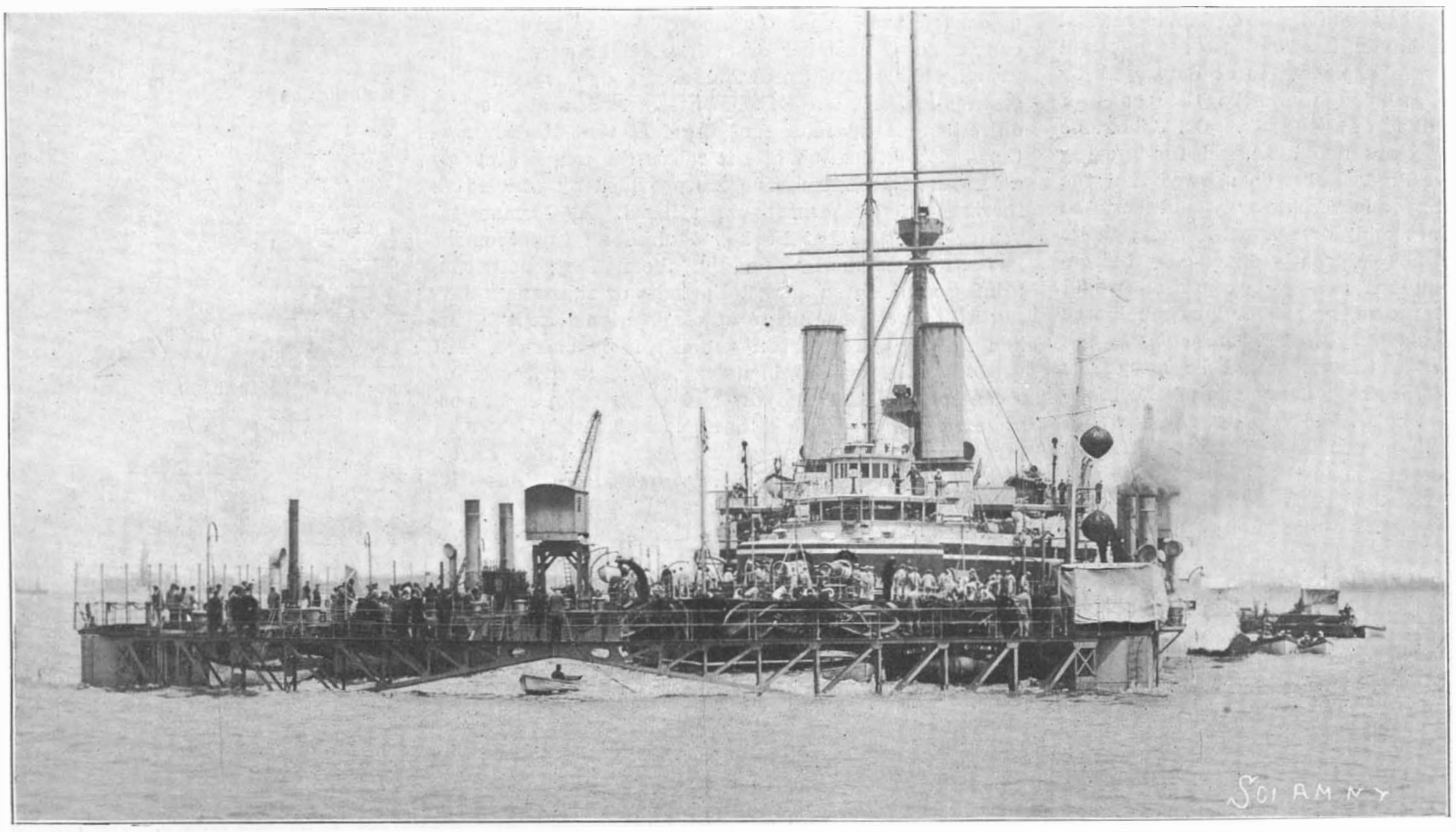
The new floating dock which has been built for the use of the British fleet at Bermuda underwent an exhaustive test recently at Chatham. As the dock has already been described in this journal a detailed account of the structure is unnecessary. It may be stated briefly, however, that the dock claims the distinction of being the longest and heaviest so far constructed. It has a length over all of 545 feet, and a hull weight of 6500 tons. It was built by Messrs. C. S. Swan & Hunter, of Wallsend-on-Tyne, England.

The huge structure was successfully launched last February from the yards of the builders, and, after completion, towed to Chatham, on the Medway, for testing purposes before being despatched to Bermuda. The test consisted in lifting the battleship "Sans Pareil." The operations were in every sense a success, particularly so when the conditions of the trial are remembered. A strong breeze was blowing at the time, and the water was very choppy. The "Sans Pareil," the ship selected by the British Admiralty, is regarded as a somewhat trying vessel to dock, being comparatively short and heavy, with a good deal of concentration of weight forward.

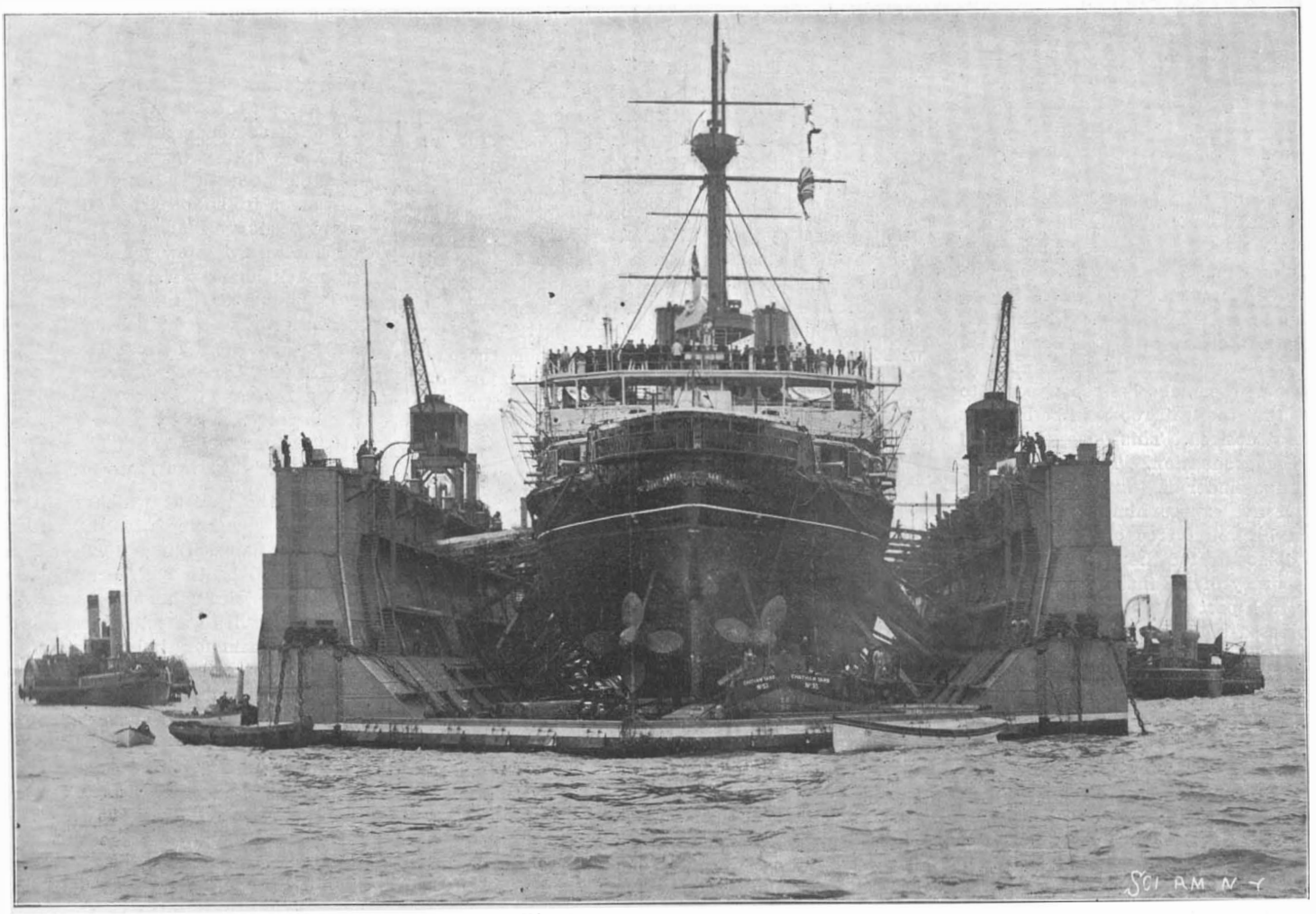
In the berthing operations the dock was sunk at high tide to the requisite depth. Tugs then brought up the man-of-war to the entrance. The vessel was hauled into its berth by the aid of strong steel-wire hawsers, fixed from the bow of the ship to the winches on the dock. As the ship drew 27 feet of water, the pontoon was sunk to a depth of 28 feet below the waterline. These operations occupied 2½ hours, which cannot be regarded as an excessive time, for considerable care had to be exercised. In the first place, the ship had to be hauled in against the tide, which was running over three knots an hour, while above everything it was necessary to keep the ship perfectly level with the sides of the dock, as the least slip in this respect might have caused serious damage to the dock. One of our illustrations shows the ship in position, prior to the lifting.

