SCIENTIFIC AMERICAN

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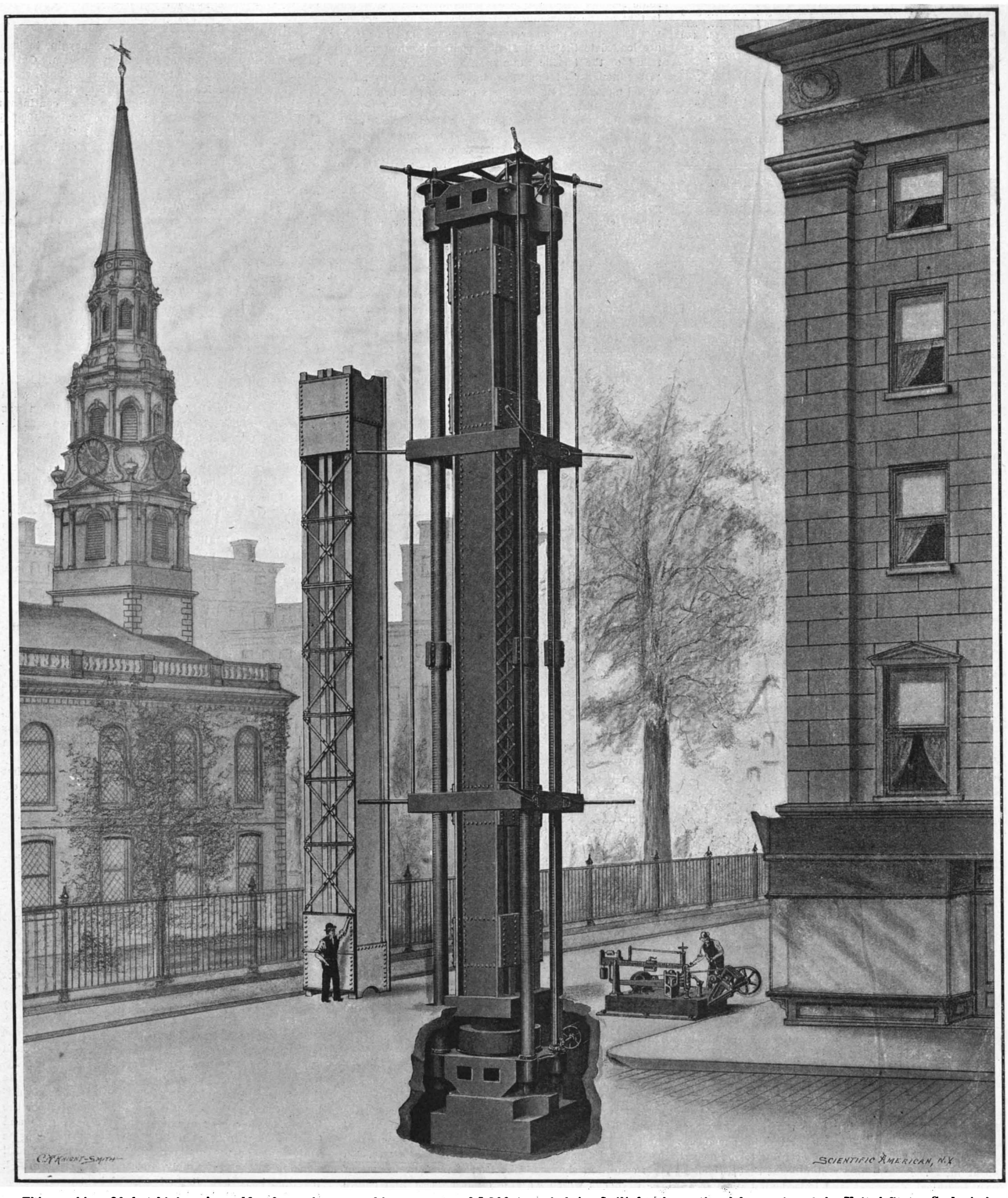

This machine, 80 feet high and capable of exerting a crushing pressure of 5,000 tons, is being built for the testing laboratories of the United States Geological Survey. It will be used to test the breaking strength of stone, brick, and concrete and of large steel columns for bridges and buildings. The two members shown are chord sections of the Quebec and Queensboro bridges.

GIANT TESTING MACHINE FOR DETERMINING THE STRENGTH OF STEEL COLUMNS.—[See page 26.]

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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.

THE ELECTRIC LOCOMOTIVE OF THE FUTURE.

The announcement has recently been made that the New Haven Railroad Company is about to extend its electric zone from Stamford to New Haven, a distance of over forty miles. It is understood that in all its essential features the same system will be employed as that which has now for nearly two years been in successful operation from Stamford to New York; and the announcement is taken to indicate that the bold experiment which the New Haven Company made in equipping its four-track trunk line with an alternating-current plant and overhead conductors transmitting current at 11,000 volts directly to the locomotives has proved to be thoroughly successful. This important extension of the electric zone is particularly significant in view of the fact that, contemporaneously with the change of power on the New Haven system, the New York Central Road, which uses the same terminal station at 42nd Street, New York, equipped its own four-track road with a direct-current system, using 650-volt direct current, and that the two roads have been operated side by side under practically identical conditions.

Under each system, alternating current of high tension is generated at a central power station. On the New York Central line it is stepped down and converted into direct current in sub-stations. On the New Haven road the transformers are carried upon the locomotives themselves, each of which, therefore, may be said to act as its own sub-station. In the latter case there is the disadvantage that there is a great increase of weight in proportion to the power delivered to the axles. This is shown by the fact that, whereas the New York Central locomotives can develop 2,200 horse-power for a weight of 102 tons, the New Haven locomotives can develop only 1,000 horse-power on 107 tons. Consequently, it is necessary to employ two locomotives to make schedule express time with a New Haven express train of from eight to fourteen cars, whereas a single New York Central locomotive can haul the same, and indeed an even larger number of cars, and maintain the schedule.

Because of the fact that the New York Central Company has not as yet extended its electric zone beyond High Bridge, which is about seven miles from the 42nd Street terminal, no opportunity has been afforded to test the behavior of the locomotives in hauling heavy trains over long distances; and the question has been raised as to whether they will be able to stand up to this service with the same regularity as has been shown by the New Haven locomotives, which have been regularly making the run of 35 miles to Stamford without developing any trouble in the way of overheating of the motors, etc.

Up to the present time neither company has shown any disposition to make public the details of the cost of operation. Both have declared that in point of convenience and regularity of service the electric has shown a decided superiority over the steam service; and it is conceivable that these advantages are such as to more than offset any increased cost due to the heavy initial outlay. It is certainly significant that although the mechanical, electrical, and indeed all the physical elements of the installations have been made public with surprising candor, absolutely no definite statement has been given out as to economy of operation. It is to be hoped that, in the interests of electrical science and for the furtherance of this most important question of the electrification of steam railroads, the two companies concerned will consent at an early date to publish this eagerly awaited information.

DRYDOCKS FOR OUR BIGGEST BATTLESHIPS.

In raising the displacement of its battleships to 26,000 tons, the United States government has produced a ship which far exceeds the largest contemporary battleships built or building of any foreign navy, not even excluding Great Britain. If the new vessels are constructed with a rapidity equal to that of the foreign navies, our navy will possess in the "Wyoming" and her sister, at the time of their completion, the largest and most powerful battleships afloat.

This extraordinary increase in size brings with it some serious responsibilities, prominent among which is that of the provision of drydocks capable of accommodating these monster vessels, not merely when they are loaded to their full displacement but when, as the result of the terrific wounds which even a victorious "Dreadnought" of the future is bound to receive, the vessel may have sunk some six or seven feet below her maximum draft.

The foreign governments, notably Great Britain and Germany, are fully alive to the importance of this question. Great Britain possesses on her eastern and southern coast eight drydocks, which are available for ships of the "Dreadnought" class, and four are in course of construction, this estimate including both government docks and those owned by private shipyards. On the west coast there are six docks, making eighteen in all, whose depth and entrance width are sufficient to accommodate the largest battleships. Germany has under construction or already completed twelve docks of the requisite capacity.

In considering our own docking facilities it will be well first of all to state the dimensions of the 26,000-ton "Wyoming." Her beam will be 93 feet 2½ inches, her draft on full load displacement slightly less than 30 feet, and the length 566 feet. At the present time the depth of water over the sills of our largest drydocks would be sufficient to float the "Wyoming" over the sill on her full-load displacement only at high water and even then with but a slight margin to spare. The navy yard docks that could accommodate her and their depth of water over sills are: Portsmouth, 30 feet; Boston, 30 feet 7½ inches; New York, 33 feet 6 inches; League Island, Pa., 30 feet; Charlestown, 34 feet; Mare Island, 30 feet; Puget Sound, 30 feet; and the new Pearl Island dock, 35 feet depth, at Hawaii. To these must be added two private docks, one at Newport News and another at San Francisco, each with a depth of 30 feet. The rest of the naval drydocks, seven in all, are either too narrow or shallow to admit the "Wyoming" at full load draft. The new docks which are now under construction or have lately been completed were originally designed to take a battleship of any size; but the dimensions of our ships have increased so rapidly that it becomes an interesting question as to what clearances of breadth and depth these docks would offer, if any, in docking the "Wyoming."

We understand that the Bureau of Yards and Docks has been endeavoring to keep pace with the work of the Bureau of Construction and Repair and that designs have been modified as far as possible to meet the new conditions. The most important consideration is that of depth, since the injuries which a warship must suffer in an engagement will in all probability involve a certain amount of perforation of the hull and starting of seams, at or near the waterline, and the entrance of more or less water, involving a proportionate increase in the draft of the ship. In a discussion of this subject, as affecting the British navy, our contemporary, Engineering, estimates that if the boiler rooms of one of the British "Dreadnoughts" of 20,000 tons displacement were flooded, her displacement would be increased about 2,500 tons and about five feet would be added to her draft; and if the engine room and side compartments were also flooded the draft would be increased seven feet above the original draft of 26 feet. It is conceded to be possible that even the wings might be also flooded in addition to the engine and boiler rooms and the ship still remain afloat; in which case the displacement would be increased from 20,000 to 32,000 tons and the draft from 26 to 38 feet.

Now at her mean draft our own "Florida" draws 28½ feet, and at full load displacement about 30 feet. It is conceivable that at the close of a fierce engagement with a "Dreadnought" of her own power, whose guns were served by such well-trained crews as are found in the navies of one or two of the leading naval powers, the "Florida," even if victorious, might get back into harbor drawing 35 or 36 feet of water. In this condition she would be barred from every one of the drydocks which we at present possess, and before she could be docked temporary cofferdams would have to be built and a part of the water pumped out.

It may be said in answer to this that it is useless to give to a drydock a greater depth than that of the entrance channels to the harbor or port in which it is located. The point would be well taken, if it were certain that the existing channel depths would be the depths for all time. As a matter of fact, the entrance channels of all of the important harbors of this country are certain to be continually deepened in response to the demands of navigation. The entrance channel to New York has been deepened from 32 to 40 feet; and in the construction of drydocks, whether for government or private yards, a due regard for the future should lead to the construction of all first-class drydocks with depths over sills and widths at entrances greater than the needs of the hour would seem to call for. At the same time it is only just to the Bureau of Yards and Docks to state that our present drydock accommodations are fairly comparable with those of the other leading powers.

THE RAILWAYS OF THE WORLD.

America still continues, by a wide margin, to lead the world in the extent of its railway system. Out of a total of 594,867 miles of railroad in the whole world, 268,058 miles are located in North America. This is but little less than the total for the three continents of Europe, Asia, and Africa; Europe having 199,385 miles, Asia 56,294 miles, and Africa 18,519 miles, a total of 274,198 miles for the Old World. South America has a total of 34,911 miles, and Australasia of 17,700 miles of railroad, which added to the figures for North America, make a grand total for the New World of 320,669 miles.

The above figures form part of a report compiled by the Prussian Ministry of Public Works, for the year 1907, which shows that, compared with the previous year, the largest percentage of increase is that of 998 miles or 5.7 per cent in Africa, followed by 7,637 miles, an increase of 3 per cent, in North America, and 2,917 miles, representing an increase of 1½ per cent in Europe. The greatest amount of construction in European countries was that in Russia, where 1,625 miles of new track were built; France was next with 431 miles; and Germany built 411 miles. The largest additions in Asia were made in British India, where 909 miles were built, China coming next with 464 miles. In South Africa, the largest addition was in British South Africa, where the mileage was increased 5¼ per cent by the addition of 352 miles.

During the decade from 1897 to 1907, there was extraordinary activity in the building of railroads throughout the world, 140,137 miles of new railroad being built in that time, representing an increase of 23½ per cent. The largest gain was in North America. The statistics of 85 per cent of the railroads owning the total mileage given above show that there is a total capital invested of nearly $42,000,000,000. If the same rate of cost has obtained in the railroads of which statistics were not available, the total outlay on railroads, from their inception to the present time, must be nearly $50,000,000,000. This would represent an investment of about $31.50 for each inhabitant of the globe at the present time.

THE DIRECTIVE SENSE OF BEES.

The directive sense which is possessed by bees is the object of researches made by M. Gaston Bonnier, of Paris, and he seems to prove that bees possess a special sense like that of carrier pigeons. Bees can fly for two miles from the hive and are then able to return after gathering their supply of honey. Langstroth and others suppose that vision comes into play and that bees can see for a great distance and can also note objects on the way so as to find their path. Others, with Dadant, suppose that the bees are guided by the sense of smell, and that they can smell flowers at distances of 1½ miles. The author makes experiments to prove that bees can return to the hive without using either sight or odor. As to sight, he takes bees to a distance of 1.2 miles from the hive, in a closed box. They always fly back to the hive when released. The same is true when their eyes are covered, so that sight is not essential. As regards odor, experiments seem to prove that bees perceive odors at only short distances. When a needle dipped in ether is brought near the head of the bee, it shows signs of perceiving the odor, but not so when the needle is placed back of him or near other organs. Besides, when the organs of smell (antennæ) are removed entirely, the bees will return to the hive. M. Bonnier makes the following experiment: At 600 feet from the hive he places a supply of syrup, and the bees soon find it, proceeding to and fro to the hive. Such bees he marks with green-colored powder. He then places a second supply of syrup at the same distance from the hive, but spaced at 20 feet from the former. Other bees are now engaged in the to and fro movement to this point, but these are not the same individuals as the green marked ones, who are still working on the first supply, and he marks these in red. We thus have two distinct sets of bees, and we see that they can distinguish two directions which form a very acute angle. We seem to have here a special directive sense which does not reside in the antennæ, but probably in the *cerebroid ganglia*. Other facts may be cited in evidence of the directive sense of bees.

ENGINEERING.

The important work of deepening the channel to the city of Baltimore has been so far completed, that there is a depth from the city to the sea, if we except the crossing of York's Spit at the mouth of Chesapeake Bay, of 35 feet, and a channel width of 600 feet. Opposite Fort McHenry the channel is to be widened out to provide an anchorage for ocean-going vessels.

The increasing precipitation of the rainy season is having its usual effect of reducing the amount of excavation on the Panama Canal. The rainfall in April was 4.36 inches; in May it was 9.82 inches, and the excavation fell from 3,454,649 cubic yards in the former to 2,896,095 cubic yards in the latter month. There is an increase, however, in the total amount of concrete laid, which was 11,586 cubic yards in May as against 7,978 cubic yards in April.

The average speed for the transatlantic passage is now within 0.12 knot of the 26-knot mark. On June 21st, the "Mauretania" on her passage to the eastward passed Brow Head at 8 A. M., having made the passage from the Ambrose lightship, Sandy Hook, in 4 days, 17 hours, and 21 minutes. The successive day's runs were 588, 606, 609, 606, and 524 miles. The total distance is 2,937 knots, and it was covered at an average hourly speed of 25.88 knots.

The new United States ships of the "Dreadnought" type, among other novelties of construction will embody three electric passenger elevators. They will have a lift of a little over twenty feet, and they will be used mainly by the watch officers whose duty takes them from fireroom to fireroom. The elevators are rendered necessary by the fact that there are no doors between firerooms on the new ships. The first elevator to be used in the United States navy was installed on the hospital ship "Solace" during the Spanish war.

The worldwide falling off in business in 1908 made itself felt in the traffic through the Suez Canal. During 1908 there passed through the canal 3,795 vessels of 13,633,283 tons net, a decrease of 472 vessels and 1,095,151 tons as compared with 1907. There was an increase in the size of the individual type of vessels, and the average time of passage, seventeen hours and twenty-four minutes, was the best that had been made in any year since the canal was opened.

It is understood that a majority both of the Canadian and American Commissioners of the International Waterways Commission will recommend that a dam be built on the Niagara River, opposite Buffalo and Fort Erie, for the purpose of raising the level of Lake Erie. In the autumn of every year there is a fall of about two feet in the level of the lake. This reduction of available navigation depth seriously affects the shipping interests; and with the increase in the size of vessels it is becoming a menace to navigation. The estimated cost of the dam is about $5,000,000.

The growth in size of steamships and in the cost of labor and the materials of their construction has caused a great increase in the total cost of transatlantic steamships during the past decade. Thus the "Kaiser Wilhelm der Grosse," 1897, cost a little over $2,500,000; the "Oceanic," 1899, $3,000,000; the "Deutschland," 1900, $3,250,000; and the "Kaiser Wilhelm II," 1903, $4,000,000; while the estimated cost of the "Mauretania" is $6,750,000. The most fruitful cause of the increase in cost has been the effort in each ship to outdistance her predecessor in speed. This has led to an increase in the engine power from 30,000 in the "Kaiser Wilhelm der Grosse" to 70,000 in the "Mauretania."

An engineer who has recently made a tour of the waterways of the Middle West, to gather data relative to proposed waterway improvements, informs us that he was astonished to find what a large amount of freighting is done by individual storekeepers and smaller merchants in launches propelled by internal-comubstion motors. The country storekeeper, living on the banks of rivers and canals, has found that he can ship his own freight from the wholesale dealer and distribute it to his retail customers by motor boat, at a cost far below that of any other available means of conveyance. There is in this fact a suggestion of future usefulness for abandoned canals in which the draft is limited.

Frequenters of the classic Battery Park at the southern end of Manhattan Island were forcibly reminded of the palmy days of "America" cup racing, when they saw a gang of Park Department riggers hoisting into position a new flagpole, which turned out to be nothing more nor less than the mast of the old cup defender "Constitution." The lower mast is built of steel and is, of course, hollow. Telescoping into this is the wooden topmast. The foot of the mast is bolted to a mass of concrete, and the truck of the topmast from which the flag flies is about 165 feet above the sea wall. In the rigging of the mast Herreshoff tried a new system of double crosstrees. Breakages of the mast were frequent, and he subsequently, in the "Reliance," returned to the old system of single crosstrees.

ELECTRICITY.

A novel grounding device is now in the market, which is made up of a number of double convex disks secured to a central rod of a conductive material. The disks are non-metallic, but are formed of absorbent material which retains moisture. The advantage of this grounding device is that it is not affected by acids or alkalis, so that it provides a permanent ground connection of high capacity. When the device is placed in the ground a pailful of strong brine is poured over it, and as the earth is filled in over the disks, more salt water is added, so as to increase the conductivity of the surrounding earth.

The recent agitation in the Southern States in favor of electric headlights on locomotives has led to the design of several very efficient turbo-generator sets of such design that they can be placed directly on the locomotive boiler and be driven by steam taken from the boiler. A very compact outfit of this type was exhibited at the recent Master Car Builders' and Master Mechanics' conventions in Atlantic City. The turbine is of the impulse type, consisting of a single wheel, provided with re-entrant paths for the steam, which receives nearly its total expansion at the nozzles. One model shown was directly connected to the headlight. It supplied a current of 25 amperes at a tension of 30 volts.

A miner standing at the bottom of a shaft 2,500 feet below the surface of the ground in the Clear Creek district, Idaho, can carry on a telephonic conversation with Chicago, says the Electrical Review and Western Electrician. However, only a miner can telephone in such surroundings, owing to the noise of the drills and other machinery in operation all about. The telephone instruments used in the mine are of special construction to protect them from dampness. There is a regular telephone system connecting over one hundred mines in the Idaho Springs district, all of which mines are tapped by an underground railway through which the telephone wires run.

