SCIENTIFIC AMERICAN

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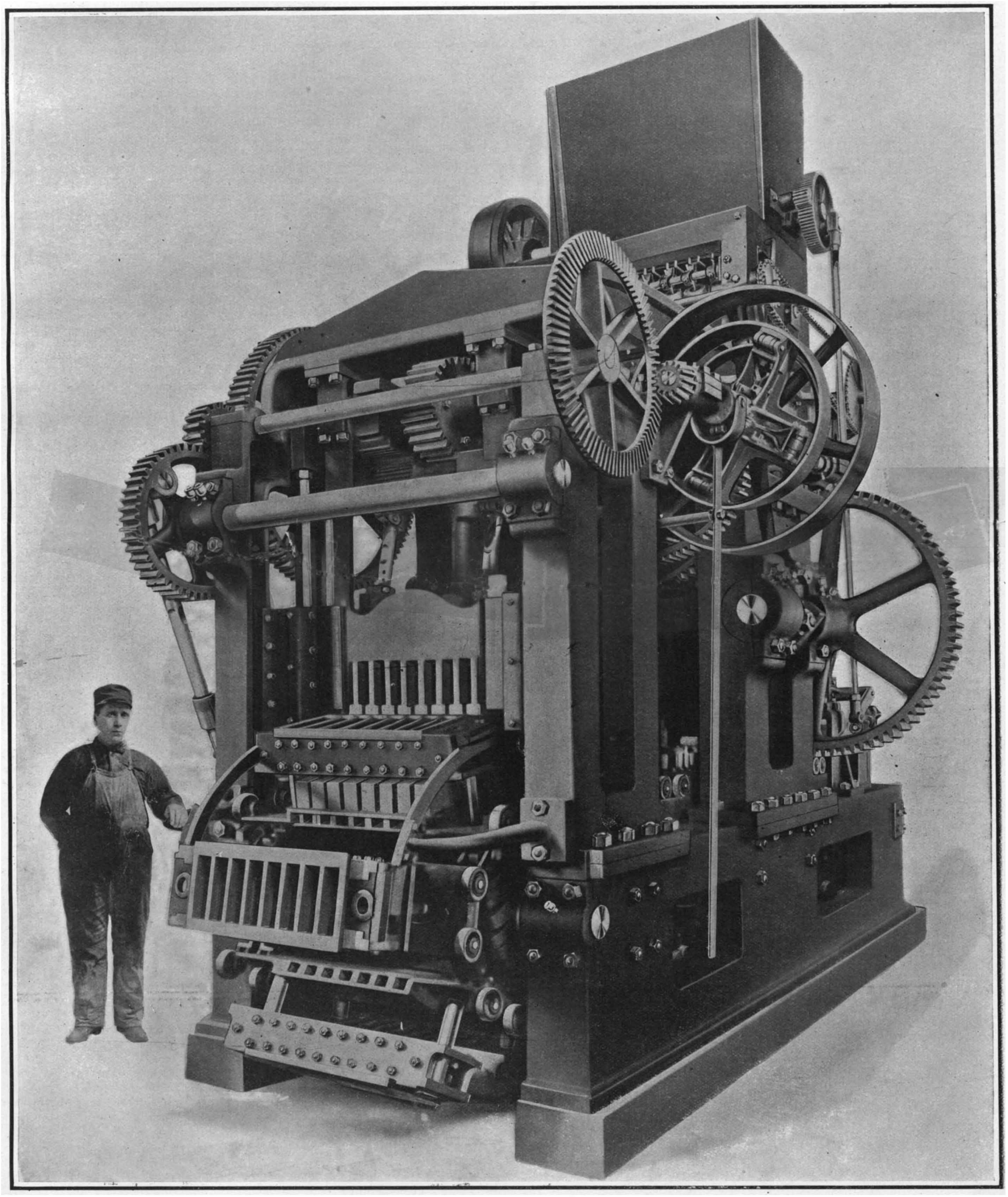

A MACHINE THAT MAKES 40,000 ENAMELED CONCRETE BLOCKS IN TEN HOURS.—[See page 368.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, NOVEMBER 20th, 1909.

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.

PURITY OF CATSKILL WATER SUPPLY.

The special experts on the purification of water for the New York Board of Water Supply have been investigating local conditions at the Ashokan Reservoir, with a view to determine whether the surface soil and vegetation on the bottom and sides of the Ashokan Reservoir should be entirely stripped down to the clay and gravel, as was done in the larger reservoirs of the metropolitan water districts of Massachusetts, or whether some other treatment to obviate deterioration during storage was preferable. It was estimated that the stripping of the soil would cost about $5,000,000. Messrs. Hazen and Fuller, the expert engineers, have decided that the stripping of the Ashokan Reservoir would not prevent tastes and odors in the water to a sufficient extent to warrant the great expenditure. They considered that aeration, at a small fraction of the cost of stripping the reservoir, would result in better water, and that perfectly satisfactory water can be obtained by both aeration and filtration, whether the reservoir is stripped or not. It was recommended that all the trees and bushes over the entire area be cut close to the ground and burned shortly before the area is flooded, and that all the stumps and roots be taken out, so that in case of low water they would not be unsightly. They also recommend that at the outlet of the reservoir a large fountain be built, where all the water drawn out will be thoroughly exposed to light and air.

THE NEW FOURTEEN-INCH ARMY AND NAVY GUNS.

Great interest attaches to the new 14-inch gun for the navy which has been delivered at the navy yard at Washington, where it will be rifled and the breech mechanism installed. On completion it will be shipped to the naval proving grounds at Indian Head, Maryland, for a test. The completed gun will weigh about 63 tons; its projectile will weigh about 1,400 pounds, and the latter will be propelled by a charge of 365 pounds of powder. The extreme range at maximum elevation will be more than twenty-five miles. As compared with the present navy 12-inch gun, this will be a far more powerful weapon. It will penetrate any armor afloat, at the most distant ranges at which accurate aiming is possible. The army has also a 14-inch gun of much lower velocity and power, which will soon be tested at the Sandy Hook proving grounds. The lower muzzle velocity (about 2,000 feet per second) of the 14-inch gun will give it additional life over the 12-inch gun. After some eighty discharges the rifling of the present 12-inch gun of 2,500 foot-seconds velocity becomes so badly worn as to destroy the accuracy. In the case of the 14-inch gun, the erosion is much less, and the gun will be serviceable for about 300 discharges.

THE NEW BRITISH AND GERMAN "DREADNOUGHTS."

The biggest "Dreadnought" of Great Britain and the most powerful German vessel of the same type were put into the water on the same day. The "Neptune," the English vessel, has a displacement of 20,250 tons, will carry ten 12-inch guns and twenty 4-inch guns, and her total broadside will weigh 9,120 pounds. The German "Dreadnought" "Ostfriesland" has a displacement of 19,000 tons; will carry twelve 12-inch guns, twelve 6.7-inch guns, and twenty-two 4-inch guns, and she will deliver 14,204 pounds in a single discharge of all her guns. The most remarkable feature of the "Neptune" will be the extraordinary power of concentrating the gunfire. The ten 12-inch guns will be mounted in pairs in five barbettes. One barbette will be placed in the forecastle on a high level. The two broadside barbettes will be *en echélon*, that on the port side being more forward than the barbette on the starboard side By a novel arrangement the superstructure is bridged over these two barbettes, both pairs of guns being fired on either side at once if required. Of the two barbettes astern, one will be raised above the other, so that all four guns can be fired direct astern simultaneously. The broadside fire of the "Neptune" will thus be ten guns, the stern fire eight guns, and the direct-ahead fire six guns. The "Ostfriesland," on the other hand, has four of her twelve guns masked by the superstructure, and can fire only eight 12-inch guns on either broadside. Her end-on fire will be six guns ahead and astern.

ACCELERATION OF LONG-DISTANCE EXPRESS SERVICE.

Hitherto the trip from New York to St. Louis has been a rather trying one. Now, however, conditions are ameliorated by two through trains which make a schedule run from New York to St. Louis in twenty-four hours. The New York Central train leaves at 2:45 in the afternoon, and the Pennsylvania train at 6:25 P. M. The Central's train is a duplicate of the "Twentieth Century Limited," and the Pennsylvania's is a duplicate of its eighteen-hour "Chicago Flier." The Central train is due to arrive in St. Louis at 1:45 P. M., which allowing for the difference in time makes a run of just twenty-four hours. The time saved is about five hours, and both of the trains are luxurious in the extreme. There are now seventeen trains daily each way on the New York Central and Pennsylvania systems.

THE LIMIT OF RAPID TRANSIT.

If all mechanical difficulties could be overcome and sufficient horse-power could be developed, what would be the minimum time in which passengers could be transported say from New York to Philadelphia? At first glance, one is apt to overlook the fact that the freight to be transported is not mechanical, but human, and this is a very important factor in the problem, because the safety and comfort of the passengers must be considered. It is really a question of starting and stopping that imposes a limit on the reduction of time consumed in transit. A very interesting discussion of the question has been received from one of the readers of the SCIENTIFIC AMERICAN. He points to the fact that the quickest way to get from one place to another without shock or jar is to travel faster and faster until half the distance is covered, and then to slow down until the destination is reached. When the rate of acceleration is just such as can be borne with comfort, the limit is attained. The effect on the passengers would be a continuous pressure against the back of the seat, of the sort experienced when a car is started suddenly, for the first half of the journey, and then in order to prevent them from pitching out of their seats, the chairs would have to be turned in the opposite direction for the rest of the journey, during which the same sensation would be felt. If an attempt were made to make the same time by any other method involving uniform speed throughout the greater part of the journey, an unpleasant jar or pressure would be experienced in starting and stopping. The highest speed attainable would therefore be proportional to the distance traversed.

Our correspondent draws a fanciful picture of the railroad of the future, which would permit of such rapid transit. The trains would have to run in a vacuum, to prevent them from being heated to incandescence by the resistance of the air. They would also have to be held in suspension in the vacuum tube through which they travel, for the slightest contact with the sides of the tube would result in enormous friction. The cars might be held in suspension by the repulsion of opposing magnets on the cars and tube respectively. When thus isolated, they could be propelled only by the magic power of magnetism. Under such conditions, the energy consumed in propelling the car would be quite low. The running time on such a road between New York and Philadelphia or New York and Boston would be a matter of a few minutes. The time for each half of the distances could be calculated from the well-known formula, $S = \frac{1}{2} a t^2$, where S is the distance, here *half* the whole journey; a, the acceleration, or change of speed each second; and t, the time in seconds. Taking an acceleration of 11 feet per second each second, which would bring to rest, in 4 seconds, a train moving at 30 miles per hour (44 feet per second) he finds that the time from New York to Philadelphia (85 miles) and from New York to Boston (190 miles) would be 6 minutes 44 seconds and 10 minutes 4 seconds respectively.

This may indeed be considered the absolute limit of rapid transit; for the passengers would be traveling each half of the distance one-third as fast as they could fall through the same space under the attraction of gravity.

THE OTHER HALF OF THE CULLINAN.

It is reported in African papers that the original stone, of which the Cullinan was a portion, has been found in the possession of the Kaffirs of the Magatos tribe in Zoutpansberg. The dimensions of this second Cullinan stone have been given as 4,323 karats.

This story has been denied by the Transvaal Department of Mines, and an official of the treasury in Pretoria states that the origin of the legend can undoubtedly be traced to the belief that enormous quantities of diamonds were buried by command of the celebrated chieftain's wife Majatje during the Boer war. These diamonds became the spoil of the Kaffirs when they returned to Kimberley. But these treasures are lost, for the Kaffirs who buried them are dead and search for them has been without result.

The possibility of finding still larger stones than the Cullinan in the soil of South Africa is, however, by no means remote. G. A. Molengraaff, professor of mineralogy in the Technical High School at Delft, recently stated that the Cullinan is only a portion of a much larger stone, the original form of which can only approximately be indicated. Four pieces must have been broken off from the original stone by natural crystal cleavage, which is evident from the cleavage planes. Each of these pieces must have been of considerable size. Accordingly, the natural end planes (called "nijf" in the language of the diamond workers) are only partially shown in the Cullinan. Most of the crystal planes are cleavage planes. The original portion of the surface shows only a single octahedral face; it also has an irregular curved front surface bearing some resemblance to the six faces of a dodecahedron, and a very irregularly formed cubical (hexahedral) surface, in which the quadrangular impressions can be recognized. These quadrangular impressions are characteristic of minerals such as diamonds, which occur in the octahedral form. The Cullinan consists of a single crystal; there are no traces either of a twin crystal or of twin lamellæ; it is completely transparent and colorless. Its transparency can be best compared with that of very pure ice, or with the complete clearness of the variety of opal known in the mineral kingdom as hyalite (principally consisting of silicic acid). It is true that the Cullinan contains a few impurities in the shape of inclosed grains, also some internal cleavages of fragmentary character, called "glessen" in the Dutch diamond trade, but their situation is such that they do not injure the value of the stone as a jewel. In any case the Cullinan is the purest of all large precious stones hitherto found.

The question now arises whether there is a possibility of finding the pieces broken off by crystal cleavage. That they can be found is certain, but it is impossible to predict whether they are now in diamond mines or elsewhere. The diamond is formed, as is known, at great depths by the decomposition of carbon, dissolved in the molten, basic, plutonic magma of the earth. (The so-called "blue-earth" is formed at a later period from this rock.) The carbon was then, under enormous pressure and at the very high temperature prevailing at these depths, deposited from the molten rock in the form of diamonds. During the volcanic discharges of the masses of rock the diamond was forced upward with tremendous force, and the very great friction to which the mass was exposed during its passage through the crater shaft caused the cleavage of the stone according to crystallographic laws to which we have referred. It is therefore not impossible that the broken-off fragments of the Cullinan are scattered over a wide space, and that they may one day be found on the surface of the earth, but it is just as possible that they are still reposing in the depths of the mines. Sir William Crookes has also lately expressed the opinion that the Cullinan is the smaller portion of an octahedron broken by crystal cleavage.

New applications of electricity are being discovered daily, but not every new application is of as much interest or importance as one recently developed for purifying the air of reading rooms, theaters, and other close places where large numbers congregate. The apparatus referred to is the ozone generator installed recently in the Chicago Public Library to purify or ozonize the 10,000 cubic feet of air per minute that is forced into the main reading room. After the installation of the ozonizing apparatus it was found that the main reading room was completely deodorized, the air being freed of that disagreeable and deleterious odor which for years had so thoroughly permeated all papers, books, furnishings, etc., in this large room. The fresh sterilized "mountain" air in the room reduced the humidity during the hot, oppressive days of summer, and greatly increased the comfort of the readers and employees. The installation renders the disinfecting of all books, periodicals, papers, etc., on the shelves, racks, tables, etc., an automatic process, keeping them constantly in a hygienic condition.

ENGINEERING.

The North British Locomotive Company has recently completed and tested the first steam turbine locomotive, and it is said to be entirely successful.

The great shops of the Pennsylvania Railroad Company at Altoona, employing 12,000 men, are now working full time. This is the first time since the financial depression of 1907 that all departments of the great shops have been operated.

A non-shrinking alloy can be produced by melting together 50 pounds of tin and 50 pounds of zinc. This gives a hard alloy if a good grade of zinc is used. Two pounds of bismuth will render it very fluid and enable it to be poured at a lower temperature.

Work is being pushed on the Cape Cod Canal. A big granite breakwater is being constructed in Cape Cod Bay to protect the end of the canal and furnish anchorage for shipping. At the other end, in Buzzard's Bay, work is also proceeding at a fair rate.

A new trolley car is being experimented with in New York city. The new car is operated by gasoline, and is also supplied with an electric equipment. In the event of a blockade or accident on the road, the new cars can be switched over to another track and be run by gasoline. Riding in the car is very much like riding in an automobile, there being an entire absence of the jerk which is so disagreeable in electric cars. The radiator is on the roof.

A twenty-four-hour test of the "North Dakota" at a 12-knot speed was finished November 7th. The consumption of coal and water was well below the guaranteed mean amount. The consumption tests of this battleship are therefore in keeping with the remarkable speed shown in her special mile trials. It has been found that her turbine engines have developed a greater top speed and generated power for a low speed at less expense for coal and oil supplies than did the reciprocating engines of the "Delaware."

The Board of Estimate of the City of New York has approved the action of the Public Service Commission in awarding contracts for the construction of the Fourth Avenue subway in Brooklyn, and work on this very much needed improvement will proceed at once. The contracts were sent to the Board of Estimate over a year and a half ago, and have been held up ever since. As the building of subways under the best conditions cannot keep pace with the increase in population, it is to be hoped that there will be no such senseless delays in authorizing future subways.

An exhibition was recently made of Mr. Louis Brennan's monoroil car which, it will be recalled, is held in upright position by means of gyroscopes. Since the first announcement of his invention, Mr. Brennan has been at work developing the car to practical dimensions and the present model is large enough to contain forty passengers. The car was operated both on a straight and a circular track, and maintained its equilibrium perfectly. So sensitive was it to the shifting of the center of gravity, that when the passengers all crowded over to one side, the car immediately righted itself and maintained its horizontal position. Mr. Brennan overcomes the precession by means of frictional devices acting on the gyroscope wheels.

The Baldwin Locomotive Works has just completed for the Atchison, Topeka & Santa Fé Railway the most powerful passenger locomotive now in use. Apart from its tender this locomotive weighs 376,450 pounds, and is 65 feet long. The tender carries 12,000 gallons of water and 4,000 gallons of oil, which will be used as fuel. The length of the locomotive and tender is 105 feet. The tractive power of the locomotive is 53,000 pounds. There are five pairs of driving wheels, 73 inches in diameter, working in sets of two, the locomotive being of the Mallet articulated type. The locomotive is the first for passenger service to be built of this type, and is the first to combine feed-water heater, superheater, and reheater in one machine. Its firebox is built on an entirely new plan which eliminates staybolts.

The October Engineering Review gives an admirable illustrated account of the progress of work on the Los Angeles aqueduct, now about half completed. It is probably little realized, away from southern California, that this is by far the largest hydraulic engineering work now in progress, with the exception of the Panama Canal. It speaks well for the courage of the people of Los Angeles, and their faith in the future of their city and district, that they should meet by this immense undertaking the serious problem of a waning water supply coupled with a growing population. The aqueduct will be 230 miles long, and will be capable of conveying 280 million gallons of water per day from the Sierra Nevada across the Mojave Desert to San Fernando Valley, providing sufficient water for power purposes and irrigation of the district, as well as for the city supply. Practically the entire work, including tunnels, steel siphons, and concrete-lined and covered canal, is being done by the city under the direction of its own engineers.

ELECTRICITY.

The city of Baltimore is evidently favorable to municipal ownership. The problem of lighting the streets is being investigated. In September, 1910, the contract for lighting the city expires, and hopes are entertained that a municipal plant will by that time be ready to furnish power for the street lamps.

Following a test of gas-electric motor cars between Manassas and Strasburg, Virginia, the Southern Railway Company has bought two of these cars from the General Electric Company. Each car is equipped with a pair of 100-horse-power motors operated on a voltage of 600. The current is generated by an 8-cylinder gas engine. The cars are 55 feet long and will seat 52 passengers.

The Third Avenue Railroad Company of this city is experimenting with gasoline-electric power on its 125th Street crosstown line. The requirements call for a car which can run up a five per cent grade and which can maintain a schedule of eight miles per hour with ten stops per mile. So far the results have been very satisfactory; the car has successfully run up an eight per cent grade and is keeping its schedule.

The new Blackstone Hotel in Chicago is provided with an unusually complete electrical equipment. In the kitchen particularly extensive use is made of electrical labor-saving devices. There are electric dish elevators, dish washers, vegetable parers, dough mixers, silver-polishing machines, etc. The laundry of the hotel is also completely equipped with electrically-driven laundry machinery of every description.