As soon as the "Sans Pareil" was centered and the upper rows of shores adjusted, pumping was commenced, and after fifty minutes both dock and vessel were raised 13 feet. Another line of shores was then placed in position, and the pumping resumed. Although the operations commenced at 11:30 in the morning, it was past 6 in the evening before the ship was clear out of the water as shown in our photograph. In smoother water it would be quite feasible, however, to berth a vessel in much less time. Great caution characterized the whole of the proceedings and often caused considerable delay; indeed, the placing of a row of shores in position frequently occupied an hour or more.

The "Sans Pareil" has a displacement of 10,470 tons. She was berthed with her guns and stores in position. It is interesting here to note that the biggest British battleship afloat—of the "London" class—displaces 15,000 tons, and the three battleships of the "King Edward VII." class, now being built, will each displace 16,500 tons, so the new dock will be up to its work for some time to come. The "Sans Pareil" at the time of docking was drawing 27 feet of water. The sides or walls of the new dock, however, are high enough to enable a vessel of 32 feet draught to be berthed on the keel blocks, the latter being 3 feet 6 inches in height.



Dock Sunk, and Battleship Towed Into Position, Ready for Pumping.



Dock Pumped Out, Raising Battleship Clear of Water.

TESTING THE NEW BERMUDA DOCK.

The docking of the man-of-war was part of the contract between the designers, builders and the Admiralty. Another of the official trials consisted in the self-docking of the structure itself. This was carried out a week previously on the Tyne before the dock was towed to the Medway. First of all the side walls were "docked" or lifted out of the water, and after this the pontoon, or platform, on which the vessel rests. As the flooring of the dock is in three pieces the center was lifted first and then the two ends. Every part of the structure therefore can be docked separately, which is essential in the sub-tropical waters of Bermuda.

A reference here to the difference in the systems of docking ships, in the case of floating docks, between the United States and England will be appropriate, in view of the discussion it is causing in engineering circles. The American system dispenses with the use of shores, only using a few for centering purposes. This is practically impossible in the case of British warships, as the vessels are minus the docking keels which are fitted to all American ships, and which enable the latter to sit upright on the keel blocks without the aid of side struts. By dispensing with shores a vessel, of course, can be docked much more quickly than it could otherwise be. But the English Admiralty refrain from adding docking keels to their vessels, believing that they detract from the speed of the ship. After all, it would appear from recent discussions on the subject that it is a very open question, no less an authority than Sir William White maintaining that such equipments detract little, if anything, from the speed of the ship, while they undoubtedly greatly strengthen the ship for docking purposes.

The trials of the new Bermuda dock being satisfactory, the structure left Chatham on June 16 last on its 4000 mile journey across the Atlantic. Three Dutch tugs, the "Zwarte Zee," "Ocean" and "L. Smit" were engaged for the task. Although floating docks have been towed across the Atlantic before, the feat is nevertheless an arduous one. The structure is naturally very bulky and represents a deadweight of over 8000 tons. This weight is made up with the numerous stores which have been placed upon the pontoon docks. The progress out of Sheerness Harbor was very slow, not more than four knots an hour, and it is expected this will be the average rate of speed across the Atlantic. The new dock, which is due to arrive in Bermuda at the end of July, has cost the British Admiralty £230,000, or about $1,150,000, which price includes delivery at Bermuda. For the loan of the photographs the writer is indebted to the builders, Messrs. C. S. Swan & Hunter,

GRASS HOUSES OF THE WICHITA INDIANS.

BY WILLIAM R. DRAPER.

The finest house ever designed by a redskin is the grass house of the Wichitas, a tribe that at present live in southern Oklahoma. They are the only tribe that ever accomplished successfully the erection of a grass structure. Soon they are to abandon these huts and take up their humdrum reservation life in two-room frame shacks, which are being built for them by the government. The grass house, it is claimed, is far from being healthful; but it is certainly comfortable.

There are but about fifty old men of the tribe alive to-day who understand the art of building one of these houses so that it will stand. And these refuse to work, even for generous wages. The government has offered these grass-house builders lucrative employment to construct some houses that may be preserved as models of an ancient art. But they refuse, and the grass huts that used to dot the prairies of the Wichita reservation are now being torn down. The Wichitas are determined that their huts shall not survive them.

Appearances are often deceiving. One can look upon a grass house and imagine it an easy thing to build. But not so. It is indeed most intricate. The grass is gathered early in the spring, when it is yet fresh. The sod cutting usually takes place immediately after a rain, the sod being removed to a thickness of about eight inches. Buffalo grass sod is the only kind that will answer the purpose of the builder. He commences to lay the foundation as does the stonemason, digging away the earth to a depth of about one foot. The grass portion of the chunks of sod is laid to the outside, and the house is built to a height of twelve to fifteen feet, in the form of a pointed dome. There is no hole in the top for smoke to pass out, the latter being carried away through a pipe on the outside of the hut. The door is usually in the south, and there are no windows. Through each tuft of sod is run a willow reed string, and these strings are bound clear around the structure. The grass remains green, and will grow if there is plenty of rain. It is not at all uncommon to see the sides of these grass houses turn green as spring approaches, just as do the pastures near them. The houses are very warm in winter and cool in summer. They never leak. Often the Indians have barns made of the same material. But in these days the redskins are made to live in frame shacks, and the once famous grass house will soon be but a recollection.

Grass House of the Wichita Indians.

The Pittsburg Reduction Company has purchased one hundred acres of land at Massena, N. Y., on which five large factories covering at least fifteen acres are to be erected. The company is to make aluminium principally, and will employ from five hundred to six hundred men constantly during the year. The cost of this plant will involve an expenditure of over one million dollars. The buildings will be up by fall, and the plant will be in operation by April next.

ARMORED NESTS.

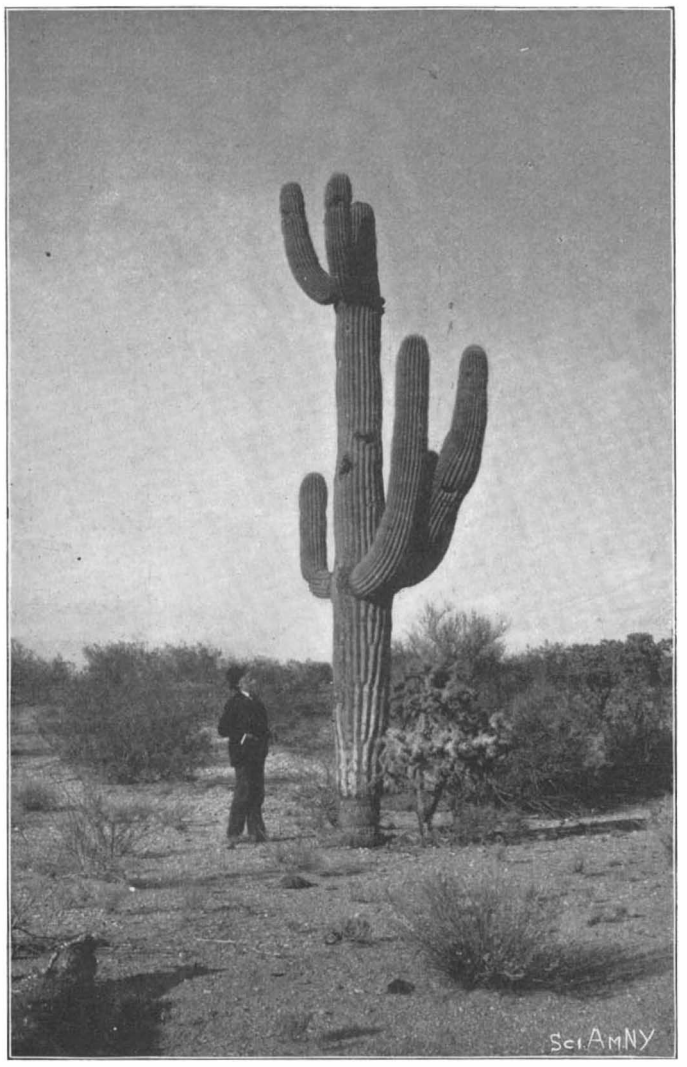
BY CHARLES F. HOLDER.