The first electric locomotive for the Detroit River tunnel has been completed. This locomotive has a weight of 199,000 pounds. It is of the articulated type. It is provided with four motors, each adapted to develop a tractive effort of 9,000 pounds at 12 miles per hour. The maximum speed of the locomotive is 35 miles per hour. It is provided with the multiple-unit type of control, the motors being so arranged that they may be operated four in series, four in parallel, or two in series and two in parallel. The system of control makes it possible to start a train so gradually that the motion is almost imperceptible. This locomotive is one of six which have been ordered for the tunnel, and is designed for use in hauling both passenger and freight trains.

As a substitute for large condensers using paper, glass, or mica for the dielectric, an electrolytic condenser has been devised, which consists of aluminium electrodes immersed preferably in ammonium borate. Magnesium or tantalum electrodes can be used, but aluminium is preferred because it is cheaper. The current acting upon the metal causes it to be coated with a thin layer of oxide, but this oxide is very porous, and in the pores a gas is formed which serves as a dielectric between the metal and the electrolyte. The resistance of this gaseous dielectric increases with the tension up to a certain critical point. Experiments have been made with various electrolytes, and it was found that the critical tension with sulphate of soda was 40 volts, permanganate of potassium 112 volts, bichromate of potassium 122 volts, silicate of soda 415 volts, citrate of ammonia 470 volts, borate of soda 480 volts, and citric acid 535 volts. The best effect was that of ammonium borate with a critical tension of 403 volts. There was quite a loss of current with tensions above 90 volts.

One of the principal problems considered by the International Meteorological Conference in London last week was the question of wireless marine weather reports. Prof. Willis L. Moore, representing the United States, urged the necessity of adopting regulations that will compel a ship beyond a certain tonnage to carry wireless instruments and operators and to take at noon Greenwich time a daily observation of the weather. Observations received by a ship would be transmitted to other vessels so that by means of such relays the weather conditions over the entire ocean would in a few minutes reach the central meteorological offices in the United States, England, France, Germany, and other interested nations. Forecasts could then be made and distributed to the vessels by wireless telegraphy. It is believed that a universal system such as this would be a great factor in saving life and property both on land and at sea. The conference has adopted an international weather signal code. Heretofore American vessels have used flags by day and lights by night to convey storm warnings while other nations have used balls and cones. Now any one will be able to read the weather signals, no matter what his nationality may be.

SCIENCE.

According to a recent report of the biological survey of the Department of Agriculture, rats destroy annually $100,000,000 worth of American grain. It is estimated that one rat will eat 60 cents' worth of grain in a year, while of oatmeal it will consume $1.80 worth. Rat-proof construction, especially the use of concrete foundations, is urged, as well as some rational method of disposing of garbage and storing food.

Prof. John A. Brashear of Allegheny calls attention to a peculiarity of the solar eclipse of June 17th. For a few seconds it was an annular eclipse, then a total eclipse, and finally an annular eclipse again. Although we have records of annular eclipses for four hundred years, and of total eclipses for thousands of years, Prof. Brashear maintains that this is perhaps the first occurrence of the kind.

The excavation of the Menelaon, the reputed tomb of Menelaus and Helen, has brought to light some interesting Mycenæan relics, among them traces of frescoes, fragments of pottery, bronze and lead votive offerings, beads, double-headed axes, terra-cotta objects, and the like. The Menelaon itself was probably built about 5 B. C., in other words, six hundred years later than the traditional period of Menelaus.

Dr. William Tell Kudlich has brought to the notice of the Health Board of Hoboken, N. J., a plan for exterminating the mosquito, which consists in planting mosquito-ridden tracts with arzolla. The plant is a native of Africa. It in a short time covers marshy land with a layer three inches thick, thus both suffocating mosquito larvæ and preventing the living insects from depositing their eggs in the water. The plant is said to have been used with some success in the German colonies of Africa.

In a process recently patented in Germany, for the regeneration of vulcanized India rubber, fragments of old rubber are mixed with from one-tenth to one-fifth their weight of anilin, and the mixture is heated until it becomes fluid. The special advantage of the process is the comparatively small quantity of solvent required. The regenerated rubber is said to be little inferior to new rubber in elasticity and other properties. It can be vulcanized in the usual way and can afterward be regenerated again by the new process.

The danger of explosion of mixtures of air and combustible dust is well known. Explosions of this character occur in flour mills and frequently in coal mines. Mixtures of air and aluminium powder are very liable to explosion. The combustion of aluminium powder produces a very high temperature. On this fact is based the process of autogenous welding of iron rails which is known as aluminothermy. Recently, in a factory near Nuremberg, where a metallic surface is given to paper by means of aluminium powder, the breaking of the globe of an inclosed arc lamp (Liliput) caused an explosion which killed two men and wounded several others.

Experiments were recently made in France on various preservatives of wood, including carbonileum Avenarius, carbonileum Lyon, gas tar, microsol, lysol, antimony, antigermine, and hydrofluoric acid. It was found that for spruce, beech, poplar, oak, and Aleppo pine, exposed to the atmosphere, the best preservatives are certainly the carbonileums, gas tar, and microsol. The other substances examined produced absolutely no effect. These same preservatives (carbonileum, gas tar, and microsol) are also most efficacious for the preservation of wood in the confined hot air of mines. Antimony and hydrofluoric acid are less effective.

Formol has been recommended as a fly poison by several writers, who have studied its action and the best method of using it. It is necessary, in order to obtain good results, that the formol shall be swallowed by the insect, hence the flies must be attracted to the poison by mixing with it an appetizing food and by spreading the mixture over a large surface. Honey has given poor results. The best mixture is that of formol with milk. The best results are obtained by using a solution containing 15 per cent of the formaline of commerce, 20 per cent of milk, and 65 per cent of water, placed in large flat vessels. Most of the dead flies fall, not within the vessels, but around them, sometimes at a great distance.

An international agreement is reported between England, France, and the United States upon a unit of candle-power of luminous intensity to be known as the international candle. No change is made in France, which adheres to the *bougie decimale*, nominally one-twentieth of the violle or molten platinum standard, but actually 0.104 carcel. In England, whatever small change may have been actually involved is covered by specifications of the national pentane flame standard by reference to the amount of moisture in the air of the photometer room. In America, a reduction of 1.6 per cent in the standard of candle-power maintained at the Bureau of Standards will be involved, a change capable of being observed only by trained photometrists.

THE GUAYULE RUBBER INDUSTRY.

BY J. E. KIRKWOOD.

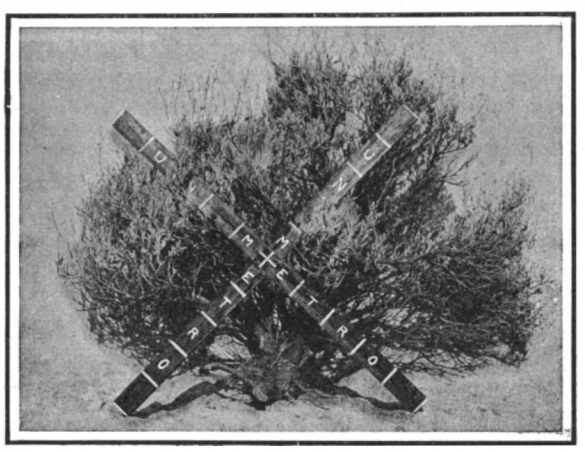
The increasing demand for rubber in the various manufactures of the present time makes the business of its production one of the most important of modern enterprises. Not only is the natural source of the supply eagerly sought and carefully guarded, but efforts for the cultivation of rubber-bearing plants are receiving attention in many parts of the world.

The rubber of commerce is derived from a number of different plants; in fact, there are many plants of more or less importance from the standpoint of the quantity and quality of the rubber they produce. Among those less generally known is a Mexican plant, called *guayule* (pronounced *wyúlie*), which is identified botanically as *Parthenium argentatum*.

The guayule is a desert plant. It thrives in those regions of relatively little rain throughout the northern half of Mexico and the neighboring areas of Texas. It is a small shrub, tree-like, and rarely attains a height of four feet or a stem diameter of more than three inches. Its leaves are small and of a silvery gray color, whence its specific name *argentatum*. The plant produces small yellowish-green flower heads consisting of many minute florets, only five of which in each head are capable of producing seeds, and each of these only one.

Most of the rubber of commerce is produced by plants having a milky juice, or latex as it is called, in which the gum is found. The trees are tapped by cutting into or through the bark, and the latex is collected as it flows down. In the guayule plant no latex is produced, and it must be subjected to an entirely different process to extract the rubber. This article occurs in the form of minute microscopic granules deposited throughout the tissues of the stem, branches, and roots, but especially in the bark of these organs. If one will take a very thin section of the stem or branch and examine it under a lens, he may see much of the tissue densely crowded with small, dark-colored granules. In these granules, deposited within the living cell, is the source of the rubber, to separate which requires a special process.

Methods of extraction of guayule rubber differ. Some obtain the rubber by trituration of the plant and a subsequent more or less mechanical process; others by means of solvents separate the gum from tissues after grinding them. But the details of the process are kept secret, the public not being admitted to the factories, which are surrounded by high walls with armed guards at the gates. However, several processes are described by Dr. F. Altamirano* in the Boletin de la



Extra large guayule bush.

Secretaria de Fomento, of Mexico. One of the methods consists in first crushing the plants by grinding them in a machine, in which they are tumbled among hard stones until thoroughly pulverized, and the gummy substance collects in lumps with a certain amount of woody tissue. To isolate the gum, this material is then boiled over steam in an iron vessel with a double bottom, and the woody particles afterward strained out. After this operation the mass is thrown into a tank of cold water; again it is strained and boiled anew with caustic soda until the woody particles are fully separated, and the gum is precipitated by chloride of calcium.

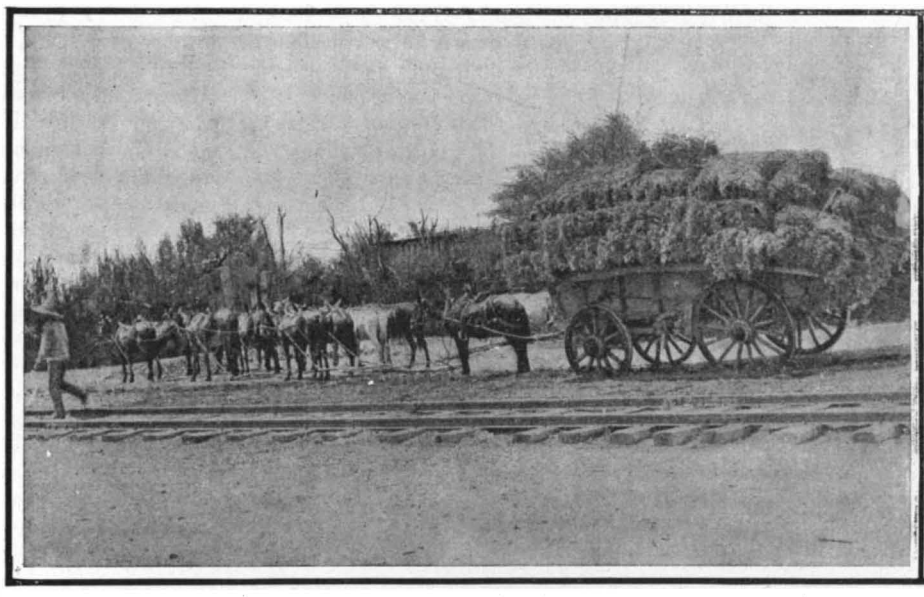
The process of extraction of guayule rubber involves therefore the immediate destruction of the plant. The natives employed to collect the plants uproot them, and take no pains to spare any part. The bushes are then packed on the backs of burros, and carried to some place for baling and shipment. The cheapness of labor makes it feasible to transport the plants for considerable distance by pack train or wagon. Sometimes the load is carried for as much as forty miles from where the plant is gathered to the railway station; such distances usually by wagon. The cheapness of labor makes such operations profitable; the wages of a peon being about thirty-seven cents a day, Mexican currency.

The manufacture of rubber from guayule is an industry of only recent development. The production of gum from this plant has been known from the middle of the eighteenth century. The Indians were accustomed to make rubber balls by chewing out the gum from the bark. If one takes a mouthful of the bark and thoroughly masticates it, rejecting the fibrous particles, he may soon obtain a small mass of rubber the size of a pea. The rubber thus obtained is soft and sticky, adhering to the skin as it is manipulated between the thumb and finger.

For some time no effort was made to manufacture this rubber on a large scale. In 1890 a German chemist first attempted to extract it in commercial quantities, but a paying basis was not reached until some years later. In 1905, according to consular reports, the guayule rubber shipment from Durango amounted to $125,478. From Torreon in 1906 rubber was shipped to the value of $917,571. During the year ending in June, 1908, there was shipped from the Durango consular district alone, guayule rubber to the value of two and a quarter millions. Since then the business has increased, and is one of Mexico's most important industries at the present time. Extensive tracts of land and millions of capital are involved in the enterprise. The Continental-Mexican Rubber Company of New York, in addition to their large factory at Torreon, acquired possession of the old Hacienda de Cedros in the northern part of the State of Zacatecas, consisting of 2,500,000 acres, valued especially for the growth of guayule which it supports. The Madero brothers of Barras

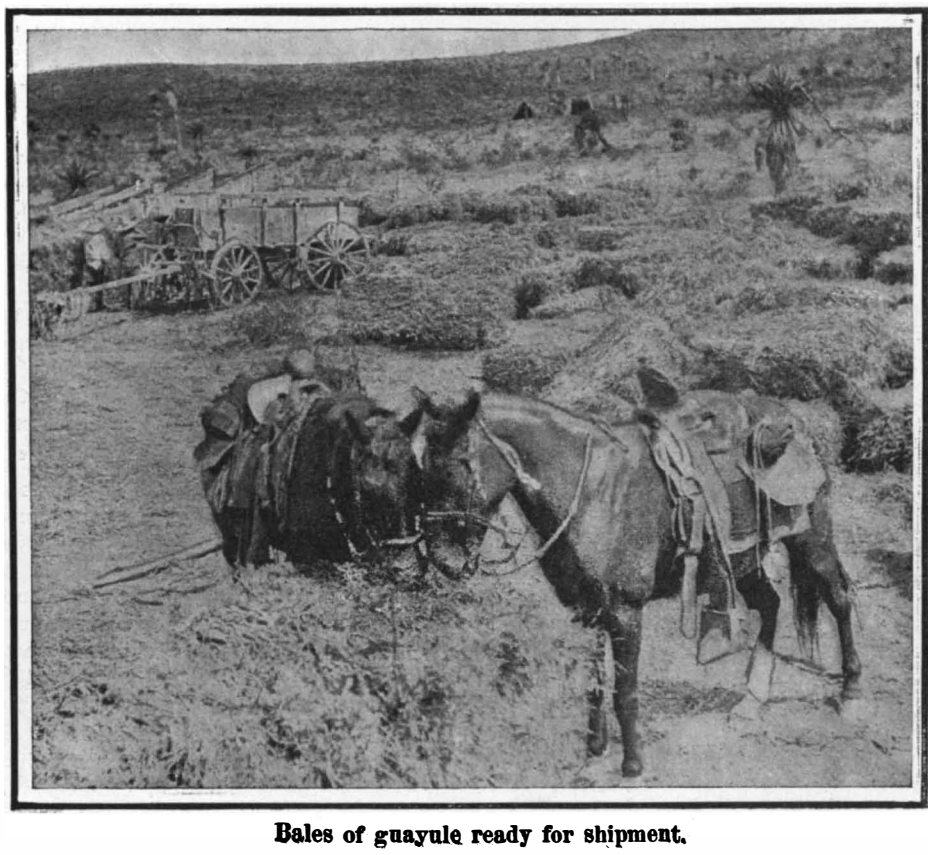
(*Concluded on page 26.*)

* Translation from the German of an article by Dr. Rudolf Endlich, published in Tropenpflanzer ix. 1905.

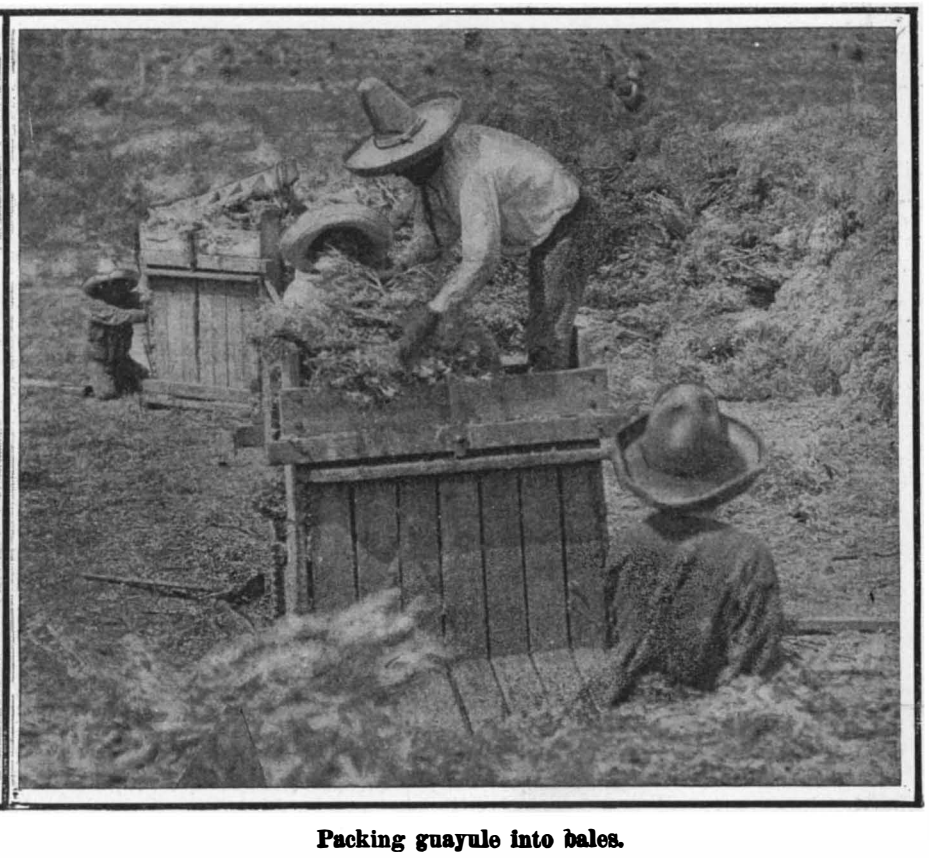


Fourteen-mule team with load of guayule.

The guayule bush in the desert.



Bales of guayule ready for shipment.



Packing guayule into bales.

THE GUAYULE RUBBER INDUSTRY.

THE STANDARD ELECTRICAL CELL—ITS USE AND ITS PRACTICAL VALUE.

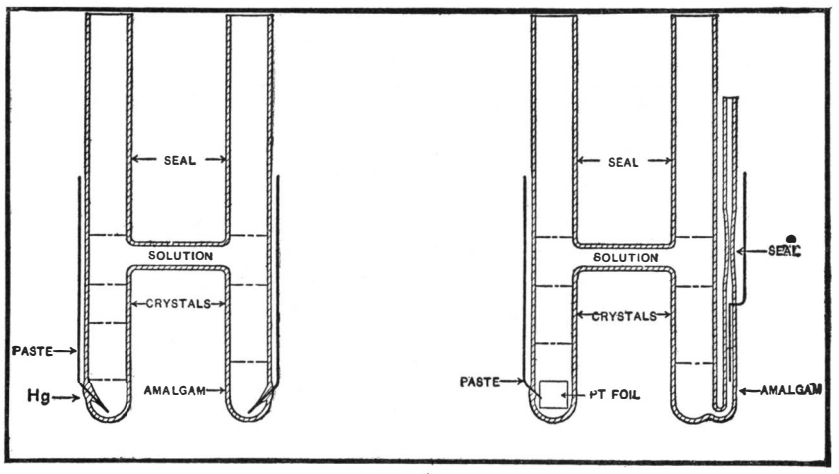
BY HERBERT T. WADE.