Before the advent of the metallic-filament street lamp, gas lamps were largely used in English cities to illuminate the side streets, as the requirements did not justify the use of flaming arc lamps. Now the gas lamps are giving way to the metal-filament lamps, which afford a considerable saving. Nearly two thousand side street lamps at Marylebone have been changed from gas to electricity, with the result that $7,500 has been saved.

The Railroad Commission of Indiana has been ordered to investigate the various types of headlights for locomotives, and when the best one has been discovered, to require the use of this headlight on every railroad in the State. The tests have recently been undertaken near Avon, Ind., to determine the relative efficiency of oil and electric headlights. The effect of opposing headlights, the distances at which obstructions on the track could be detected, and the effect of observing signals were investigated, but as yet no conclusions have been reached.

A new form of electro-magnetic clutch has recently been devised, in which a stationary electro-magnet is used to draw the clutch members together into frictional engagement. The magnet coil is placed between flanges formed on the two members of the clutch, and when it is energized it attracts the clutch members with sufficient force to permit one to drive the other. When the current is cut off, a spring serves to separate the clutch members. The advantage of this system lies in the fact that the magnet does not come in contact with the parts it actuates.

The Electric Railway Journal calls attention to the many problems which arose in modernizing the traction system of Bombay. As the average daily income of the inhabitants is but 25 cents, five-cent fares are out of the question. The fare is two cents for a seven-mile ride, while the average fare is one anna, or one and one-third cents. In order to withstand the ravages of insects, special varieties of wood had to be used in the cars and track system. Even the overhead system had to be modified so as to permit of the passage of the tall shrines used by the natives in their religious pageants.

Practically all the coal consumed in Brazil is imported. As a consequence the cost of fuel is very high and this has done a great deal to prevent the growth of manufacturing industries. However, advantage is now being taken of the water power of the country. A recent consular report points out the development of hydro-electric power systems around Rio de Janeiro, showing that many manufacturing concerns are changing from steam to electricity and it is hoped that the industrial development will be largely increased because of the greater advantages and the economy of using electric power.

The new articulated electric locomotives of the Pennsylvania Railroad for service in the New York and Long Island section virtually are two separate locomotives coupled together. The motive power comprises a pair of 2,000-horse-power direct-current interpole motors, which are crank-connected to the driving wheels. The locomotives are required to start a 550-ton train on a two per cent grade, and must have a tractive effort of 60,000 pounds. Although a speed of sixty miles per hour was called for in the specifications, the locomotive now under test has made seventy-two miles per hour. The weight of the locomotive is 332,100 pounds.

SCIENCE.

Lieut. E. H. Shackleton, who returned from an Antarctic expedition early this year, after reaching a point within 111 miles of the pole, has been knighted by the King of England.

Arrangements will shortly be made by the Austrian government for the public sale of radium for medical and experimental purposes. The total quantity of radium which has been thus far recovered for scientific use throughout the world is estimated not to exceed a quarter of a pound.

The Harvard Observatory announces that a photograph of the spectrum of Morehouse's comet, taken on November 17th, 1908, with an eight-inch telescope, shows six broad, bright bands. These bands appear to coincide with the hydrogen lines zeta, epsilon, delta, gamma, beta, and the strong, bright band at wave length 464 to 473, characteristic of spectra of the fifth type.

Tantalum is a "rare metal" of slight importance, the only practical use to which it is now known to be put being in making filaments for incandescent electric lamps. The efficiency of the tantalum lamp is greater than that of the carbon lamp, but somewhat less than that of the lamp with tungsten filament. As more than 20,000 filaments of 20 candle-power can be made from a pound of tantalum, the market is not large. It is at present probably supplied by rich manganotantalates from western Australia. No tantalum minerals are known to have been produced in the United States in 1908, according to F. L. Hess, whose report on various rare metals forms an advance chapter of "Mineral resources of the United States, calendar year 1908," published by the Geological Survey. The tantalum used in the manufacture of lamps in this country is made in Germany and imported at a cost of $300 or more a pound.

A great daylight meteor of October 6th was observed by many persons in various parts of England. The particulars to hand are not very definite, and it is scarcely possible to compute the real path of the object. From a comparison of about fifteen descriptions, W. F. Denning states in Nature that there seems little doubt that the meteor moved in a direction from south to north over Reading, Thame, and on to a termination near Market Harborough. The radiant point was in Leo, and it is hoped that more observations of an exact character will be supplied. The sky was clear over a large extent of England, and hundreds of persons saw the meteor, though only a small proportion of that number have reported their observations. The great daylight meteor of 1900, January 9th, was directed from Aquila, that of 1894, February 8th, emanated from Hercules. It is seldom that meteors appearing at such times can be suitably observed, as the sky does not afford any reference objects such as is furnished by the stars at night.

Before timber is subjected to preservative treatment it is customary to remove the bark. Unless this is done very thoroughly, however, patches of the inner bark will remain on the wood. Until recently, it does not seem to have been realized that this bark presented a very effectual hindrance to the penetration of creosote. The same thing was discovered by the management of one of the large creosoting companies in the South, and steps were immediately taken to see that every particle of bark was removed from piling and other timbers. While it is probable that the bark of all species is not as resistant as that of pine, it is not known how the different species rank in this respect. In the creosote treatment of timbers it is rarely that the entire stick is penetrated by the preservative. The value of the treatment consists largely in the creating of an exterior antiseptic zone around the untreated interior portion. If this outer zone be broken, the value of the treatment is to a large extent lost.

Recent investigations by the United States Geological Survey have shown that oxygen, so essential to all life, forms in coal an impurity that is almost as injurious as the ash content. Oxygen and ash are of very nearly equal negative value, ash being probably a little more injurious in most coals. The calorific value of coals in general is indicated by the balance between the total carbon on the one hand and the sum of the two great impurities, oxygen and ash, on the other. The practical application of these statements appears in considering the effect of the exposure of coal to the weather. The weathering of the lower grades, especially lignites, bituminous coals, and peats, is marked by the accession of oxygen, which is taken into combination. This increase of the oxygen content permits a calorific deficiency, which, on account of the high anticalorific value of oxygen, is often serious. It is possible that in many cases considerable increase of oxygen and consequent loss of efficiency are suffered by the lower-class fuels between removal from the bed and consumption; and it is probable that in the sub-bituminous coals, and more especially in the lignites, oxygenation begins immediately after the coal is blasted from the face in the mine.

SOMETHING NEW IN CONCRETE BLOCK MAKING.

BY M. H. HUNTING.

Of the many recent applications of concrete to the building industry in this country, few, if any, have attracted more attention than the process invented by a Des Moines, Iowa, man for the manufacture of enameled concrete blocks. A machine of gigantic proportions performs the many operations through which the block passes without the aid of the human hand, turning out 40,000 perfect blocks in each day of ten hours, each one an exact duplicate of every other in form and color.

The machine is 13 feet 8 inches in height, 17 feet in length, 6 feet in width, and weighs over 70,000 pounds. In the accompanying illustrations a man is shown standing beside the machine. This comparison gives a good idea of the machine's great size.

The process for the manufacture of the blocks, as before stated, is automatic from first to last. The raw material, including cement, sand, and gravel (or crushed stone), is first screened, and then workmen separate the aggregates into several sizes to eliminate voids and give added strength to the finished product.

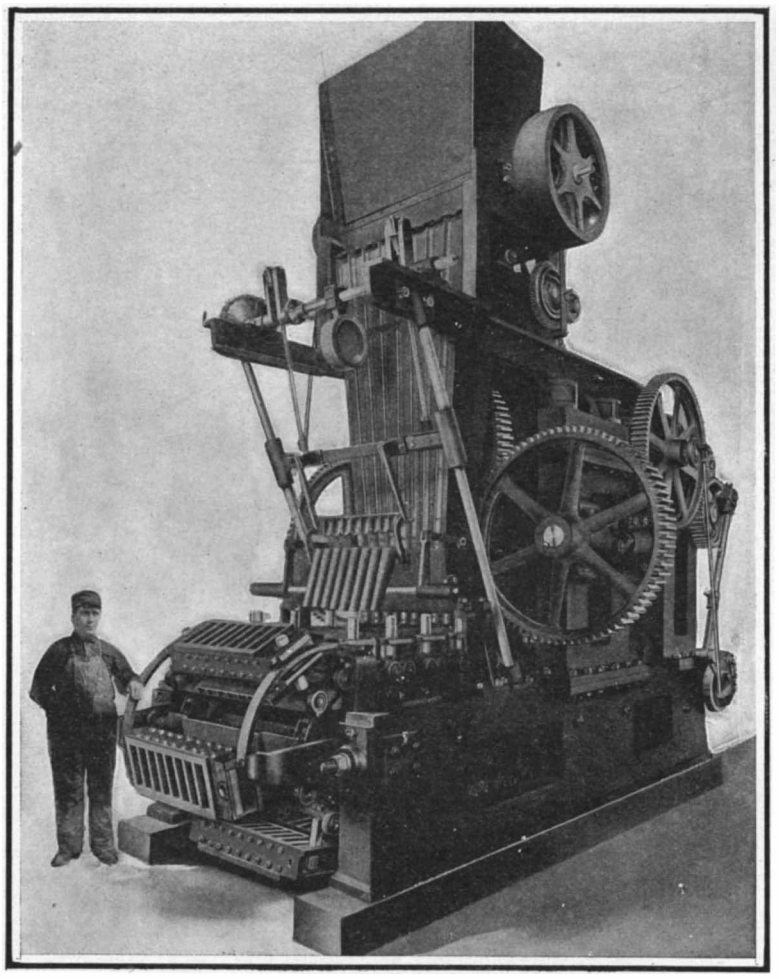
The ingredients are then mixed dry, after which a sufficient quantity of water is added to bring the mixture to a proper consistency. This mixture is then fed into an agitator, where it is kept under continual motion and permitted to flow into eight individual scale hoppers, each weighing the exact amount of material required for a single block. Then in unison these hoppers are dumped through receiving spouts into the molds which form the block, these being prepared in advance for the reception of this material.

While the above process is going on, a similar one for the preparation of the material forming the enameled part of the block is taking place in another part of the machine. This also starts by taking a dry mixture from individual bins, and measuring it automatically in a receptacle known as the reserve tank. At this time also the proper amount of coloring matter is added, so that blocks of a uniform shade may be produced.

Any color or combination of colors may be used; and no matter whether one, one hundred, or one thousand blocks are made, the same shade is produced in each one.

Water is next added after being automatically measured, and from the reserve tank the material is discharged into a receiving tank, a part of the machine proper with which are connected eight dipping cups conveying the material in a liquid form to the individual molds.

The molds are now ready for the body material, which has been in preparation as already described, and with the next movement of the machine an intimate association is effected between the two by the enormous pressure of 3,200,000 pounds applied to produce perfect cohesion.



A CONCRETE BLOCK MACHINE WEIGHING 70,000 POUNDS.

The molds move forward until they reach the releasing section of the machine, where the blocks are ejected, eight at a time, upon a pallet and loaded intact by workmen upon a car especially constructed for the purpose.

They are now conveyed to suitable storage, where they are allowed to season, no burning being required. Nature finishes the work by a process of crystallization, which gives each block a perfect surface without danger of distortion, as commonly results from burning clay bricks.

The illustration shows the machine to contain a rotary carrier consisting of thirty mold frames, each containing eight individual molds. At each movement of the machine several of these molds are receiving material at various fixed points; one group the enameling material, one the body material, while a third is submitting to the tremendous pressure which unites the two. After the application of this pressure, the next motion delivers the blocks contained in one mold frame upon the pallet as described elsewhere.

Anyone familiar with the process of manufacturing clay brick will readily realize the tremendous saving of time and expense accomplished by this process of manufacture. It has been estimated that the cost of sorting clay brick for quality and color is not less than $6 per thousand. This work of course is entirely done away with, as the enameled concrete blocks are absolutely uniform as to size and shape, and there can be no variation in color.

While especially designed for the manufacture of blocks, this is not the only function of the machine. Tile of various shapes, sizes, and colors are also produced by it with equal facility.

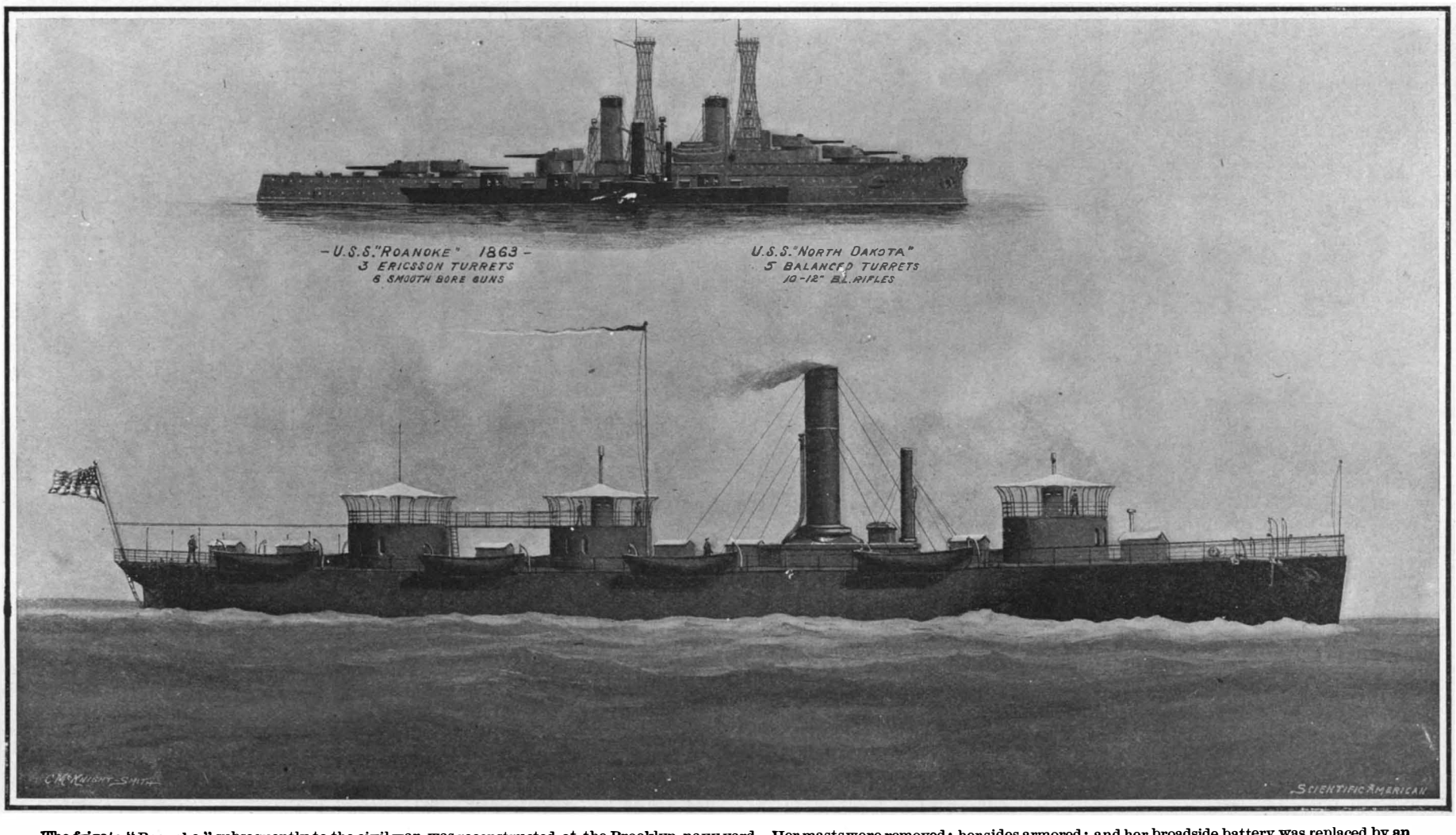
Though not in general use thus far owing to the inability of the manufacturers at the present time to supply the demand, the machine has nevertheless received exhaustive tests, and in each has given entire satisfaction. As for the material it produces, there can be no doubt as to its becoming popular. Our forests are rapidly disappearing, stone is prohibitive because of its expense, and the prospective builder turns with satisfaction to this comparatively new material, which recommends itself not only because of its cheapness, but because of its great lasting qualities.

A "DREADNOUGHT" OF 1863.

[The correspondent who sends us the photograph of an engraving from which the accompanying illustration of the "Roanoke" is reproduced, believes that this United States warship is entitled to be considered as the prototype of the modern "Dreadnought." We doubt if any early vessel can be quoted as having a stronger claim to be regarded as the first warship of this type.—ED.]

To the Editor of the SCIENTIFIC AMERICAN:

In the battleships of the "Lord Nelson" class of 1906, the British had come to about the limit of their intermediate battery, which consisted of ten 9.2-inch guns; these being substituted for the four 9.2 and ten



The frigate "Roanoke," subsequently to the civil war, was reconstructed at the Brooklyn navy yard. Her masts were removed; her sides armored; and her broadside battery was replaced by an all-big-gun armament of six heavy guns mounted in three armored turrets. The correspondent who sent us the above illustration suggests that she was the first of the "Dreadnoughts."

U. S. S. "ROANOKE," 1863. IS THIS THE PROTOTYPE OF THE MODERN "DREADNOUGHT"

6-inch of the "King Edward VII." class launched three years previous. In this same year they also launched their first "all-big-gun" ship, the "Dreadnought," by abolishing the 9.2-inch guns, substituting in their place six 12-inch guns, and adding these to the four 12-inch guns, which the other two classes already had, making ten in all, and placing them in pairs in five turrets. This is the ship that in three years has revolutionized the navies of the world, all of whom are now building this class known as "Dreadnoughts." But was not this idea of the "all-big-gun" ship taken from one that was first produced in the American navy?

The definition of a "Dreadnought," as I understand it, is an armored ship with a high freeboard, carrying only guns of the largest caliber in use, these arranged on one deck in pairs and in armored turrets; the number of turrets not being restricted necessarily to five, can be one more or one less according to the tonnage of the ship.

In 1852 there was a steam frigate built by the United States at the Gosport navy yard at Norfolk, Va., and called the "Roanoke." She was 265 feet in length, with a breadth of 52½ feet, and a depth of 26. Her machinery was built by the Tredegar Iron Works at Richmond, Va., and consisted of a pair of trunk engines with cylinders 72 inches diameter and 26 inches stroke.

This frigate was anchored in Hampton Roads at the time of the battle between the "Monitor" and "Merrimac." After this fight, which introduced to the world the revolving armored turret with its pair of heaviest guns afloat (15-inch smooth-bores) she was taken to New York and razed at the Brooklyn navy yard. Her masts and sails were removed, her sides were armored, and she was equipped with three Ericsson turrets at the Novelty Iron Works in 1863. Each of the turrets contained a pair of the heaviest guns in use, and they were placed fore and aft on the center line of the vessel, which is the arrangement of the turrets on American "Dreadnoughts." The vessel had no masts and no secondary or auxiliary battery, only the "all-big-gun" armament.

It seems to me that the "Roanoke" complies in every way with the definition of the modern "Dreadnought"; that the idea of the "Dreadnought" was first developed in her; and that she *was* the first "Dreadnought"—or in other words, the great "Dreadnoughts" are developed "Roanokes." Their arrangement of guns, armor, and turrets is from her. The "Roanoke" had no military or skeleton masts or rapid-fire guns, these at that time not being necessary, as wireless telegraphy and torpedo boats were not then known.