In the countries where cactus is common, numbers of animals evidently recognize the availability of this armed plant as a retreat in time of danger. In San Gabriel, Cal., the old mission fathers planted a hedge of prickly pear or tuna about their property as a protection from marauding Indians, disconnected patches of which still stand—interesting relics of the past. Such a group of spine-covered plants would seem to be the last place to be selected as a refuge, yet this *cheveaux de frise* constitutes the home of many rabbits that choose it as such, digging their burrows under its branches and roots, knowing that here they are safe from the pursuit of owls, coyotes, hawks and hounds, their enemies.

Almost every cactus patch in California will be found to afford similar protection, and the average hunter will invariably forego the game rather than engage the array of javelins. The various cacti, especially the variety which grows in clumps, serve as a protection particularly to birds. The writer has chased the roadrunner on horseback, the bird refusing to fly, finally seeking refuge in an extensive cactus patch, where it dodges slowly in and out, apparently knowing that it was safe from pursuit. The nest of the roadrunner has been found in the cactus, and the writer has seen the nest of the California quail deftly concealed beneath the broad overhanging leaves with their spiny armament. One of the most interesting nests discovered in cactus is shown in the accompanying photograph of a giant candle cactus, a typical form on the New Mexico desert and in old Mexico. The nest is indicated by the dark broken places halfway up the trunk, which were made by the Gila woodpecker—*Centurus uropygialis*—an interesting bird discovered by Dr. Kennerly many years ago when on his expedition along the thirty-fifth parallel, and first described by Prof. Spencer A. Baird in 1854. The bird is, comparatively speaking, rare, not often seen, its strange and peculiar notes being seldom heard, even by those who frequent the great deserts of the Southwest where it is found. Sometimes it is seen among the mesquite trees, rising when observed with a loud note of alarm, calling to mind, according to Dr. Cooper, that of *Phaenopepla nitens*. During the nesting season the woodpecker clings to the cactus, and soon forms an opening, which by persistent pecking it gradually enlarges until it reaches the interior of the column, when it begins work in the pith in a downward direction, finally completing a hollow into which it takes leaves and the soft material from seeds, these constituting the nest, which, being twelve or even thirty feet from the ground, in the heart of a column whose surface is a mass of needles, may be considered impregnable. The huge nests or the columns are among the picturesque features of the arid regions; and few, if not familiar with the habits of the Gila woodpecker, would suspect that the black or decayed holes on the surface are the openings for nests of this interesting and clever bird, which in this manner hides its eggs and young from the intense heat of the sun and from all pursuers.

A great mass of cacti, illustrated herewith, is a veritable city. On the ground floor or in the cellar dwell the cottontails, kangaroo rats, and on the edge of one patch found by the writer, heaped up against the cactus, was the enormous nest of the wood rat, while near at hand was the burrow of a kangaroo rat; numerous gopher holes in the vicinity suggested the proximity of these pests. In the upper story were various kinds of nests—mocking-birds, finches and a humming-bird with several others which could not be determined, at least by the finder. Gorgeous spiders weave their webs from one great leaf to another. Various lizards claim the patch as their home, sunning themselves along the branches on warm days, retreating at night to the ground, where their burrows lead in every direction. All these varied forms — and many beetles and several other mammals could be added —find perfect shelter in the cactus, protected by the array of spines which pierce and rend the inquisitive enemy.

Cactus "Forest" in Which Many Birds Build Their Nests.



The dark spots are the openings to the nest.

Nest of the Gila Woodpecker in the Heart of a Giant Cactus.

A flannel rag dipped in hot water and sprinkled with turpentine is a good remedy against hoarseness. This poultice is also employed for lumbago and rheumatism. For facial neuralgia it is also said to give relief.

AN EXPERIMENTAL MOTOR AND DYNAMO.

BY W. E. PARKER.

In his work in teaching physics the writer has often felt the need of a simple and inexpensive outfit for illustrating the principles of the electric motor and dynamo. Not finding anything satisfactory in the market, he has built the apparatus described and illustrated, having in mind a model used by himself at college.

The magnetic needle shown in Fig. 1 is an ordinary needle mounted so as to move freely in a horizontal plane, and above it is suspended a wire. If an electric current is passed through the wire the needle is deflected, the direction of deflection depending on the direction of the current and the position of the wire, whether above or below the needle. A current flowing through the wire above the needle in a given direction will produce a deflection of the same kind as a current beneath the needle flowing in an opposite direction. It becomes easy, therefore, to increase the effect of the current upon the needle by replacing the single wire by a coil of many turns of fine wire, as in Fig. 2. When a momentary current is passed through the coil, the needle is thrown violently around, and by properly timing the impulses due to a series of momentary currents, the needle may be kept in rapid rotation in either direction. Here then is the fundamental electric motor: constant rotary motion, produced by a magnet, and an electric current passing through a coil of wire.

So far as the principle is concerned, it is immaterial whether the magnet or the coil of wire be made the moving part. In Fig. 3 the coil is mounted vertically, so that it is capable of rotation, and the magnetic needle is replaced by a powerful electromagnet. When a current is passed through the coil in the position shown, it is thrown violently around till the opposite side comes next to the pole of the magnet; if at this instant the direction of the current through the coil is reversed, it will continue in rotation. It is, however, difficult to reverse the current by hand with sufficient rapidity and at exactly the right time, hence it is not possible to produce continuous rotation for any considerable period of time.

We may substitute for the single coil two coils mounted at right angles, as in Fig. 4, and having their ends connected to a mechanical switch, or commutator, which automatically reverses the current through the coils at the proper instant. With this addition continuous rotation immediately results, the direction of which may be changed at will, either by reversing the current through the moving coils, or changing the polarity of the magnet.

The machine shown in Fig. 5 approaches a little more nearly the commercial form. Here we have replaced the two coils by four, intersecting at angles of 45 degs., mounting them upon a shaft supported by durable bronze bearings, the electromagnet which furnishes the field resting upon the two upper rods which hold the bearings in position. The direction of rotation may be changed at will by reversing the polarity of the field or the current through the armature. The polarity of the field may be reversed by changing the position of the electromagnet, or by reversing the current through it. To reverse the armature current, a switch may be inserted in the armature circuit, or, what is much easier, the position of the brushes may be reversed by turning the brush holder on its bearing through 180 degs.; this showing also the effect upon the speed of the machine of the position of the brushes.

The machine shown in Fig. 5 operates equally well as a series or shunt motor; and if the field is separately excited and the armature driven by a belt, it may be used as a shunt dynamo. The apparatus operates most satisfactorily with an E. M. F. of 8 to 12 volts, though 4 volts will give good results.

Arrangements have been made whereby the entire outfit can be placed on the market at a reasonable price. Further information may be had by addressing Mr. Parker at the High School, Torrington, Conn.

Fig. 1

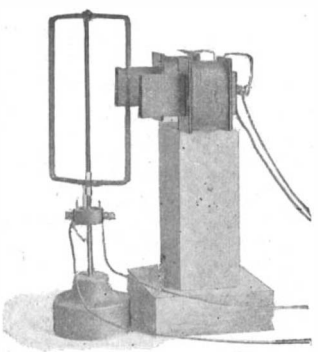


Fig. 3.

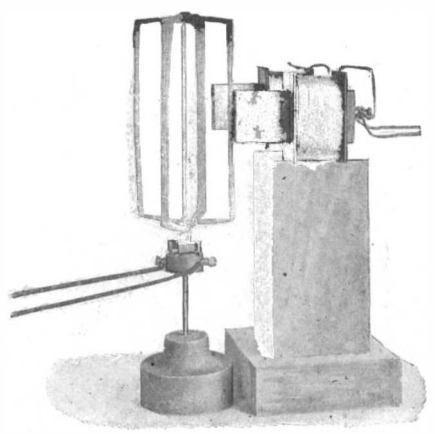


Fig. 4.