One of the most important lines of research in the field of electricity in recent years has had to do with the study of the standard cell, from which is obtained a certain definite and constant electromotive force. Indeed, the standard cell practically underlies all measurements of electromotive force or difference of potential, and its study and investigation have interested workers at the great national physical laboratories, especially since the Clark cell was adopted as the standard of electromotive force in the definition of the volt by the Chicago Electrical Congress of 1893. To-day not only methods and results are compared by these national laboratories and bureaus, but the very cells themselves are interchanged, and a surprising degree of uniformity obtained on their comparison. Now the standard cell in electrical measurements has the same function that a standard measure such as a scale or gage has in the shop, and it must be used in the fundamental testing of a direct-reading voltmeter, and in other forms of laboratory work where accuracy in electrical measurement is essential. While there are electrical units on the absolute system logically derived and inter-related, and such practical units as the ampere, volt, and ohm, yet it is just as difficult to reproduce and apply these units as it would be an inch or foot without recourse to some concrete standard.

To realize the fundamental definitions, and then to construct standards, is a task requiring the most refined physical work; but once the units are realized or known in terms of certain standards which may be reproduced readily and used in the laboratory, accuracy of measurement follows without difficulty. The standard cell enables us to define the volt as one of the fundamental units in addition to its general utility for electrical testing. Various physicists and the investigators at the U. S. National Bureau of Standards have made a careful study of various types of these cells, and it is their opinion that the standard cell has preponderating advantages over the coulometer as a fundamental standard. However, aside from this matter of defining the fundamental unit, the present condition of the standard cell and its construction and testing present much that is of interest.

The first standard cell, or rather a constant cell in terms of which electromotive force was measured, was the Daniell cell, where zinc in a porous jar containing zinc-sulphate solution served as the anode, while the cathode was copper in a solution of copper sulphate. This cell was and is very useful as a constant source of current, as in telegraphy, having an E. M. F. of about 1.1 volts, but as a standard it was supplanted by the Clark cell, devised by Latimer Clark in 1872.

In its original form the Clark cell consisted of a test tube containing a mercury electrode covered with a paste made of mercurious sulphate, zinc-sulphate crystals, and solution, while above to form the second electrode was a rod of zinc in a saturated zinc-sulphate solution, and in contact with an excess of zinc-sulphate crystals. With an E. M. F. taken as 1.434 volts at 15 deg. C. the Clark cell found wide usefulness, and various improvements in the materials and form of construction resulted, especially the evolution of the H-type containing vessel and the substitution of zinc amalgam for the zinc rod, due to Lord Rayleigh. In 1893 the Chicago Electrical Congress adopted the Clark cell as a standard of electromotive force; and while international specifications for its construction never were prepared, yet in the United States and in other countries legal specifications for making the cells were promulgated, and the E. M. F. was started at 1.434 volts at 15 deg. C. In the United States type a glass



Figs. 1 and 2.—Sectional views of standard cells.

vessel in the shape of an inverted Y was prescribed, in one limb of which was pure mercury, and in the other an amalgam of zinc and mercury. On the mercury was a layer of mercury and zinc-sulphate paste, above which, as well as above the zinc amalgam, was a layer of neutral zinc-sulphate crystals, and over all was a solution of zinc sulphate. Somewhat different types of construction were adopted in different countries, and in Germany the value of 1.4328 volts was adopted for the E. M. F., which is nearer correct than the United

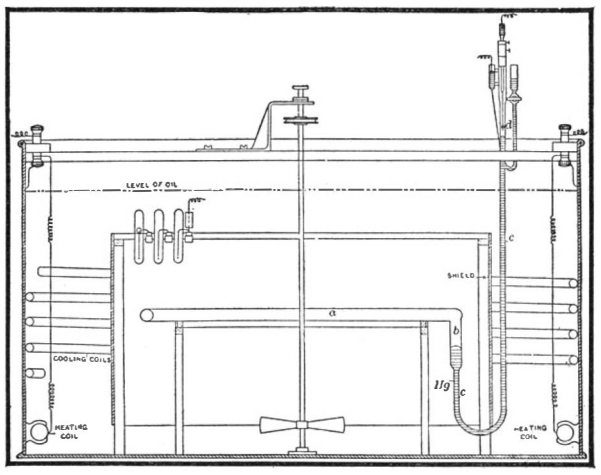


Fig. 3.—Sectional view of comparing bath.

States legal value. Mention here should be made of the Weston cell, brought out in 1892, which since has been widely used and studied both independently and in connection with the Clark cell. In the Weston cell, cadmium and cadmium sulphate replace the zinc and zinc sulphate of the Clark cell, and the change of the E. M. F. with temperature is so small as to be practically negligible. For this and other points of advantage the Weston cell with its E. M. F. of 1.1025 volts immediately found a place in the testing laboratory.

Now, while both of these cells could be made with ordinarily "chemically pure" materials of sufficient accuracy for most ordinary work, yet their permanence and durability, as well as the limits of accuracy and reproducibility, became a matter for investigation, and this has continued with all the refinements possible in modern physical work. The purity of the chemicals used has been determined beyond question, and electrolytic and other methods have been used to obtain materials of absolute purity and uniformity, even the size of the grain of the mercurious sulphate having received attention.

The form of cell now made by the United States National Bureau of Standards is shown in the accompanying illustration, Fig. 1, a half-size diagram. The size does not affect the E. M. F. of the cell, but it does determine its polarization and its power to assume quickly the temperature of its surroundings. The lead wires are of platinum sealed into the tube, and within are coated with a thin layer of glass to nearly the end. Cracking at the point of sealing has always been a weak point with the Clark cell, and this arrangement reduces the danger, though the form of vessel serves equally well for the Clark and Weston cells.

The Reichsanstalt, or German Imperial Testing Laboratory, recommends the form shown in Fig. 2, in which the platinum terminal of the amalgam limb is sealed into a side tube, into which the amalgam is sucked up while still liquid. In a portable type of cell a piece of amalgamated platinum foil, as shown in Fig. 2, at the bottom of the left limb is welded to the platinum lead wire and replaces the mercury. This type also has been extensively used by the Bureau of Standards. The preparation of the chemicals and the construction of these cells involves the most painstaking care and the following of most detailed directions, and of equal importance is their testing. In the Clark cell especially the variation of the E. M. F. with temperature requires special temperature-regulating apparatus, which enables the temperature of the oil bath in which the cells are placed to be maintained constant to within 0.01 deg. C. This is installed in a basement room of the Bureau of Standards, where the temperature for the greater part of the year can be controlled automatically within 1 deg. or 2 deg. The illustration and diagram show the arrangement of the comparing baths and the regulating device which controls the temperature. The various cells to be tested are immersed in the kerosene baths, and their E. M. F. is measured by the potentiometer method, using a very accurate potentiometer of 10,000 ohms resistance and a sensitive galvanometer, so that a difference of 0.00001 volt is plainly indicated on the scale. In this arrangement a storage battery arranged across the terminals of the potentiometer provides a constant fall of potential. Now, by adjusting the coils of the potentiometer, points can be found where there is no deflection of the galvanometer, showing that the fall of potential of the standard cell is the same as that over a certain proportional part of the resistance of the potentiometer. Both Clark and Weston cells thus were checked against each other; and as a result of a large number of experiments and observations, it was found that taking care that the mercurious sulphate was pure, the remaining material of requisite quality could be obtained readily, so that both types of cells are reproducible to within 2 or 3 parts in 100,000. These cells properly constructed gen-

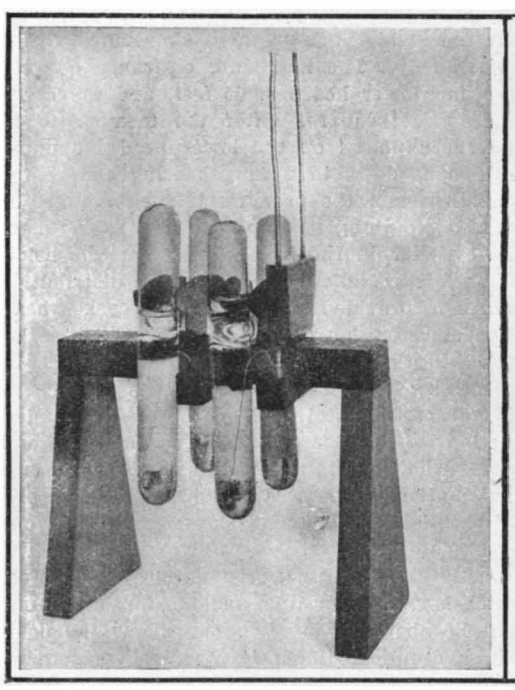


Fig. 4.—Cells, showing traveling contacts and method of mounting.

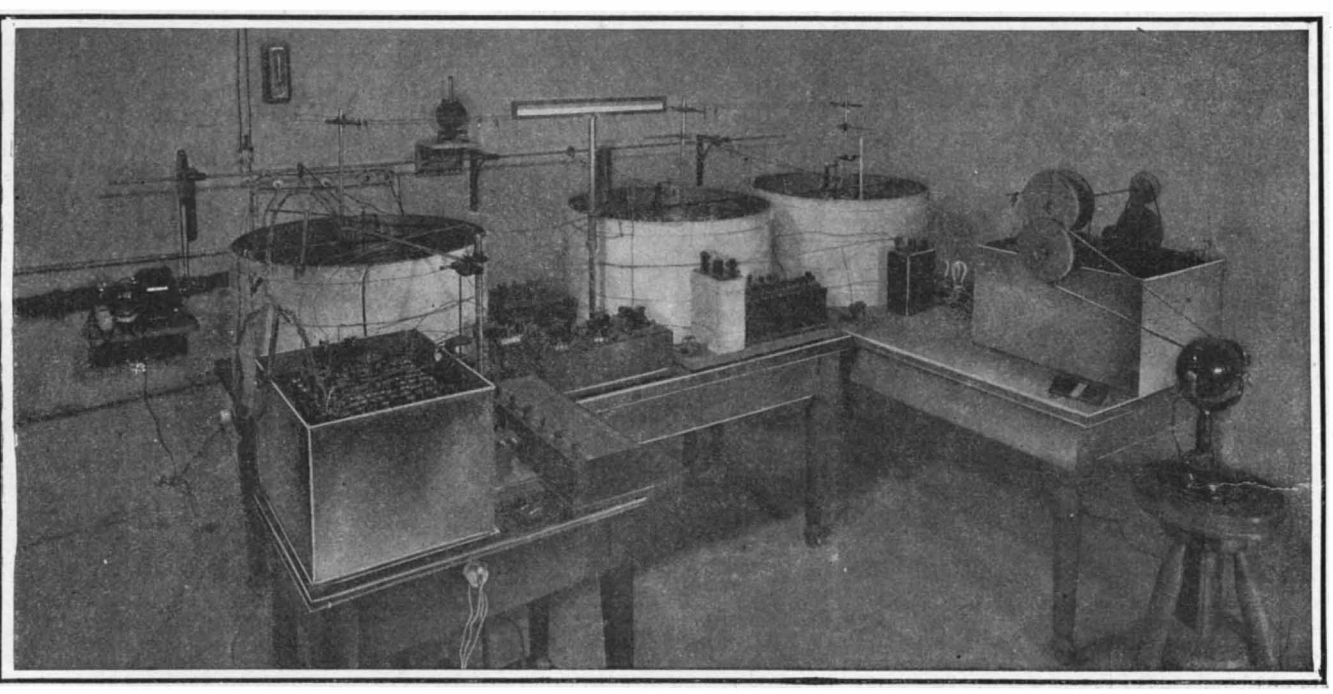


Fig. 5.—Laboratory for studying standard cells.

erally reach a constant value within a few days, and their E. M. F. can be depended on within the above limits for at least a year.

The investigators at Washington have studied not only their own cells made in various ways, but also those of other investigators, particularly those of the Reichsanstalt, the National Physical Laboratory of Great Britain, and the Laboratoire Centrale d'Electricité, comparison with the cells of these institutions having been made both in Europe and in Washington. The conclusion was reached that standard cells could be set up by different investigators which will agree to within a few parts in 100,000, and that they can be constructed and carried considerable distances even on shipboard if ordinary precautions are observed.

In the present condition of the standard cell, the national laboratories can secure the desired accuracy and reproducibility, and this extending in turn to the secondary standards must have its effect on electrical measurements. If it is not feasible for the national laboratories and bureaus to construct these standard cells for ordinary testing or manufacturing laboratories, it has been suggested that they might supply the materials of the requisite purity, and thus obtain substantial harmony, as the mere following of the specifications is not difficult, while testing and certification by the Bureau would be a sufficient guarantee of accuracy. The Weston cell, which undoubtedly will be selected as an international standard of E. M. F. at the coming congress, though possibly without a legal numerical definition of its voltage to supplant the Clark cell of the present definition, has now been demonstrated as a convenient standard and one easily reproducible with exactness. It is for these reasons that many physicists, especially those in America, wish that the volt as defined by the standard cell should form with the ohm the two fundamental electrical units.

THE GUAYULE RUBBER INDUSTRY.

(*Concluded from page 24.*)

are said to own or control 3,000,000 acres of guayule lands, and there are other large interests besides these.

The rate of consumption of guayule is a subject of interest and importance. With several well-equipped factories in active operation working, at least a part of the time, both night and day, the inroad upon the supply is a matter demanding consideration. Although the acreage above cited seems large, the fact is that only parts, favored situations, of these large holdings actually produce the plant—the foothills especially, of limestone formation. A single factory may consume 30,000 tons of guayule shrub in a year, or approximately 100 tons a day. This may represent the growth on anywhere from 25 to 100 acres of land. The number of plants on an acre, and the weight of the individual plant, vary so much that no constant figures can be given. One may find on guayule lands a stand of from 1,000 to 2,000 plants to the acre, and the plants weigh anywhere up to 15 pounds (very large); probably the majority of the plants taken weigh dry from 1 to 4 pounds. Thus on an acre we should find from 1,000 to 8,000 pounds of the shrub. If we call the average yield two tons per acre, we may estimate the area harvested at fifty acres for one day's consumption at a large factory.

While the fact is patent that the supply of guayule is decreasing and must ultimately be exhausted, the opinions of experts place the date, some at ten, some at twenty years hence. Large factories running steadily at Parras, Torreon, Saltillo, and elsewhere, using the product of no less than 100 acres every day; the activities of the camps which the traveler may see in a dozen places in a day's journey; the bales of the shrub piled high by the siding awaiting shipment, all point to the speedily approaching day when the factories must shut down for want of material.

This menace to the business interests involved has not been overlooked or ignored. To provide a continuous crop upon which the business could depend is an idea that has appealed, not only to the members of interested corporations, but also to private landholders, who appreciated the income prospective from such an enterprise. Experiments here and there have been tried, and various opinions have taken form as to the prospect. The most notable of these experiments was that conducted at the instance of the Continental-Mexican Rubber Company, who recently established an elaborate department of investigation at Cedros, Mexico, and spent much money in forwarding the work. Although less than a year was allowed for this large task, the time sufficed to show some insuperable obstacles to the cultivation of the plant on anything like an economic scale.

In the first place, the slow production of seeds, and the care required in their planting, and the rearing of young plants, make the procedure unprofitable from an economic standpoint. With a possible germination rate of 10 per cent of the seed sown, the failure through one cause or another of the young seedlings to pass the initial stages of development, the ranks of the young plants again depleted by pest or parasite, the loss by accidents or in the process of transplanting, and a few subsequent vicissitudes both possible and probable, make it doubtful whether one can count on as much as 1 per cent of the seed sown to mature plants, even under the most favorable conditions. Cuttings mostly fail to grow except from portions of the roots, or stems having part of the root system in connection with them, and only under certain conditions of irrigation; even then, as in the case of seedlings, the cost of the operation exceeds its value. Irrigation is quite essential to the starting either of seeds or cuttings, and in the subsequent growth the rapidity of development depends upon the quantity of water supplied.

But the rapidity of development is in inverse ratio to the formation of rubber in the tissues. Plants grown under irrigation grow rapidly, and attain in four years a weight of six pounds or more, but the rubber content in such plants is practically *nil*, while in native desert-grown plants it is about 10 per cent of the dry weight. If, however, water is withheld, as under desert conditions, the plants grow very slowly, and it is doubtful whether a crop could be matured much under twenty years. Of course, rubber is present in desert-grown plants at an age much less than this, but it is a question at what age plants may be most profitably taken, though certainly not in less than ten years.

Reforestation by natural processes must be very slow, and as in the case of the lumber forests of the North, the second growth is never equal to the first. A guayule seed in the desert has about one chance in ten thousand of coming up, and thereafter danger from drought, disease, and accident make its hold upon life exceedingly uncertain. The only hope of prolonging the business seems to be in so harvesting the plants that the roots are left in the ground; from these new shoots will arise, and in a few years possibly yield another crop worth the taking. How long this process can be kept up profitably is at present unknown. However, the guayule rubber industry seems destined to have its day and pass out.

The above statements are issued only after much observation and experiment, the details of which are soon to be published in a book under the joint authorship of the investigators.

A 5,000-TON TESTING MACHINE.

After the Quebec Bridge fell into the river, it was found that the special member which gave way had failed under a load far below that which theoretically it should have carried. The steel of which the bridge was built was of excellent quality, and in the compression member which doubled up under its load there was sufficient steel for the purpose, if it had only been assembled and braced together in the proper manner to develop its full strength. The engineers who built the bridge believed that the box-like form in which the plates of the bottom chord had been assembled and latticed together represented the strongest form of construction. They believed that the latticing was quite sufficient to hold the deep webs or plates of the chord in true line and prevent just that very buckling which brought about the fall of the bridge.

If we take a one inch cube of steel, of the same quality, say, as that in the Quebec Bridge, and subject it to compression in a testing machine, it will begin to give way at a certain maximum load, which represents the ultimate compressive strength of the material. If we take another piece of the same steel, one inch square and six inches long, and subject it to compression in the direction of its longer axis, failure will take place under a load less than that which was necessary to destroy the one inch cube. Similarly, if we take another specimen, one inch square but twelve inches long, there will be a still further decrease in the comparative compressive strength of the specimen. As the length of the successive bars tested increases, there will be a rapid decrease in their resistance, failure taking place, not as in the case of the cube by the actual crushing of the material, but by the bending or bowing of the specimen away from its longitudinal axis. If, however, as the length of the specimens is increased, sufficient bracing be applied to prevent their bending from the straight line, they will carry the same maximum load, or nearly so, as the first specimen measuring one inch on every side.

Now, in designing steel compression members, whether in the form of columns to support the walls of buildings, or of posts or chords for steel bridges, an effort is made to so tie together the angles, plates, etc., of which they are composed, that the steel will stand a compressive stress as near as possible to that which is necessary to crush a one-inch cube of the same steel. Formulæ have been drawn up, based upon tests to destruction of built-up members of comparatively small size, which are used in designing the big compression members that are too large to be placed in any existing testing machine. All of the large bridges which have been built in this country during the past few years, including the Quebec Bridge, have been designed by these formulæ which were formerly believed to give closely accurate results. Consequently, when the failure occurred at Quebec, it is not putting the case too strongly to say that it produced positive consternation among bridge builders, not only here but throughout the whole world. And although subsequent investigation of the bridge proved that it was overweight, and that the latticing which failed was lighter and more openly distributed than in the judgment of many eminent engineers would be considered safe practice, it is still a fact that if the commonly accepted theory of latticing was correct the bridge should not have gone down. Hence there has risen a demand among bridge engineers for the construction of a machine large enough to take the biggest compression members and test them to absolute destruction. It has come to be understood that only by this means will it be possible to draw up formulæ which will be absolutely reliable in the design of compression members of unusual size.

Largely as the result of the agitation of this subject the United States Geological Survey is having built a mammoth testing machine, which will have the large capacity of 5,000 tons. This powerful plant, which forms the subject of our front page engraving, is now under construction for the Structural Materials Testing Laboratories of the Geological Survey by Olsen & Company of Philadelphia. The main purpose for which the machine is being built is the testing of large blocks of stone used for building purposes by the United States government. It was also desired to obtain data regarding the strength of columns of brick, concrete and structural steel. Originally designed to take members 25 feet in length, the machine is now being built to accommodate specimens up to 65 feet in length. It will have a total weight of over 200 tons and its height above its foundation will be 80 feet. With a view to exhibiting its great proportions our artist has shown how the machine would appear if it were erected at the corner of Broadway and Vesey Street, adjoining the southeast corner of the old Astor House, which is shown in the illustration. Although the machine has a total compression capacity of 5,000 tons, it will not be capable of crushing to destruction a chord section of the Quebec Bridge, or of the recently opened Queensboro Bridge in this city. The drawings of these two sections have been introduced into the picture merely to show their huge proportions. The Quebec Bridge section is shown adjoining St. Paul's Churchyard, and the Queensboro Bridge section is shown within the testing machine whose length is sufficient to include it.