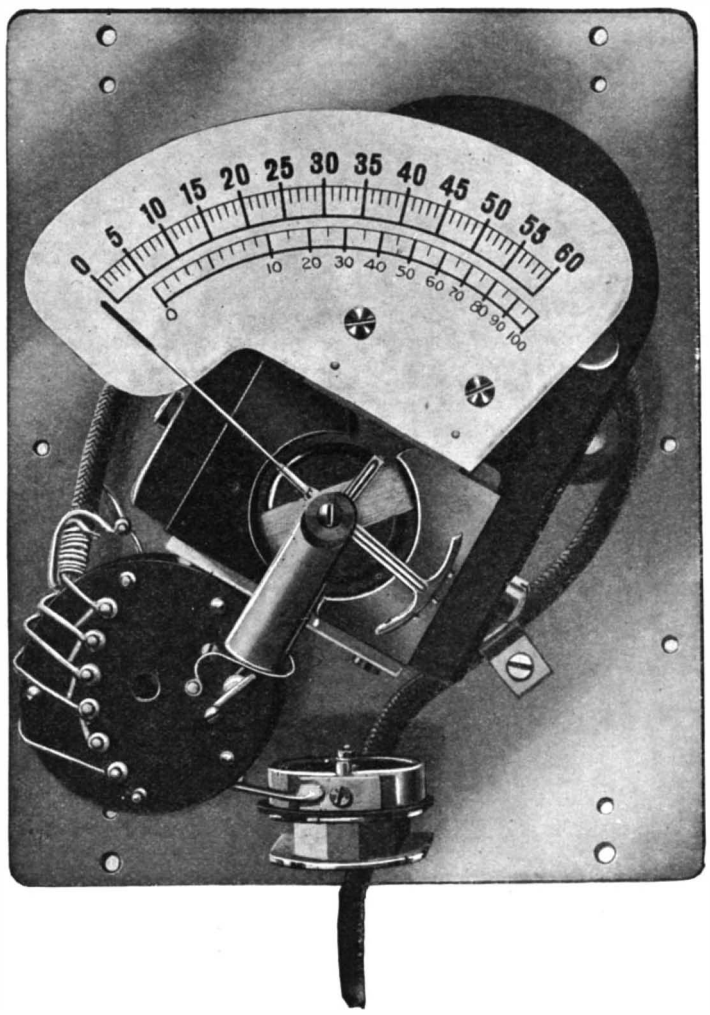
The American navy had the first steam vessel of war and the first "Monitor," and should it not be credited with the first "all-big-gun" ship, the "Roanoke," of which the "Dreadnoughts" are but an enlargement of the same idea? I inclose a photograph of the "Roanoke," taken from a large lithograph made for the Navy Department, and presented to me by the Assistant Secretary, G. V. Fox, with a number of others in 1863.

WILLIAM BOERUM WETMORE.

Allenhurst, N. J.

POWER INDICATOR FOR INTERNAL-COMBUSTION ENGINES.

A strikingly novel instrument, the invention of Prof. N. Monroe Hopkins of the George Washington University, is pictured in the accompanying engravings. The instrument is a combination power indicator and precision speedometer without a flexible shaft, and when the equipment is installed upon a stationary engine, automobile, motor boat, or aeroplane, shows what the cylinders of the engine are doing separately or together; which, if any, cylinder is missing; the power of the engine and the conditions under which it is doing the most useful work; how to adjust the carbureter perfectly when the engine is idle as well as under load; speed with absolute precision from 1 to 60 or 100 miles per hour, and mileage; and the revolutions per minute of the propeller in aeroplane and marine work.



Interior details of the indicator.

The instrument is an original application of the fact that an electric current is produced by the simple heating of the junction of two dissimilar metals, and the magnitude of the current so generated is proportional to the junction temperature.

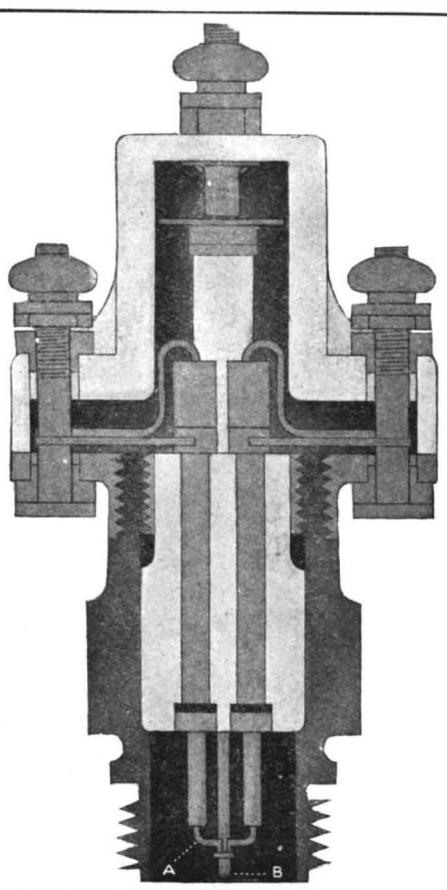
Ordinary thermo-couples as evolved by Becquerel, and used for general temperature measurement in the arts and sciences, would never "live" to operate under the high temperature and peculiar chemical conditions in a gasoline engine cylinder, because they would become so heated as to pre-ignite the charge and cause the gas engine to buck, hitch, or back-fire, and in addition would become brittle and drop apart, either through oxidation or the absorption of carbon, after a short period of use. Actual temperature measurements by means of thermo-couples or thermometers could not be made in gasoline engine cylinders.

Prof. Hopkins's thermo-couples are of original construction and are designed to give an idea of the temperature in a gasoline engine without actually attempting to measure it. His instrument faithfully and continuously shows, by modified temperature readings, the working conditions of gasoline engine cylinders. The "thermo-plugs" give the same "electrical pressures" after 50,000 miles' use on an automobile as when first applied.

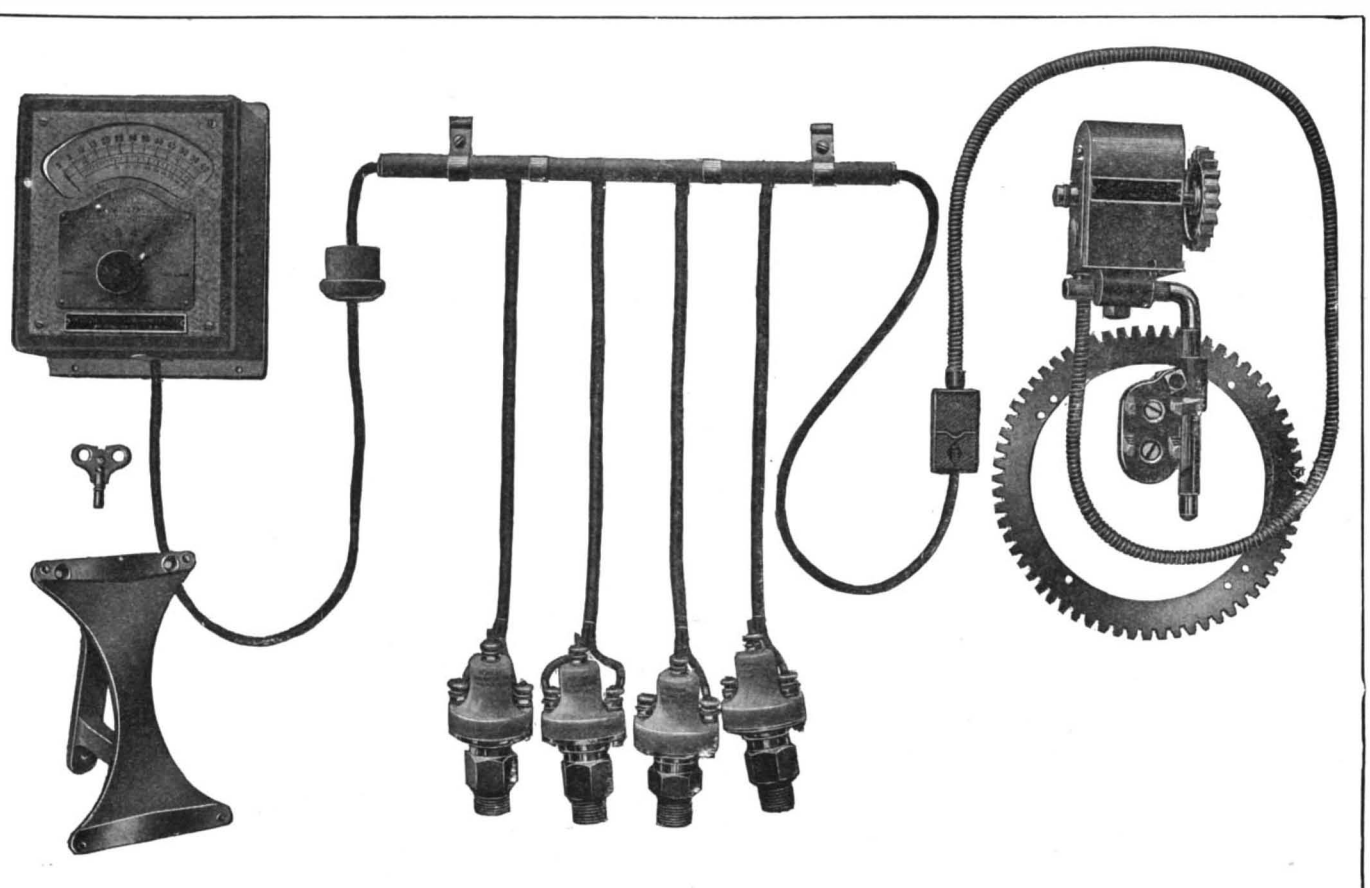
One of the illustrations shows a sectional view of a combination firing and indicating plug. The thermo-couple may be seen at *A*. It consists of special alloys drawn into wires surrounded by massive metal tubes closely fitting the wires and adjustably receiving them. These metal tubes are connected at their upper ends through the agency of heavy metal lugs connecting with the binding posts, and dissipate the heat by conducting it at a predetermined rate away from the tip of the thermo-couple within the engine cylinder to the binding posts without. All plugs are calibrated and are interchangeable. The adjustment in such plug being obtained by sliding the thermo-couple wires through the heavy metal tubes to a greater or lesser distance into the engine cylinder. Stuffing boxes screw on to the top of the metal tubes, making a gas-tight joint between the thermo-couple wires and said tubes. In practice they protrude beyond the lower end of the metal tubes about 3/64 of an inch.

An engine should have these specially constructed thermo-couples in each spark plug. They may be selectively or collectively connected with an electrical indicating instrument which gives an accurate reading of the current delivered by one particular cylinder or by the combined cylinders if the spark plugs be connected in series.

There is a switch on the instrument for obtaining separate or combined cylinder indications. The instrument has two scales, the upper a speed scale and the lower a power scale. On the switch there is also a speed contact *S* which connects a small magneto-dynamo with the indicating instrument and electrical current is furnished in direct proportion to the speed at which the dynamo is driven. In addition to this com-



Spark plug fitted with thermo-couple.



General view of the indicator and speedometer.

POWER INDICATOR FOR INTERNAL-COMBUSTION ENGINES.

bination speedometer and dynamometer, Dr. Hopkins has also invented an electric speedometer indicator and tachometer of great sensitiveness and accuracy.

THE SOLAR AND LUNAR ECLIPSES OF 1909.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

The intervals of time between the dates of the eclipses of the sun and moon this year, which occur alternately, illustrate the effect of the rotation of the plane of the moon's orbit in a direction contrary to her orbital motion. If this plane moved parallel to itself, there would never be more than two eclipse seasons in the year; and eclipses would occur when the earth would be at or near opposite points in its orbit, at average intervals alternately of a little more and a little less than six months. This inequality, due to the eccentricity, would evidently disappear if the line of nodes were always parallel to the axis of the orbit.

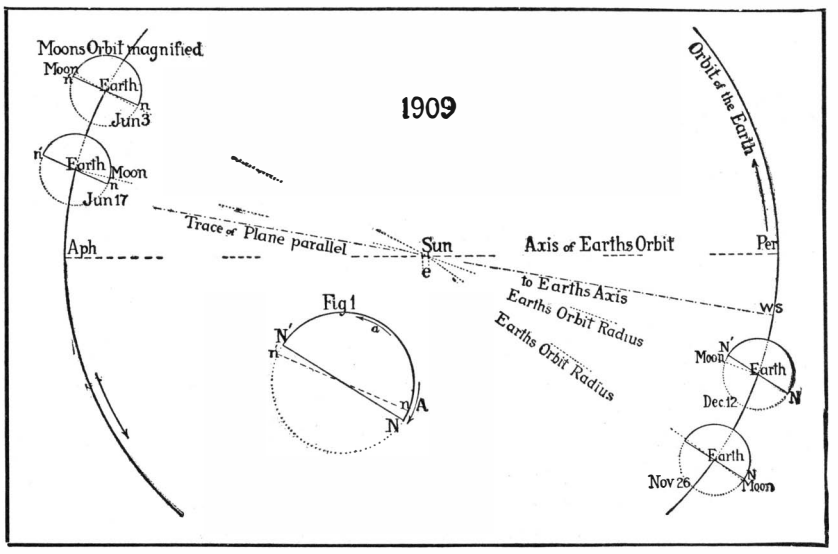
Fig. 1 illustrates the rotation of the moon's orbit between the months of June and December this year. The lines *nn'* and *NN'* are drawn parallel respectively to the line of nodes for these months. The angle included between them is about 9 degrees. The arrow *A* shows the direction of rotation of the orbit; the arrow *a*, that of the moon's motion. The rotation of the line of nodes into the position *NN'* obviously will bring it into coincidence with the radius of the earth's orbit at an earlier date than the line *nn'*, which will coincide with the orbit radius when the earth has reached the opposite point in its orbit.

The eclipses of both the sun and moon in June occurred when the moon was in that part of her orbit which was *above* the plane of the ecliptic. The eclipses in November and December will occur when the moon will be *below* that plane. In order to show this clearly, it is necessary to represent the moon's orbit on a scale very much greater than that of the earth's orbit, only a portion of which, including perihelion and aphelion, is plotted. The position of the earth is shown for the dates of the eclipses on June 3 d. 13.3 h. and 17 d. 11.5 h.; also for November 26 d. 20.75 h., and December 12 d. 8.15 h., Greenwich mean time. Since the diameter of the moon's orbit is less than a half a million miles, it would be correctly represented in the plot by a diameter a little less than a third of the linear eccentricity of the earth's orbit (= *e*). The dimension has been magnified forty times, in order to show the earth's and moon's orbit radii and the line of nodes clearly, which would be indistinguishable by the smaller scale. It should be noted that in magnifying the moon's orbit, the relation between these lines is not disturbed, that is, the angles included between them are preserved. In the drawing the diameter is enlarged sufficiently to show that on June 3rd, the date of the first lunar eclipse this year, when the earth's and moon's orbit radii were projected in the same line on the plane of the ecliptic, the moon was approaching the descending node *n'*, and was above the plane of the ecliptic. On June 17th, the date of the solar eclipse, the plot shows that the moon had recently passed the ascending node *n*; but her distance was so far from the node and above the plane of the ecliptic, that while the eclipse was central, the moon's shadow was projected on the earth very near the north pole.

On November 26th, the date of the total eclipse of the moon, the plot shows that the moon will be below the ecliptic and approaching the ascending node *N*. On December 12th, the date of the partial eclipse of the sun, the moon will be below the ecliptic, and will have recently passed the descending node *N'*. The distance below the ecliptic will be so great, that the eclipse will be visible principally in the region of the south pole.

The enlarged plot of the moon's orbit shows the position of the moon at Greenwich noon for each day from November 21st to December 18th; and also at the dates of the eclipses. On November 26th, when the moon will be near perigee, *P*, and very nearly a minimum distance from the earth, she will come wholly within the earth's shadow. On December 12th the enlarged plot shows more clearly the great distance between the moon and the node at the time of the eclipse of the sun. These plots may be compared with those printed in the Scientific American for May 15th, 1909 ("The Lunar and Solar Eclipses in June, 1909"). Figs. 2 anl 3 are projections of the earth on a plane parallel to its axis, and perpendicular to the plane of the ecliptic. Its trace on the plane of the ecliptic drawn through the sun evidently intersects the earth's orbit at points which the earth reaches at the dates of the summer and winter solstices. In these projections less than one-half the visible hemisphere is illuminated between the autumnal equinox and the winter solstice.

The direction in which the eclipse of the moon will be seen, Fig. 2, is shown by the arrows. It will be visible at Washington; the beginning visible generally in North and South America, and northeastern Asia; the ending generally visible in North America, northwestern South America, eastern and northern Asia, and Australia.



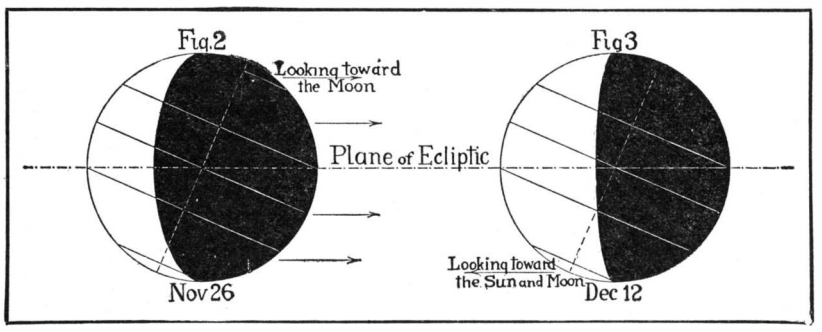
ROTATION OF MOON'S ORBIT BETWEEN JUNE AND DECEMBER.

In Fig. 3 the arrow shows the direction in which the eclipse of the sun will be seen. The limit of visibility will include a very small part of Australia, New Zealand, Tasmania, and the South Shetland Islands.

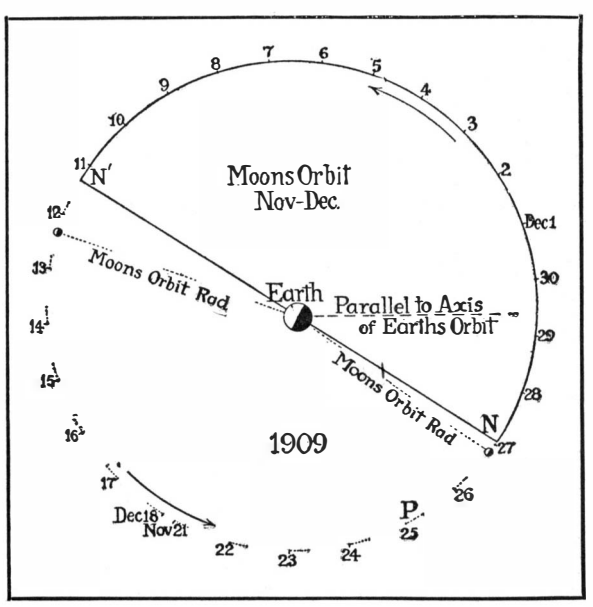
Why the Pole Shifts.

It is well established that, at least during historic times, no changes of any considerable magnitude have occurred in the latitudes of places on the earth. It has long been suspected by astronomers, however, that minute changes of latitude were taking place, but it is only during the last quarter century that the methods of observation and calculation have reached that degree of refinement necessary to detect these small changes.

In 1884 and 1885 Dr. Küstner, astronomer at the Royal Observatory of Berlin, made a series of observations upon certain stars for the purpose of determining the constant of aberration—the maximum apparent displacement of a star due to the finite ratio between the speed of the earth in its orbit and the velocity of light. One of the quantities used in the reduction of these observations is the latitude of the place of observation. Dr. Küstner found his results to be discordant, much more so than he had good reason to believe that they should be from the known care and precision with which the observations were made. Upon investigation it was found that these discrepancies could be almost entirely explained away by assuming a change in the latitude. Dr. Küstner, therefore, in 1888, made the bold announcement that the latitude of the Berlin Observatory had changed during the period over which his observations extended.



DIRECTION IN WHICH ECLIPSES WILL BE SEEN.



ENLARGED PLOT OF MOON'S ORBIT.

This announcement aroused widespread interest, and steps were immediately taken by the International Geodetic Association to test the reality of the announced variation. Through the co-operation of the observatories at Berlin, Potsdam, Prague, and Strasburg, observations for latitude were begun in 1889 and carried on continuously over a year. These observations agreed in showing a minute but appreciable change in the latitude. In order to test the matter still further, an expedition was sent in 1891-2 to Honolulu, and observations for latitude were made there simultaneously with others made at the observatories just named. As Honolulu is on the opposite side of the earth from Europe, it is seen at once that if the latitude were increasing at the European observatories, a corresponding decrease should be shown at the Honolulu station. The results came out as expected, and this was generally accepted as a complete demonstration of the reality of this phenomenon.