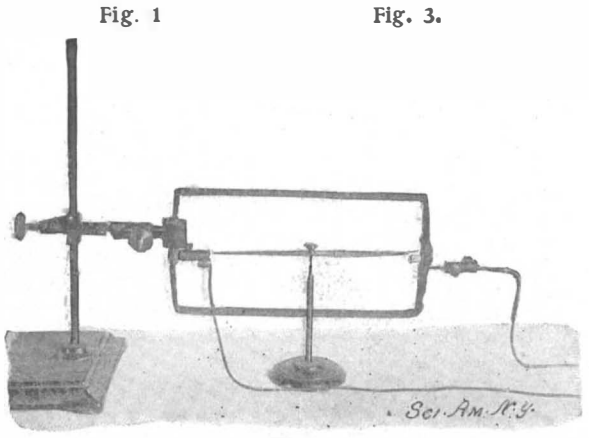


Fig. 2

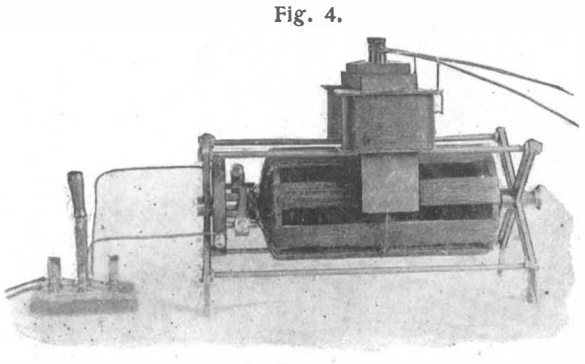


Fig. 5

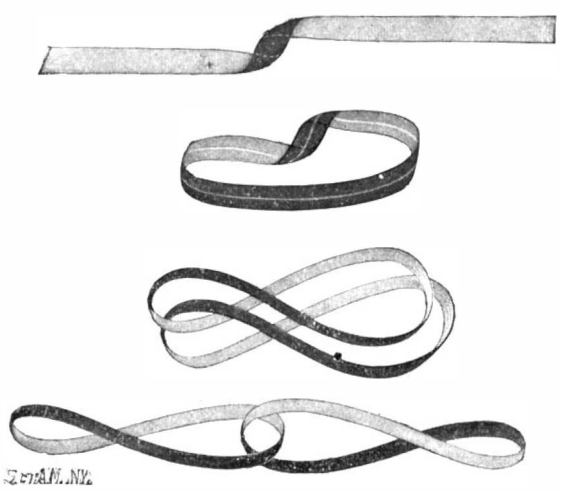
1. Magnetic Needle.—2. Needle Arranged to Turn in Magnetic Field.—3. Coil Arranged to Rotate in the Field of a Strong Magnet.—4. Two Coils at Right Angles in Field of Magnet.—5. Experimental Motor and Dynamo.

Japanese dentists perform their operations in tooth drawing with the thumb and forefinger of one hand.

A PERPLEXING PUZZLE.

The following puzzle, culled from an English magazine, has been sent to us by Mr. O. Podewils, of New York city, who asks to have it explained.

If a flat strip of paper be taken, and its ends pasted together to form a ring, and it be then cut along its center line, two similar but entirely separate rings will be formed, unconnected in any way. If, however, the paper be twisted as illustrated in the uppermost view, and its ends be pasted together to form a ring with a single twist in it, this ring, when cut along its center line, will form two rings, one looped within the other as shown in the third and fourth views.



A PERPLEXING PUZZLE.

Perplexing as this may seem at first glance, the explanation is quite simple. We may consider the upper edge of the paper strip as one ring, and the lower edge as the other. Now, following the edges of the twist, as shown in the second view, it is evident that one edge has been twisted completely around the other edge; or in other words, one edge or ring has been passed through the other ring, which when cut apart form two interlooped rings.

The Reforestation of South Australia.

According to the report of the Conservation of Forests the reforestation of South Australia by the State during 1901 resulted in 68,695 trees being planted, of which 49,219, or 71.5 per cent, have thrived. In the Ayers district, however, only 42.25 per cent of the trees have survived, owing to the ravages of grasshoppers which have destroyed them. The losses have been confined for the most part to the manna gum and the Tasmanian blue gum, planted many years ago at Bundaleer. Although some of them have attained substantial proportions, the testing conditions of the northern districts are not favorable to their reaching in most cases beyond the pole and firewood stage. The value of this class of forest produce is but low. It has, however, in all cases returned the original cost per acre with more or less additional revenue. During the unfortunate continuation of dry seasons to which South Australia has been subject of late years valuable experience has been gained regarding the resisting power which various trees possess to inimical influences. The red gum, the blue gum, and the sugar gum, being species indigenous to the country, have stood well, as would naturally be expected. They cannot, however, claim a monopoly of drought-resisting power, as the Victorian ironbark, both at Bundaleer and Wirrabara, has held out well even on indifferent soils, and made steady growth in spite of adverse conditions. The growth of the sugar gums at the Ayers Forest Reserve in the older plantations is very encouraging. Since they have been planted the seasons have certainly been far from favorable, and the position of the reserve is one of considerable exposure to the arid northerly winds, which are so trying to all vegetation. Notwithstanding these drawbacks, however, large numbers of the trees have attained heights of from 14 to 20 feet, with a circumference of from 12 to 18 inches.

On the Kuipo Forest Reserve, in addition to what has been cleared for planting purposes, about forty acres have been cleared of the undergrowth of honeysuckle as well as of the manna gum timber, in order to promote the stocking of this area with red gum by natural generation, and a promising start has been made by the young seedlings after burning the debris from the clearing. The ironbarks already planted are making satisfactory progress. As an exceptionally large amount of replanting has been necessary this year in consequence of the heavy losses last season at Wanilla, Ayers, and Bundaleer, caused by rabbits and grasshoppers, it has only been possible to plant about 100 acres. Owing to the spread of the rabbit pest it is now absolutely necessary to protect young plantations on almost all reserves by wire netting the fences, which, of course, very largely increases the cost of fencing. Hitherto large reserves such as Bundaleer and Wirrabara, which for years have been the centers of the greater part of the operations, have been practically free from this scourge, but in consequence of the recent protracted droughts in the pastoral country these pests have gradually worked their way further and further into the more settled parts, and will now evidently have to be reckoned with for the future.

Professor Rowland.

Yet perhaps a few more words of personal delineation may help to keep in mind his remarkable individuality. He was tall, slender, but not slim, well proportioned, alert, giving every indication of a healthy body. Of physical exercise he was very fond; in winter the horse, in summer the sailboat, gave him never failing delight. He knew where to find the trout and how to handle the rod. He would take great risks in following the hounds. "You should think of the fox, and not of the ditch," I have heard him say when he was chided for his rash horsemanship. He landed once in Liverpool and saw an advertisement of a meet. He took a train to the nearest station, hired the best nag he could find, joined in the run, won the brush, and then disappeared from among his competitors, who hardly knew what to make of this unexpected victor. He designed a sailboat, and before it was launched he told the builders to paint the water-line where his calculations said that it should be. They objected; he persisted. The boat was launched, and the builders smiled when they saw that the line was above the water's edge. "Put in the mast," said Rowland, and the boat sank to the painted line. "That was what I had figured on," he exultantly said. The incident was closed.—D. C. Gilman, in Scribner's Magazine.

French Population.

The French government has issued the results of the quinquennial census taken in France in 1901. The total population is returned at 38,961,945, showing an increase of 444,613, as compared with 1896. The increase between 1891 and 1896 was 175,027. The movement of French population from the country districts to large towns is still noticeable. The population of Paris is returned at 2,714,068, and France has now fifteen towns with populations of 100,000 and upward; in 1896 the corresponding number of towns with populations of more than 100,000 did not exceed twelve.

An Investigation of the Physical Effects of Mountain Climbing.