During the present Congress a bill was introduced but failed to pass, authorizing the construction of a testing machine by A. H. Emery, who built the celebrated 400-ton testing machine at Watertown Arsenal from which such great benefits have been derived. This huge machine, which will have a capacity in compression of 11,000 tons and in tension of 5,500 tons, will be able to handle specimens one hundred feet in length. Its total length will be 153 feet; it will be 25 feet in width; its weight will be about 3,500 tons, and its cost would be $1,750,000. Had such a machine been in existence during the design and construction of the Quebec Bridge, it is safe to say that the catastrophe would never have occurred.

Returning now to the 5,000-ton Olsen machine, as herewith illustrated; the base contains a hydraulic cylinder or ram of 2,000 square inches cross-sectional area, upon which is placed the lower platform. From the four corners of the base extend four huge vertical screws, each 13½ inches in diameter and 72 feet 2 inches in length. At their upper extremities they pass through a massive upper head and are provided with four nuts which are operated simultaneously by means of gearing. The maximum clearance between the upper and lower heads is 65 feet, and the heads are each six feet square. After the member to be tested has been placed on the lower head the upper head is brought down to a snug bearing on the top of the member, and the pressure is then applied by means of a triple plunger pump connected to the main hydraulic cylinder in the base of the machine below the lower head, which, to secure an even distribution of pressure, is provided with a ball-and-socket bearing. The determination of the pressure which is being applied to the member tested is arrived at by means of a set of standard levers upon which is weighed 1/80 of the total load on the main cylinder, the reduction being secured by means of a piston and diaphragm. The weighing beam is balanced by means of an automatically operated weight, and it is provided with a device by which counterweights of one million pounds each may be successively applied. The machine will stand upon a foundation of concrete eight feet below the floor line, and the top of the machine will be about seventy-two feet above the floor. The main hydraulic cylinder is fifty inches in diameter, and each of the 13½-inch main screws will weigh over twenty tons. The contract calls for an accuracy of at least one-third of one per cent for any load over fifty tons and up to the full capacity of 5,000 tons.

THE FOURTH DIMENSION SIMPLY EXPLAINED

THE FIRST HONORABLE MENTION ESSAY IN THE FOURTH DIMENSION COMPETITION.

BY "INCREDULUS ODI" (EDWARD H. CUTLER, NEWTON, MASS.)

[It was one of the conditions of the Fourth Dimension Competition that the editor of the SCIENTIFIC AMERICAN reserved the right to publish those essays which were considered worthy of honorable mention. In accordance with that condition, the essay which in the opinion of the judges, Profs. S. A. Mitchell and H. P. Manning, was deemed worthy of first place in the honorable mention class is here printed. Prof. Manning does not dissent for the most part from the conclusions of the author of the essay, but believes that the author has not quite fairly treated the arguments of the "fourth dimensionists." Prof. Manning will later offer some detailed criticisms on this point.—ED.]

The fourth dimension has no real existence in the sense in which the external world that we know by means of our senses has real existence. It is a philosophical and metaphysical conception, whose actual existence cannot be demonstrated by observation or by logical reasoning. The existence of the fourth dimension is regarded by some as in a high degree probable, and as furnishing a basis for metaphysical investigation, and a means of explaining some physical phenomena, the occurrence of which, however, is not universally admitted. It may also, like any supposition, true or false, be made the hypothesis for mathematical speculations, which are comprehensible, however, by the very small and select number only who are endowed by nature with the ability to cope with original investigation in the domain of the higher mathematics.

The word "dimension" is more readily explained than defined. All more or less clearly conceive of space as extending indefinitely or infinitely in every direction; and of extension in space there are three "dimensions"—length, breadth, and thickness. Or, in another point of view, having three fixed points from which to reckon measurement, by three dimensions or measurements we can fix exactly the position of any point in space. Thus, if the three fixed points be the center of the earth, one of the poles, and some other point on the surface, as the location of the Royal Astronomical Observatory at Greenwich, the length of the line drawn from the center of the earth to the point in question in space, as a star, however remote, and the latitude and longitude of the point in which the line from the center intersects the surface, will be three dimensions, which fix exactly the position of the point in space, or of the star. Or again, starting from any point in space, we may reach any other point by proceeding successively in three directions at right angles with one another. Thus, moving from the starting point, first the proper distance east or west, then from the point arrived at the proper distance north or south, and finally the proper distance up or down, we reach the second point in question.

In all the ways in which the meaning of the word is thus illustrated we see that we can have no fewer and no more than three dimensions; but the believers in a fourth dimension infer its existence from analogy in one of the following deductive processes:

(1) Conceive, we are bidden, of a space of but one dimension. A being in such a space would be limited to a straight line, which he would conceive as extending infinitely in both directions. His only possible movement would be along this line, and if he encountered another being, neither could pass the other. If he is really within a space like ours, although his perception is confined to one direction only, and a being in our space should lift one of the two beings, and place him on the other side of the first, the latter would lose sight of the other as soon as the lifting took place, and the movement by which the change of position had been effected would be utterly unintelligible to him.

Conceive of a space of but two dimensions, like the flat surface of a table. Beings in such a space could move around one another, but one of them completely surrounded by others would be imprisoned by them. If, as before, the two-dimension space is within our space, and really depends on the limitation of the perceptive faculties of the beings in question, the imprisoned being could be lifted by a being in our space, and set down outside of the beings surrounding him. The latter would lose sight of him during this movement, and could not understand how it had been effected.

From these suppositions of one-dimension space and two-dimension space, the inference is drawn that there may be a fourth dimension in our space, and that our ignorance of it arises only from the limitation of our perceptive faculties.

These suppositions, however, involve a fatal confusion of mathematical with physical conceptions. Mathematical lines and plane figures do not, like matter, occupy space, and they present no obstruction to the movements of one another. They may freely intersect, or pass through one another, or coincide wholly or in part with one another. If these supposititious beings in one- or two-dimensional space find any obstruction to their movements, it must be because they occupy space, and therefore are really in three-dimension space, however little they extend except in one or two directions. A line or a plane surface can be conceived only with space around it in every direction. The supposition of a one-dimension or a two-dimension space is therefore impossible except as a mathematical abstraction, and furnishes no basis for belief in a fourth dimension.

(2) The straight line, a one-dimension magnitude, ends in points; the square, a two-dimension magnitude, is bounded by straight lines, one-dimension magnitudes; the cube, a three-dimension magnitude, is bounded by squares, two-dimension magnitudes. It is inferred by analogy that three-dimension magnitudes bound four-dimension magnitudes, although the latter are not known by us. Thus the "four-dimensional cube" receives a name, the "tessaract," and is said to be bounded by cubes.

But there is no such analogy as is here assumed. All lines end in points, although some lines, like circular arcs, require two-dimensional space, and others, like a corkscrew curve, three-dimensional. Nor are all two-dimensional figures bounded by straight lines. The bounding lines of circles and ellipses, for example, require two-dimensional space, as much as the figures themselves. Still further, solids like spheres or egg-shaped bodies, are bounded by three-dimension surfaces. There is, therefore, no regular progression which would lead us to suppose the existence of magnitudes bounded by solids. In fact such a supposition is inconceivable. The only possible boundary of a solid is a surface, whatever be the number of the dimensions of space.

(3) In the series of the successive powers of a number, a, a^2, a^3, a^4, . . . a^n, a may be represented graphically by a straight line, of which a denotes the length; a^2, by a square, of which a denotes the length of a side; a^3, by a cube, of which a denotes the length of an edge. It is inferred that if we keep on, there must be a magnitude corresponding with a^4, and so on indefinitely up to a^n. Such magnitudes are incompatible with three-dimension space, and suggest for their possible existence "spaces of higher order."

To those who have some elementary knowledge of analytical geometry, or even of the use of graphs in algebra, the origin of the conception of spaces of higher order may be presented in a different way. As an equation containing two "variables" may be considered as representing the locus of a series of points in a plane, so an equation with three variables is the locus of points in space, referred to three rectangular axes. But since, as shown above, in explaining the word "dimension," three dimensions or co-ordinates fix definitely and exactly the position of a point, equations with more than three variables transcend the scope of our geometry, and require for analogous interpretation spaces of more than three dimensions.

There is no objection to the hypothesis of spaces of a "higher order" as a purely mathematical conception; but this abstract supposition has no bearing on the number of dimensions of actual space as we know it.

(4) If we connect by a straight line the upper extremities of a capital V, we form what is called an isosceles triangle. If we connect the middle point of our line with the bottom point of the V, we have divided the triangle into two triangles which are plainly equal. If we were confined to the two-dimensional surface of which the triangles are a portion, we could never move them about so as to apply one to the other, and prove them equal by coincidence. Not being under this restriction, but being in three-dimension space, we turn one of the triangles a half revolution on one of its sides, and then the two figures may be made to coincide. Now there are many symmetrical solids, for instance, the two hands, which can never be brought into identical shape. We cannot prove the left hand equal to the right by putting on the left the right-hand glove. But if we turn the right hand glove inside out it will fit the left hand. Just as we can prove two-dimensional figures equal by availing ourselves of the possibilities presented by three-dimensional space, it is inferred that in four-dimensional space, not only the glove, but the hand within it, might be turned inside out, and made identical in shape with the other hand. No explanation is offered of the way in which an additional dimension would render such a eversion possible, and if we could admit that it would do this, we are not shown why the actual existence of a fourth dimension follows. Some four-dimension enthusiasts appear to believe that symmetrical forms in organic bodies could not originate without a fourth dimension, but no reason is given for this belief.

The four numbered sections above include virtually all the lines of thought along which the effort is made to substantiate the existence of a fourth dimension. Metaphysical considerations are sometimes added of the uncertainty and possible inaccuracy of our conception of space, but with no suggestion for correcting this inaccuracy, and no argument for the belief in a fourth dimension. Admit that the mind must itself contribute an *a priori* element to all knowledge, and that the truth of things is not limited by the phenomenal apprehension of them; it does not follow that this apprehension is to be assumed without demonstration to be false or incomplete. In an investigation like the present one it is unnecessary to consider whether our conception of the *non ego* is subjective or objective; we must accept the world of matter and of mind in which we live as our perceptions present it to us, and as it is generally conceived. No observation has ever discovered the existence of a fourth dimension in space, and it may safely be said that there is no reason for believing in its existence.

The theory of spaces of a higher order, as developed in section (3) above, is entirely legitimate as an abstract mathematical conception, but furnishes no basis for the supposition of a fourth dimension in our space. It virtually assumes space as we know it to be three-dimensional; yet from a suggestion arising from this theory apparently (for no other origin for the assumption is to be found) the four-dimensionists have made space as we know it a space of the highest order; for the same analogies and inferences on which they depend would lead us to a fifth, a sixth, an *n*th dimension. A fourth dimension belongs (or rather four dimensions belong) to the theoretical four-dimension space; but mathematics furnishes no basis for ascribing to our space more or fewer than three dimensions.

The confusion of thought of the four-dimensionists characterizes their writings on the subject. The most thorough-going devotee of the fourth dimension asserts: "There is nothing mysterious at all about it . . . From every particle of matter there is a new direction, not connected with any of those which we know, but independent of all the paths we can draw in space, and at right angles to them all." It would seem indisputable that a direction at right angles with all the paths or lines that we can draw in space from any point, would produce lines coinciding with all the lines drawn from the point, and therefore giving no "new direction." But we do not need to be convinced that there is no "direction" from which we are cut off, and in which we cannot direct our perceptions.

The attempted analogies described in section (1) above, are those on which the four-dimensionists chiefly depend, and they rely upon them to show that a fourth dimension would explain how a body may become invisible. They assert that a body would disappear on "entering the fourth dimension." This expression is manifestly unintelligible. Every body extends constantly in all the dimensions of space; we cannot think of it as "entering the dimension" of length, breadth, or of thickness, or of "entering the fourth dimension," if there were one. But the disappearances produced as in section (1) depend wholly on removal from the limited perceptive faculties of the supposed observers; but our normal perceptions are unrestricted in direction, and extend to every point in space, unless cut off by distance or by an interposed physical obstruction. If all the particles of a body moved in the "new direction" of the imaginary fourth dimension, the body would still retain its length, breadth, and thickness, and would still remain within the range of our perceptions.

The assertion is made on the authority of eminent mathematicians, that in space of four dimensions there would be no obstruction to entering or emerging from space shut in on every side, as a tightly shut box or room, and "the fourth dimension" is relied upon to explain supposed mysterious occurrences of such entrance or emergence. The modification of physical laws in spaces of a higher order, those of unusual mathematical ability alone can be expected to understand, and in the special instance in question no explanation is vouchsafed. Until such explanation is given, those who can make no claims to exceptional mathematical talent will be unable to believe it possible, in space of the fourth, or of any order, to extract the contents of an egg, or to pass an object within the egg, and at the same time leave intact the continuous material structure that we call the shell. But whatever may be possible in theoretical spaces of higher order, we need not accept an unintelligible fourth dimension to aid in the explanation of something equally unintelligible.

It may be said in conclusion, that the only "explanation of the fourth dimension" that can reasonably be given, is to say that, in the sense in which the expression is used, the fourth dimension is absolutely non-existent. It could have meaning only to designate the dimension, in addition to the three that we know, belonging to the imaginary mathematical hypothesis of four-dimension space. The "fourth dimension" has no relation to the actual universe in which our sensations and perceptions are exercised, and belongs to that realm of thought to be entered only by the select few, whose exceptional genius includes the development of the mathematical imagination.

CARVING STATUES BY MEANS OF PHOTOGRAPHY.

BY J. HAMMOND SMITH.

The device illustrated is intended for use in the production of all kinds of statuary, where it is possible to use the original as a model, or where it is possible to arrange a model after the original idea. Its principal use is in copying from life and existing statuary. It is especially useful where a likeness may be desired, and where variation of relative sizes of the statue from the model may be necessary. For instance, a man may be used as a model, and his exact likeness produced, in a statue of any reasonable size, smaller or larger than the man himself.

The device is composed of combined cameras and projecting lanterns, which I call camera-projectors. These camera-projectors are located in suitable positions about and at variable distances from a common center, where the model is located. In the illustration the camera-projectors are located in a horizontal plane about the central bust. These instruments are adjustable along radial lines. Other adjustable camera-projectors, with their optical axes passing through center, may be located at any desirable points.

The plates on which the contours and dimensions are recorded, as well as the plates for the illumination of the finished statue, are obtained, photographically as follows: Screens, like the one shown in positive at the top of the engraving, are placed in a number of the camera-projectors. Then all extraneous light is shut out, and these used as lanterns to project images of the screen on the model, which is located at the center. The other camera-projectors are then used as cameras, in which photographic plates are exposed. Thus photographs of the model while illuminated with the screens are obtained. The screens are then removed from the lanterns, and the model illuminated by the lanterns or from some outside source, as flash light or daylight, and other photographs of the model, still in the same position, are taken, to be used in the illumination of the finished statue. These plates may be stored away in small space for any length of time, and then brought out for the production of the statue of the model and its illumination.

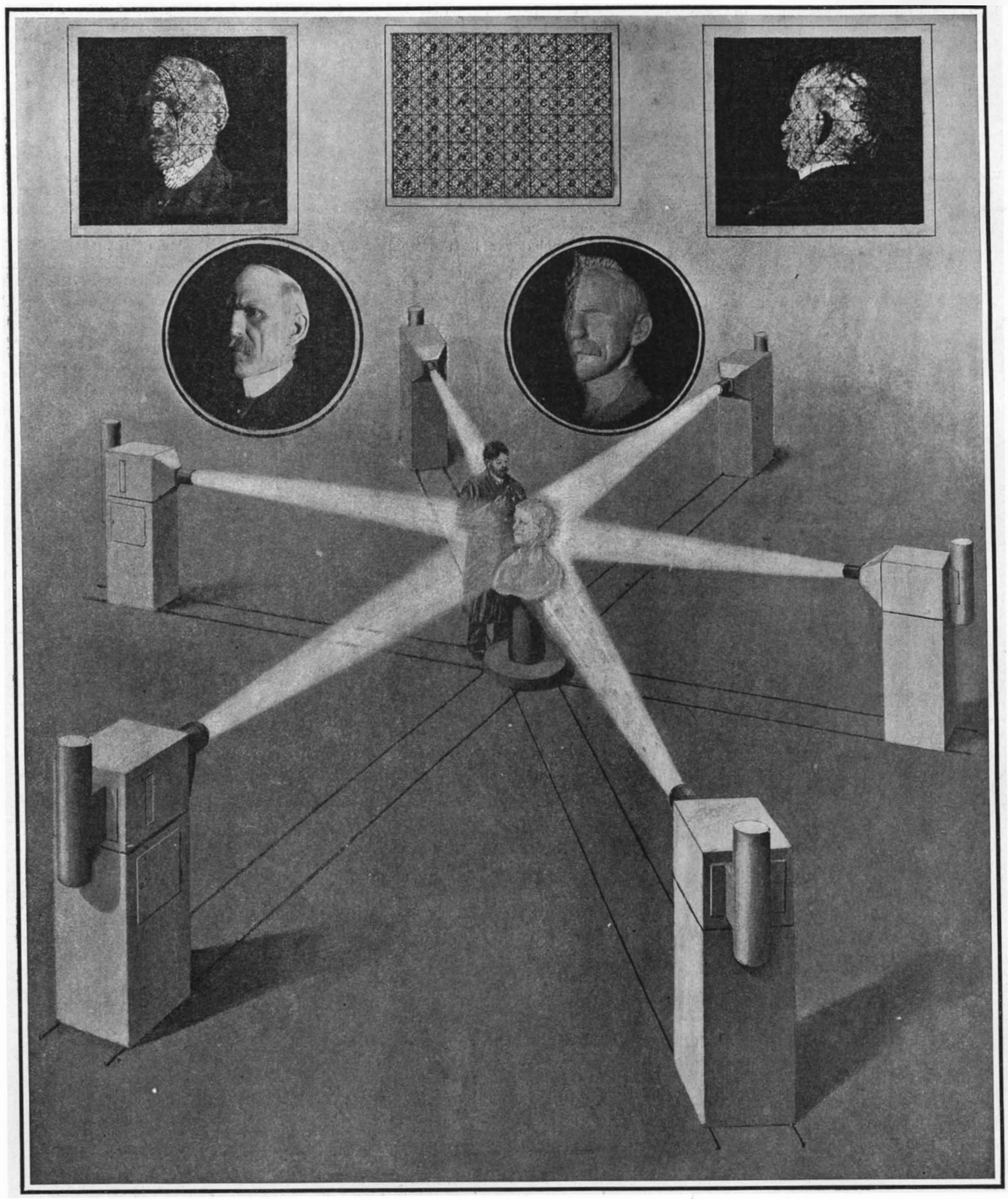
The method of producing the statue, after the photographs have been taken, is as follows: After the plates have been developed and dried, they are returned to their respective positions in the camera-projectors. Then the instruments are used only as projecting lanterns, and generally only two at a time. If the statue is to be smaller than the model, the instruments must be moved nearer the center; but if it is to be larger than the model, the instruments must be moved farther away from the center; the distance depending on the size of the statue desired.

The statue is built up or carved out by locating points, by the intersection of light beams from the lantern, with corresponding beams of the same marks or symbols of the screen, coming from the camera, which is now being used as a lantern. When the photographs were taken, certain marks on the screen were projected on the model by the lantern. These marks were photographed on the plates of the cameras. When these plates are developed, and replaced in the camera, and the camera used as a lantern, the same marks will be projected on a surface located in the same position as the model when the photographs were taken. Therefore, if both instruments are used as lanterns, the two projections must coincide on a surface located as the model formerly was. For instance, suppose lantern 2 projects the letter *O* of its screen on the model. The letter *O* is reflected to camera 3, and the impression on the photographic plate is the letter *O*. Now with camera 3 used as a lantern, and with the developed negative in the same place as when the photograph was taken, an image in white, of the letter *O*, will be projected from 3, and will exactly cover the image in black of the letter *O* projected from 2. But it will be noticed that these two images will coincide only when the model, or a statue of the model, occupies the same position and space as was formerly occupied by the model when the photographs were taken. If this part of the surface of the statue is too far from the center, the black image of the letter *O* from 2 will appear to the right of the white image of the letter projected from 3. But if the surface is too near the center, the black image will appear on the left and the white image on the right. Therefore, in making the statue, corresponding images projected from the two instruments must be made to coincide, by building up or carving out the material of the statue. Lights of different colors may be used in the projecting instruments to heighten the contrast of the two images.