What is the cause of this wandering of the Pole? In an article by Dr. Sidney Dean Townley of Stanford University, this explanation is given:

In 1765 Euler, a famous Swiss mathematician, demonstrated, as a proposition in dynamics, that if a free rigid oblate spheroid rotates about an axis which differs slightly from the axis of figure, or shortest axis, then the axis of figure will revolve about the axis of rotation in a period the length of which will depend upon several factors. He computed that, if the assumed conditions obtained for the earth, then the period of revolution of the axis of figure above the axis of rotation would be 306 days. Obviously, however, the earth is not rigid; the oceans are quite plastic and the ground itself is possessed of some elasticity. Prof. Newcomb computed some years ago that, if we assume the earth as a whole to possess the rigidity of steel, then the period of revolution of the one axis about the other would be 441 days, as against 306 days found by Euler on the assumption that the earth is perfectly rigid. The actual observed period is fourteen months, or 427 days, and the legitimate conclusion to be drawn is that the earth as a whole is somewhat more rigid than steel—a conclusion that agrees with that derived by Lord Kelvin and others from entirely different considerations.

Now the question arises, Why does the earth not rotate upon its shortest axis? The explanation is simple. If the earth ever did rotate upon its shortest axis it could not continue to do so because of the shifting of matter upon and within the surface. Winds, rains, rivers, and ocean currents are ceaselessly transporting matter from point to point, and during the winter great masses of snow and ice accumulate in the temperate and frigid zones only to disappear again in the summer. Although these effects will, to a large extent, neutralize each other, the sum total can not be other than to produce at least a theoretical lop-sidedness to the earth; and as soon as this takes place there must be a shifting of the axis of rotation. The time of revolution of the one axis about the other could be accurately computed if the exact form of the earth, the structure of the earth's interior, and its coefficient of elasticity were known.

In addition, there are other phenomena, namely, volcanoes and earthquakes, through which considerable quantities of matter may be displaced. That the amplitude of the polar motion might be affected by earthquakes was pointed out by Prof. Milne ten or fifteen years ago and a French scientist has more recently compiled a table showing the number of severe earthquakes each year and the amplitude of the polar displacement. A rough proportionality between the two seems to exist; that is, the greater number of earthquakes each year, the greater the amplitude of the polar displacement. Such results, however, are to be taken with several grains of allowance. The term "severe earthquakes" is rather indefinite and by modifying the definition quite a variety of results may be obtained from the given data. It might be pointed out that in 1906, the year of the great earthquakes in California and Chile, the amplitude of the polar displacement was small.

We have then a rational explanation of the phenomenon of the variation of latitude. The axis upon which the earth rotates is not in exact coincidence with the

shortest axis; such being the case, according to the principles of dynamics, the axis of figure must revolve around the axis of rotation, giving rise to the changes of latitude. But on account of the changes incessantly taking place in the distribution of matter upon the earth's surface, and perhaps also within the surface, the amplitude of the polar displacement, and perhaps the principal period of revolution of the one axis about the other, are changeable, the changes taking place in an undetermined way.

In connection with this explanation we should not lose sight of the fact that all the material moved through meteorological, volcanic, and seismic agencies is probably almost infinitesimal as compared with the total mass of the earth, and no one has as yet shown that the shifting masses are sufficient in magnitude to account properly for the observed annual and other unexplained components of the polar motion.—Abstracted from the Popular Science Monthly.

An International Sport Exposition.

An exposition devoted to sports and games is to be held in Frankfort-on-the-Main in 1910. Frankfort is annually the scene of many sporting contests, for which reason the selection of the city for the purpose of an international exposition is certainly wise. An executive committee has been formed, the first task of which was to give the organization its name, which rings imposingly "Verein Internationale Ausstellung fuer Sport und Spiel." The exposition will be divided into the following groups: 1. Horses and vehicles (harness, riding and driving equipment, stables, horse breeding and care). 2. Automobiles and motor-driven vehicles. 3. Turf sports, such as gymnastics, fencing, open-air athletics (tennis, football, golf, handball, polo, cricket, gymnastic apparatus, weapons, etc.). 4. Aquatic sports (rowboats, sailboats, motor boats, swimming, and fishing). 5. Winter and Alpine sports (skates, skis, snowshoes, sleds, huts, climbing outfits). 6. Hunting (guns, sportsmen's apparatus, stuffed animals). 7. Aerial sports (free balloons, dirigible airships, flying machines, models, aeronautic instruments). 8. Tourists' exhibits, such as photographic and optical apparatus (charts, guide books, history and literature of traveling, telescopes, etc.). 9. Application of sport to therapeutics (gymnastic apparatus, life-saving devices, transportation of invalids). 10. Sporting outfits of all kinds. 11. The artistic side of sport. 12. Toys. 13. Miscellaneous.

Award of a Medal for the Discovery of Bakelite.

At the second regular session of the New York Section of the American Chemical Society, held at the Chemists' Club, 108 West 55th Street in this city, on the evening of November 5th, Dr. Leo H. Baekeland, president of the Electro-Chemical Society, was awarded and presented with the Nichols medal for his papers on "The Synthesis, Constitution, and Industrial Application of Bakelite" and "Soluble and Fusible Resinous Condensation Products of Formaldehyde and Phenol."

In accepting the medal Dr. Baekeland expressed his thanks for this expression of regard for his work, and alluded feelingly to the friendly co-operation and aid he had received from the fellow members of the section. He then exhibited several industrial applications of the new compound bakelite, and made an experimental comparison of the resiliency of a ball of bakelite the size of a billiard ball with an ivory billiard ball. A stand three feet high was set upon the lecture table. The ivory ball was then dropped from the upper side of the stand to the table, the height of its rebound was noted, and the length of time of the rebound until it came to rest, which was six seconds, by the use of a stop watch. The ball of bakelite passing through the same height to the table rebounded at least six inches higher and came to rest in ten seconds, showing much greater resiliency than ivory.

Bakelite is used very successfully in the manufacture of electro-magnet spools, and is claimed to be superior to gutta percha in that it will stand a greater degree of heat, in the event of a short circuit.

The Current Supplement.

The opening article in the current SUPPLEMENT, No. 1768, deals with Henry Farman's new biplane. An excellent picture of the machine with Farman seated in it is presented. The first installment of an article on bakelite, a new composition, is given by L. H. Baekeland, its inventor. Samuel K. Patteson writes instructively on the measurement of humidity. The relation of Charles Darwin to Mendelism is set forth by Dr. A. E. Shipley. Recent models of superheated steam locomotives are described and illustrated. An illustrated description of the fast turbine yacht "Winchester" is published. Major H. L. Hawthorne critically points out the advantages and defects of balloons and dirigibles in war. Mr. Snowden B. Redfield concludes his article on the making of automobile tires. Hervey J. Skinner tells how tar is applied to the surface treatment of roads. The usual electrical, engineering, and trade notes and formulæ will be found in their accustomed places.

Correspondence.

FIGHTING POWER OF THE "INFLEXIBLE."

To the Editor of the SCIENTIFIC AMERICAN:

May I call the attention of your correspondent, Emerson B. Manley, whose letter appeared in your issue of October 23rd, to the fact that the "Inflexible" is not a sister ship of the "Dreadnought"? The "Inflexible," despite the number and power of her guns, is not rated as a battleship, but belongs to the cruiser class.

In an engagement between such a ship and a battleship carrying four 12-inch guns and a powerful secondary battery of 8's and 7's, it is most improbable that the ship of the "Inflexible" type would engage—and her excessive speed would give her the range decision—at such a range that her enemy's secondary battery could be effective. Her preponderance in big gun power—eight 12's against four—would enable her to demolish the secondary battery before the 8-inch and 7-inch guns could get a single effective shot home.

M. LATOUCHE THOMPSON.

St. John's Rectory, Manitou, Man.

WHY WATCH SPRINGS BREAK.

To the Editor of the SCIENTIFIC AMERICAN:

Being an old subscriber to your most valuable paper, I take the liberty of writing you regarding the unusual, or I should say peculiar, action of main springs in watches. My father, an horologist of over fifty years, and I, who learned the trade from him, have had some, as we think, remarkable experiences in the main-spring line. We think climate has much to do with their breakage; but if a watchmaker with sweaty hands handles a spring, there will be trouble. Also one who uses gasoline or any of the similar fluids will have the same trouble.

Our trouble has been mostly in the season when electric storms prevail, or a sudden change of temperature. We always advise our customers not to put watches on a marble dresser or any cold surface, but leave them in their pocket. The temperature in the vest or other garment changes gradually, and thus does away with any sudden expansion or contraction. We have been in the Mississippi Valley for many years, and our experience has been that, specially during the fall and spring seasons, during thunder storms we have more trouble with main springs. Sweaty hands do no good to a main spring. Tissue paper, in our experience, is the proper thing to wipe a spring with. May be slightly oiled. My father has been very successful in that line of watch repairing.

Natchez, Miss. F. T. BESSAC, M.O.

RAILWAY MOTOR CARS.

To the Editor of the SCIENTIFIC AMERICAN:

In your last issue I notice that you are to have a special issue on the middle West. I wish you would call attention through your valuable magazine to the need of some kind of a motor car that will run on railway tracks. It should be an independent motor car, run by its own engines. There is an opening for thousands of miles of so-called interurban railways in Iowa and other middle West States, where it would not pay to build an electric railway line on account of the large expense; but if some economical and reliable form of independent motor car could be perfected, such cars could be used for passenger traffic, and small steam locomotives for freight cars, and such roads would pay well. The track should be built on modern lines, with easy grades and curves and independent right of way, so that trains and cars can make good time for passenger service and can also handle freight cheaply, by use of regular freight cars from the steam roads, and thus would be valuable feeders and distributers for the steam roads, where branch steam lines would hardly pay. Such motor cars for passenger service should also be used on many branch steam railway lines, where better passenger service is badly needed, and where steam passenger trains are too expensive to run often enough to give good service.

Motor cars of this sort to use gasoline for power have been perfected and are in use in several places, but they are gradually being abandoned on account of the constantly increasing cost of gasoline. It seems that little or no progress is being made in perfecting such motor cars to use alcohol or kerosene. Might not the producer-gas engines for small boats requiring less than 500 horse-power be adapted for these motor cars? In your issue of September 18th, 1909, on page 191, you made mention of a very remarkable demonstration of the possibilities of producer-gas engines of this sort by Mr. H. L. Aldrich, using pea-anthracite, which at a cost of $4 per ton is stated to be one-tenth the cost of operation of a gasoline engine with gasoline at 15 cents a gallon, to produce equivalent power.

For a long time it has seemed to me that there is an excellent opportunity for invention in the production of such an independent motor car, operated by some power other than gasoline. Some cars of this sort are in apparently successful operation which generate electric power by means of a gasoline engine, but it seems that in so roundabout a system, there must be a large waste of power.

Equipped with motor cars of the sort suggested, such railways could be built much cheaper than trolley lines, and also operated much cheaper, until the business grows to a point where it would pay to change to electric power. The perfecting of such a car would mean the building of many miles of new railways, and possibly the cars would also be adopted in time by the steam railways to give better local passenger service. Many good towns in Iowa are made "whistling stations" by the steam roads in their mad race for through business.

Lack of better railway facilities, and lack of many miles of new railways that should have been built long ago, are factors that are holding back the development of a great deal of this middle West country.

Steam railways want through business, long hauls, and great tonnage; electric railways are too expensive as yet in many places; if a motor car that is light, reliable, and not expensive to operate, can be perfected, using producer-gas engines, there is no question but that there is a great opportunity and opening for such a car, as above suggested.

I trust that you will deem this communication as important as the number of our ancestors, for instance.

Belle Plaine, Iowa. H. R. MOSNAT.

ANOTHER EVIL OF DEFORESTATION.

To the Editor of the SCIENTIFIC AMERICAN:

One of the recognized evils produced by the woodmen who spare no tree (but leave where once the lord of the forest stood, the earth all bleak and bare) is the reduction in the yield of water power. But it seems that the fact that deforestation also increases the cost of what water power you do get, has never been mentioned.

Suppose that the flood level of a normal river is such as to require a 25-foot dam for power purposes. After the valley has been skinned of its foliage, the flood level will be so much greater that a dam 30 feet or more in height will be necessary.

As the cost of dams increases with the squares of the heights (because the higher up the thicker), the 30-foot dam will cost nearly fifty per cent more than the 25-foot, and yet it will yield less power than the 25-foot would yield in the normal river, because deforestation has diminished the flow of water in the dry season.

The yield in the dry season is the available yield, because the larger yield at other seasons is of little value, for almost all users of power want power all the year around.

It is true, as I showed in my article in Cassier's Magazine of September, 1909, that if we would use both turbines and current motors in the same dam, high dams would not be necessary in many rivers; but this truth may be disregarded, because it will probably be a hundred years before the system there mentioned will meet the right man—the man who will introduce it. SYLVESTER STEWART.

Brooklyn, N. Y.

The Death of Theodore R. Timby.

Theodore R. Timby died on November 9th, 1909, at Brooklyn, N. Y. He was chiefly known because of his claim to having invented the revolving turret of the famous "Monitor," and that, accordingly, he should have received the fame history accorded to John Ericsson. For more than forty years he had tried to collect $500,000 from the United States for two inventions, one the revolving turret on warships and the other a device that points and fires heavy guns with electricity. Other things which Timby invented, and from which he obtained both recognition and financial reward, were a floating drydock, a system of coast defense, and a turbine wheel which proved especially successful.

A Book of Fourth-Dimension Essays.

The subject of the fourth dimension seems to have aroused so much interest among the readers of the SCIENTIFIC AMERICAN that we have decided to publish in book form the prize essay, the three essays that received honorable mention, and about sixteen of the best essays which were submitted in the recent Fourth Dimension Contest. The entire collection will be edited by Prof. H. P. Manning, who will prepare an introduction of considerable length, in which the subject of the fourth dimension will be simply and lucidly discussed. The book will be ready about the latter part of December.

The meeting of the British Association in Winnipeg on August 25th, is the third which has been held in the Dominion. The first Canadian meeting took place in 1884 at Montreal; the second thirteen years later at Toronto. The fact that the third was held at Winnipeg may be regarded as significant of the enormous development of the West during the past few years.

HOW LEMON OIL IS MADE.

BY FRANK N. BAUSKETT.

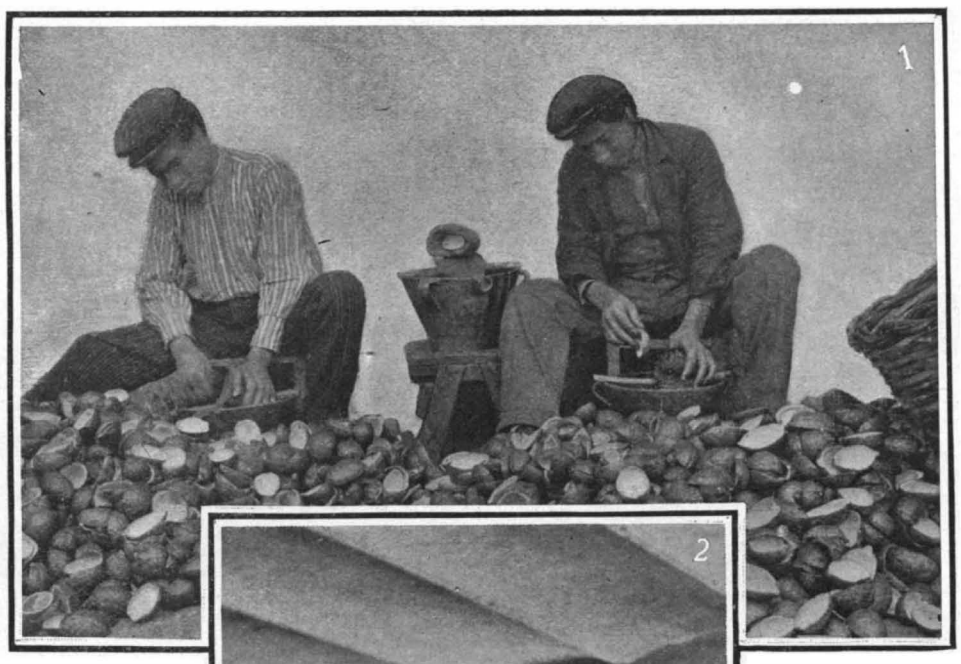
We all know that the flavoring extracts used in this country are of domestic manufacture, and that the two principal flavors are vanilla and lemon, but few have a knowledge of what actually constitutes these extracts. To quote from the standards laid down by the United States Department of Agriculture, a flavoring extract "is a solution in ethyl alcohol of proper strength of the sapid and odorous principles derived from an aromatic plant, or parts of the plant, with or without its coloring matter, and conforms in name to the plant used in its preparation." Peach, strawberry, pineapple, and some other flavoring extracts are always artificial, it being impossible to make an acceptable extract from the fruit itself, and therefore cannot be, in accordance with the United States standard, termed flavoring extracts. However, very little flavoring extract is used outside of vanilla and lemon, as at least ninety-five per cent of the extracts manufactured are of these two varieties. The government through the Agricultural Department has delved deeply into the methods of the manufacture of flavoring extracts, but the story as to how the lemon oil is made from which the extract is manufactured is the more interesting.

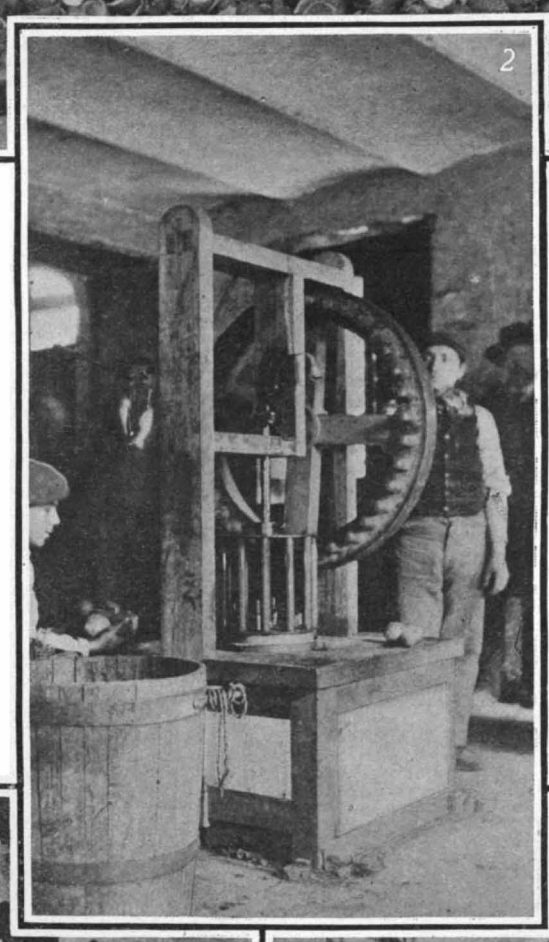
The oil of the lemon is the essential oil secreted by cells lying near the outer surface of the rind, and the world's supply of this oil comes from the island of Sicily in the Mediterranean Sea. This island is the greatest lemon-producing region in the world, and all parts of the world receive their supply from that island. The oil for making the extract is produced as a by-product of the crop from the culled lemons —those which for any reason will not stand shipment.