Some interesting experiments and observations have been made by Signor Mosso, upon the subject of man's endurance in mountain climbing. Up to the present, the highest point to which a man has ever climbed is 23,393 feet—the summit of Aconcagua, the loftiest mountain of the main Cordillera range of the Andes. Signor Mosso asks will it ever be possible to reach 29,000 feet? We live at the bottom of an ocean of air, and our bodies are specially adapted for life at low levels; consequently, when we are placed in unusual conditions, such as exist at great heights, we are affected in different ways. Respiration becomes difficult, the circulation of the blood is altered, the heart is fatigued, "mountain sickness" is experienced, followed by lassitude and exhaustion. The reason that so few men have attempted the ascent of the highest mountain peaks in the world is due to the general conviction that man cannot withstand the rarefied air of these altitudes. From his own experiments and observations, however, Signor Mosso is convinced that man will be able slowly to accustom himself to the diminished barometric pressure of the Himalayas. To accomplish such a climb, it will be necessary for the climber to acclimate himself during a slow rate of progress, in order to reach the top in conditions of health and strength. His victualing arrangements must be generously but prudently made, more especially as the last stages would have to be performed very slowly. Mountain expeditions have hitherto adopted too rapid a rate of ascent. The nervous system consequently has not time to accustom itself to the action of rarefied air, nor the organisms to the cold, the fatigue of the ascent consumes the strength of the climber, and leaves him no time to regain it; whereas by slowly making the ascent the climber adapts himself to the fluctuating conditions as he rises higher and higher.

BEET-TOPPING DEVICE.

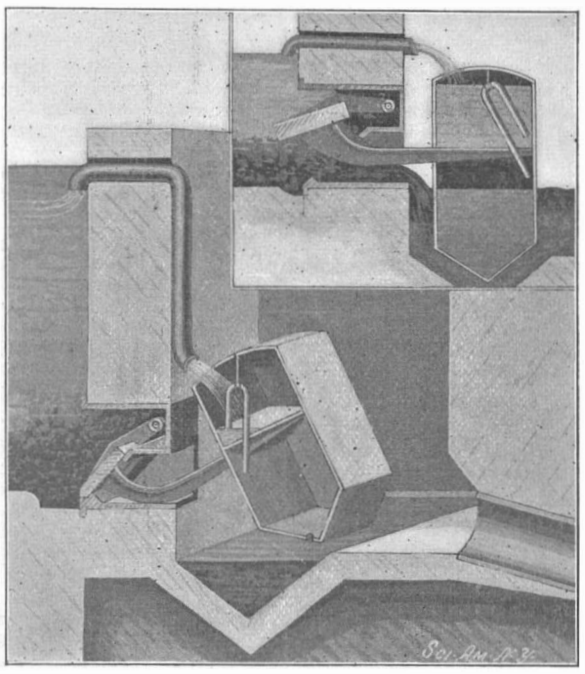
Messrs. Klaas Zuidewind and Adrian Van Putten, of Holland, Mich., are the inventors of a new hand-operated device for topping beets. The top or crown of a beet is of a woody nature, containing little or no sugar, and it is therefore necessary to remove this portion. The device here illustrated is designed to be operated by a person in a standing position, and is so constructed as to release the severed top when the device is open. It is furthermore provided with an adjustable gage for regulating the depth of the cut. This gage automatically centers itself above the meeting edges of the knives employed, and upon contact with the top of the beet will indicate to the operator that the device is in position for topping.

The device as shown comprises two handle-portions pivoted together and provided with shoulders, which when brought into engagement limit the forward movement of the handles. At their lower ends these handle-portions spread out into a forked or bifurcated frame-section. To these sections the knives are adjustably secured, so as to permit adjustment relative to each other when worn out. The cutting edges of the knives are beveled from beneath, and their bottom surfaces are inclined, so that the heels of the knives will not engage with the ground until after the cutting process is completed, thereby avoiding friction and affording the knives a better chance to take hold of the beet at a proper depth. The gage-rod, as shown, is threaded into a carrier which is hung, with some play, on the hinge-bolt of the handles. This freedom of movement permits the gage-rod to always assume a vertical position. Being threaded in the carrier, adjustment can easily be made by turning the rod to the left or to the right. To operate the device, the handles are open and the body-portion brought over the beet to be topped. As soon as the flattened foot of the gage-rod is felt resting upon the upper surface of the beet, the operator will know it is time to close the handle, whereupon the knives, entering the crown of the beet at opposite sides, will quickly and cleanly sever the top portion. It is evident that earth will not collect and interfere with the action of the knives, since the body is open at all sides, and any dirt taken up will quickly find an escape.

BEET-TOPPER IN OPERATION.

AN AUTOMATIC SIPHON OVERFLOW VALVE.

Cases often are found in which it is necessary to have the overflow from a tank pass out at the bottom instead of at the top, when fresh layers of liquid accumulate on the surface. This is necessary, for example, in septic reservoirs for treating sewage by filtration, where, especially by the action of the bacteria, the filtered liquid sinks to the bottom and passes out. This emptying of the tank at the bottom is the end sought and attained in the construction of the Ridgeway valve, illustrated herewith.



AUTOMATIC OVERFLOW.

The illustration shows the valve as arranged in a sewage tank. The outlet opening is in the side of the tank at the bottom, and it leads into the V-shaped intermediate chamber, which in turn overflows into the main sewer. Normally, this outlet is closed by a square clapper that is suspended from a projecting arm pivoted horizontally above it. In this position the clapper is at an angle of 45 deg., as shown. A curved metallic arm fastened to the back of the clapper supports, outside the wall of the tank, a metal box which acts as a float and which is divided into two compartments by a central horizontal partition.

When the tank has become filled it overflows through the siphon pipe seen in the upper part of its side wall (Fig. 1), and the water that thus runs out flows into the upper chamber of the small metal box on the outside, where its weight, coupled with the leverage of the arm attached to the clapper, tends to raise the latter slightly and allow the fluid to escape through the outlet in the bottom. As this outlet is sufficiently large, the liquid escapes rapidly, and soon fills the bottom compartment of the box, and causes the clapper to open wide, because of the additional weight thus exerted upon the lever arm. By this time the upper compartment has become filled (Fig. 2), whereupon it is quickly emptied by a small siphon that connects the compartments.

As the weight of the box is thus considerably diminished the clapper closes by its own buoyancy, aided by the pressure of water in the tank and the rush of the outgoing current. The emptying of the tank is therefore stopped till the water again rises and starts the large siphon once more.

The invention may have some slight defects, such as allowing the surface water that fills the upper part of the movable box to escape; but it certainly is very ingenious, for, by regulating the different openings which let the water into the upper part of the movable box or control its escape therefrom, the time during which the clapper will remain open may be regulated exactly.—La Nature.

The Balloon as a Detecter of Submarines.

The French Naval Department has been carrying cut a series of interesting experiments with balloons for detecting submarine boats, when submerged, the results of which proved that the course of a submarine craft can be easily followed from a balloon in the air. The "Gustave Zédé" was used for these experiments. The boat was submerged to a depth of ten feet and more, but it was easily discovered by the aeronaut when the boat ran counter to the sun's rays, although the balloon remained at a height of 1,500 feet. An ingenious telephonic apparatus was connected from the submarine to the balloon, in order that the latter might signal when it had discovered the boat. The experiments further proved that the green color at present employed in painting submarines is not an effective disguise, and that the ease with which submarines may be descried beneath the surface depends on their angle with regard to the sun.

Mediterranean Trip.

The Count de la Vaulx is making active preparations for another attempt to cross the Mediterranean by balloon, and the experiment will have a better chance of success, as it will be carried out early in the summer. Last year the trip was delayed until late in the autumn, and it was undoubtedly due to the bad weather that the aeronauts were unable to cross. The start is to be made from a different point on the coast this time, at Palavas-les-Flats, near Montpellier, and here a great balloon shed is being erected on the beach. The balloon, after the last trip, was sent to Paris to be reconstructed and will be called the "Mediterranéen No. 2." The balloon shed at Toulon offered a great resistance to the wind, and on one occasion was nearly carried off by a violent storm, although it was well braced by guy-ropes. The aeronauts will profit by this experience and are building the shed in a tent-like form which will offer less resistance. The balloon, which is now in construction, has a volume of 4,160 cubic yards, and the upper part has been made in conical form to shed the rain. M. Hervé has availed himself of the data obtained on the last trip to make some improvements in his steering and floating devices, of which an account will be given later. The balloon is arranged so as to be either attached to the float upon the water or to take a free flight; for the latter case it is provided with an interior air-balloon gaging 1,300 cubic yards which will be kept inflated by a ventilating fan. The former arrangement of water-ballast tanks will be used, and this time will be improved by adding a 12 horse power petrol motor which operates a pump for automatically filling the tanks by a pipe which runs down to the water, and the tank will also be discharged by an automatic device. It is probable also that the balloon will be made partially dirigible by using the motor to operate a propeller.

FASTENING DEVICE FOR HORSES.