A set of negative plates (the original plates) may be used in all instruments in making statuary, or a complete set of positive plates may be used. In either case the black markings from either projection will be superimposed by the white markings from the other projection. The positive plates are found most convenient to use, on account of the positive image of the model thus obtained.

The finished statuary may be illuminated by simply using the camera-projectors as projecting lanterns; using slides made from the second set of negatives exposed while photographing the model. Instead of projecting the image of the model on a flat surface, as is ordinarily done, producing a flat picture, the image is projected on the statue at just the proper angle and distance to enhance the likeness of the statue to the original model. Thus a projected picture and a statue, both of which bear likeness to the original model, are combined, producing a likeness which cannot be attained by picture or statue alone. When a statue is to be illuminated in this way, a number of small projecting lanterns must be installed in the exhibit place, at the proper angle and distance with respect to the statue, to produce the proper illumination. These projecting lanterns must have the same optical arrangement as the standard camera-projectors used in making the statuary. They may be mounted in ornamental pendants, pedestals, walls, or columns.

With the artificial illumination of the statue, which is a part of the system, a most natural and lifelike appearance is obtained. Thus two distinct effects are produced by the statuary; one effect in daylight as ordinary statuary, and another and entirely different effect when the illumination is produced artificially.



The dimensions of the model are recorded photographically on a plate or screen. The plate or screen is used to project these dimensions on a block of wood or stone. The sculptor carves away enough material so that the images projected from two cameras coincide.

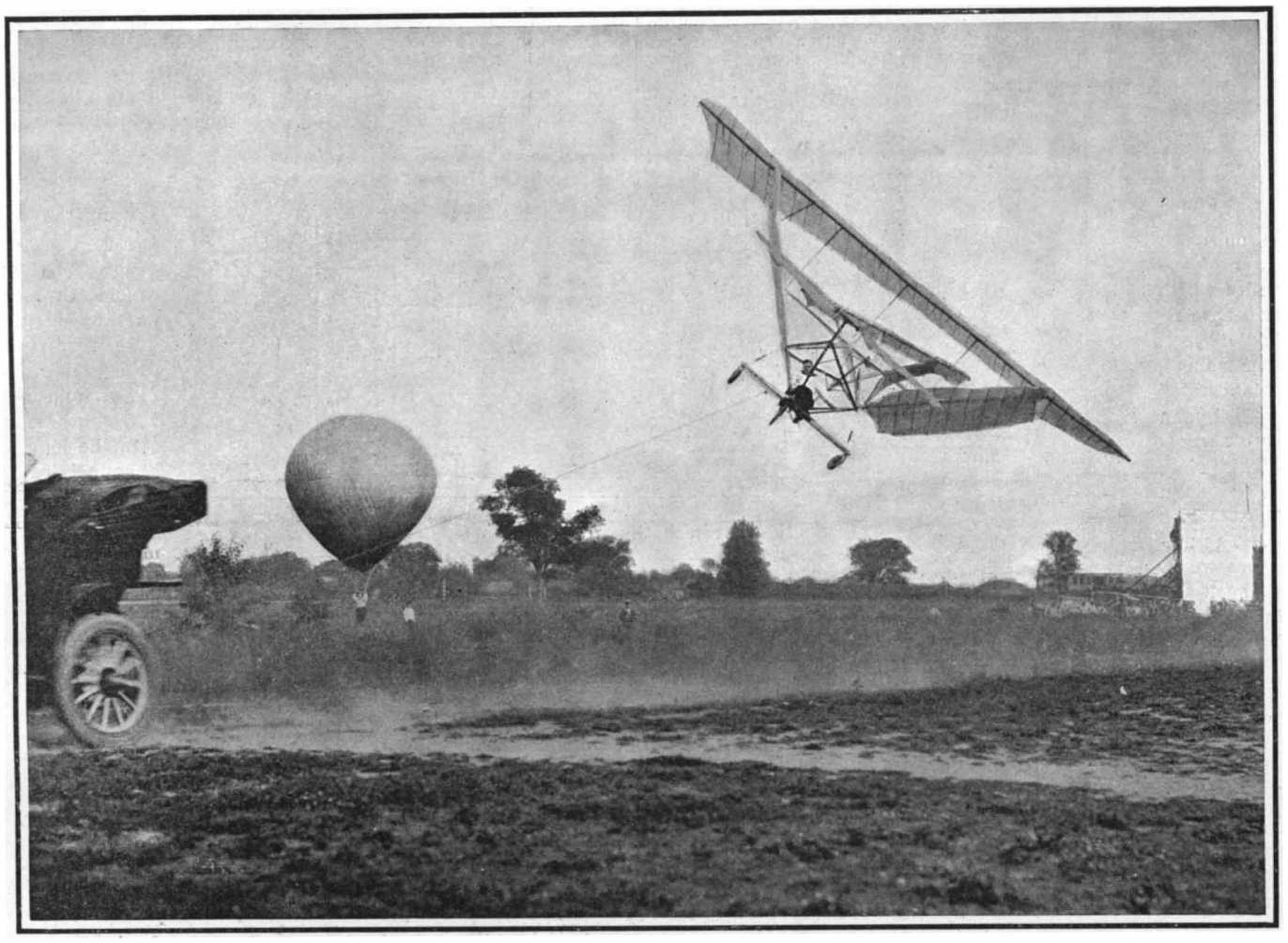
CARVING STATUES BY MEANS OF PHOTOGRAPHY.

THE FIRST FLIGHT EXHIBITION AND TOURNAMENT OF THE AERONAUTIC SOCIETY.

As noted in our last issue, the first opportunity to witness aeroplane flights in the vicinity of New York city was given the public on June 26th at Morris Park. Several very successful flights were made that day by Mr. Glenn H. Curtiss with the new biplane he has built for the Society, the longest of these being almost a complete circuit of the Morris Park race track in about 1½ minute. A half dozen other new aeroplanes, built by members of the Society, were exhibited, and one of these was shot off the catapult in an effort at flight.

Next to Curtiss's flights the most sensational feature was a towed flight in a glider made by Mr. William H. Martin of Canton, Ohio. One of our illustrations shows this flight, while the other shows the flight made by Curtiss. The glider was towed at too high a speed by the Kissel car employed for this purpose, the result being that it swayed violently from side to side, tipping up as shown in the photograph, and finally crashing into the fence when the tow rope broke. Fortunately, save for a sprained wrist, Mr. Martin was uninjured. He has repaired his glider, and expects to try it again at the next meet on July 5th. At the same time Mr. Curtiss will attempt to set up a record for 1909 for the SCIENTIFIC AMERICAN Trophy—a record which, if unsurpassed this year, will entitle him to be declared the winner for the second time, and make it necessary for him to win it only once more to become the permanent holder.

The fact that even those most skilled in the art will not attempt flight with an aeroplane as yet except under the most favorable conditions, was brought out by the failure of the Wright brothers to try their machine for the first time late in the afternoon of June 28th at Fort Myer, because a light breeze sprang up at the last moment. Congress had adjourned specially so that its members could witness a flight, and most of its members had been present at the Fort Myer parade ground all the afternoon, waiting in the broiling sun. It was a terrifically hot day, and when the breeze came it was welcomed by the spectators, but not by the Wrights, who refused to attempt a flight with their new machine save in an absolute calm. The following two days only short flights of a few hundred yards were made, the engine developing insufficient power to make turns. Some damage was also sustained in alighting.



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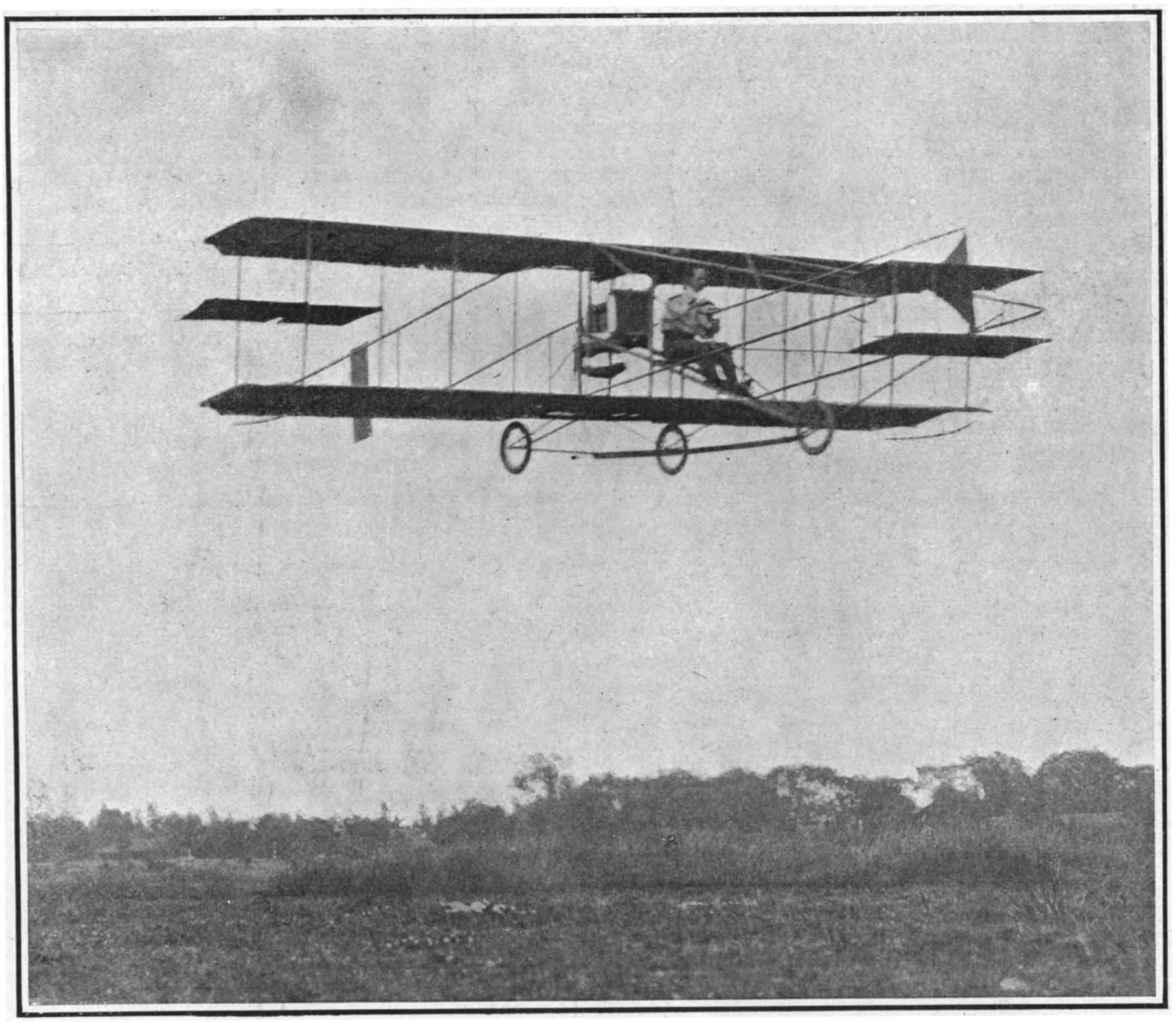
The Martin glider towed by an automobile at Morris Park.

The photog aph shows the glider tilted to one side and swaying badly owing to the high speed at which it was being towed. The rope broke and the glider crashed through the fence just after the picture was taken.



Copyright 1909 by Edwin Levick.

Curtiss flying on his new biplane, built for the Aeronautic Society, at the Society's grounds at Morris Park.

The photograph was taken just before making the turn during the first circular flight on June 26th.

THE FIRST FLIGHT EXHIBITION AND TOURNAMENT OF THE AERONAUTIC SOCIETY.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1749, gives a description of a novel railway testing machine. Col. Sir Frederic L. Nathan contributes an authoritative paper on guncotton and its manufacture. Marine producer-gas power is a subject very much in the engineering eye at present and is discussed by Mr. C. L. Straub. Roger B. Whitman of the New York School of Automobile Engineers has prepared a handy testing chart for automobilists, which tells the chauffeur what to do when the engine stops. A description is published of the casting of a colossal statue for the monument to King Victor Emmanuel II. Wilhelm Krebs writes on how the earth looks from the moon, supplementing his explanation with excellent drawings. S. Frank Aaron contributes an instructive article on cocoons. The sea, carbon dioxide, and the duration of human life on the earth is the subject of an interesting article by J. C. Greggory.

Ingenious men are continually contriving new kinds of shoes, new suspenders, and hundreds of different kinds of braces, but so far no one has taken up the idea of making a hat which will hold on the head and not blow off, and at the same time not bind the head all around like a constricting band. Some one ought to invent a hat which will prevent baldness. Hundreds of remedies are on the market which are advertised as sure hair restoratives, but not one of them will bring back one hair once the hair follicle is atrophied and functionless; nor will any of these remedies prevent the falling of hair unless the habits of the sufferers are changed. At best these remedies are merely skin irritants, which promote a slightly increased flow of blood to the scalp. Dandruff cures are mostly fakes. The only good accomplished by these medicaments is the scalp massage indulged in while applying them, and the practitioner should make a fight against their use.—Dr. T. O. Cobb, in the N. Y. Med. Jour.

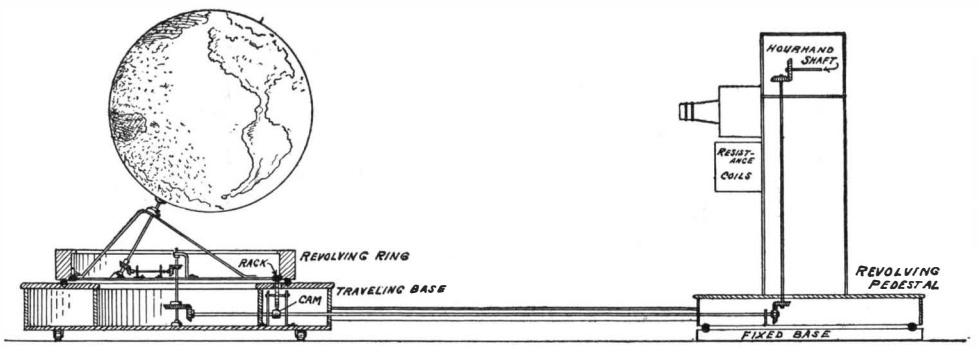
A HUGE PLANETARIUM.

BY GEORGE SHERWOOD HODGINS.

A wonderful object lesson on the movements of the earth may be had by any visitor at the American Museum of Natural History in New York. The relations of the earth and sun are represented by a model erected under the supervision of Dr. H. C. Bumpus, director of the museum. The mechanical details have been very carefully worked out by Mr. H. F. Beers, an expert mechanician on the museum staff. The globe representing the earth is about four feet in diameter, made of paper, and turning on its axis once in 24 hours. The sun is represented by an electrically lighted stereopticon lamp of 3,000 candle-power, which throws a divergent beam of white light upon the side of the globe turned toward it. The lamp is placed on a revolving stand in the center of the hall, and the 92,700,000 miles which separate earth and sun are here reduced to a distance of about 14 feet.

The light, hollow paper sphere, showing land and sea, is carried on a steel shaft supported by an iron frame, which rests upon a revolving wooden ring. This ring, turning on a ball race, rests on a traveling base, mounted on castors which roll upon the floor. The motive power for the miniature world is a Howard steeple clock, such as is used in churches. The clock is inclosed in a glass case, the pendulum swinging in a cabinet below. The cabinet stands on a circular wooden pedestal, and like the revolving wooden ring below the globe, the pedestal rotates on a ball race. The clock cabinet also carries the stereopticon lamp, so that lamp and clock rotate together on the fixed base. The work done by the clock is probably less than that which would be required in moving the eight hands of a tower clock. The minute-hand shaft is not used, and this clock steadily turns only the shaft usually employed to drive the hour hands. As the globe is required to revolve but once in 24 hours, a pair of gear wheels is interposed so that the hour-hand shaft moves as it would for a clock having 24 hours shown on the dial.

No dial is used, however, and the slowly driven hour-hand shaft terminates in a 45 deg. bevel gear, just behind the lamp. This bevel wheel meshes with a similar gear on the upper end of a vertical shaft, which shaft therefore turns in unison with the hour-hand shaft of the clock. At the bottom of the vertical shaft, a pair of 45 deg. bevel gears transmit similar motion to a long horizontal shaft, laid in the hollow of a 4-inch channel iron, which connects the revolving pedestal of the clock with the traveling base below the globe. In the center of the traveling base a third pair of 45-deg. bevel gears give the motion of the horizontal shaft to a short upright shaft, and a fourth pair of 45-deg. bevel gears at the top of the upright shaft transfer the motion to a short horizontal shaft. All these shafts are carried on bicycle ball bearings. The connection between the short horizontal shaft and the axis of the globe is made by a pair of specially cut bevel gears, so that while the axis of the globe receives its motion from the clock, through the intermediate shafts and gears, the specially cut bevel wheels preserve an angle of 23 deg. 27 min. from the vertical, for the axis of the globe. The complementary angle 66 deg. 33 min. at which the axis of our earth is inclined to the ecliptic, or plane of its orbit about the sun, is thus maintained. The axis of the globe is placed, like that of the earth, so that it points toward the pole-star in the heavens. The globe is therefore made to turn upon its axis once in 24 hours, and with the same axial tilt as that of our planet, and with its poles directed as are those of Mother Earth.



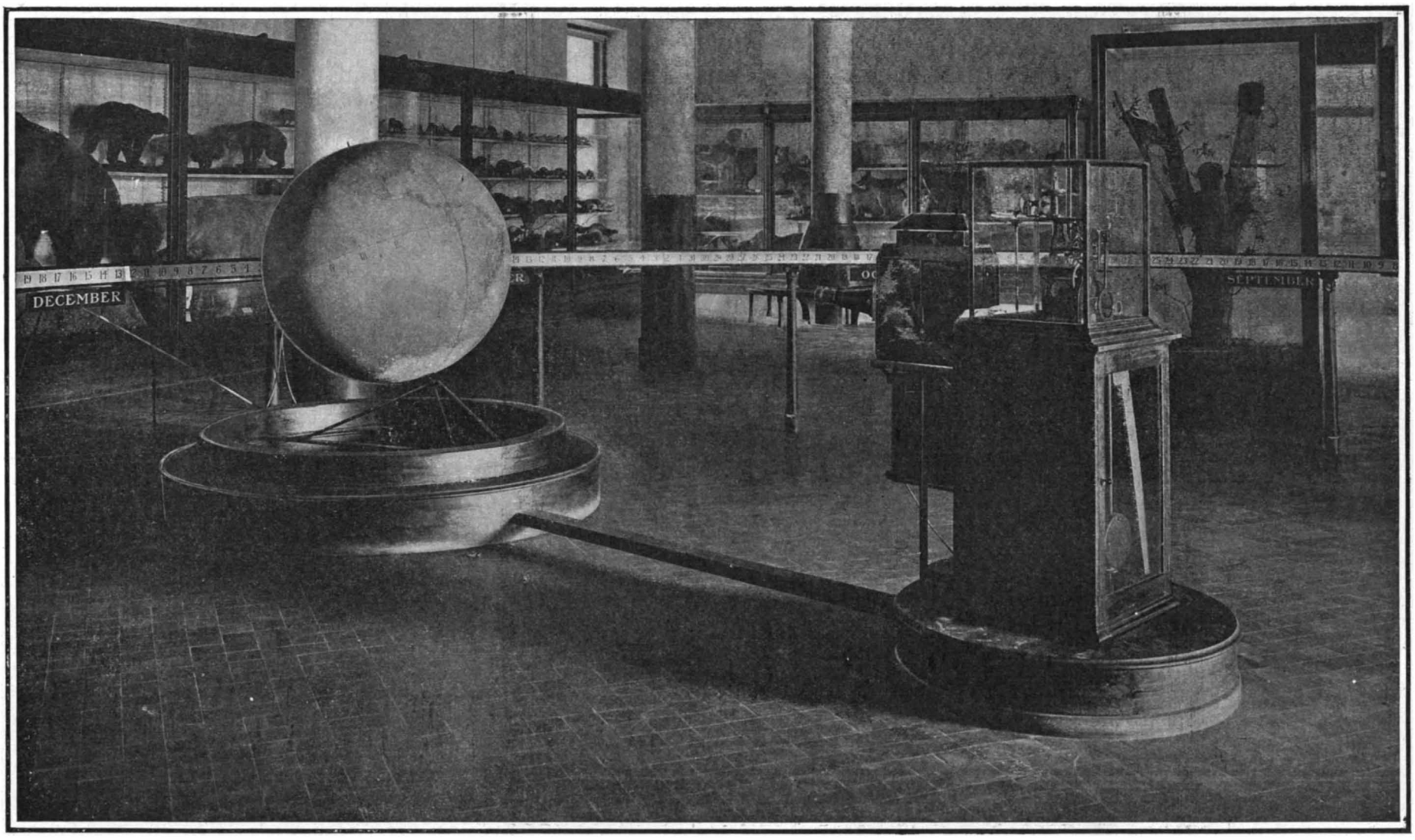
Section through the planetarium.