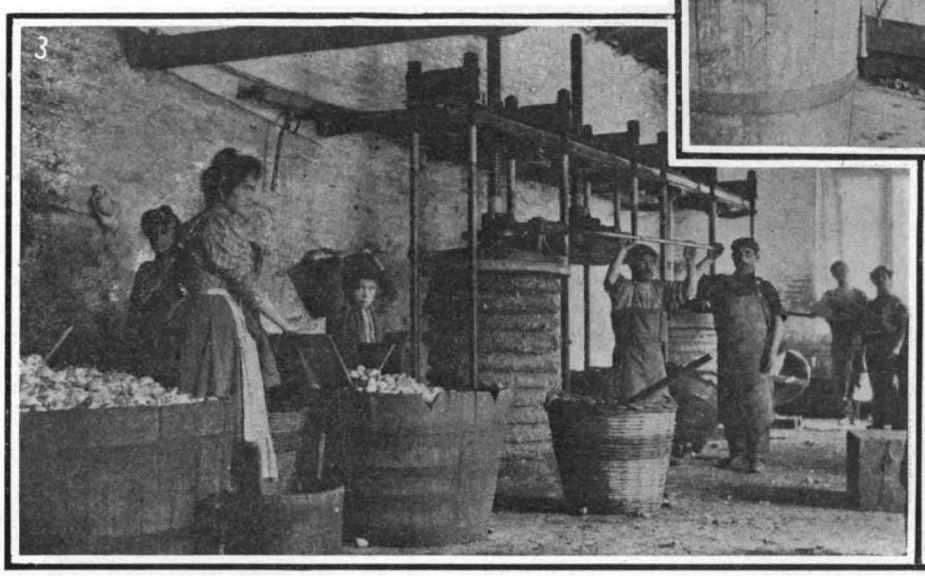
For obtaining the lemon oil, there are three processes, all of which are extremely crude. There are two processes known as the sponge methods, and one known as the machine method. In the sponge methods the lemons are cut in pieces by children and women, the cheapest form of labor. The work is carried on with great rapidity, the knife being started through the rind and the fruit cut in two and thrown into storage tubs by one motion of the arm. The tubs containing the halved lemons are dumped into shallow troughs, where the pulp is separated from the skins. For this work older girls and women are employed, and so expert do they become, that in the twinkling of the eye a spoon-shaped instrument is inserted between the pulp and rind, and with one twisting motion the pulp is scooped cleanly from the rind and deposited in the trough. The rinds are thrown into baskets to be conveyed to the spongers. However, before the sponging process is begun, the baskets of rinds are immersed in water for four or five hours. The work of extracting the oil is done entirely by men, as the task is quite a laborious one. These workers sit upon low stools, the skins being dumped upon the floor near them, and a basket for the exhausted skins set in a convenient place. A small earthenware bowl is placed on the floor between the workman's knees. This bowl has at one side a lip, directly beneath which is a concave depression, which serves to hold back the residue when the oil is poured from it. Across the top of the bowl is placed a round stick about one inch in diameter, notched to fit the widest part of the vessel. Across this stick is hung a flat sponge surmounted by another thicker one, and finally a third, which is cup-shaped, into which the lemon rind is inserted with one hand, the other being used to press the sponge, the weight of the whole body being thrown into the motion. The lemon skin is then turned partly over and the pressure renewed. Each half rind is handled separately, receiving three or four pressings. It requires about two thousand of these half rinds to produce one pound of oil, the exact quantity depending upon the size, ripeness, and freshness of the lemons. The green fruits produce more oil than the ripe. A good workman can squeeze out two or three pounds of oil a day, for which he receives about fifty cents. This oil is worth in quantities about one dollar a pound. But for making lemon extract, but a small portion is required. The method of manufacture is simple. The oil is dissolved in strong alcohol in the proportion of five parts oil and ninety-five parts alcohol; it is then filtered and bottled. An idea of the small proportion of the oil required may be had when it is considered that five barrels of the oil and ninety-five barrels of alcohol would make just one hundred barrels of pure lemon extract.

By the two-piece method only a small quantity of water is expressed with the oil, and the process of separation is very simple, the bowl being tilted forward until the oil can be blown from the surface over its edge into another receptacle. The water and residue remaining are separated from the traces of oil by the same means, and finally filtered through felt bags. The residue left in these bags is collected for several days, when the bags are placed under a hand press and freed from the last traces of oil. What is known as the three-piece method differs from the one just described mainly in the preparation of the skins before pressing. The rind of the fruit is pared off in three slices, leaving the greater part of the pulp with some little skin at the ends. This paring, as a rule, is done by boys or men, and the skins are washed and soaked as in the two-piece process. Much more pulp is left adhering to the skins in the three-piece method, and naturally more juice is mingled with the oil than by the other method. The claim is made, however, that oil made in this way filters more rapidly and remains clear longer.

The use of machines in producing lemon oil is confined to the Province of Calabria in Italy. But the oil manufactured in this way forms but a small percentage of the total product. It has, however, a deeper color than the oil pressed out by hand, and is used to deepen the color of the latter product. The machine for extracting lemon oil is about as crude as the hand process. The fruit fed to this machine must be of uniform size and in small quantities. The lemons are placed in a receptacle between the grinding disks, the lower of which is stationary, while the upper one is turned by an arrangement of wooden cogs against the side flywheel. The pressure exerted by the weight of the upper disk is partly compensated for by the arm at the rear, which is also used to raise this part of the machine, so that the fruit may be placed in position and the pulp removed. A bell rings after a certain number of revolutions, and the machine is stopped to remove the squeezed rinds and to reload the receptacle. Indeed, this machine method of oil extraction is no faster than the sponge processes followed by the inhabitants of the island of Sicily.







1. Two-piece method of extracting the oil. 2. A Calabrian lemon-oil machine. 3. Interior of Sicilian lemon-oil factory. 4. Removing the pulp of the fruit.

Sand Lime Brick.

According to the U. S. Geological Survey, the sand-lime brick industry is a comparatively new one in the United States, having had its beginning in Michigan City, Ind., in 1901. Its progress was slow at first, the value of the production in 1903 being only $155,040. From that time the value increased each year until 1907, when the maximum of $1,225,769 was reached. In common with other building materials there was a decrease in 1908 in the production of sand-lime brick to $961,226. The number of plants reporting made a rapid growth from 16 in 1903 to 94 in 1907, with a slight decrease in 1908 (to 87).

Common, front, and fancy brick were manufactured from sand and lime in 1908. The average price per 1,000 for common brick was $6.63, as against $6.61 in 1907, and $6.71 in 1906; for front brick the price was $12.16, against $10.96 in 1907, and $10.42 in 1906. In 1908 common brick composed 83.57 per cent of the value of all bricks, and front brick 15.37 per cent.

Thirty States reported both in 1907 and 1908, Alabama dropping out of the list in 1908 and Montana appearing. Of the individual States Michigan, as in 1907, was the leading State in 1908, reporting bricks valued at $138,809. Florida was second in both years.

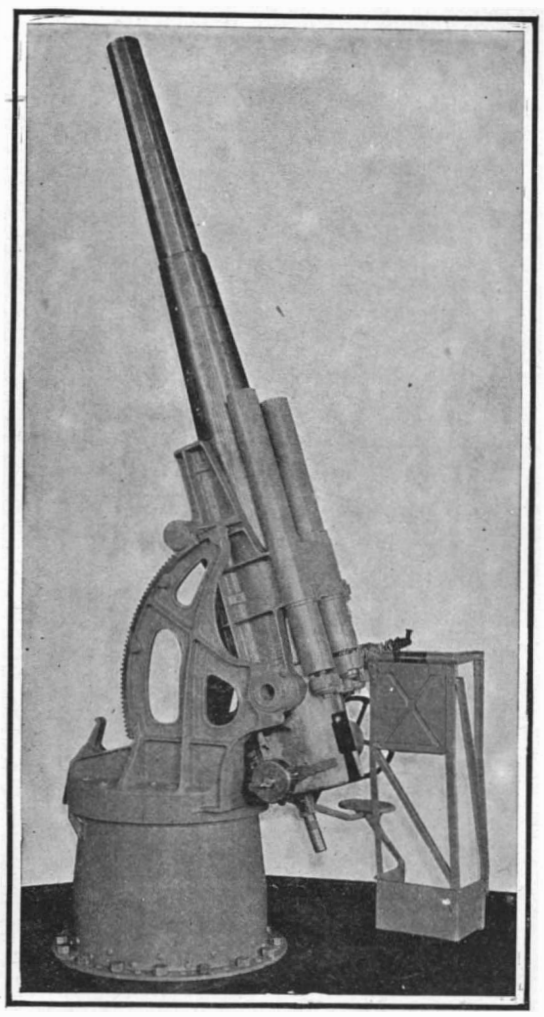
ARTILLERY FOR AIRSHIP ATTACK.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

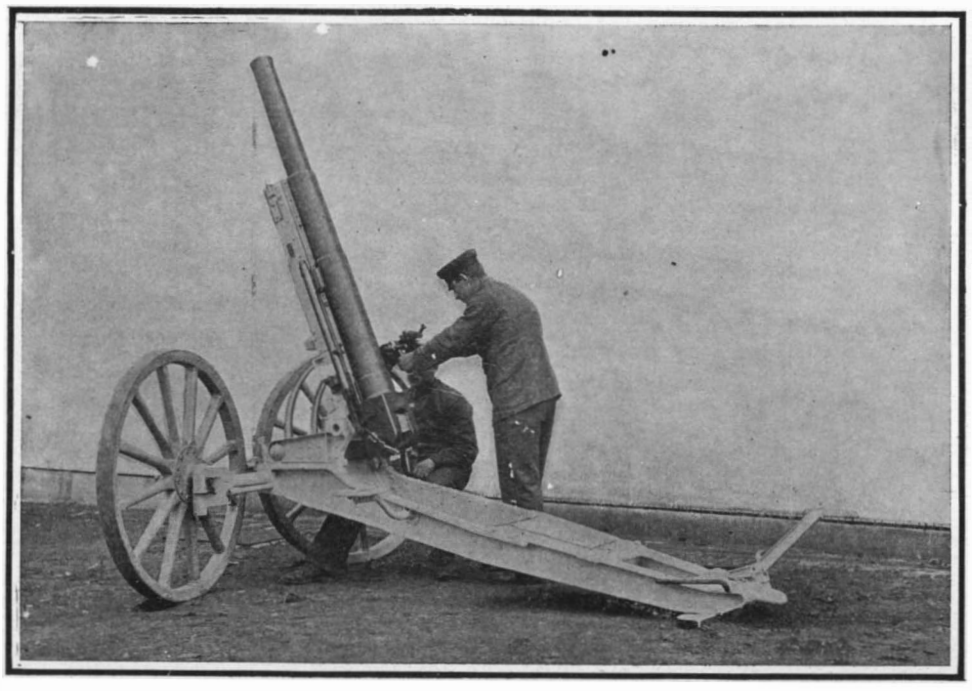
After having carefully studied the problem which is presented by the conditions of firing at great heights and at a large angle such as is required for use with airships, aeroplanes or balloons, the Krupp firm has brought out three general types of cannon, each of which is adapted for a special use. In the first place we have the more simple type of cannon with field mounting, while a second type is constructed with a view of being placed upon a motor car. For use on shipboard they design a third type which is represented in our engraving. In the second and third cases, the cannon is designed to be rapidly rotated in all directions by the use of a central pivot base such as is usually installed on vessels and for coast defense use. On the other hand, the field gun has its wheels arranged so as to turn upon pivots, which allows of placing the wheels in the crosswise direction in the position here shown. In order to give effective results it is found that the angle of elevation must be at least 70 degrees, and the field gun is designed to reach this angle. The automobile and ship cannon will, however, make a greater angle, the maximum being for these two types as high as 75 degrees. In all these cases a rapid rate of firing is given by an automatic opening and closing of the breech. The caliber has been reduced as much as possible, as also the weight of the projectile, while the long bore gives a high initial speed to the shot and diminishes the time required to attain the mark. Owing to the lessening of the caliber, greater lightness is obtained, and this is of service especially in the field and the automobile types of gun.

Sighting is carried out in the most efficient manner by the use of an appropriate form of sighting telescope in combination with a general finder which covers a wider range of field. There is also a range-finder by which the distance is first obtained, and afterward the indications are directly given so as to be able to point the gun for different heights of the airship without loss of time, and thus the use of firing tables is dispensed with in all these cases.

The question of the kind of shot which is best adapted for firing upon balloons or airships is of prime importance; and this matter has been made the object of a number of experiments. It is recognized that shrapnel will penetrate the balloon envelope, but without doing much damage at least of an immediate nature, seeing that the holes are closed again for the most part by the internal pressure of the gas, so that the loss of gas is not a rapid one and the airship is able to reach a place of safety in the majority of cases. It is found that the most effective form of projectile is a special kind of grenade, which is designed to explode in the interior of the balloon and to bring about ignition of the gas. The new projectile designed by the Krupp firm is intended to accomplish this, and at the same time the path of the projectile from the time it leaves the gun can be followed by the use of a special smoke producer carried on the shot. By observing the trail of smoke the gunner learns whether the shot comes near the mark. When the projectile leaves the gun, the smoke producer has been set working by an appropriate device. At night the path of the shot is still followed by the light which the smoke producer gives out. When it penetrates the envelope, a very sensitive device causes the detonation of the grenade.



The 4.2-inch Krupp gun for aeronautic attack, on a naval mount.



Bore, 2.6 inches; projectile, 9 pounds; velocity, 2050 f. s.; maximum range, 28,550 feet.

Field gun for airship attack.

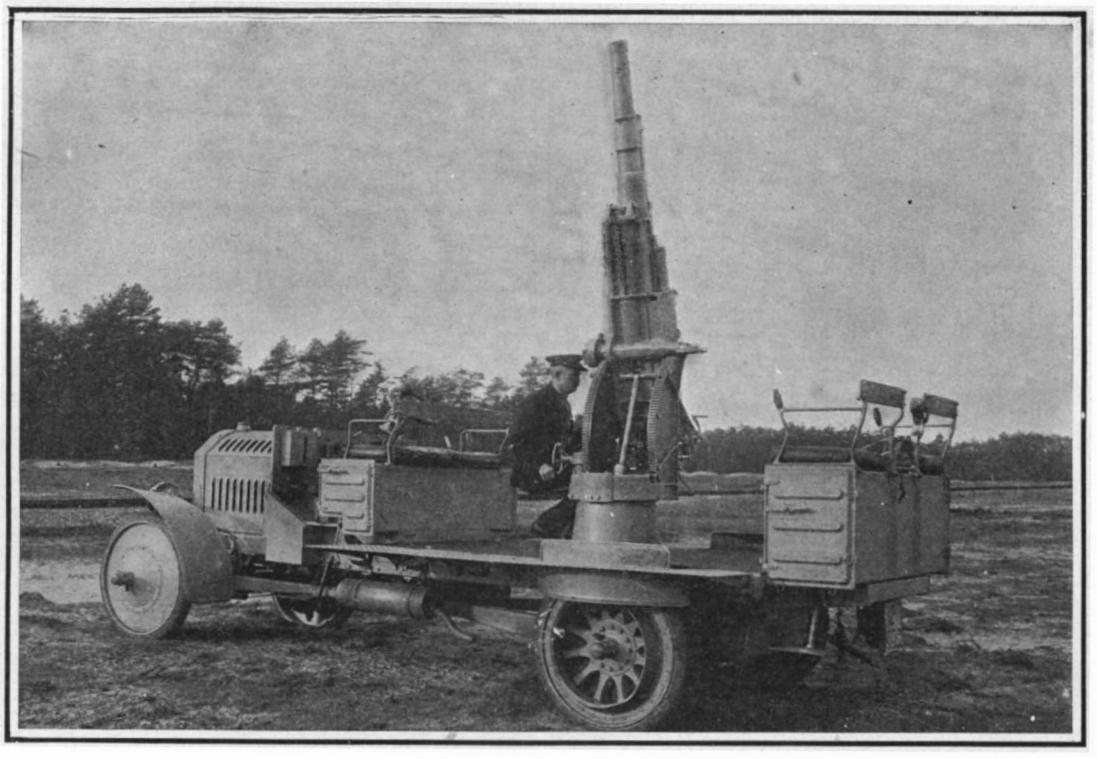
In the case of the field cannon, which has a 6.5 centimeter bore (2.6 inches), the weight of the gun itself is 775 pounds and that of the chassis 1,150 pounds, making a total of 1,925 pounds for the cannon when prepared for actual service. The gun can be turned about through a complete circle, and has a maximum vertical angle of 70 degrees. The weight of the projectile for this type is 9 pounds. The initial speed of the shot is 2,050 feet per second. With the field gun it is possible to cover a maximum range of 28,550 feet, and a maximum height of 18,800 feet.

Of a heavier build than the former, and also of greater range, is the second type of gun of 7.5 centimeter (3 inch) caliber, which is designed to be mounted upon a heavy motor car, as we represent it in our engraving. Like the former, it is provided with hydraulic recoil brake, and in the present case there is used a middle pivot. For elevating and lowering the gun through the required range there is used a double-toothed sector which is driven by pinion and crank. A special arrangement is used for the rotation, by which a slow movement is obtained, but a quick rotation may also be given by a more rapid mechanism when it is needed to turn the gun rapidly into any desired position. It is to be noted that, owing to the high speed at which the airships move, such quick movements are one of the features which need to be especially designed in the case of guns for balloon firing. The weight of the gun itself, or 990 pounds, combined with the weight of the support, 1,550 pounds, gives a total weight of 2,540 pounds for this type of gun. We have here the maximum angle which is reached in the Krupp cannon, or 75 degrees. The weight of the projectile is 12 pounds, and the initial speed 2,060 feet per second. The maximum range is about 30,000 feet, and the greatest height about 20,000 feet. As regards the automobile car which is designed to take the present cannon, its total weight (exclusive of the gun) is 3½ tons, and it has an average speed of 30 miles an hour.

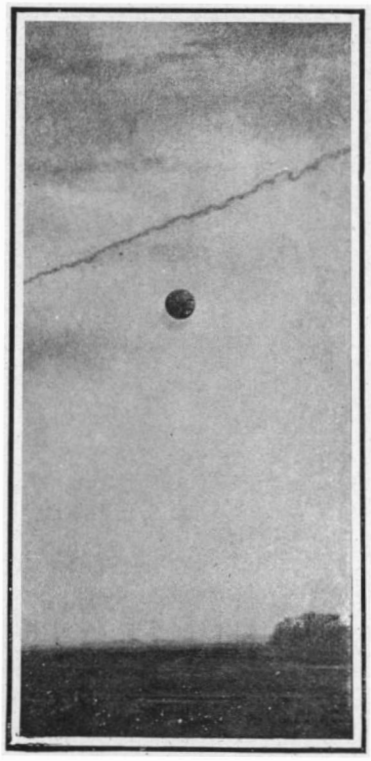
Owing to the fact that both axles are driving axles, with the use of the 50-horse-power motor the automobile car is able to travel over very difficult ground, and it easily mounts very steep grades. Under the front seat is a roomy chest which holds a good supply of tools and extra fittings, and special attention has been given to this point so that the car will not easily become disabled. To make the platform of the car as steady as possible during the firing, the platform

(*Concluded on page 383.*)

Destruction of a captive balloon by a special form of aeronautic grenade.



The 3-inch 12-pounder Krupp field piece for airship attack. The weapon can be brought to a maximum elevation of 75 degrees. The motor car on which it is mounted is of 50 horse-power and has an average speed of 30 miles an hour.



The projectile emits a train of smoke which marks the path of its flight.

WIRELESS COMMUNICATION WITH BALLOONS.