It is no longer necessary for a driver to fasten his horse to a hitching post. If provided with the fastening device here illustrated, he needs simply to slip his reins on the catch in the wagon, and the horse will be unable to run away. Mr. Phillis Mayotte, of Wells, Mich., is the inventor of this new fastener. The construction of the device is very simple. Supported in a bracket on the vehicle is a spindle carrying a disk provided with hooks to serve as a fastening means for the reins. Beneath this disk is a ratchet wheel engaged by a spring-pressed pawl. The lower end of the spindle protrudes from the bracket, and is connected by a universal joint to a rod which telescopes in a tube carried in a bracket on the front axle. On the rod are a series of pins, which project through longitudinally ranging slots in the tube, whereby the rotary motion of the tube is communicated to the rod. At the lower end of the tube is a small bevel gear, which engages a large bevel gear on the hub of one of the front wheels. The teeth of these gears are curved outwardly, so as to allow for any unevenness in the road, and all play in the parts is taken up by a spring coiled in the tube and abutting against the end of the rod held therein. A lever on the rod connects with the top of the tube and permits the latter to be lifted sufficiently to disconnect the gears. This will be found useful in long drives, when it is desirable to save the parts from wear.

DEVICE FOR HOLDING HORSES.

To fasten the horse, one needs simply to wind the reins around the spindle and secure them under a hook on the disk. If the horse should start forward, the reins will be quickly wound up on the spindle, and the animal suddenly checked. Any subsequent backward movement would have no effect, on account of the spring-pressed pawl ratchet, which prevents rotation of the spindle in the opposite direction. Hence, whichever way the horse may turn, the wheels cannot be moved.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

SHOCK-LOADING APPARATUS. — A. C. HAUDYSHELL, Tama, Iowa. The construction of this apparatus is such as to elevate and deposit the shock of grain in a vertical path, whereby the shock may be stood up on end for the purpose of transportation. A hoisting mechanism is provided which is operable by the advancing movement of the loading apparatus, whereby the load may be conveniently deposited in transport vehicles.

SUGAR-CANE CONVEYER.—C. H. MCNALLY, Waipahu, Hawaii Ty. This sugar-cane conveyer is a self-propelled machine which conveys cane and loads it upon cars, thereby saving a large amount of manual labor and enabling a small number of men to do the work which hitherto required six or seven times as many men.

Engineering Improvements.

LOCOMOTIVE VALVE-GEAR.—H. MAXWELL, West Oakland, Cal. The valve-gear is arranged to actuate the admission valves from the locomotive engine and permits the manipulation of a separate reversing valve by the engineer for quickly reversing the engine independently of the motion of the admission valve-gear, thus preventing the flying back of the reversing lever.

RETAINING VALVE.—W. G. LAMB, City of Mexico, Mexico. The invention relates to fluid pressure brakes of the Westinghouse type, and aims to provide a new and improved retaining valve arranged to hold automatically the full pressure on the brakes while recharging the auxiliary reservoir, so that releasing does not take place until the full pressure is obtained in the auxiliary reservoir, to which the retaining valve is set.

OIL-FEEDER.—L. G. NILSON, New York, N. Y. In usual forms of oil-feeders it is found difficult to get a uniform positive and reliable flow, because the viscosity of most oils changes with the temperature, also when gasoline and the like is fed through needle valves, foreign particles carried with the oil interfere with the flow, and in carbureters where air is forced in with the gasoline, the light portions of the oil are carried off leaving a residue difficult to evaporate. The object of the present invention is to provide a feeder in which the above difficulties will be obviated.

Hardware.

NUT-LOCK.—T. C. BORNMAN, Summit, Miss. This nut-lock is particularly adapted for use on fish-plate bolt-nuts. One member of the lock consists of a washer having a tube formed on the lower corner in which a movable spring cotter is held in engagement with the nut to prevent it from turning.

GAS-BURNER.—T. HOLLAND, New York, N. Y. The burner is made of cast metal, the parts of which may be readily placed together and tightly clamped. The construction is such that three rows of jets may be directed to, and mingled at, the horizontal center of the burner, forming a practically continuous body of gas and giving a steady flame of great heat.

COMBINED DOUBLE ESCUTCHEON AND PAINT PROTECTOR.—S. THOMPSON, Chicago, Ill. The invention relates to a means for protecting the painting and enameling of fine doors and to provide a more ornamental and serviceable combined escutcheon for door-locks. Means are further provided for protecting the door-plate against injury.

Machines and Mechanical Devices.

SHOE-TURNING DEVICE.—G. B. GARDNER, Haverhill, Mass. This invention relates to a device for turning the heel or counter of a shoe. It is adapted to be used in connection with a previously patented device for turning the toe or front part of a shoe. When the two devices are placed together on a single bench they will provide an apparatus on which all necessary turning operations may be performed.

CIGARETTE-MACHINE. — J. C. HANSEN-ELLEHAMMER, 22 Oehlenschlagersgade, Copenhagen, Denmark. The improvement relates to a filler-forming mechanism in which a mold is employed to which a layer of tobacco is delivered, the layer being divided or cut off by the action of a combined plunger and cutter mechanism. The plunger serves to pack the tobacco and press it down between the pressing-molds. It also serves to shut off the space in which the tobacco is located, as the molds are nearing each other, in such a manner that the entire quantity of the tobacco cut off is gathered together and no portion of the same is lost.

VENDING-MACHINE.—J. C. DE JANISCH, Paris, France. This invention provides a machine for automatically supplying the public with postage stamps, postal cards, letter cards, or other similar articles of predetermined value on the insertion of a coin of proper value. Means are provided to prevent spurious coins from operating the machine.

REVERSIBLE DRIVING MECHANISM.—C. S. PARCELLS, Willard, N. Y. This mechanism is of simple construction and is adapted for use in connection with motor or horseless carriages to change the speed of the driven shaft without altering the speed of the motor, the motor running at one speed at all times.

EMBOSSING-MACHINE.—I. CLAPPER, Osnaburg, Ohio. This invention is an improvement in machines for forming and ornamenting hollow clay building tile. The machine may be quickly adjusted to emboss one or more surfaces of a tile as it passes through the forming die, or it may be arranged to permit the formation of a tile without embossing.

COMPRESS AND PACKER.—J. B. GRIFFIN and S. C. ANDERSON, Van Alstyne, Texas. This machine, which is adapted for compressing, packing and baling cotton or the like, will operate automatically to form the bat as the material is received from the gin, and will fold the bat back and forth in even layers in the press, forming a complete and symmetrical bale.

STAMP-CANCELING MACHINE.—G. R. SHERWOOD, 135 Adams Street, Chicago, Ill. The stamp-cancelling machine embodies a carrier and a holder thereon arranged to secure the letter by the action of atmospheric pressure, and to convey the same to and past the cancelling devices. A novel construction of parts is provided which permits the operation of the machine.

GRINDING-MACHINE.—W. H. FETTERS, Sycamore, Ohio. The invention relates particularly to improvements in machines for grinding or sharpening lawn-mower blades, and the object is to provide a machine of simple construction by means of which the blades may be quickly and accurately ground without removing the same from the mowing-machine.

Medical Appliances.

CLINICAL THERMOMETER.—J. F. WINDOLPH and R. C. STOFER, Norwich, N. Y. This thermometer is held against breakage in a casing in which it is submerged in an antiseptic solution. The construction is such as to wipe and clean the thermometer on removal from or insertion into the casing, and also to prevent leakage of the solution.

CLOSING AND LOCKING DEVICE FOR DENTAL FLASKS.—D. A. BAKER, Schenectady, N. Y. This closing and locking device may be readily applied to dental flask sections to securely close and lock them together without requiring much exertion on the part of the operator.

DENTAL APPLIANCE.—H. E. LINDAS, Greatbend, Kans. This appliance is adapted for use in the correction of irregularities of the teeth to establish harmonious relations between the jaws. The device enables the operator to make use of all the teeth in each dental arch as a reciprocal anchorage for changing the relative shape of maxilla, and at the same time permits the opening and closing of the mouth without interfering with the force used in the correction of the deformity.

MASSAGE-MACHINE. — C. PFANSCHMIDT and J. SIEFFERT, Chicago, Ill. The invention relates to a massage-machine for the use of barbers, physicians, nurses and others, suitable for general use and also for special use upon the face and scalp. The machine runs smoothly and safely without any appreciable jar and its effect upon the person operated upon is very agreeable.

Vehicles and Their Accessories.

VEHICLE-BRAKE. — W. A. CRITCHLOW, Vancouver, Canada. This brake is automatically brought into action by the pressure of the neck-yoke, saddle, back-strap, and breeching when the horse or team is holding back. The construction is such that the brakes will be off when the horse or team pulls ahead or when the vehicle is backed.