The divergent beam of light from the lamp bathes one-half of the globe in bright light, while the other is enveloped in the comparative gloom of the hall. Thus the recurrence of day and night is made plain to the beholder. The equator of the globe is divided into twenty-four spaces with fractional divisions for half and quarter hours, and the shadow from a wire in front of the lens of the lamp draws a meridianal line upon the globe. This shows the advance of "high noon" in the center of the illuminated surface, as the globe turns continuously from west to east, as does the earth. During the time the earth is making one complete revolution on its axis, it is swinging on in its vast journey around the sun. The rate of this motion has been calculated by astronomers as about 18 miles a second.

If the earth did not revolve around the sun, one complete axial revolution would be made in 23 hours and 56 minutes. In other words, the meridian passing through New York would be back again under the central beam of light from the sun in 4 minutes short of 24 hours, and the corresponding meridian on the globe would coincide with the shadow line from the lens, in just that time. The earth, however, has in one day been carried forward more than a million miles in its path around the sun, and the meridian of New York is therefore behind the central beam from the sun by about 4,320 miles, and 4 minutes more are required to bring this meridian under the central beam, indicated by the shadow line, and so completes one revolution which we call day and night. The period of 24 hours is called the solar day, while the shorter period is the sidereal day.

The constantly north-pointing direction of the earth's axis is also represented and maintained by the globe through a cleverly devised arrangement. On the underside of the revolving wooden ring below the globe, a circular rack is fastened, and a suitably proportioned spur wheel gears with the rack. On the long horizontal shaft in the channel iron, there is fixed a cam or dog, which revolves with the long shaft. The cam has one tooth, which engages with the spur wheel at every revolution of the long shaft. The contact of cam and spur wheel gearing with the rack, moves the wooden ring, which supports the globe, the distance necessary to preserve the position of the axis of the globe always pointing north.

The requisite movement of the traveling base is made each day by the museum attendants. The advance of the base represents the orbital motion of the earth in one day. On the model this amounts to 3 inches. All round the planetarium there is a protecting handrail. On the inner face of the handrail a series of divisions is marked off, each corresponding to a day. The whole circle of the handrail approximately indicates the earth's path around the sun. The top of the handrail is divided into 360 spaces representing the degrees of a circle. If there were only 360 days in the year, the divisions for days and degrees would correspond. There are 365 days in the year and 360 deg. in a circle. The divisions representing the days are each smaller than the space occupied by a degree. This slight discrepancy between each of them increases as the circle of the handrail is followed round. At the end of the year the accumulated difference is practically equal to a quarter of a division representing a day, and thus the spectator has ocular demonstration of what leap year means, by the adding of one day to every fourth year.

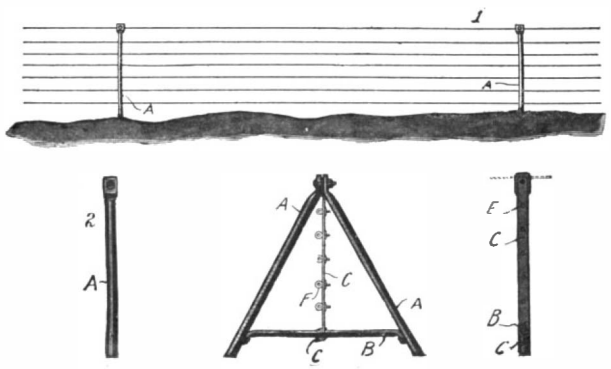


THE GREAT PLANETARIUM OF THE AMERICAN MUSEUM OF NATURAL HISTORY.

Patent Department

PORTABLE METAL FENCE.

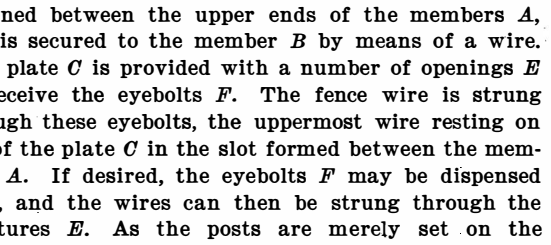
The growing scarcity of timber demands economy in its use, and the employment of substitutes for wood wherever possible. This is one of the reasons why wooden fences are giving way to metal constructions. Other and more potent reasons are because the metal fence is stronger, less liable to deteriorate, less combersome, and generally more ornate. One of the latest constructions, which is very interesting, is pictured in the accompanying engraving. This fence is unique in that it is portable. The fence posts are built up into an A-shaped form consisting of two side members *A* of metal tubing, which are flattened at their upper ends and bolted together, while their lower ends are spread apart by a member *B*. A central plate *C* is fastened between the upper ends of the members *A*, and is secured to the member *B* by means of a wire. This plate *C* is provided with a number of openings *E* to receive the eyebolts *F*. The fence wire is strung through these eyebolts, the uppermost wire resting on top of the plate *C* in the slot formed between the members *A*. If desired, the eyebolts *F* may be dispensed with, and the wires can then be strung through the apertures *E*. As the posts are merely set on the ground and not imbedded in it, they may be moved to any desired position. The inventor of this fence has called our attention to the fact that the ground on each side of an ordinary fixed fence becomes a breeding place for weeds, briers, and undesirable grasses, whose seeds ripen and are spread broadcast over the adjoining land. The portable fence, however, may be moved to one side when the field is being plowed, so that every foot of land may be cultivated. Mr. Calvin Wilson of 1004 Park Avenue, Richmond, Va., has secured a patent on this portable fence.



PORTABLE METAL FENCE.

IMPROVED HEAD FOR STRINGED MUSICAL INSTRUMENTS.

The object of the improved head for stringed musical instruments which is pictured in the accompanying engraving is to enable the player to string the instrument when necessary without loss of time. The pegs on which the strings are tightened may be removed from or replaced in the head without detaching the string and in case of a string breaking a new string may quickly be applied. It will be observed that the head is in the form of a box with holes passing through the sides to receive the pegs, but notches are cut through the sides, leading to alternate holes. The string is knotted at one end in the usual manner so that it may be readily caught in the tailpiece while the opposite end is fitted into a slot in the peg and is wound thereon. The peg is seated in the head by inserting its inner end into the hole and lowering it bodily through the notch into the opposite hole. The string is then tightened until it has been properly tuned. Thereupon the peg is jammed into the hole so as to prevent it from turning. It is the object of the inventor to provide a number of pegs each wrapped with a string so that in case of a string breaking the old peg may be lifted out of the head and the new string and peg inserted in its place. In this way the operation of replacing a string will consume a minimum time and will not seriously interrupt the playing, particularly in an orchestral production. The actual time consumed in taking out a broken string, putting in a new one, and tuning it is 15 seconds. The operation can be performed in the dark. The holes and the notches for the pegs are tapered to correspond with the taper of the peg so that when the latter is tightened to a sufficient degree and jammed into the hole it will be held in place with the requisite friction. The construction does not limit the head to any particular form. It may be made plain as in Fig. 1, or with the usual fancy scroll as indicated in Fig. 2. Mr. Arthur S. Leslie, of Sapperton, British Columbia, Canada, is the inventor of this new form of head for musical instruments.



IMPROVED HEAD FOR STRINGED INSTRUMENTS.

New Use of Paper.

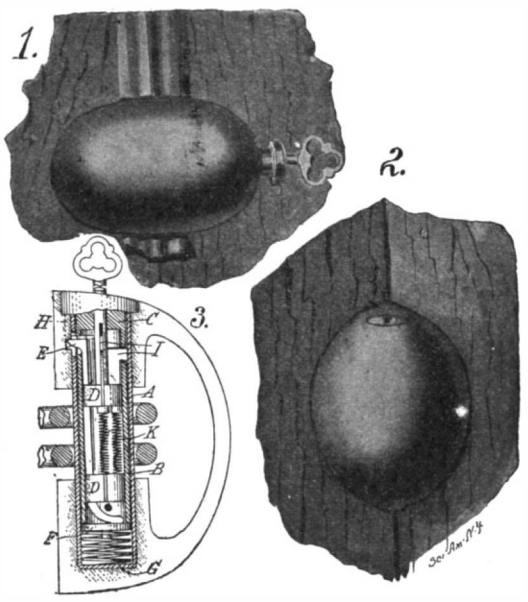
Germany manufactures annually 425,000 tons of paper, England 260.000 tons, France 190,000 tons, Austria 155,000 tons, and Italy 120,000 tons. But the United States makes and uses more paper than all Europe, the annual production amounting to 1,330,000 tons. A French journal mentions the following novel uses of paper in America:

Roofs of paper and compressed wood pulp have proven successful. A Chicago firm makes paper garments which are so light, flexible, and convenient that they are largely used in hospitals. The paper is made of the bark of the paper mulberry tree and is tub-sized and finely craped. Several sheets are superposed and sewn together. The garments have narrow woolen bindings, buttons, buttonholes and other fastenings. Paper cigars are made by steeping paper pulp for ten days in a decoction of cigar clippings, passing it between cylinders and rolling the sheets into the form of a cigar.

Paper bottles and grain bags are made in Philadelphia. A recent invention is the paper horseshoe which, according to the inventor, is more durable as well as lighter than the iron shoe and eliminates all danger of injury to the hoof as it is attached, not by nails, but by cement. Two German engineers have invented a sort of reinforced paper, composed of paper pulp, canvas, linen and raw silk, reinforced with steel wire. The new material is light, waterproof, fireproof and suitable for the construction of vessels, including warships, automobiles, and other vehicles, for railways, street pavements, and many other uses.

PADLOCK WITH INCASED BOLT.

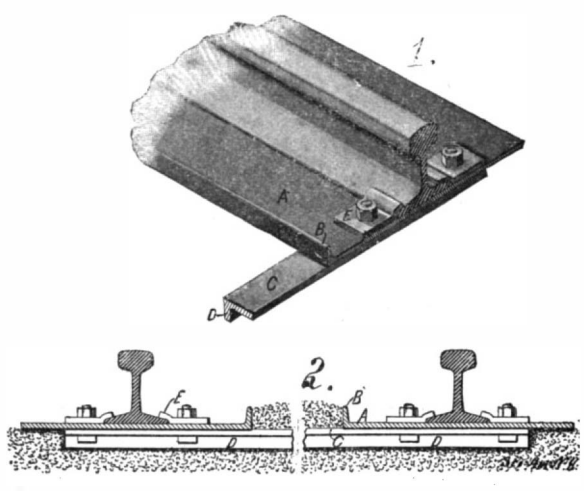
A padlock as commonly made offers but slight security against thieves. The lock itself may be of most elaborate construction, so that it is well nigh impossible to pick it, but that matters little when the door can be opened without touching the lock, merely by filing or sawing off one of the screw eyes through which the bolt is passed. The weakness of the padlock lies in the fact that the screw eyes and bolt are unprotected. This weakness is very cleverly overcome in the lock herewith illustrated by having the casing of the lock extend over the bolt and screw eyes, completely inclosing them. The casing is made in two forms, one for double doors, which is of hemispheroidal shape (Fig. 1), and the other for single doors, which has the form of a section of a sphere (Fig. 2). The screw eyes with the bolt passing through them are shown in section in Fig. 3. It will be observed that the casing fits very snugly against the doors, and its form is such as to offer very little grip for a tool, should anyone attempt to force the lock. The locking mechanism is contained in the bolt, as shown in sectional view, Fig. 3. The bolt comprises a cylindrical barrel *A*, into which is fitted the sleeve *B*, the latter being formed with a head *C*, through which the key is inserted. Within the sleeve are the tumblers and locking dog mounted in a pair of heads *D*, which are secured to a central stem. The locking dog *E* is fulcrumed in the lower head *D*, and is provided with a curved extension against which the plate *F* is pressed by the coil spring *G*. The spring *G* causes the upper end of the dog *E* to project through an opening in sleeve *B* and barrel *A* and to enter a recess in the casing of the lock, thereby retaining the bolt in the locked position. To unlock the bolt, it is necessary to turn the heads *D* within the sleeve *B*, so that the dog will be brought into register with the slot indicated by dotted lines at *H*, and the spring *G* will then force out the sleeve with the mechanism it contains to the position shown in Fig. 1. The bolt may then be drawn out by taking hold of the projecting sleeve. The tumblers *I*, which are mounted to slide in heads *D*, enter bayonet slots in the sleeve *B*, and normally prevent the dog from turning until they have been forced down against the pressure of springs *K* sufficiently to enter the lateral extensions of the bayonet slots. The barrel of the key is slotted, so as to press the several tumblers to exactly the required extent. Then when the key is turned, the tumblers and dog will be turned. Any number of combinations may be had by changing the depth of the bayonet slots. If one so desires, he may change the combination of his own lock by taking out the tumblers from their seats within the heads *D*, and transposing them from one position to another. Of course, in such a case a new key would be required, so as to depress the tumblers to the proper degree. The inventor of this improved padlock is Mr. Raffaele Feola, 40 Stuyvesant Street, New York city.



PADLOCK WITH INCASED BOLT.

METAL RAIL BASE AND CROSS TIE FOR RAILWAY TRACKS.

Time was when railroad tracks consisted of wooden rails faced with a strip of sheet metal. Such construction seems absurd to us now. No doubt the time will come when our present track construction, in which the rails are secured to wooden ties, will seem as absurd. The objections to wooden ties are many, and have so often been referred to in these columns, that it is not necessary to enumerate them now. A substitute for the wooden-tie construction is illustrated in the accompanying engraving. The rails are laid on metal base plates indicated at *A*. Each base plate is provided with a flange along its inner edge, which is denoted by the letter *B*. It will be observed that these base plates extend longitudinally under the rails, and form a continuous support for them. At frequent intervals the base plates are connected by means of cross ties *C*, which are also provided with a flange along one edge. This flange extends downward, as indicated at *D*, and is imbedded in the ballast of the roadbed so as to provide an anchor for the tie. The rails are secured to the base plates and ties by means of clamps *E*, which are fastened in place with bolts. The upturned flanges *B*, of the base plates afford abutments, against which the ballast is packed. Thus they guard against lateral movement or distortion of the track, while the flanges *D*, of the ties prevent longitudinal movement or creeping. The flanges *D*, also serve as guard rails to catch and retain the wheels of a derailed train or car. The base plate provides a smooth surface for the derailed car, obviating injury or shock which results from a car bumping over the ordinary ties. The continuous bearing for the rails provided by the base plates prevents low joints with the resultant hammering, which soon wears out the track. Messrs. Murray A. Temple and Harry C. Temple of Berlin Heights, Ohio, have just secured a patent on this tie construction.



METAL RAIL BASE AND CROSS TIE FOR RAILWAY TRACKS.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

AIR-DRIER FOR STATIC ELECTRIC MACHINES.—M. R. FARRAR, Greensboro, N. C. This drier for such static machines as the Holtz or Wimshurst type is designed with a special reference for this use and combined with the machine as an integral part thereof, whereby the moisture is eliminated from the air within the casing by condensation and congelation on a refrigerating receptacle over which the body of air from the casing is continuously circulated in an endless cycle by means of a fan.

Of Interest to Farmers.

AUTOMATIC COTTON-TRAMPER.—E. H. CAMPBELL, Blooming Grove, Texas. The aim in this invention is to produce a tramper having means for controlling the feeding of the lint through the same, so that when the compressing plunger is in its withdrawn position the feeding operation proceeds, but when the plunger is advancing, the feeding operation ceases.

TRACK-CLEARER FOR MOWERS. — G. BRAUN, Duncan, Neb. The improvement has in view a device which will effectually throw the grass as it is cut from the standing grass, completely within the swath cut by the mower, and have a space on the outer side of the swath clear of cut grass, in which the horse can walk and follow in the succeeding cut.

PEANUT PICKER AND STEMMER.—J. T. BENTHALL, Suffolk, Va. In this device the vines are fed into a hopper, are seized by disk fingers and become partially wedged in the throats between the fingers and the teeth. The portion wedged the tightest will draw the vine through the other throats, stripping the nuts and passing the vine to the next pair of disks. The nuts and leaves fall on a screen, the leaves and vine being blown out while the nuts pass to the stemming device, which removes the stems, and the nuts then pass into a conveyer, the trash being blown away.

Of General Interest.

FLOAT FOR LOGS.—W. J. PIERPONT, JR., Savannah, Ga. In operation the fastening pin or spike may be driven into the log or timber and the buoy body be then secured upon the pin, and when the log has reached its destination the float, including its fastening pin, may be withdrawn from the log, thus avoiding the use of any nails or other metallic fastening which may be broken off in the logs and injure saws or other tools used in working the logs.

SYSTEM FOR MINE VENTILATION.—D. BELLONI, Edri, Pa. Mr. Belloni's invention relates to improvements in means for ventilating mines. It is especially applicable to the ventilation of coal mines in which noxious gases are liable to accumulate, but it is also applicable to any mine in which the removal of foul air is desirable.

COMPOSITION OF MATTER.—C. A. GOLDSMITH, York, Pa. The invention is a composition of matter designed for use in the treatment of smoking tobacco, and tobacco for use in making cigars, and the object is to provide a liquid for treating the tobacco for removing therefrom the musty odor and cellar smells and other foreign odors sometimes found in tobacco.

BOX.—P. H. KRAETSCH, Astoria, Ore. The object of the invention is to provide a box provided with a plurality of compartments, for containing postcards, each of the compartments being independently removable from the box. The cards may be inspected without removing them from the tray, a notch permitting the lowermost card to be lifted from the bottom of the tray.

SIPHON.—S. J. GRAHAM and A. E. FOWLER, Trout Lake, British Columbia, Canada. The discharge leg of the siphon is provided with a valve such as to prevent the suction of air into the leg through its discharge end, but permits the passage of a fluid in the opposite direction; and an air pump having a connection with the siphon for exhausting the air therefrom. In connection with the siphon is a vent opening having a manually-operated valve by which the flow of the liquid may be easily controlled.

WINDOW.—J. CHLEBORAD, Omaha, Neb. By releasing a locking pin, either of the window sashes may be rotated in its groove, whereby to open the top or bottom of the window, or to reverse the position of the sashes. In assembling the window the casement being in position, the front or upper sash is put in place, and the parting strip is inserted and the lower sash is put in place. The inside rim is then placed in position, and the annular ring or stop is secured in place by screws.

DOOR-HANGER.—G. L. SCHNEPF, New York, N. Y. The invention is an improvement in door hangers and tracks for sliding doors, primarily such as include free and lineally movable roller bearings between the track and hanger, and has in view a hanger and track by which the door may have an increased travel over doors supported on tracks and hangers of the same working length as hitherto constructed.

ROLLER.—H. R. DERBY, Jerseyville, Ill. The roller is suitable for pulverizing and smoothing the ground, the pulverizing taking place when the roller is moved one direction, and smoothing when moved in the opposite direction. These two operations are performed by a single roller constructed with a series of disks independently revoluble, each disk having an approximately central rib with teeth projecting from each face of the rib, having radial or pulverizing faces at one side and rounded or inclined smoothing faces at the opposite side.