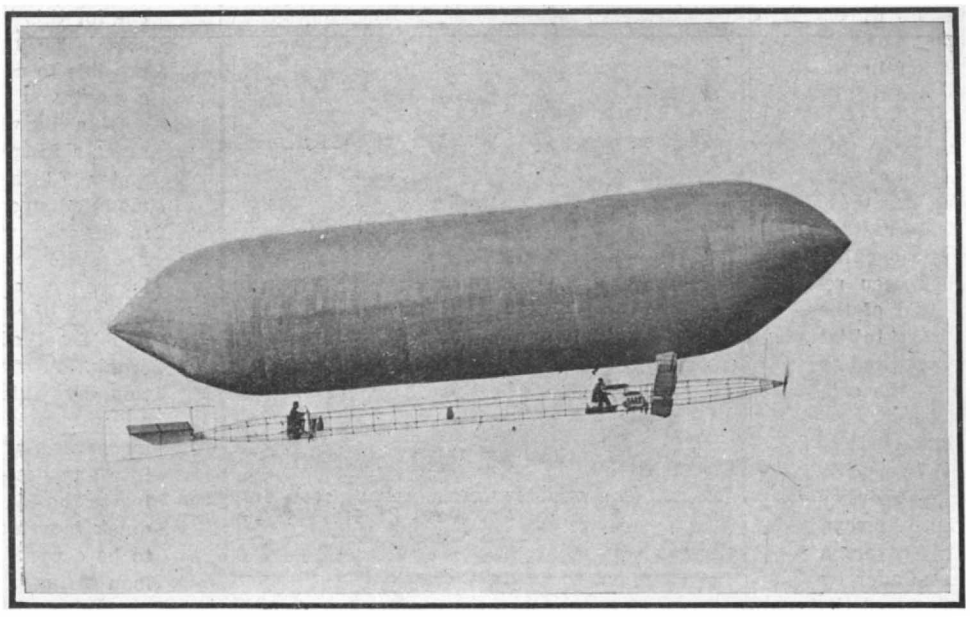
On May 13th, 1908, an ascension was made with the United States Army Signal Corps balloon No. 10 with Lieut.-Col. F. P. Lahm, Major E. Russel, and Capt. E. S. Wallace as passengers. Major Russel assisted by Capt. E. S. Wallace made some wireless telegraph experiments in this connection.

The basket of the balloon, which is about five feet long, four feet wide, and three feet high, was surrounded on three sides by light galvanized wire netting about two and a half feet wide, the surface being about thirty square feet. When the balloon had ascended to a height of about one thousand feet, a flexible phosphor-bronze wire three hundred feet long, such as is used in our army, was paid out from the net of the basket not occupied by the wire netting. The wireless receiving set consisted of a tuning device and small condenser similar to that used in the field wireless set connected with a silicon detector. A Sullivan telephone receiver was used.

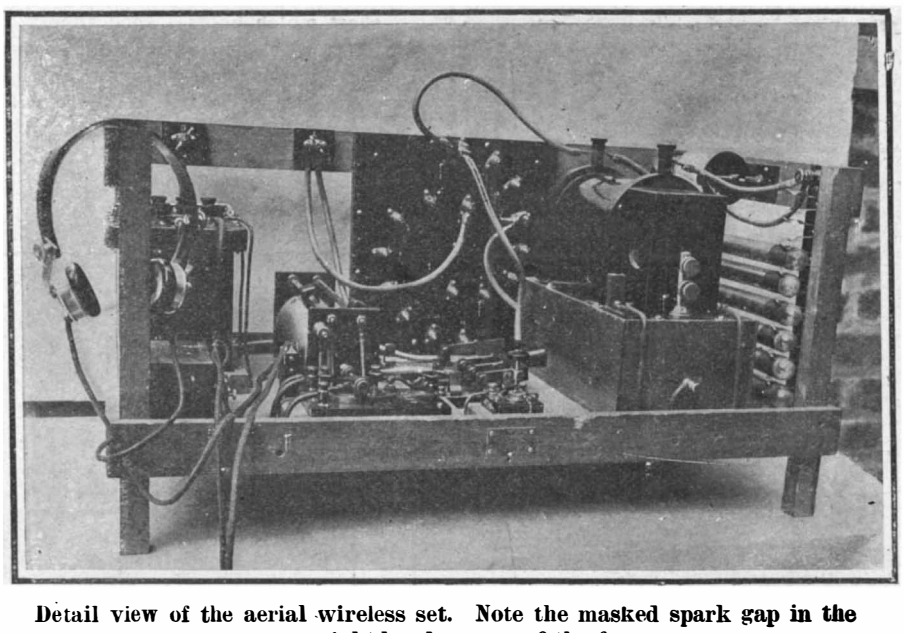
The Washington navy yard station and the Annapolis station agreed to begin sending signals every fifteen minutes for five minutes each. The Washington station began at 1:45, and the Annapolis station at 2:30 o'clock. This sending was to be kept up until 3:30 o'clock. Signals were immediately picked up from the Washington station, although not very clearly, and the reception of signals continued until the balloon was about six miles away, when the Washington station could no longer be heard. It was learned that the Washington station was being overhauled, and that only one of their small sets was used. Signals from the Annapolis station were picked up easily as soon as the sending began, these signals coming in so loudly and clearly that it would seem as if the excellence of this means of receiving would be all but equal to that of the land station. During each of the sending periods after this until 3:30 o'clock the Annapolis signals came in clearly, the distance from that station varying about twenty miles at the beginning to ten miles at the close. No disturbance from atmospheric electricity was apparent, although the vertical antenna was several times left disconnected for some little period, in order to see if any spark could be obtained between it and the netting. No spark could be detected.

It is believed by the army officers who made the experiments that this extension of the use of wireless telegraphy may prove of considerable value in extending the usefulness of an aerial reconnaissance. It may be regarded as certain that at least over distances no greater than were worked at this time, a sending set could have been utilized. It will be necessary, of course, to provide some means of masking all of the apparatus which might produce hot sparks, and it is probable that a special means of preventing the gas from pouring from above should also be provided.

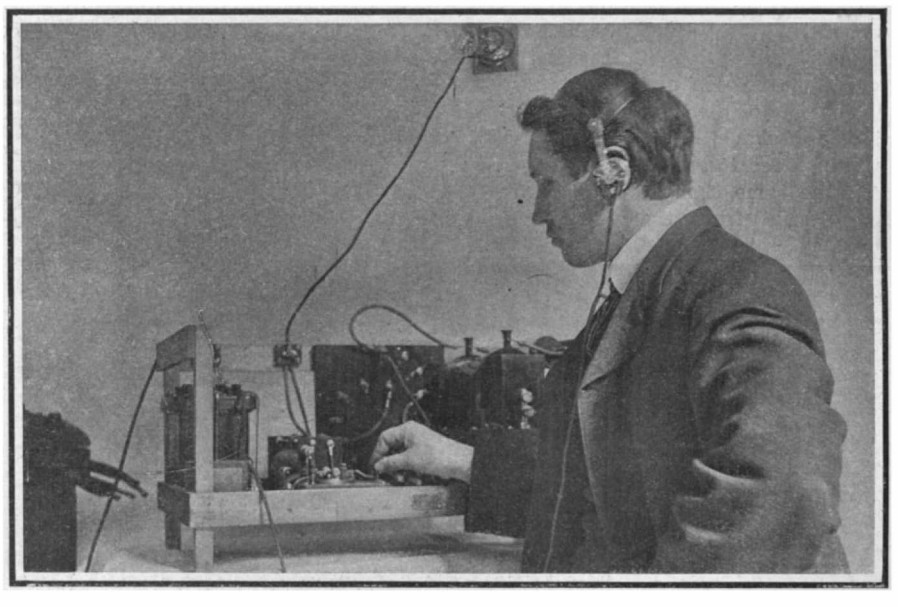
The photographs herewith presented show a sending and receiving outfit that has been prepared for the War Department for use on a balloon, but there is no record describing this apparatus or describing any contemplated use thereof. Since the apparatus was designed for aeronautic purposes, it seems not unlikely that it may be used with the Baldwin dirigible.



U. S. Army dirigible No. 1 (Baldwin type) with which wireless experiments may possibly be conducted.



Detail view of the aerial wireless set. Note the masked spark gap in the upper right-hand corner of the frame.



The wireless set employed by the Signal Corps for aeronautic use. The total weight is about 70 lbs. An 8-volt, 20-lb. accumulator supplies the current.

WIRELESS COMMUNICATION WITH BALLOONS.

Aeroplane Flights in America.

The efforts of the numerous experimenters in the United States and Canada are beginning to show results in the form of short flights by a number of embryo aviators just at the time when public interest in flying machines is becoming sufficiently great to cause the organizing of aviation meetings with liberal prizes, such as have been held in Italy, Germany, and England recently with the Rheims meeting in France as a model. The first such meeting in America to have more than one aeroplane make flights occurred last week at the Latonia race track at Cincinnati, Ohio. Besides flights by Glenn H. Curtiss, Charles F. Willard also made a number of successful flights with the biplane of the Aeronautic Society, which is the first aeroplane Mr. Curtiss built for sale. When Mr. Curtiss damaged his machine by hitting a wagon in alighting, the spectators were not obliged to leave disappointed, since Willard made some excellent flights. Roy Knabenshue, Lincoln Beachy, and Cromwell Dixon, the 17-year-old aeronaut, all made excellent flights in their dirigibles, and the three-day meet was a decided success.

Encouraged by the success of Mr. F. Raiche in getting his small biplane off the ground at Morris Park some time ago, a number of other members of the Aeronautic Society have been actively engaged in completing their machines. The second biplane to make several short flights there was that of P. Brauner and A. J. Smith. In the morning of October 31st Mr. Brauner flew about 350 feet at a height of 8 feet, and in the afternoon Dr. Green made a flight of some 250 feet. The following day, after getting off the ground once, Mr. Brauner, in a second attempt, sent the machine aloft too suddenly, with the result that it lost headway, dropped backward to the ground, and was smashed. The aviator pitched forward but was not hurt. Using the same motor—a 25-horse-power A. & B. 4-cylinder water-cooled engine of 260 pounds weight—upon his biplane, Dr. William C. Green got off the ground and made six flights of from 30 to 100 feet in length at Morris Park on the 12th instant. The last flight was made at dusk, and a wheel was broken in alighting. Both of these biplanes resemble the Curtiss in design, having balancing planes and a single propeller on the engine shaft back of the main planes. They are both larger machines than the Curtiss biplane, however, as the power plant is much heavier.

Another experimenter who has gotten off the ground and made flights of several hundred feet lately is Mr. Frank Van Anden, of Islip, L. I. Mr. Van Anden's biplane is a very light machine, weighing complete with a 15-horse-power motor but little more than 200 pounds.

At the Petewawa military camp in Canada, J. A. D. McCurdy also made a number of excellent flights recently with his new "Baddeck No. 2" biplane. The new machine, which was constructed after the "No. 1" was demolished in an accident, has shown excellent speed and stability. It is fitted with a relatively heavy 4-cylinder water-cooled motor having a single propeller on its crankshaft. In general design it is like Curtiss's, being, like his, the outcome of the experiments of the Aerial Experiment Association. Mr. McCurdy had hoped to take his machine to England and fly there for the $5,000 prize of the Daily Mail offered for the first mile flight in a circle by a British-built aeroplane piloted by a British aviator. Capt. Cody, the American who has been experimenting in aeronautics for some time past for the English army, recently became naturalized so as to compete for this prize with his aeroplane. But both aviators have lost this opportunity, since Mr. J. C. Moore-Brabazon, a well-known English sportsman, has lately won the prize with a machine resembling the Wright, but having peculiar balancing planes between the main planes at their ends instead of warping the latter.

Gasoline vs. Alcohol.

A gallon of denatured alcohol can be made to do the same amount of work in an engine as a gallon of gasoline; moreover, the alcohol does not produce smoke and is less liable to yield obnoxious odors, but the lower price of gasoline makes it the cheaper fuel. These conclusions, based on the results of 2,000 comparative tests of the two substances as engine fuels, are given in Bulletin 392 of the United States Geological Survey. R. M. Strong, the author of the bulletin, briefly describes the tests but discusses the more important results at some length. The tests formed part of the investigation of fuels now being carried on by the Survey. To determine the relative efficiency and economy of gasoline it was compared with denatured alcohol. In this comparison not only the heating values of the two fuels but their adaptability to engine use and the effects of variations in fuel quality and in the principal operating conditions—such as load, fuel supply, and time of ignition—were carefully studied. Tests were made with gasoline and alcohol in the same engine and repeated in other engines of approximately the same size (10 and 15 horse-power) and the same piston speed, with different degrees of comparison, different methods of governing, and different combustion.

If most Americans were asked which is the highest mountain in the United States, they would probably answer Mount Rainier. As a matter of fact, the honor belongs to Mount Whitney, which exceeds Mount Rainier in height by less than 200 feet. The summit of Mount Rainier is 14,363 feet above mean sea level, and that of Mount Whitney, by checked leveling, is 14,501 feet above mean sea level.

THE WELLCOME TROPICAL RESEARCH LABORATORIES.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

It is only ten years since the whole of the Sudan was a closed book to the outside world, being under the sway of ruthless barbaric Mahdism. To-day it is a country of increasing prosperity, and at the ancient capital of the Dervishes has been erected a magnificent pile of educational buildings, the Khartum College, a portion of which comprises an extensive and elaborately equipped tropical research laboratory. When the country was finally subdued, it was realized that the peculiar conditions prevailing, both climatic and geographical, rendered the territory a difficult one for the residence of the white man. It was the home of innumerable and mysterious diseases and infectious maladies, which rendered it untenable to the white man, and were also destructive among the ranks of the natives. Moreover, these maladies were peculiarly endemic to the country, and it was realized that the only possible method of reclaiming it for civilization was the investigation and solving of these problems upon the spot, by the most up-to-date scientific methods possible.

Scarcely had the last shots in the campaign been fired, when a movement was started for the foundation of an educational college on the site of the Mahdi's stronghold. Here it was decided to study the questions upon a small scale at first. Owing to the generous munificence of a well-known Englishman, Mr. Henry S. Wellcome, however, it was found possible to establish an extensive institution for tropical research. The donor, in connection with his gift to the Sudanese government, offered to equip the laboratories with all the latest appliances that might be desired, so that the investigations could be carried out upon the most comprehensive lines. These laboratories are unique, inasmuch as they are the only ones of their character upon the African continent, which is unanimously held to be the greatest seat of all those peculiar natural conditions inimical to the white man which have appreciably retarded the development of the country in the past. But through the efforts of this institution invaluable work has been accomplished in reclaiming the northern part of the country, which, in conjunction with that of the Liverpool and London Tropical Schools of Medicine, has assisted in the hygienic betterment of the continent at large.

The work of the Wellcome Tropical Research Laboratories is broadly divided into six ramifications, as follows: (1) The promotion of technical education; (2) the bacteriological and physiological study of tropical disorders, more especially the infectious diseases of both man and beast peculiar to the Sudan, and to extend assistance to the officers of health and to the clinics of the civil and military hospitals; (3) to assist experimental investigations in poisoning cases, by the detection and experimental determination of toxic agents, particularly the obscure potent substances employed by the natives; (4) chemical and bacteriological tests in connection with water, food-stuffs, and such sanitary matters as may be found desirable; (5) the promotion of the study of disorders and pests which attack food and textile producing and other economic plant life in the Sudan; (6) to undertake the testing and assaying of agricultural, mineral, and other substances of practical interest in the industrial development of the Sudan.

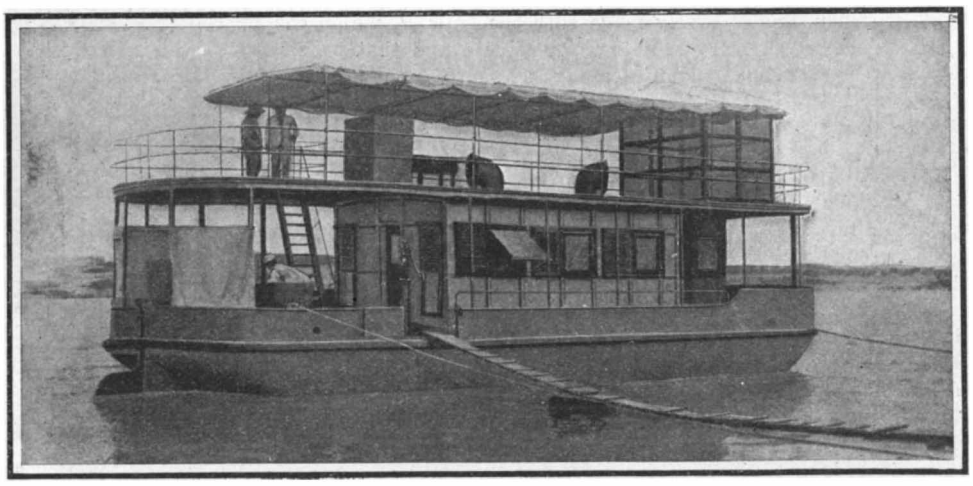
The work upon these diverse subjects is under the direction of Dr. Andrew Balfour, B.Sc., D.P.H., F.R.C.P., and he is gladly assisted by the various other departments of the government which are interested in one or more of the avowed objects of the Institution, such as the Egyptian Army Medical and Veterinary services; indeed, the co-operation of outside workers in the same field is much appreciated and fostered, so that there may be an indisputable conclusiveness concerning the results achieved. Within the first year of its foundation the laboratories became fully occupied in all their departments, and then Dr. Andrew Balfour gradually and carefully selected the best fields of work, and concentrated the attention of his staff thereon. Chemistry and entomology have received almost as much attention as tropical medicine, and recently the work of the Institution has been extended to the sciences of ethnology, ethnography, and anthropology.

Tropical medicine comprises researches in the trypanosomiasis of animals, chiefly cattle and camels—fortunately the dreaded scourge of sleeping sickness among humans has not extended to the Sudan. Piroplasmosis, spirochætosis of Sudan fowls, and studies of the many fell diseases such as kala-azar, mycetoma, and dengue fever, which cripple human life in the tropics, constitute the most prominent of the purely pathological and bacteriological work. Then again the sanitary organization of Khartum and Omdurman has been taken in hand, involving the destruction of mosquitoes and the introduction of sanitary laws and a conservancy service. Dr. Balfour, the director, is the medical officer of health of the towns, and, with the adequate laboratory resources at his disposal, has been able to revolutionize completely the conditions of life in a few years, and has practically exterminated malaria at Khartum.

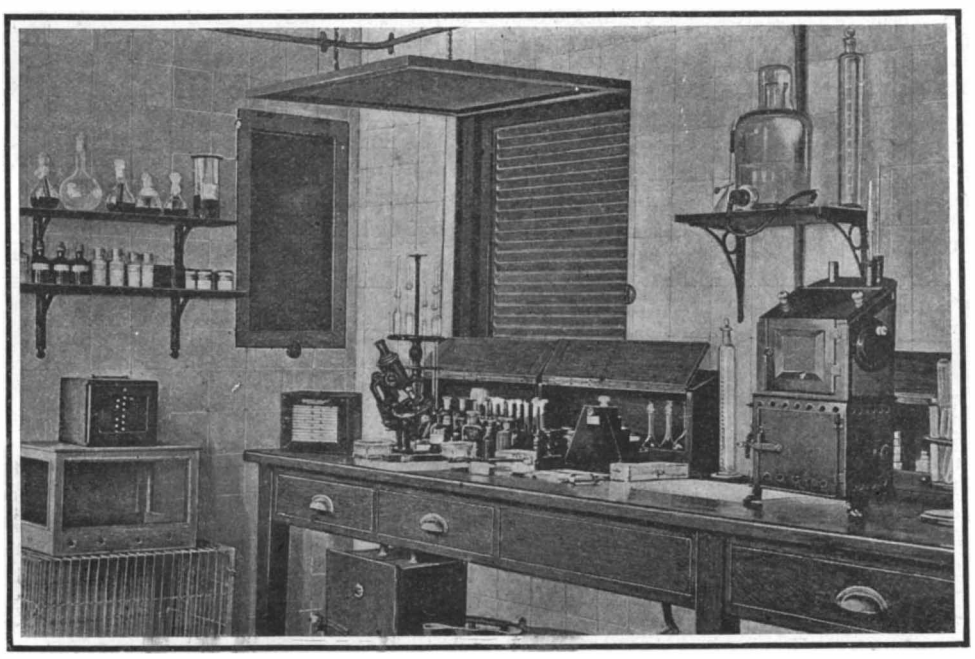
The headquarters of the laboratories are at the Gordon College; and here within a period of seven years innumerable experiments and investigations were carried to a successful issue, and a mass of unique information collected which is of inestimable value in connection with the subjects treated. It was found, however, that the conditions under which the researches were made were not quite perfect, on account of the possibility of change in or damage to bacteriological and other specimens in their transmission from remote districts to Khartum. It was therefore decided to carry the war into the enemy's camp, and to carry out the investigations on the spot under conditions very similar to those at the Gordon College. For this purpose a floating laboratory was established, and the work accomplished therewith has been of far-reaching value. The southern Sudan is a country criss-crossed by waterways, on the banks of which are clustered native villages, wherein all manner of rare and interesting pathological conditions are to be found. Flies and mosquitoes abound; the birds, reptiles, and fish harbor strange parasites; men die from curious diseases, and there is a vast field for the study of tropical medicine. Before the days of the floating laboratory, material occasionally reached Khartum from these distant territories, but too often it was in a badly damaged condition. Blood slides were dirty and spoiled, insects broken, and notes incomplete. On the whole, it was recognized that the proper study of conditions must be conducted on the spot, and then many valuable data could be gathered.