BICYCLE.—G. M. LILBURN, Haverstraw, N. Y. A novel construction of the bicycle frame and a novel method of driving the machine permits a great reduction in size of the frame of this improved wheel, and also enables the gearing of the bicycle to be changed while the rider is in motion. The driving mechanism is so arranged as to leave no parts exposed to the dust.

ELLIPTIC CHAIN DRIVING-GEAR.—W. F. WILLIAMS, London, England. Two patents have been granted to Mr. Williams for improvements in elliptic sprocket-wheels. These, being improvements on a previous invention, provide for the adjustment of the rectilinear ball bearings used to diminish the friction between the arms of the elliptic sprocket-wheel and the corresponding arms on the pedal crank. A further improvement provides means for excluding dust without interfering with the shifting movement of the sprocket-wheel.

Miscellaneous Inventions.

FOOT-WARMER.—J. P. MCABEE, Piedmont, Ala. The foot-warmer is of convenient construction to be used in buggies and vehicles for keeping the legs and feet of the occupant warm beneath the lap-robe. Provision is made for the burning of one or more lamps, and radiating heat therefrom.

BOLT-LOCK.—H. A. STOCKMAN, Johannesburg, South African Republic. Mr. Stockman has received two patents for improvements in bolt-locks which are designed especially for use in mine shafts for securing the upright guides to the cross-timbers. The invention will be found useful, however, in any location where it is desired to bolt together timbers which are subjected to vibration tending to loosen them. The first invention is especially designed for shaft work in mines where two bolts or lag screws are secured from opposite sides. The second invention has a more general application, and provides a locking device by which the insertion of the bolt from one side will operate to make the lock or holder fast in its place and also secure the bolt from accidentally loosening.

EYELET. — I. W. GILES, New Bedford, Mass. As usually constructed eyelets have a uniform thickness of metal in both the tubular body and the flange. In attaching the eyelet to a boot or shoe, the flange is bent or curved down, and in such operation it is liable to be changed and distorted in form. Mr. Giles has invented an eyelet which is not subject to such distortion.

PUZZLE.—M. CODY, New York, N. Y. In this puzzle a cord is required to be several times wound around a rod against an abutting device, and a retainer is provided which, when removed completely releases the tie from the rod. The arrangement of the rod, abutting device and removable retainer is such that if the tie is not properly tied it will be held fast on removal of the retainer.

SHOE-POLISHER.—E. DE BAUN, Passaic, N. J. The invention relates to a device for polishing shoes, the device being especially adapted for individual use and being of such construction and arrangement that it may be effectively and easily used on one's own shoes and readily carried from place to place, so as to be within convenient reach.

SAD-IRON HANDLE.—C. T. DEMAREST, Hackensack, N. J. This handle is designed for convenient and quick attachment to and detachment from a single-cross-bar sad-iron. The construction is simple and positive in action, and the handle is locked in place without the use of a spring liable to lose its resiliency under the influence of the heat radiating from the sad-iron.

DERRICK-FRAME AND JOINT-COUPLING THEREFOR.—J. H. LOHNER, Bradford, Pa. The derrick frame which is adapted for use in drilling deep wells may be formed either of wood or of metal, and combines novel details of construction that adapt the parts for very convenient and reliable connection when the frame is being erected, and also permit their ready detachment when the derrick is to be removed.

SAFETY DEVICE FOR GAS-LINES.—J. C. FURMAN, Strattanville, Pa. The safety device is designed to guard against gas escaping in the house-service pipes in case the flames of the burner have gone out owing to lack of gas supply. The arrangement is such that the line is automatically shut off in case the gas pressure falls below a predetermined degree, and the line is kept closed until the safety device has been reset manually.

WEATHER-STRIP.—B. M. WHITING, Spokane, Wash. The weater-strip is adapted for use upon the bottom of a door, to render the same weather-tight. It consists of a movable panel so attached to the door as to be lifted out of engagement with the floor when the door is opening or shutting, but is held under spring pressure against the floor when the door is closed.

MUSICAL INSTRUMENT.—H. LANGFELDER, Berlin, Germany. The invention relates to citherns, guitar-citherns, and the like, and provides a new and improved musical instrument arranged to permit of readily sounding the strings by the use of flexible hammers pressed and released by the finger of the performer.

DEVICE FOR ARRESTING RUNAWAYS.—F. E. ARNOLD, Salt Lake City, Utah. The improved device consists essentially of a wire cable or other flexible member stretched across the street at a suitable height to arrest the further forward movement of the runaway animal. The cable is wound on a reel provided with a resistance device which tends to oppose with increasing force its continued rotation.

LINE-GRIP.—F. L. FERRE, New York, N. Y. Mr. Ferre provides a gripping and coupling device for clothes-lines, running over pulleys attached to houses. This line-grip will readily take up slack in the clothes-line and hold the slack without the trouble and annoyance of tying the ends of the line together.

WATER-WHEEL. — S. SHULTZ, Strongstown, Pa. The invention relates to a water-wheel arranged to turn on a vertical axis and having peripheral buckets acted on by a stream of water directed into or against the buckets diagonally to the frame of the wheel.

ELECTRIC BEEHIVE-HEATER.—H. VOGELER, Newcastle, Cal. The invention relates to improvements in beehive heaters wherein electricity is used to generate heat to warm and dry the inside of a beehive and preserve colonies of bees during very cold weather. The heater comprises an open-end tube held in an opening in the hive wall, and adapted to contain an incandescent electric lamp which supplies the heat.

SANITARY RECEPTACLE AND CESS-POOL.—J. F. MCCOY and T. N. GILMORE, New Orleans, La. The improved sanitary receptacle and cesspool is so arranged that the solid matter discharging therein will be liquefied before passing into the earth under the disintegrating action of the ammonia contained in the receptacle.

BOAT.—C. SCHAER, Superior, Neb. The invention relates particularly to boats as distinguished from large vessels It comprises a novel form of centerboard which may be adjusted to contribute to the stability of the boat, and it further comprises a novel form of hull and emergency float.

POULTRY-ROOST.—J. H. F. EVERSZ, Walla Walla, Wash. This poultry-roost is designed for use in poultry houses and is arranged to prevent the fowls from contacting one with the other while roosting. It also brings vermicide in close proximity to the roosting fowl without the latter touching it.

REVOLVING CHIMNEY-CAP.—A. E. and F. J. COOK, Lawrenceburg, Ind. This revolving chimney cap is a substitute for high smoke-stacks and will prevent the wind from blowing the smoke back into the chimney, as the improved cap turns with the wind and insures a perfect draft.

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Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 2848.—For dealers in second-hand naphtha engines of 6 h. p.

Machinery designed and constructed. Gear cutting. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 2849.—For a burner for attaching to a house furnace so that oil can be used instead of coal.

We design and build special and automatic machinery for all purposes. The Amstutz-Osborn Company, Cleveland, Ohio.

Inquiry No. 2850.—For an apparatus for placing in a vertical furnace so as to use oil as fuel.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 2851.—For some economical fuel to be used instead of coal.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2852.—For machinery for making a spring wire hook.

Clippings of everything printed on any subject in the American and foreign press. United States Press Clipping Bureau. 153 Lasalle Street, Chicago, Ill.

Inquiry No. 2853.—For machinery for making bone and ivory buttons.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

Inquiry No. 2854.—For makers of machinery for turning grindstones.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2855.—For the manufacturers of the "Leland Broiler."

INVENTIONS DEVELOPED.—Designing and building of labor-saving machinery and general engineering. L. J. Zimmerman, Elect. and Mech. Engineer, 106 Center St., N. Y.

Inquiry No. 2856.—For machines for making toothpicks.

An experienced business man desires correspondence with party requiring means for developing, manufacturing or marketing a patented specialty of merit. Address Specialty, Box 773, New York.

Inquiry No. 2857.—For manufacturers of small ice machines.

WANTED.—A chemical method for treating Copper tailings containing one half per cent copper, one tenth (1-10) ounce gold, two (2) ounces silver. Address Copper Tailings, Box 773, Scientific American.

Inquiry No. 2858.—For makers of broom machinery.

$500 down to me and pay fees for obtaining foreign patents will give half interest in a very valuable invention. Patent allowed in U. S. Article selling. Investigate fully. No agents. J. M., Box 773, New York.

Inquiry No. 2859.—For a plant for refining about 500 barrels of crude oil per day.