MOLD FOR MAKING FLUTED COLUMNS.—J. P. ARCHDEACON, Boston, Mass. The inventor provides a mold for making fluted columns of cement, plaster or other plastic material, the mold being arranged to permit of building the column at the intended place on a building or in a shop, and giving it the desired tapering form and producing the flutes on the exterior surface with gradually less depth and width according to the taper of the column.

LOCK FOR TOY BANKS.—C. HANSEN, San Antonio, Texas. The invention relates to toy banks, and has for its object to provide a bank with a door to which is secured a receptacle which is adapted to contain camphor, menthol, or other similar substance, which will gradually decrease in size when exposed to the air, there being a supported bolt on which there is a plate which is adapted to press against the contents of the box; and means provide for a pawl to slip off a bar when the door will be found to be unlocked.

FOLDABLE DISPLAY-TRAY FOR MERCHANDISE.—F. R. FAULK and T. BRATT, Allegheny, Pa. The purpose here is to provide a construction used for exposure of seed packages or other merchandise, in a prominent manner, and that adapt the trays for close assembling in a suitable receptacle, when the trays are not in use, or are to be shipped to different localities where the goods held in the trays are to be exposed for sale.

Household Utilities.

FIRE-LIGHTING DEVICE.—J. FERO, Bellingham, Wash. The object here is to provide details of construction for a fire lighter which is controlled by the ordinary alarm mechanism of a portable alarm clock, and that will ignite fuel in the fire pot of a stove or range, when the alarm is put in motion at the instant of time for which it was set.

Machines and Mechanical Devices.

COMPUTER.—C. A. PITKIN, Montpelier, Vt. The invention relates more particularly to that type of computer in which there are provided two relatively movable members, one of which carries a series of multipliers and the other of which carries a series of multiplicands, and for each of the latter a series of products resulting from the use of each of the several multipliers.

EXHIBITING DEVICE.—E. W. LIVERMORE, Bellingham, Wash. The object of this invention is to produce a device which is especially adapted for use in exhibiting fishes. The construction is such that the mounted fish will be presented to view within a glass jar and under water, so that they resemble closely their natural appearance in life.

Prime Movers and Their Accessories.

ELASTIC-FLUID TURBINE.—J. P. NIKONOW, Evansville, Ind. The invention relates to turbines of the general kind used in connection with elastic fluids, such as steam, compressed air or gases of combustion, the more particular purpose being to produce a device of this type having its parts so shaped and arranged as to be easily assembled, and in its complete form offering particular advantages as to replacement and interchangeability of parts.

Railways and Their Accessories.

RAILROAD-TIE.—E. A. BUELL, Norfolk, Va. The invention is an improvement particularly in metal ties. It provides a construction whereby rails may be securely held from spreading and will be cushioned, and the cushion will have its elasticity entirely confined within the tie and the rail can rise and fall without displacing the tie, thus permitting the rebound of the track without loosening the tie in its ballast, or other seat.

RAILROAD-TRACK.—E. A. BUELL, Norfolk, Va. The invention is an improvement in railroad tracks, particularly in the ties and the cushioning and fastening devices. The cushioning block of wood is confined in a recess and a metal cap which confines the cushion in the recess projects into the recess so that no portion of the cushion block is exposed and the elasticity of the block wholly available or fully utilized.

Pertaining to Vehicles.

WIND-SHIELD.—J. H. SPRAGUE, Norwalk, Ohio. The invention more particularly relates to improvements in the frame which supports the transparent section. One object is to provide improved means for connecting the lower portion of the frame with the dashboard or filler-board interposed between the wind shield and dashboard.

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

NEW BOOKS, ETC.

FACTORY ORGANIZATION AND COSTS. By J. Lee Nicholson. New York: Kohl Technical Publishing Company, 1909. Quarto; 410 pp. Price, $12.50.

This work is intended primarily as a handbook for manufacturers who are interested in modern methods of organization in systems of accounting, as a book of reference, and also as a text-book on cost accountings for the student. It requires a fully qualified accountant—be he private or certified—or a business engineer to deal with this most important subject. The author has a splendid grasp of the theory and technique of cost accounting. Critical examination of this book shows that not a single germane item of any description has been neglected or slighted in any way. The forms are given on a good scale, making it easy to compile forms adapted to the individual needs of the cost specialist. The book is beautifully gotten up and is a credit to both author and publisher. There are also chapters relating to office appliances, which are very full. If large concerns were aware of the savings that could be effected with the use of this machinery, they would not hesitate an hour to put in the necessary equipment. Many a firm has gone to the wall for the lack of statistics which an adding machine would have helped to turn out in a few days. One section of the book which strikes us as being particularly valuable is the distribution of indirect expenses, which is the bugbear of any one who attempts to analyze accounts.

EFFECTIVE MAGAZINE ADVERTISING. 508 Essays, About 111 Advertisements. Edited, with an Introduction to the Science of Advertising Copy, by Francis Bellamy. New York: Mitchell Kennerley, 1909. Large 8vo.; 361 pages. Price, $5.

A couple of years ago Everybody's Magazine offered a series of prizes, ten in number, of $25 each, for the ten best essays in answer to the pertinent question, "Which is the most effective advertisement in this November issue of Everybody's Magazine?—and why?" The aim of this offer was to gain information which would be of value to the science of advertising in general, and to the art of magazine advertising copy in particular. The people who are influenced by advertising are the only criterions of effective copy. The mere subjective theory on the part of the copy-artificer is valueless, unless proved by the effect on the magazine reading public. In other words, the advertisements were "tried on the dog," and the "dog" responded in the 500 essays which are herewith presented, which were in turn selected out of some 950 essays. This book is a clarification of the advertising pages in the issue. The selected advertisements are well printed, and are accompanied by excellent essays written by individuals. It is remarkable to see what a hold advertising has on the American people, and it is little wonder that advertisers continue to spend their millions in periodical publicity when they can see that their efforts are appreciated by such a highly intelligent audience of readers and buyers. The book is a very novel one, and we can heartily commend it to all who are interested in any way in buying or selling advertising space.

HANDBUCH FUR HEER UND FLOTTE. Enzyklopädie der Kreigswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten, Generalleutnant z. D. Vollständig in 108 Lieferungen reichillustrierten Textes mit farbigen Beilagen, Karten, Plänen, Gefechtsskizzen, etc. Deutsches Verlagshaus Bong & Co., 1909.

The last four installments of this handbook are primarily distinguished by the insertion of longer essays, which discuss the handling of troops. The essays are to be found under the headings *Angriff* (attack), *Angriff und Verteidigung* (attack and defense), and *Armeereserve* (army reserve). The author of these essays is a military instructor of repute, and evidently an authority. Many authors of note have covered important topics. Count von Beck, an Austrian general of infantry, has prepared an excellent biography of Archduke Albrecht of Austria, and has interestingly traced the career of this officer. The stirring events of 1866 are tactfully and yet ably discussed. General von Verny du Vernois outlines the generalship of Alexander the Great. The articles on "Algeria," "Tunis," "Arabia," and "Argentine Republic" ably discuss the military geography and military history of these foreign countries. The importance of the age of men, animals, and warships in their relation to military science is well brought out. Among the novel articles that deserve mention are those on "Amsterdam," "Anchor," "Antwerp." Under "Armament" an excellent discussion of the army and of warships will be found.

THE LIFE OF A FOSSIL HUNTER. By Charles H. Sternberg. New York: Henry Holt & Co., 1909. 12mo.; 286 pages. Price, $1.60 net.

This is one of the "American Nature Series." This is a new and attractive series, the first volumes of which have already been published. The author is the oldest and best known of the explorers in the palæontological field, and he has contributed some of the finest specimens from Kansas, Texas, Oregon, and other places, which adorn the museums of America and Europe. It is a most interesting biography, bubbling full of adventure and representing a life of self-sacrifice worthy of record and recognition by all lovers of nature. It is handsomely bound and printed.

THE BIOGRAPHY OF A SILVER FOX. By Ernest Thompson Seton. With 100 illustrations by the author. New York: The Century Company, 1909.

Although Mr. Thompson Seton has been branded by a faunal naturalist now in foreign parts as a "nature fakir," it cannot be denied that he writes with sincerity and with charm. This little story of "the monogamy of the better class fox," to quote the author's words, may be regarded as a graceful narrative of animal life, the kind of narrative that has made Mr. Seton deservedly famous.

Legal Notices

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending June 29, 1909,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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Adding and subtracting machine, Brown & Burks 926,166
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Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than ten lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Further information sent on request.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated.

MUNN & CO.

PATENTS FOR SALE.

FOR SALE.—U. S. and Canadian patent No. 912,190. Adjustable standard and improved bolster for wagons. A leader. Manufacturers and wagon companies address C. M. Shotwell, Box 422, Kemmerer, Wyoming.

Inquiry No. 8868.—Wanted to buy nickeloid for buttons.

FOR SALE.—Patent No. 917,390. Rotary engine, compound expansion, continuous drive, reversible, cheap to manufacture, other advantages. For full particulars address Patentee, 3 Durocher St., Montreal, Canada.

Inquiry No. 8904.—Wanted to buy new or second hand machinery for making "bow type" mouse and rat trap springs and wire parts, single machine or full outfit.

FOR SALE.

FOR SALE.—Specialty for manufacturers. Dental floss holder, patented May, 1909. For further particulars apply direct to inventor, T. A. Tubbs, Seattle, Wash., care H. S. Emerson Company.

Inquiry No. 8908.—For a dealer in tapes and cords for Venetian blinds.

PARTNERS WANTED.

CAPITALIST OR PARTNER WANTED by the inventor of patent leak stopper for ocean ships. The object is to secure capital to pay for foreign patents. A grand opportunity. Address O. F., Box 773, New York.

Inquiry No. 8918.—For manufacturers of "Wydt's Electro-Catalytic Sparking Plug."

HELP WANTED.

MECHANICAL ENGINEER wanted for charge of designing and drafting office for large engineering works. Give experience. Address Canada Foundry Company, Ltd., 212 King St. West, Toronto, Canada.

WANTED—MISCELLANEOUS.

ENAMEL PREPARATION for certain conditions for utilization on steel, iron. Must be as represented. Send correspondence and samples prepaid to William R. Reinick, 1217 Chestnut Street, Philadelphia, Pa.

Inquiry No. 8921.—For the manufacturers of gilt paper.

WANTED.—Customer heavy oak and Southern pine shavings. The Wm. J. Oliver Mfg. Co., Knoxville, Tenn.

Inquiry No. 8922.—Wanted the address of Worthington Boiler Co.

LISTS OF MANUFACTURERS.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., List Department, Box 773, New York.

Inquiry No. 8928.—For the manufacturers of a steam rotary excavator as described in the Scientific American of December 12, 1908, page 347.

Inquiry No. 8931.—For parties who manufacture the Western Stump Borer for boring stumps.

Inquiry No. 8936.—Wanted machinery used to spin or wrap paper pencils in the manner that paper pencils are made.

A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co., List Department, Box 773, New York.

Inquiry No. 8941.—For manufacturers of machinery for making fly screens.

Inquiry No. 8957.—Wanted manufacturers of angle bars either malleable steel or sheared.

Inquiry No. 8960.—For the address of the Windsor Mfg. Co., manufacturers of waterproof collars and cuffs.

Inquiry No. 8966.—Wanted the address of the Cohendet Motor Co.

Inquiry No. 8969.—Wanted machines that make accordion dress plaiting (steam).

Inquiry No. 8972.—Wanted to buy complete outfit for making meat hooks.

Inquiry No. 8974.—For address of firms interested in fishing reels.

Inquiry No. 8975.—Wanted the address of the builders of moving stair cases.

Inquiry No. 8977.—For manufacturers of machinery for manufacturing denatured alcohol.

Inquiry No. 8978.—Wanted the address of manufacturers of dry pans or crushers to grind sand for plastering and cement works.

Inquiry No. 8980.—For the address of manufacturers of mortars and pestles that are used by druggists.

Inquiry No. 8982.—Wanted a machine or process for slitting or laminating the edges of heavy cardboard, impregnating the slit or laminated edge with a waterproof material and compressing the edge after treatment. The object of the process is to produce an edge that shall be waterproof and which shall not fray or split when in use.

Inquiry No. 8984.—Wanted the address of the manufacturers of Cypress wash tubs.

Inquiry No. 8986.—Wanted to buy crown and flint glasses for telescope objectives.

Inquiry No. 8987.—Wanted, the manufacturers of the Van Winkle, Woods & Sons, and the Weber power meters.

Inquiry No. 8989.—Wanted a machine for making cocoa fiber mats.

Inquiry No. 8990.—For information regarding shoes not made of leather but similar to the same and are as durable.

Inquiry No. 8991.—Wanted to communicate with manufacturers of large straw hats for every-day wear.

Inquiry No. 8993.—Wanted to buy producer gas plants.

Inquiry No. 8994.—For manufacturers of an apparatus to produce very high temperatures.

Inquiry No. 8995.—Wanted to buy round and oval glass paper weights, such as are used for mounting photographs.

Inquiry No. 8996.—Wanted addresses of manufacturers of machinery for working orange wood manicure sticks.

Inquiry No. 8997.—Wanted the address of the manufacturers of bread or cake boxes.

Inquiry No. 8998.—Wanted an automatic snap, ball and socket or other device which can be used easily and securely to fasten together the edges of small wooden boxes.

Inquiry No. 8999.—For manufacturers of combined clothes and clothes pin receptacle.

Inquiry No. 9000.—Wanted, a combined appliance for holding hats, coats and umbrellas safely and securely.