The floating laboratory is a commodious vessel well adapted to service upon the waters of the South. The main working room is completely mosquito proof, and is adequately fitted out for proto-zoological and entomological work. Its maiden voyage was carried out

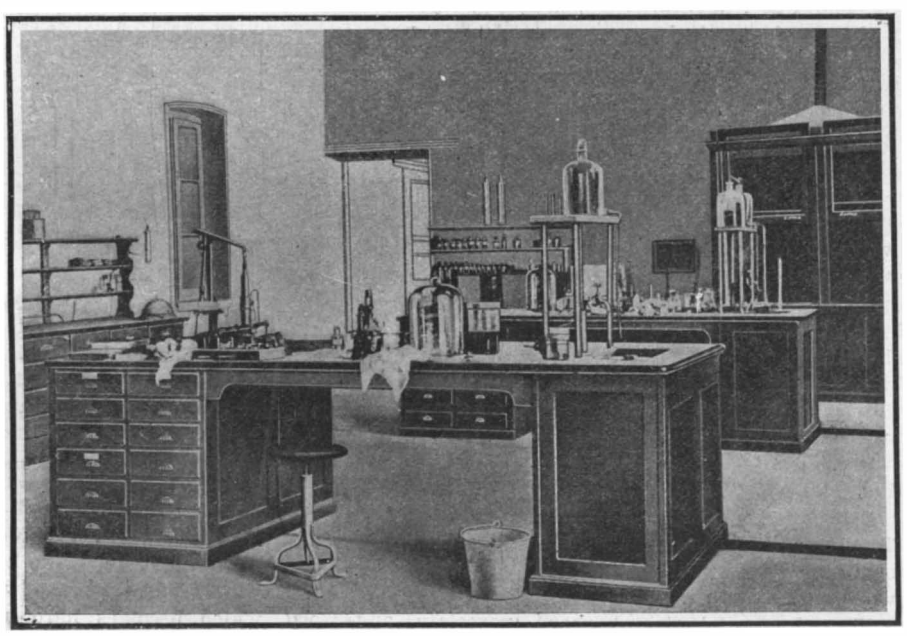
(*Continued on page 381.*)



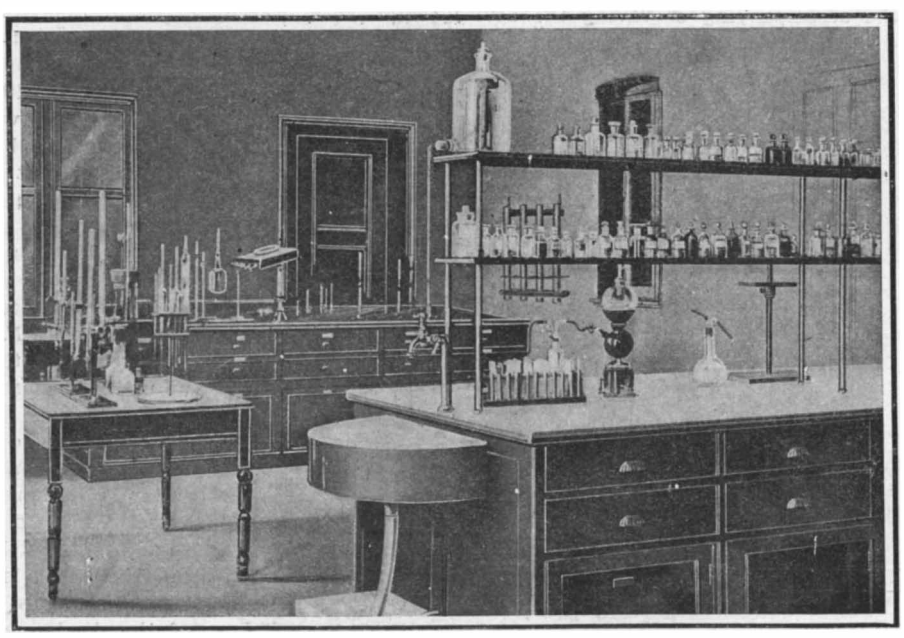
The floating laboratory on the Nile, auxiliary to the Wellcome Research Laboratories.



Part of bacteriological section of floating laboratory.



Bacteriological room.



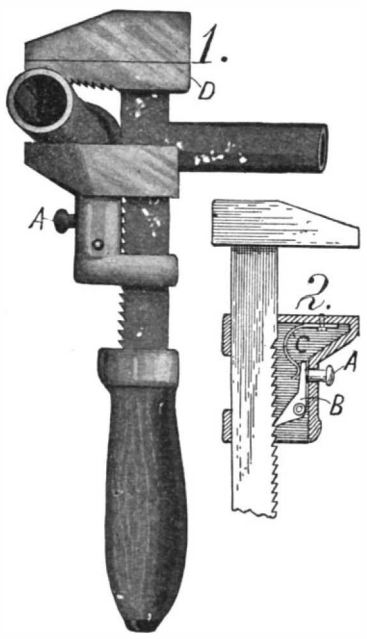
General chemical laboratory.

THE WELLCOME TROPICAL RESEARCH LABORATORIES AT KHARTUM.

Patent Department

COMBINED PIPE WRENCH AND MONKEY WRENCH.

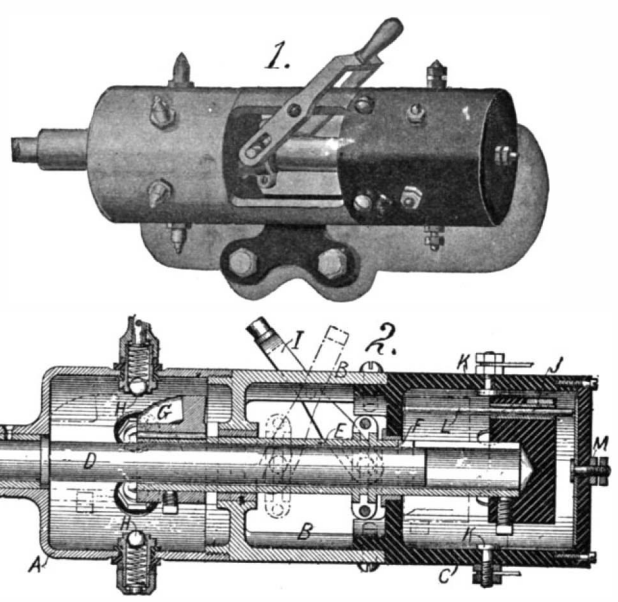
The wrench illustrated herewith differs materially from the ordinary in the fact that the usual screw mechanism is entirely dispensed with, and the jaws may be instantly opened or closed to any desired extent. The wrench is also provided with a removable jaw piece, which may be quickly applied to adapt it for use in gripping pipe or round work. Fig. 1 illustrates the wrench with the pipe-gripping attachment applied thereon, while Fig. 2 shows the wrench adapted for ordinary use. In this view the lower jaw is cut away to show the interior details. It will be observed that the ratchet mechanism with which this wrench is equipped in place of the screw mechanism is controlled by a button *A*, that projects from the forward face of the lower jaw. When the button *A* is depressed, the dog *B* is disengaged from the ratchet teeth, permitting the jaw to be moved downward on the shank of the wrench. A spring *C* serves to hold the dog in engagement with the ratchet teeth when the button *A* is released. It is not necessary to operate the button *A* when closing the jaws on a piece of work, but merely when it is desired to open them. The pipe-gripping device consists of a slotted member, which may be fitted over the shank of the tool, and is provided with inwardly-inclined teeth, as shown in the illustration. The inventor of this improved wrench is Mr. Charles Waller of Hamilton, Wash.



COMBINED PIPE WRENCH AND MONKEY WRENCH.

COMBINED TIMER AND DISTRIBUTER FOR INTERNAL-COMBUSTION ENGINES.

The speed of an internal-combustion engine is commonly regulated by varying the time of the spark with respect to the position of the piston. In the case of a multiple-cylinder engine, the casing of the timing device carries a number of terminals, which contact in succession with an inner rotatable member, and the casing is mounted to oscillate for a limited distance, in order to vary the time of the spark as above referred to. A disadvantage of this system is the fact that the casing cannot be held rigid, and the time of the spark cannot be accurately controlled when the engine is operated at high speed. Furthermore, the oscillation of the cylinder casing and the rattle and jar due to the fact that it is mounted on a single short bearing are apt in time to break away the connecting wires. In the timer here illustrated the casing is fixed and the timing is accomplished by a sliding sleeve mounted on a long bearing. As shown in the accompanying engraving the device comprises a casing formed of three separate sections. The section *A* contains the timing mechanism, the insulated section *C* a distributer, while section *B* serves to connect the other two sections and support the controlling lever. A shaft *D* runs through the two sections, and is geared to the engine shaft. Mounted on the shaft *D* is a sleeve *E*. A pin *F* in the shaft engages the slot in the sleeve *E*, which serves to couple the sleeve to the shaft *E* and yet permit the former to slide on the latter. Mounted on the sleeve *E* in the timer section is a drum which carries a spiral metal strip *G* adapted to come in contact with a series of spring-pressed balls mounted in, but insulated from, the casing. As the shaft *D* revolves, it will be observed that contact is successively made with the balls *H*, which control the primary winding of the coil, and that by sliding the contact strip *G* along the shaft *D*, the time of the contact with respect to the position of the pistons will be varied. The contact strip *G* may be moved along the shaft *D* by means of a lever *I*. The opposite end of the sleeve *E* carries an insulating block in which a spiral contact strip *J* of the same pitch as the strip *G* is fitted. The strip *J* is adapted to make contact with buttons *K*, which correspond in position with the terminals *H*, and are connected to the spark plugs. A metal sleeve is fitted in the insulating block in contact with the strip *J*, and this is adapted to receive a metal rod *L*, which bears against a plate connected with the terminal *M*. By this means electrical connection is always maintained between the strip *J* and terminal *M*, no matter what position the sleeve *E* may occupy along the shaft *D*. This arrangement is particularly adapted for use on low-speed marine engines where a single coil suffices for all cylinders. For high-speed automobile engines a separate coil is required for each cylinder and hence the distributer can be dispensed with. The inventor of the combined timer and distributer is Mr. G. T. Brown, of 225 West 80th Street, New York city.



COMBINED TIMER AND DISTRIBUTER FOR INTERNAL-COMBUSTION ENGINES.

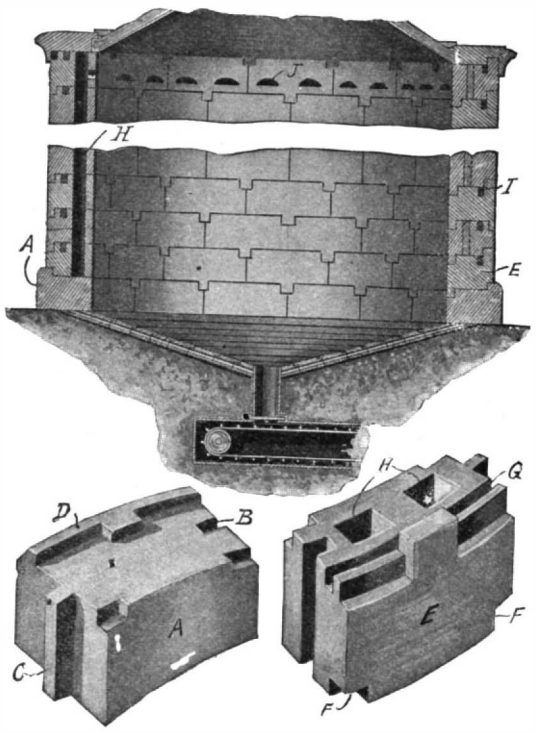
AN IMPROVED STEAM TRAP.

Pictured in the accompanying engraving is an improved steam trap, which is of simple and durable construction and arranged to discharge the water of condensation periodically as required. The apparatus comprises a closed vessel *A*, into the top of which the steam supply pipe *B* opens. Passing through the steam supply pipe, and reaching to within a short distance of the bottom of the vessel *A*, is the water discharge pipe *C*. The vessel *A* is adapted to slide vertically on the pipe *B*, and is provided with rollers that engage guide rails at opposite sides. The steam supply pipe *B* is connected with the apparatus on which the steam trap is to be used, so that the water of condensation accumulates in the vessel *A*. The water discharge pipe *C* is provided at *D* with a valve. A lever *E* presses against the valve stem at one end, while the opposite end engages a cross piece *F*, attached to the vessel *A*. The cross piece is in turn connected by a link to a lever *G*, which carries a weight *H* that may be adjusted along its length. The weight *H* may be adjusted to lift the arm *E*, so that it depresses the valve stem and keeps the valve *D* closed. As the water of condensation accumulates in the vessel *A*, it overbalances the weight *H*, drawing down the cross piece *F*, and with it the lever *E*, and thus releasing the valve stem, which springs up under tension of a small spiral spring. The steam pressure in the upper part of the vessel *A* then forces out the water of condensation through the discharge tube *C*. As soon as the water is discharged, the weight *H* lifts up the vessel *A* to its normal position. The weight is so adjusted that it will act before all the water in the vessel is discharged, and will leave enough water in the vessel to seal the bottom of the discharge tube *C*, and prevent steam from escaping therethrough. The inventor of this improved steam trap is Mr. M. J. Boyle, 315 49th Street, Brooklyn, N. Y.

AN IMPROVED STEAM TRAP.

A NEW GRAIN BIN CONSTRUCTION.

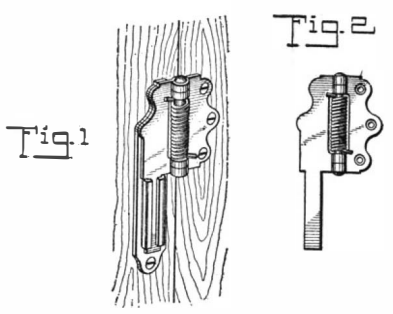
The grain bin illustrated in the accompanying engraving is designed to provide a dry and well-ventilated structure. While the construction is such that it may be easily and quickly built, it will withstand great pressure from within. The floor of the bin preferably slopes downward toward the center, leading to a chute that extends to a horizontal passage below, in which is mounted an endless belt carrier. The walls, floor, and roof of the bin are preferably constructed of blocks or tiles of fireproof construction. The first course of blocks of which the wall is formed are made as indicated at *A*. Each block is provided with a recess at one side and a tongue at the other, so that the blocks may be successively rabbeted together. It will be observed that the block *A* is provided at its outer upper edge with a flange *D*, which has a lug projecting inwardly therefrom. The next course of blocks, which are of the form indicated at *E*, are provided with recesses *F*, which fit over these lugs on the flanges *D*. It will be understood that each course of blocks breaks joints with the course below it. The blocks *E* are provided with grooves *G*, adapted to receive metallic bands, which are shown in section at *I*. Each block *E* is provided with a pair of vertical passages *H*, which are adapted to register with similar passages in the successive courses, so as to form continuous passages from top to bottom of the bin. The blocks in the intermediate courses of the wall are somewhat different in form from the ones shown at *E*, but it is sufficient to state that they are provided with projecting lugs that enter recesses on adjacent blocks, so as to form an interlocking construction. The uppermost course of blocks differs from the others in having apertures *J*, which provide communication between the interior of the bin and the vertical passages. These apertures are above the grain line, and afford ventilation of the walls. The inventor of this grain bin construction is Mr. Thomas Dougherty, 624 18th Avenue South, Minneapolis, Minn.



A NEW GRAIN BIN CONSTRUCTION.

ODDITIES IN INVENTION.

DETACHABLE HINGE.—One of the bugbears of the man who has to do his own odd jobs around the house, is the putting on and taking off of screen doors, particularly if provided with spring hinges. It is quite a difficult matter to apply the hinge without the help of an assistant holding the screen door. The invention illustrated herewith aims to overcome this difficulty by making the hinge detachable. A socket piece is permanently fastened to the door jamb, and the spring hinge may be fitted into this socket piece, or removed at a moment's notice.



DETACHABLE HINGE.

Universal Cement.—4 parts alabaster plaster and 1 part of finely-pulverized gum arabic mixed with a cold-saturated borax solution into a thick paste, make an unequaled all-around cement for stone, glass, bone, horn, porcelain, and wood, which becomes hard as marble and possesses the agreeable quality of not solidifying immediately after mixing, but only after 24 to 30 hours.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SUBSTITUTE BUTTONHOLE ATTACHMENT.—F. ROBERTSON, Denver, Colo. This attachment serves as an inexpensive substitute for frayed and worn-out buttonholes and may be quickly applied and detached without the use of any device other than the hands, and when applied presents a neat appearance and does not interfere with the flexibility of the surrounding material.

RECEPTACLE FOR BABY-CLOTHS.—C. BREWER, New York, N. Y. This receptacle is adapted to be set within the bowl of a water closet during the cleansing manipulation of the cloths and to retain no water when lifted therefrom. It is provided with a plug or stopper adapted to hold the water of the flushing system in the bowl.

Electrical Devices.

HAIR-DRYING APPARATUS. — W. A. SOLES, New York, N. Y. The invention is more especially designed for use in hairdressing establishments, barber shops and other places, and is arranged to insure drying of the hair by heated air and under the invigorating influence of artificial light, by the use of an electrically driven fan arranged in the rear of a cluster of electric lamps contained in a hood open at the front for the passage of the heated air and the rays of light.

Of Interest to Farmers.

MILK PASTEURIZER AND FILTER.—C. C. STAMBAUGH, New York, N. Y. In the present patent the invention has in view a simple apparatus for use in the pasteurization and filtration of milk, the pasteurizing and filtering being successively and continuously performed by passing the milk through a pail or vessel having the inventor's improvements.

Of General Interest.

PACKAGE-TIE.—H. J. LEE and E. F. GRAY, Scranton, Pa. The purpose here is to provide details of construction for a package tie, which are simple, practical, very convenient to tie or release a package, and that particularly well adapt the improvement for binding together a number of letters or documents in a compact package that may require separation quickly.

SHEET-METAL TUBING.—W. P. LAWRENCE, Colorado Springs, Colo. This improvement has reference more particularly to a construction of tubing for use in the frames of window sashes, window screens, or for the uprights or transverse members of metal furniture, or for paneling or any other similar structure in which it may be desired to employ sheet metal tubing.

KNOCKDOWN BOX.—W. L. HOWLAND, Cedar Rapids, Iowa. This hollow box frame is open at the top and bottom, close around the inner sides of which is disposed a continuous piece of material projecting beyond the top and bottom of the frame, and having its projecting portions cut and bent down and against the top and bottom of the frame, so that when the top and bottom members are secured, the continuous piece of material will be held close to the inner sides of the frame, while it may be readily removed by removing the top and bottom members.

HAND MIXING-RECEPTACLE.—A. HALLENBERG, Fargo, N. D. This inventor furnishes a receptacle for materials wherein the same may be mixed by compression of the walls of the receptacle. He provides a receptacle to receive materials to be mixed, provided with finger holds to protect the fingers, and to provide holding means for the receptacle.