LET ME SELL YOUR PATENT.—I have purchasers waiting. Charles A. Scott, Granite Bldg., Rochester, N. Y.

Inquiry No. 2860.—For dealers in shingle mills and model saws.

An eminent firm of engineers, largely interested in hydraulic and hand lifts, desire to represent a first-class maker of electrical lifts in Great Britain. Every prospect of business on a large scale if suitable work can be offered at reasonable prices. Either on commission or would buy and pay for goods delivered. Apply Watts, Fincham & Co., 17 Billiter Bldgs., London, E. C.

Inquiry No. 2861.—For dealers in fire brick making machines.

Inquiry No. 2862.—For manufacturers of fire brick along the Mississippi, Ohio or Cumberland rivers.

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Mr. Dewsnap has issued a book of attractive houses which, at this season of the year, should be particularly welcome. The houses are pictured both as they actually are or will be, and are also illustrated by the usual plans. The descriptions are concise. In each case the cost of the dwelling is given.

USEFUL DESIGNS AND DETAILS. Containing 43 full-page plates. Chicago: Porter, Taylor & Co. 1902. Price $2.

This book is an architectural work comprising forty-three full-page plates of architectural details.

Notes and Queries.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
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Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
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(8629) C. H. asks: Will you kindly answer me this question: Has the metal selenium the property of offering resistance to a current of electricity when a light is thrown upon it? A. Selenium is not a metal. It is an acid-forming element. Its resistance to the passage of electricity is very great. When a beam of light falls upon a piece of selenium, its electrical resistance is much reduced, but not so that it becomes a good conductor of electricity.

(8630) O. M. K. asks: Is there a metal or alloy of metals that can be had on the market that will take the place of platinum for sparking points in gas engine cylinders? A. Nothing is known to take the place of platinum for this purpose. Any metal which could be used by reason of its high fusing point is more expensive than platinum.

(8631) W. F. G. writes: I have read in past years some discussions on music, and among others found that someone made statements as to the proper value of each tone or note as they follow in the scale, *a, b, c, d, e, f, g, a.* It was stated that the half-tones were not half, but varied from it, he giving the proper value of each in this respect. I cannot recall now who it was nor in what paper I read it. Can you help me out and give me information in regard to it? A. The scale in music based on standard pitch, as determined by the Paris Congress of Music, has an *a* of 435 vibrations per second. In instruments with fixed keys, such as a piano, cornet, etc., the tones have equal intervals, so that each is a half-tone from the next, sharp or flat, throughout. This is called the scale of "equal temperament." The correct scale is formed from a keynote by multiplying the keynote by the following numbers: 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8, and 2 for the octave. This is called the "diatonic scale." It can be played upon a stringed instrument which can be fingered, and thus the strings made of any length desired. Stone, "Elementary Lessons in Sound," will explain this more fully than our space permits.

(8632) B. C. V. asks: Am interested in the manufacture of phonograph records. What light can you give on the composition and process of manufacture of the former process wax records, also the new molded records? A. The composition of phonograph records is regarded by manufacturers as a trade secret. We have no formulæ for them.

(8633) O. M. S. asks: 1. Why is it that a common electric vibrating bell cannot be made to ring if the ground is used to complete the circuit? The batteries are about 300 feet from the bell and they consist of dry cells? A. You ask why an electric bell will not ring if the ground is used for return. We can see no reason why it should not with suitable battery power. All telephone calls on grounded lines are given in this way, and bells are often used for signal calls on short telegraph lines. The trouble does not lie in the ground in your case. 2. Does the ringing of an electric bell depend upon the amperage or voltage of the current? A. The ringing of an electric bell depends upon the strength of the magnets in it. These depend upon the ampere turns of electricity which flow around the iron cores of the coils, and these depend upon the voltage of the current and the resistance of the circuit. So the ringing of an electric bell depends upon the volts, ohms and amperes of the circuit. 3. Why will a current, which has gone through ½ mile of iron wire ⅛ inch in diameter, and measures at the terminals, ½ mile from the battery, 1 volt, not ring a common vibrating bell, which can be rung by a cell with a voltage of ½ volt, the cell being connected to the bell by a few feet of copper wire? A. The resistance of the line wire is enough to cut down the current, so that there is not magnetism enough to ring the bell. 4. I want to make an electromagnet to be operated by a low current and will have the greatest magnetic power. Will you tell me what kind and size and how much wire to use? A. There is no general answer to the question. Make iron cores such as you wish and wind with as coarse wire as you can use in the space at your disposal and produce strength enough for your purpose. No. 16 or 18 wire should be used.

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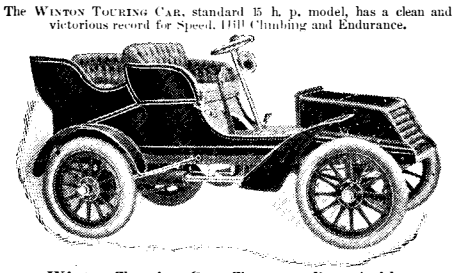

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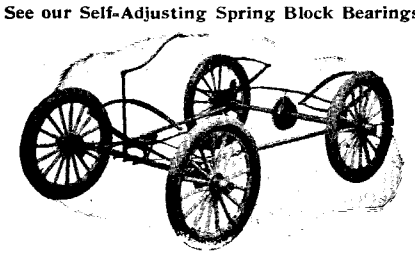

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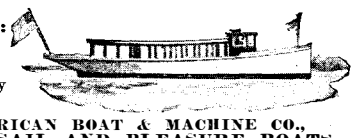

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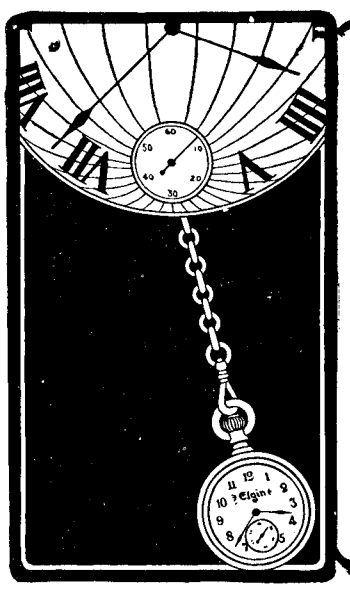

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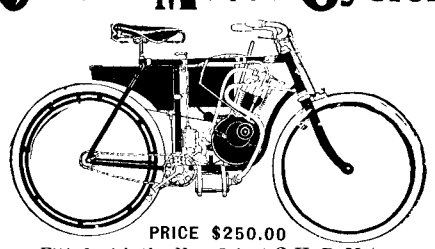

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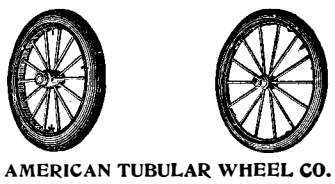

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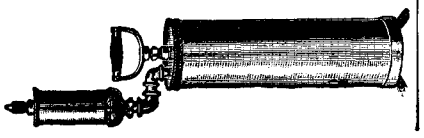

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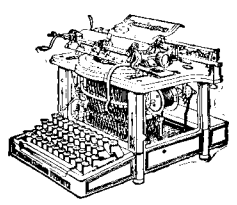

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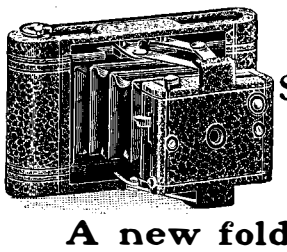

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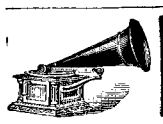

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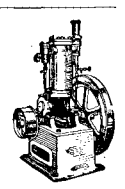

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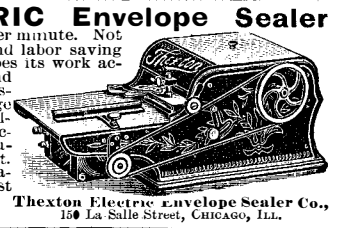

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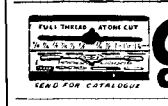

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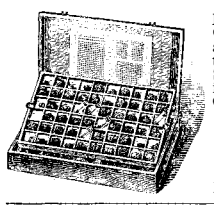

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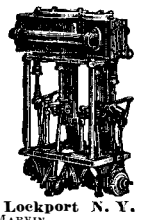

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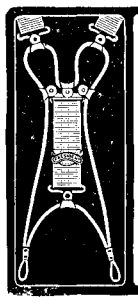

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