Can, C. E. Bertels 926,461
Can marking device, T. O. Matthews 926,271
Can opener, safety, F. Behrens 926,234
Canning apparatus, steam, E. McCoy 926,588
Cane for exploding caps, C. V. Wertz 926,307
Cane mills, figured roll for sugar, J. & C. McNeil 926,667
Canopy, I. E. Palmer 926,209
Caps, making vizors for, J. Mackey 926,343
Car body, J. M. Hopkins 926,416
Car construction, Dunbar & Berg..926,396, 926,645
Car coupling, C. A. Schroyer 926,295
Car door operating device, dump, F. L. Irwin, reissue 12,981
Car draft and buffing gear, M. A. Garrett. 926,110
Car fender, Fajans & Chambers 926,398
Car, mine, T. W. & C. B. Weaver 926,446
Car running gear mechanism and brake apparatus, tramway, V. Zdziarski 926,534
Car safety device, railway, W. S. Jackson. 926,334
Car seats, extensible leg rest for, H. Witte 926,309
Car stake, T. H. MacLafferty 926,203
Car switch controller, trolley, S. Uslianer ... 926,150
Cars or other vehicles, bolster for, W. H. Miner 926,432
Cars, tipple for coal, Hansen & Hayes 926,116
Carbureter, Winton & Anderson 926,533
Carbureter, W. L. Perry 926,598
Card, electrically operated price, P. L. Dirking 926,393
Carrier, L. B. Larsen 926,264
Carrier system, A. Swahn 926,302
Cartridge having multipart projectiles, G. Luger 926,431
Casting machine, ingot, L. E. Howard 926,489
Centrifugal separator, T. S. Patterson 926,596
Chafing dish lamp shutter, E. D. Holley ... 926,487
Cheese cover, T. A. Thompson 926,304
Churn operating means, C. L. Archie 926,535
Circuit controller, W. L. Bliss 926,164
Circuit controlling switch, W. S. Ryan 926,681
Cistern, air-tight, B. L. Mills 926,674
Cistern, siphon discharge flushing, J. W. Walls, Jr. 926,155
Clasp. See Jewelry clasp.
Clipper, sheep, C. D. T. McQuoid 926,130
Clock setting means, alarm, W. A. Armour 926,454
Clock winding indicator, W. J. A. Mielke .. 926,277
Closet seat bumper, J. Bropson 926,466
Clothes line reel and tightener, R. M. Kneisley 926,576
Clothes lines, etc., holder for, C. C. Gould. 926,405
Clutch, C. Schmidt 926,141
Clutch, C. W. Hart 926,184
Cock, stop, J. E. Van Nostran 926,627
Coffin box mold, E. W. Ellington 926,554
Coke oven, W. M. Person 926,285
Comb stamping and cutting die, G. R. Farrell 926,693
Composition of matter, Borland & Haney .. 926,463
Concrete construction for floors, walls, ceilings, etc., reinforced, M. Waddell 926,152
Concrete mixers, feed mechanism for, L. W. Cargill 926,172
Concrete mixers, measuring attachment for, L. W. Cargill 926,171
Concrete road beds, apparatus for laying, F. M. Talbot 926,443
Concrete walls, one side mold for, J. H. Magdiel 926,269
Condenser, electrolyte, I. Moscicki 926,128
Condenser, steam, E. Koerting 926,198
Cooker, fruit butter, M. M. Chase 926,240
Cooking utensil, I. Bauer 926,163
Corn husking machine separator attachment, O. Boyer 926,464
Cotton chopper, W. S. & J. J. Pace 926,594
Coupling carry iron, B. P. Flory 926,477
Coupling pin, L. Huey 926,568
Coupling pin lifter, Arthur & Birmingham .. 926,636
Crack filling device, A. Murrie 926,129
Crate and coop, folding, W. A. Tomison ... 926,367
Crib structure, J. B. Marshall 926,707
Current collector, electric, Angle & Hecker. 926,088
Curtain fixture, G. J. Johnson 926,193
Cushion spring for vehicles, upthrow, C. L. Thomas 926,685
Cycle, motor, J. David 926,390
Damper and flue ventilator, A. R. Clark ... 926,174
Damper, fireplace, D. B. Livesey 926,266
Damper regulator, thermostat, R. E. Dewey 926,391
Dental clamp, H. S. Miller 926,583
Derrick, F. Hunt 926,191
Designs and producing the same, pattern plate for reproducing, J. Jacobson 926,656
Display case, A. H. Simon 926,298
Display stand, jeweler's, Jersemann & Wagner 926,657
Displaying device, sign, W. S. Ryan 926,682
Distillation, condensation, and rectification of liquids, apparatus for the fractional, V. Slavicek 926,216
Ditching machine, C. W. Rood 926,136
Door check, W. Dominik 926,321
Door, grain, W. Jordan 926,494
Door hanger and guide, E. T. Robinson 926,356
Door lock, sliding, J. A. Benedict 926,460
Door locking mechanism, emergency exit, A. Carpenter 926,545
Door, sheet metal, N. P. Sjobring 926,361
Door stop, Parish & Kendig 926,595
Doubletree attachment, Alter & Einert 926,379
Draft equalizer, J. R. Bouldin 926,542
Draft rigging, W. S. Miller 926,279
Draft rigging, W. H. Mussey 926,351
Dredge, G. H. Johnson 926,122
Drilling machine, automatic, L. Reichert ... 926,606
Drinking fountain for poultry, W. S. Bandy 926,538
Dust collector, O. M. Morse 926,206
Egg beater, F. H. Speer 926,362
Electric brake, F. B. Rae 926,605
Electric circuit control system, F. W. Clarey 926,243
Electric conductors, connection terminal for, H. G. Addie 926,451
Electric furnace, J. Bouneau 926,236
Electric machine, dynamo, L. J. Hunt 926,192
Electric machine, dynamo, J. A. Williams. 926,225
Electric machine, dynamo, R. S. Feicht 926,248
Electric machine, magneto, E. Troike 926,368
Electric outlet box, C. J. Dorff 926,246
Electric switch, pendent, G. B. Thomas ... 926,622
Electrical circuit or circuits, device for making an, W. S. Ryan 926,680
Electrical switch, etc., Morris & Lister 926,584
Electrolier holder or hanger, J. C. Vogel ... 926,445
Electrotherapeutic apparatus, B. Y. Boyd .. 926,384
Elevated carrier, W. Nummedahl 926,283
Embossing and printing presses, winding mechanism for, C. E. Brooks 926,715
Endurance testing machine, H. Souther 926,513
Engine, H. E. B. Blomgren 926,540
Engine igniter, gasoline, MacCarthy & Darling 926,202
Envelop, W. E. Rickey 926,607
Envelop, J. J. Tishler 926,624
Excavator and dredge, twin boom adjustable, C. D. Campbell 926,096
Explosion motor with rotating cylinders, H. Nielsen 926,353
Explosive engine, C. C. Coffey et al 926,641
Explosive engine, H. Greer, Jr. 926,651
Eyeglass frame, F. A. Marcher 926,667
Factories, electric production controlling device for, W. H. Chappell 926,386
Farm gate, G. A. Manfull 926,345
Faucet, J. B. Woodworth 926,713
Feather stock, J. E. Snevely 926,219
Feed, automatic spring tension, W. Paterson 926,508
Feed water heater and purifier, J. W. Gamble 926,109
Feed water heater and separator, Hallowell & Gamble 926,115
Fence post, Akers & Smith 926,229
Fender. See Car fender.
Fertilizer and seed distributer, O. Wingreen 926,160
File, bill, A. H. Kelly 926,257
Fire escape, F. H. Lombard 926,342
Fire escape, J. Luckett 926,430
Fire extinguisher, D. I. Garretson 926,481
Fire shutter, automatically closing, A. Rush 926,138
Firearm, B. Behr 926,456
Fireplace, W. W. Guy 926,183
Fireplace attachment, L. A. Maiden 926,344
Fish dressing machine, J. M. Meredith, Jr. 926,582
Floor construction, J. Kahn 926,497
Floor polishing machine, I. B. Barrire 926,232
Floor scraper, A. T. & I. W. Beeler 926,458
Flower or plant holder, R. Kift 926,574
Flush tank, T. Zwermann 926,633
Fly trap, W. Engelbrecht 926,323
Flying machine, J. H. Wilson 926,159
Foot rest, W. C. Ovenden 926,207
Freight transfer device, J. L. Adam 926,227
Friction controlling device, S. J. Dibbins ... 926,392
Fuel, making artificial, M. J. Yampolsky .. 926,449
Furnace charging apparatus, blast, G. C. Shackleford 926,143
Furnace grate, E. Katzinger 926,335
Furnaces, stock distributer for blast, J. M. Roe 926,357
Fuse box, electric, T. E. Murray 926,433
Garbage can, M. T. Taylor 926,684
Garment fastener, B. L. Lewis 926,500
Garment fastener, C. D. Smith 926,614
Garment pressing machine, G. Rowland ... 926,291
Gas and collecting by-products, purifying coal, T. McWatters 926,352
Gas generator, acetylene, S. T. Russell 926,292
Gas generator, automatic high pressure acetylene, C. Woolley 926,632
Gas lighting appliance, R. M. Dixon 926,474
Gas, means for controlling the feed of oil and steam in the manufacture of, F. H. Wagner 926,628
Gas purifier, C. Flossel 926,647
Gas retort charging apparatus, E. G. B. Korting 926,702
Gas retort furnace, H. Ries 926,135
Gases, removing carbon bisulphide from, Mayer & Fehlmann 926,273
Gearing, drive, N. Frye 926,557
Glass drawing process and apparatus, J. H. Lubbers 926,501
Glazier's table, W. B. Cosby 926,470
Grader and ditching machine, road, Mock & Prather 926,503
Grain bin, W. S. Thompson 926,366
Grate, E. R. Cahoone 926,095
Grater, B. F. Hoffman 926,327
Greenhouse, E. A. Holt 926,119
Grinding machine, F. N. Connet 926,101
Grinding mill, T. C. Cadwgan 926,168
Grinding mill, E. Utz 926,305
Gun carriage or mounting, Dawson & Buckham 926,551
Gun, magazine air, J. H. Cox 926,546
Harvesting machine, cane, T. J. Peters ... 926,599
Hat frame, lady's, H. H. Scholl 926,360
Hat holder and support, H. A. Every 926,397
Hay beater, H. Chesebro 926,241
Hay lifter and stacker, combined, J. Trekofski 926,222
Hay loader, S. K. Dennis 926,177
Hay press, D. S. Beard 926,382
Heater and separator, combined, J. W. Gamble 926,108
Heating and lighting system, hydrocarbon, J. Stubbers 926,514
Heating apparatus, gas, T. B. Jarvies 926,699
Heating device, J. R. & E. D. Holley 926,188
Heating system, hot air furnace, T. E. Hunt 926,332
Heating systems, fresh air intake device for, Smith & Weidenbach 926,217
Hinge, O. J. Therriault 926,365
Hinge and door check, combined spring, Thornton & Hoadley 926,520
Hitching device, H. A. Wettstein 926,448
Hoe, G. F. A. Sordi 926,220
Hoisting and dredging bucket, L. Rauhauser 926,132
Hoisting apparatus, Basham & Donaldson .. 926,314
Holdback device, W. H. Thornburg 926,519
Hook, R. & V. Waterhouse 926,156
Hook, A. Hauer 926,697
Hook and eye or collar supporter and stiffener, F. Bilharz 926,539
Hose pipe coupling, Hooper & Bratt 926,415
Hose rack, E. F. Fisher 926,556
Hull constructon, J. Andrews 926,635
Hydrant, W. L. Selleck 926,512
Hydrant, wall, D. Hunsberger 926,190
Hydrocarbon burner, Smyth & Allinger 926,218
Hydrocarbon burner, J. Stubbers 926,300
Hydrostatic indicator, G. Harding 926,251
Ice cream freezer, F. P. Burr 926,639
Ice cutting machine, L. M. Macy 926,666
Ice pick, M. H. Mann 926,346
Ignition apparatus, electrical, T. Hubert ... 926,654
Ignition device, electric, T. Hubert 926,330, 926,698
Impalement trap, O. J. Merritt 926,275
Incubator, P. J. McCabe 926,434
Incubator alarm, P. S. Martin 926,669
Incubator thermometer holder, C. A. Cypers 926,549
Innersoles, machine for applying and using resinous cement in the manufacture of, A. Thoma 926,712
Innersoles, manufacture of, A. Thoma 926,711
Internal combustion engine, W. H. Hollopeter 926,564
Internal combustion engine, compound, S. A. Reeve 926,134
Iron products, apparatus for breaking and transporting, A. C. Eastwood 926,691
Ironing, folding, and shaping machine, edge, P. H. Larson 926,660
Jewelry clasp, A. J. Pollock 926,602
Joint. See Rail joint.
Journal lubricator, I. E. Farr 926,476
Key retainer, A. I. Jacobs 926,491
Kiln, etc., burner, cement, W. H. Harding 926,561
Knitting machine attachment, circular, H. H. West 926,629
Ladder, Concoff & Lovett 926,642
Ladder and ironing board support, combination step, A. Stevens 926,363
Lamp, L. W. Griser 926,406, 926,407
Lamp holder, adjustable, L. E. Hall 926,114
Lamp union coupling, R. H. Welles 926,528
Lamps, mask for automobile, H. D. Penney 12,983
Lamps, etc., spring catch for, H. E. Harbaugh 926,560
Latch, O. T. Belsvig 926,090
Lathe boring attachment, J. N. Rundle 926,612
Lathering utensil, C. E. Thompson 926,303
Latrine incinerator, J. Conley 926,099, 926,100
Leatherlike surfaced fabric and making same, E. Weinheim 926,526
Level, spirit, H. W. Leiby 926,661
Life saving apparatus for use at sea, A. J. Macleod 926,268
Light fixture, extension, C. M. Pitel 926,600
Lighting system, W. L. Bliss 926,165
Lighting system, W. I. Thomson 926,518
Lightning, protecting buildings from, R. C. Totten 926,521
Link, elastic, J. J. Jacobs 926,665
Liquid materials, package for, N. C. Phillipps 926,355
Loading device, T. F. Summers 926,619
Lock face and escutcheon, combined, H. F. Keil 926,336
Lock seamer, Odquist & Lyche 926,592
Locomotive hand rail support, C. L. Nagel. 926,506
Locomotive tenders, water supplying device for, J. L. Wissinger 926,373
Loom attachment, W. P. Watson 926,447
Loom, filling replenishing, J. Northrop 926,354
Loom shuttle, Northrop & Wood 926,678
Loom shuttle, A. B. Edmands 926,692
Loom shuttle box, bobbin changing, J. Gabler 926,480
Magnesia, preparing concentrated hydrated, W. S. Morrison 926,280
Magnet winding for dynamo electric machines, field, F. R. Kunkel 926,262
Magnetic motor, W. H. Von Tish 926,369
Mail bag handler, J. L. Adam 926,228
Mail bag transfer device, J. L. Adam 926,226
Mail box, Sheets & Barlow 926,613
Manifolding device, J. H. Schweich, 926,212, 926,213
Massage instrument, W. H. Coon 926,245
Match box, A. E. Miller 926,673
Match safe, A. M. Cairns 926,316
Mattress, spring, R. Ackermann 926,375
Measure, J. R. Carroll 926,688
Measurer, lumber, W. B. Woodruff 926,631
Mechanical movement, T. V. Buckwalter ... 926,238
Metal heading machine, A. C. Campbell ... 926,170
Metal jacket, corrugated, T. S. Friend 926,648
Metals from their ores, extracting, W. T. Smith 926,718
Miner's knee pad, Horath & Williams 926,328
Molding branch block, E. Sullivan 926,148

Mower grass catchers, conveyer for lawn, F. E. Harris 926,485
Music leaf turner, B. C. Howell, Jr. 926,566
Musical nstrument, tracker board and note sheet mechanism for mechanical, J. O'Connor 926,679
Musical instruments, volume controlling means for mechanical, J. H. Dickinson 926,178
Nail feeding and driving device, H. & A. H. Hayssen 926,412
Nail lock, clenching, F. C. A. Schlottmann. 926,140
Nitrogen by electricity, oxidizing atmospheric, D. Helbig 926,413
Nozzle, L. R. Nelson 926,435
Nut, lock, P. Moodie 926.504
Nut lock, Gins & Peters 926,696
Nut, screw-locking, A. E. Terry 926,517
Oar lock, C. J. Malmberg 926.127
Oil burner, C. Y. Roop 926.137
Oil burner, R. B. Disbrow 926.473
Oil purifier, W. S. Elliott 926,179
Onion topping machine, C. J. Petrie 926.286
Operating table, J. Laughlin 926.579
Orchard heater, H. P. Holt 926,120
Ore reducing apparatus, W. V. Jean 926,492
Ore separating machine, W. V. Jean 926,493
Ore separator, J. Krabill 926.577
Ore separator, dry, J. J. Lapping 926,428
Ores, desulphurizing and agglomerating, C. Robinson 926,289
Oven, continuous, C. A. Gorndt 926,404
Packing, S. P. Morrison 926,676
Packing for steam and other joints, fluid pressure, J. F. Hendrickson 926.414
Packing vessel, H. W. Avery 926,230
Panel-board, Walker & Van Valkenburg 926,154
Panel-board, J. J. Wesley 926,372
Paper bags and the like, machine for manufacturing, B. J. Jensen 926,422
Pattern-former, M. Dubinsky 926.322
Pedestal, F. J. & H. G. Carl 926,097
Pen, reservoir, E. De la Rue 926.611
Perforator, E. L. Krag 926.261
Permutation-lock, M. Spinello 926,221
Phonograph-horn, P. B. T. Berner 926,235
Phonograph-record holder, O. Laroussini 926,659
Photographic-print washer, L. M. Sherow .. 926,144
Photographic change-box, P. Kaemmerer .. 926,495
Photographic developing apparatus, C. D. Waldron 926,153
Photographic filter, E. Wandersleb 926,523
Photographic washing-tank, W. A. Amon .. 926,380
Pile, F. A. Noullet 926,505
Piling, interlocking metal sheet, G. H. Barbour 926,455
Pillow, R. B. Hobson 926,563
Pin. See coupling-pin.
Pin-holder, M. Franke 926,478
Pipe-bending machine, C. N. Brown 926,093
Pipe connection, corrugated, G. E. Wilson .. 926,532
Pipe-covering, metal-cased, C. G. Kelly 926,423
Plants, machine for the fecundation of, J. M. Dennis 926,690
Plants, stay for, R. C. Meneray 926,274
Plectrum-machine, C. E. Schmidt 926,511
Plow, R. H. Cadenhead 926,544
Plow, harrow, etc., riding attachment, H. P. Curtright 926,548
Plow, traction, G. K. Wedlake 926,306
Plug, repair, R. H. Weber 926,371
Pneumatic device, F. Beck 926,315
Pneumatic engine, D. Klein 926,260
Pneumatic for wind instruments, W. B. Tunstall 926,686
Pocket-closure, J. W. Wilkinson 926,530
Pocket, safety, H. V. Geissler 926,402
Point and switch operating apparatus, H. F. Marriott 926,668
Point-shifting mechanism, electrically-operated, A. Oesterreicher 926,507
Post or pole, H. S. Albrecht 926,311
Potato-digger, S. Moeller 926.350
Press-bed, A. B. Liddel 926,341
Printing-blocks, apparatus for making autotype, E. Albert 926.376
Printing-blocks, making autotype, E. Albert 926,377
Printing-frame, automatic, G. S. Edwards 926,553
Printing-machine feed mechanism, H. W. Morgan 926,205
Printing-plates, producing, J. Jacobson 926,121
Printing-press, G. R. Cornwall 926,102
Printing-presses, rotary folding mechanism for, J. J. Walser 926,223
Protractor, J. G. Spofford 926,615
Pump, cam-operated, S. W. Luitwieler 926,267
Punching-press dividing-table, T. Poljakoff-Kowtunoff 926,601
Rail clamp, guard, W. W. Allen 926,717
Rail-joint, G. W. Sheffer 926,215
Rail-joint, J. Sheets 926,297
Rail, train-actuated, H. F. Roach 926,210
Railway-crossing, B. C. Meyer 926,672
Railway-frog, T. M. Hopper 926,488
Railway-gate, D. A. Hall 926,113
Railway-rail bed, C. M. Culp 926,547
Railway-rails, laying renewable-head, R. B. Davis 926,105
Railway safety system, J. W. Sharp 926,214
Railway signal system, electric, Y. Burgess. 926,687
Railway-tie, R. How 926,418
Railway-track structure, A. J. Pembleton .. 926,133
Rake and loader coupling, hay, F. H. Minnich 926,349
Ratchet-wrench, J. B. Hampton 926,653
Razor, rotary safety, A. M. Rankin 926,509
Recoil-pad, J. H. Wesson 926,529
Rein-guide, W. M. Kayser 926,573
Relay, meter, H. S. Baker 926,312
Respirator, W. F. Merryman 926,671
Rheostat, H. D. James 926,254
Ribbon pin, hair, W. M. Yeomans 926.450
Rolling metal sheets, A. H. Beale 926,233
Rotary machine, J. Sveich 926.301
Rotary press motor, P. T. Coffield 926,689
Ruching- reel, J. C. Schmieder 926.359
Rug stiffener and protector, C. E. Lane .. 926,125
Safes and strong rooms, safety-screen for, Branly & Laurent 926,385
Safety locking-switch, D. A. Beezley 926,459
Safety-switch, automatic, T. C. King 926,575
Sand-box, Mullen & Brennan 926,586
Sash-lock, J. P. Cassidy 926,173
Sash-lock, M. W. Griswold 926,482
Sash-operating mechanism, R. B. Browne .. 926,094
Saw-gage, E. W. Habermaas 926,652
Saw-tooth, insertible, J. H. Miner 926,675
Sawing machine, wood, W. M. Lee 926,265
Scow pocket-door and hinge therefor, S. G. Perry 926,597
Seal device, E. C. Yeoman 926,161
Sealing-nipple for vacuum-jackets, J. L. Fate 926,694
Seamer, double, Odquist & Lyche 926,591
Self-leveling table, R. G. MacKinnon 926,655
Separator J. W. Gamble 926,107
Sewing-machine grinding attachment, Cox & Peterson 926,471
Sewing-machine guide, K. M. Lacey 926,703
Shade and curtain hanger, E. Fish 926,181
Shade-hanger, C. H. White 926,630
Shade roller and curtain-pole support, curtain, J. A. Haas 926,484
Shade-roller bracket, J. J. Fleming 926,399
Shade, window, F. R. Longstreet 926,200
Shampoo-shield, R. Ernest 926,555
Sheet-metal plates, apparatus for deforming, G. H. Hyde 926,253
Sheet-metal wheels or pulleys, making, J. F. Craven 926,643
Shell, explosive, F. M. Hale 926,558
Shingle carrier and support, M. F. Stowe ... 926,364
Shipping-case, E. N. Bagley 926,537
Shirt-waist adjuster, M. W. Sutherland 926,621
Shoe-closer, F. J. Leggott 926,340
Show-case, C. C. Wright 926,374
Shutter or curtain, flexible, A. Rush 926,139
Sign, F. Hauff 926,326
Signal. See block-signal.
Signal, electrical apparatus for producing sound, C. H. O'Brien 926,284
Signaling device, B. Behr 926,457
Silk in hanks, apparatus for treating, F. Lindenmeyer 926,429
Sink-trap, T. E. Doyle 926,552
Skate, R. B. Eubank, Jr. 926,646
Skirt-marker, A. M. Meston 926,276
Slag, cinder, etc., handling, J. B. Clark 926,242
Slag-net, J. B. Clark 926,719
Slide-bearing lubricator, F. P. Ide 926,333
Smoke-stack, C. P. Byers 926,167
Soldering-iron, A. P. Olmstead 926,708
Soldering machine, can, G. H. Stewart 926,618
Souvenir, E. C. Richmond 926,440
Spade, E. M. Skinner 926,146
Spectacles, frameless, J. Savoie 926,293
Spot-setter, S. W. Reynolds 926,287
Springs to corrugated cross-bars, clamp for attaching, W. H. Bates 926,381
Square, magnetic, Draper & Reid 926,247
Stacker, McCall & Orendorff 926,587
Steam-generator flue, C. F. Jenkins. 926,700, 926,701
Steamer, wheat, A. A. Brooks 926,465
Storage battery, Stirien & Gardiner 926,649
Stove, combined gas and coal heating, A. C. Mott, Jr. 926,585
Stove oven-burners, valve-locking device for gas, Pope & Kahl 926,603
Stoves, automatic regulator for gas, H. Junkers 926,194
Strainer, J. Levy 926,704
Strainer for sinks, bath-tubs, etc., S. E. Horner 926,417
Straw-holder, T. S. & A. L. Lewis 926,581
Street-sweeping machine, V. F. Pretorius ... 926,709
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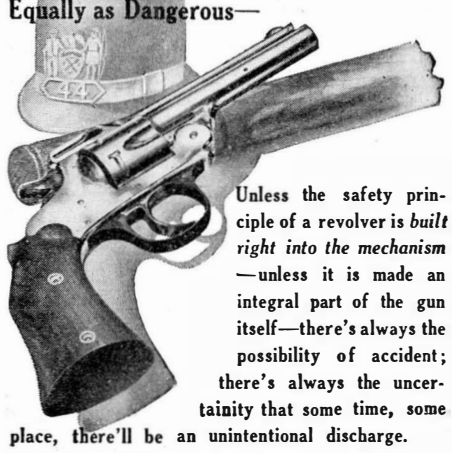

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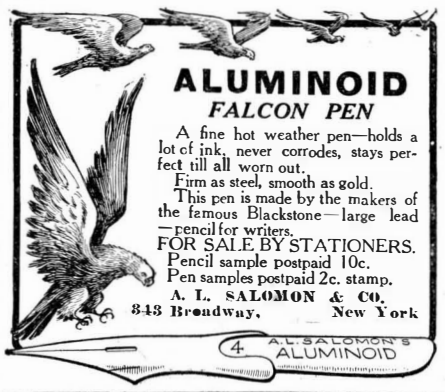

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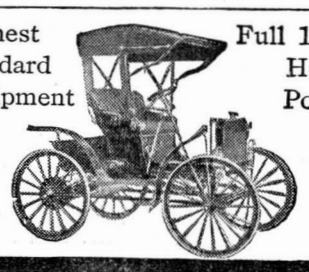

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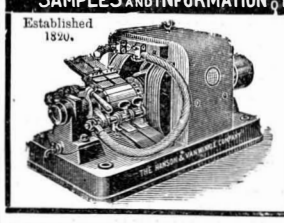

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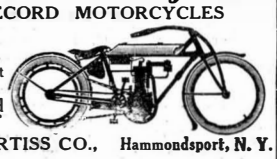

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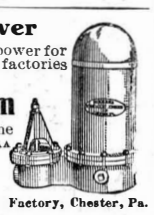

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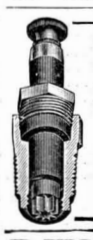

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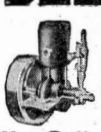

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