MEANS FOR HANGING DOORS, SCREENS, ETC.—T. GILL, Follansbee, W. Va. The means consists in the main of a post or column of a length nearly equal to the height of the door opening or casing and provided with a suitable adjusting device for extending its length until it clamps at its ends against the door casing with sufficient force to retain it in place, the door being hinge-connected to this post in the usual manner of connecting it directly to a door casing.

BUTTER AND LARD CUTTER.—C. H. CARLSON, Iron Mountain, Mich. The aim in this instance is to provide a device especially adapted to cut out and remove a shaped pat of butter or lard from a firkin or other receptacle, and which is provided with means for ejecting the pat from the device without the necessity of touching it with the hands or any tool.

Hardware.

BENCH-STOP.—M. R. RAYNESFORD, Ellis, Kan. This invention relates to stops, and more particularly such as are adapted to be used on carpenters' benches for holding one end of a board firmly against the apron of a bench while the opposite end of the board is clamped in a vise. It constitutes an improvement on the device shown and described in a U. S. patent formerly granted to Mr. Raynesford.

HOSE-COUPLING.—W. F. KOPER, Chillicothe, Ohio. In using this invention, the head piece is introduced in the terminal of the union member having an annular chamber therein, and it is rotated in the terminal until the stems of the T-shaped members are in alinement with the slots that separate the pairs of lugs, when the head piece is pulled outwardly until the T-shaped members interlock with the inner faced lugs. In this position the head piece protrudes through an opening in the rubber cup.

Household Utilities.

CLOTHES-LINE HANGER.—C. C. LOVEJOY, New York, N. Y. The device may be conveniently attached, and will operate to support the line in such a way that the end of the line may be brought into the room to enable the clothes to be hung thereupon, and the device may be readily folded up out of the way when not in use.

CLOTHES-LINE TIGHTENER. — R. C. SCHEURER and L. MAREK, Union Hill, N. J. This invention pertains to clothes line tighteners, and the object of the inventors is to produce a device which can be readily applied to a clothes line, which will enable the slack of the line to be taken up, and which will maintain the line under tension.

Machines and Mechanical Devices.

DEVELOPING-MACHINE FOR PHOTOGRAPHIC FILMS.—ELIZABETH A. TAYLOR, Steilacoom, Wash. This invention consists of a plurality of cylinders of different diameters disposed one within the other, there being slots in the cylinders, and projecting therein which engage each other so that when one cylinder is rotated a predetermined distance the projection thereon will engage the one on a neighboring cylinder to rotate it. In use the end of the film is secured to one of the cylinders and as they are rotated the film is wound around them, the film passing through the slots from one cylinder to another.

Musical Devices.

REED-ORGAN.—L. A. MCCORD, Laurens, S. C. It is sought in this invention to provide an organ attachment which can be applied to any of the ordinary reed organs and will permit the playing of the organ by an automatic or self-player such for instance, as those using a certain perforated paper strip or sheet, and which self-playing attachment may be adjusted out of the way so the organ may be played in the usual manner.

ADJUSTABLE PIANO-PEDAL CONNECTION.—H. MEYER, New York, N. Y. The intention here is to provide an adjustable piano pedal connection, arranged to insure accurate working of the hammer rest rail, the damper rail and the muffler, as desired. The connecting bar is adjustably secured to a flat spring, which forms the fulcrum for the bar and is attached to a base secured to the bottom of the piano frame.

Railways and Their Accessories.

RAILROAD-TIE.—J. W. SNEDDEN, Falls Creek, Pa. Disclosed in this patent is a tie the sides of which are connected below the top by a web, the upper edges of the sides having inwardly projecting flanges between which the movable member of the rail fastening means coact with fixed rail retainers at the opposite side of the rail. The tie is hollow and between the walls either a filling of concrete or a block of wood is adapted to be received.

BLOCK-SIGNAL SYSTEM.—J. D. NIX, Ferriday, La. An object of this inventor is to provide a mechanism which is located on the engine and forms part of the mechanism thereof which may be automatically operated by an electric current from a generator carried on another engine which is in the same block. The generators for furnishing the current may be either dynamos or batteries.

FLAG OR SIGNAL.—G. W. DALLIMORE, Pocatello, Idaho. The object here is to produce a flag for use on railways, having a pole or staff within which the curtain or body of the flag may be received when the signal is not being displayed, and further, to provide a simple construction enabling a flag to be extended or withdrawn from view.

CAR-FENDER.—G. A. ESTLER, Standish, Mich. In this fender, a catching and supporting means prevents injury to a person with whom the fender has forcible contact, and the purpose of the invention is to provide for a fender effective in service, and which may be placed on street or other cars for service without requiring changes in the construction of the cars.

LOCK-VALVE.—T. M. SWANK, Louisville, Ky. This valve is for use in connection with the train pipe of an air brake system, which has locking mechanism serving to prevent unauthorized and malicious tampering with the valve, which also prevents accidental closing of the valve when open, and which will not cause unnecessary delay in certain operations such as in switching or coupling cars.

AUTOMATIC TRACK-INSPECTOR. — T. ELLIS, Tacoma; G. H. PURVIS, Seattle, and J. S. CREECH, Raymond, Wash. The invention relates to automatic track inspectors, that is, to mechanism for indicating the condition of a railway track. More particularly stated it comprises various improvements, whereby the general efficiency of such mechanism is greatly increased, and the operations rendered more practicable.

Pertaining to Recreation.

COMBINED CREEL AND KIT.—H. W. WAKEFIELD and C. F. HARTER, Seattle, Wash. The improvement is in anglers creels, the purpose of which is the provision of a kit in connection with the creel or basket for the storing of hooks, lines, leaders and other fishing paraphernalia, in order that the same may be at all times readily accessible and thus facilitate the replacing of lost hooks, etc.

GAME.—H. E. HIRE, Mark Center, Ohio. Mr. Hire's invention relates to games, and the object is to provide a game which has many of the features of the game of base ball and is especially devised to assist in the training of pitchers for the outdoor game of base ball, and to test their skill at the outdoor game.

TOY CANNON.—W. H. CORNFORD, Mornington, Victoria, Australia. This application is in part a division of the application formerly filed by Mr. Cornford for Letters Patent on a military game or toy, and the present invention relates to a toy cannon or gun of special construction adapted to be used in connection with the said game. It provides for rapid firing of pellets, retaining them in position till fired, automatically readjusting them if displaced, and means for elevating and depressing the cannon.

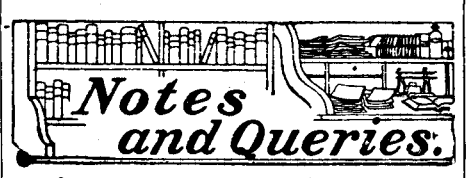
Pertaining to Vehicles.

INFLATING DEVICE FOR TIRES.—E. HAYNES, Bisbee, Ariz. Ter. This invention is particularly useful in connection with pneumatic tires such as are used on motor vehicles and the like. The aim is to provide an efficient device for tires, which is automatic in operation and which obviates the necessity for manually or otherwise extraneously inflating a tire.

VEHICLE-TIRE.—C. F. FISK, Allentown, N. J. The invention consists of a rim of two sections bolted or otherwise detachably secured to the felly and having relatively deep outwardly-extending flanges, with a shoe rim at the outside of each flange, a tire having resilient ribs in engagement only with the inner faces of the flanges and the tire and ribs otherwise disengaged from the rim, a shoe extending around the tread of the tire having its edges located in the shoe rims, and clamping rings securing the shoe to the shoe rims.

DRIVING-GEAR FOR AUTOMOBILES.—E. G. WHITACRE, Wellsville, Ohio. This invention relates more particularly to the mounting for the driving engines used in automobiles. The style of the engine may vary, but any form wherein the motive power is a gas under pressure will serve. It might be used in internal combustion engines provided any of the well known relief valves were used in conjunction with one or the other of the engines, which would be operated automatically as the automobile is driven in a curved path. The valve would lessen the power stroke on the engine on the inner side of the curved path being followed by the automobile.

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.



Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12136) A. R. S. says: 1. Why when the moon is growing can one see a bright outline of that satellite, while the inner portion of the circle appears dark? A. When the moon is within two or three days of new, the earth reflects light enough from the sun to make the dark portion of the moon visible. The earth at that time is full as seen from the moon. This is called seeing "the old moon in the new moon's arms." The light is called "earthshine." It is described in the astronomies, such as Todd's "New Astronomy," which we send for $1.50. See page 225. 2. Why do moon and sun appear to be much larger when rising and setting? A. The sun and moon seem larger near the horizon by an optical illusion due to contrast. With an instrument they do not measure any larger near the horizon. The sky itself is affected in the same way. Stars seem farther apart. 3. How can I locate the following planets: Mercury, Mars, Jupiter, Neptune, Venus? A. The position of the planets is given each month in our article, "The Heavens in September," etc. The proper thing to do is to become a subscriber to the SCIENTIFIC AMERICAN and have the instruction given in the paper. Neptune cannot be seen excepting with a good telescope. The rest you name may be seen with the unaided eye. Mars is now very bright in the night sky. 4. What size wire will be necessary to wind an ordinary telephone generator for ten volts? How many turns will be required? A. A telephone generator is wound with wire from No. 30 to No. 35, and from 75 ohms to 550 ohms. From this you will see that we cannot tell you what to use. If you would make a generator to work with others, you would better copy one of the others.

(12137) C. L. L. says: Two horses are attached to opposite ends of a rope and are pulling against each other. Both horses are capable of pulling 200 pounds apiece. Is there more strain on the rope with the horses pulling against each other than if one end of the rope is attached to an immovable stake and only one horse pulling it? A. The pull upon the rope with a horse pulling 200 pounds at each end is 200 pounds. One horse is but a post for the other to pull against, and a post can as well be used as a second horse. This anyone can prove by having two persons pull against each other on a spring balance, and then letting one person pull with the balance fastened to a hook on the wall or to a hitching post in the yard. If the balance will indicate all that a person can pull, the experiment will be identical with the one you propose.

(12138) F. S. says: Some time ago we wrote to an electrical supply house asking them whether the numbers in the Brown & Sharp wire tables followed any regular law, and were told that they did not. We are of the impression that the people we wrote to concerning this question must be mistaken, and are writing you, and would like to have you either confirm or deny their statement. A. The sizes of wires by Brown & Sharp's, or as it is better termed, the American wire gage, are not determined by any formula, but are a growth. However, the sizes are such that a wire three sizes larger will have a sectional area about double that of a given wire. This is only an approximation. It is very convenient in electrical work. See our article, "How to Remember the Wire Table," in SUPPLEMENT No. 1,530, price ten cents.

(12139) W. B. H. says: 1. Why is a magneto used to make the spark for a gasoline engine in preference to a small dynamo? A. The field of a magneto is always ready for use, and does not require to build up its magnetism as a dynamo does. 2. Why are the permanent magnets of a magneto divided up into several instead of one large one? A. A compound magnet made from several thin magnets is much stronger than a single magnet of one thick piece of steel.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending November 9, 1909,

AND EACH BEARING THAT DATE

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

Adjustable bolt, quickly, N. W. Trautner	939,933
Aeroplane, S. W. Applegate	939,651
Agitator, F. E. Goldsmith	939,905
Agricultural implement, W. B. Estis	939,820
Air brake regulator, C. J. Doerr	939,896
Air brake retaining valve, J. F. Speigel	939,928
Air compressor, F. A. Preuss	939,314
Arrship, B. W. Dysart	939,483
Annunciator case, H. D. Crouch	939,672
Ash tray, S. Grunthal	939,909
Auger attachment, post hole, E. Eisenbraun	939,235
Auger, square hole, J. Nielsen	939,438
Axle, combined steering and driving, J. W. Buchan	939,795
Bag closure, F. McKain	939,736
Bag fastener, Hiering & Fuller	939,256, 939,257
Bag fastener, N. L. Ranum	939,316
Bag frame catch, Hiering & Fuller	939,913
Bale tie straightening and cleaning machine, cotton, Morton & Dismuke	939,532
Baling press, F. A. Bothwell	939,466
Ball grinding machine, C. A. Hirth	939,502
Balloon, R. C. Tilghman	939,644
Ballot box, W. W. Wills	939,367
Band brake, J. N. Lawrence	939,519
Banking machine, A. Clark	939,472
Bath tub attachment, A. Bulin	939,797
Bearing, ball, W. E. Cane	939,391
Bearing, center, H. S. Rader	939,443
Bearing, thrust, A. T. Killian	939,269
Bed covering, W. H. Bender	939,585
Bed, folding, C. R. Gardner	939,241
Bed, wall or cabinet, N. B. Douglass	939,482
Beet blocker, E. Kraak	939,715
Belting, H. Loeb	939,724
Benzoate, manufacturing, E. O. Barstow, 939,584, 939,940,	939,941
Bin. See Display bin.	
Block signaling apparatus, S. A. Wood	939,370

Bluing device, Willcocks & Thorley	939,649
Boat, W. T. Urie	939,878
Bobbin case, L. E. Weaver	939,647
Boiler bracket, W. Withem	939,368
Boiler compound mixer and feeder, Palmer & Baker	939,540
Boiler superheater, locomotive, L. E. Feightner	939,237
Bolt case, R. W. Hubbard	939,694
Boot and shoe polishing machine, H. C. Lowenstein	939,725
Boot or shoe upper, D. Sack	939,639
Bottle, antirefillable, J. N. Landon	939,602
Bottle, non-refillable, E. Ferguson	939,238
Bottle, non-refillable, L. M. Packard	939,300
Bottle, non-refillable, S. Peloso	939,305
Bottle, non-refillable, S. A. Miner	939,430
Bottling machine, J. H. Champ	939,214
Bowling alley amusement device, H. Leighton	939,280
Bowling alley finishing and leveling machine, O. L. Pickard	939,544
Box, H. L. Miner	939,287
Box, E. Langschmidt	939,517
Box filling machine, J. C. Thom	939,455
Box or case, F. J. Kress	939,272
Braiding machine, A. E. Chernack	939,216
Braiding machine, Parks & Wardwell	939,622
Brush guard, A. D. Lockwood	939,522
Buckle, A. Cohen	939,394
Built-up article, W. C. Harlow	939,833
Burette, automatic, S. D. Beard	939,382
Button, cuff, L. A. Gardner	939,680
Button, link cuff, E. W. Morehouse	939,851
Cabinet and display rack, combined, A. E. Baker	939,199
Cake coating machine, P. D. Harton	939,836
Calks, making steel center, J. R. Williams	939,884
Can bottoms, machine for applying, J. C. Thom	939,454
Cans, heading sheet metal, B. Adriance	939,197
Canning apparatus, T. H. Eidson	939,485
Car angle cock holder, railway, L. A. Hoerr	939,421
Car brake, J. W. Johnson	939,701
Car coupling, W. S. Lennon	939,720
Car door, F. X. Malocsay	939,919
Car door, grain, Bickle & McMillan	939,660
Car door operating mechanism, C. A. Lindstrom	939,425, 939,426
Car door operating mechanism, dump, S. Otis	939,298
Car, dump, C. H. Clark	939,588
Car end gate, mine, L. F. Brubaker	939,944
Car fender, M. L. Keizur	939,915
Car fender, J. O'Leary	939,952, 939,953
Car, motor hand, Hovey & Rix	939,423
Car mover, R. F. Hageman	939,249
Car, pay-within passenger railway, A. H. Englund	939,899
Car seat, folding, Farrell & Lewis	939,593
Car ventilator, C. M. Askegren	939,784
Car, weed burning, G. L. O'Neale	939,538
Cars, lumber roller for, E. L. Stocking	939,452
Cars, radiator suspension for motor, G. Enrico	939,961
Carboy, A. J. Miller	939,286
Carboy protector, F. B. Lothrop	939,283
Carbureter, E. A. Dickson	939,481
Carbureter, R. Papanti	939,856
Carbureter, reed air intake regulator for, F. C. Reineking	939,549
Card case or pocketbook, Cummings & Jordan	939,673
Carding machine alarm, E. P. Schmitt	939,750
Carpet fastener, stair, C. W. Kirsch	939,601
Carpet fasteners, tool for detaching, W. H. Boles	939,207
Carpet sweeper brushes, device for cleaning, F. W. Myers	939,290
Carrying and pressing apparatus, C. S. Wheelwright	939,576
Cartridge, blasting, Wolsey & Fussey	939,886
Cash register, W. H. Muzzy	939,289
Catamenial garment, A. L. Brodton	939,943
Cement block machine, Emal & Horn	939,236
Cement kiln, T. A. Edison	939,817
Cement, manufacture of, S. O. Cowper-Coles	939,217
Centrifugal machine, G. N. Goddard	939,904
Chain manipulating tool, J. C. Jensen	939,511
Chair attachment, A. V. & W. H. Jackson	939,841
Chair detachable book rest, Vickers & Henry	939,764
Chair extension arm, Payne & House	939,623
Chairs, adjustable foot rest for Morris, C. L. Greilick	939,827
Chalice, G. Valley	939,960
Chopper. See Cotton chopper.	
Chuck, Pearson & Seward	939,304
Churn and ice cream freezer, combined, W. A. Jones	939,512
Chute, bean, R. A. & H. O. Haenke	939,830
Chute, waste, G. A. Hofmeyer	939,690, 939,691
Circuit breaker, automatic electric, Meter & Rideout	939,730
Clay gathering machine, C. E. Olden	939,855
Cleaner, J. Hadka	939,248
Clothes drier, G. B. Deacon	939,398
Clothes line reel, S. S. Rider	939,862
Clothes line support, G. A. Culbertson	939,811
Clutch, driving and brake, F. T. Gottschalk	939,411
Clutch, pulley, A. H. Cameron	939,663
Coin operated machine, W. W. Rosenfield	939,746
Collar, E. L. Bevington	939,204
Collar machine, horse, Collett & Jackson	939,218
Collar supporter, B. C. Bubar	939,388
Compass, beam, F. S. Hurst	939,597
Compasses, apparatus for recording, Schuette & Dedrick	939,866
Compasses, chart for recording, E. Schuette	939,867
Composition of matter, C. F. Ackerman	939,938
Computing machine, J. M. Daly	939,221, 939,479
Concrete beams, girders, and arch ribs, constructing and erecting reinforced, F. W. Skinner	939,642
Concrete block machine, O. H. Davis	939,225
Concrete block machine, C. E. Phillips	939,543
Concrete conveying and mixing cart, F. H. Lathrop	939,275
Concrete mixer, M. H. Reed	939,629
Concrete mixers, power charging device for, A. E. Smith	939,341
Concrete, reinforced, F. Thun	939,567
Concrete reinforcing bar, J. M. Dudley	939,403
Concrete reinforcing, holder for, J. W. Reed	939,743
Concrete tile mold, portable, F. M. Wiltrout	939,578
Conveyer bucket, J. B. Gibson	939,243
Coop, poultry, C. I. Bumpass	939,798
Copper or copper-nickel mattes, treatment of, J. T. Carrick	939,947
Cornet, Z. A. Meredith	939,285
Corset, A. M. C. & M. M. J. Serruys	939,868
Corset, J. A. Daley	939,893
Cotton chopper, I. F. Harris	939,253
Cotton chopper, S. L. Martin	939,429
Cotton separator, W. A. Patterson	939,303
Craft adapted to travel in a resisting medium, C. M. Stanley	939,344
Crate, folding, J. I. Hall	939,250
Crate, folding, F. C. Edson	939,484
Crate, shipping, H. N. Backus	939,582
Credit system, J. O. Greenvald	939,245
Crown matrices, machine for contouring, F. O. Jaques, Jr.	939,261
Cuff, E. L. Bevington	939,203
Cuff holder, W. S. Bachman	939,464
Cultivator, S. Waltman	939,766
Curtain bracket, C. B. Dumond	939,815
Cushion stuffing device, C. A. Lee	939,278
Cutting, heating, and pulverizing machine, C. M. Lauritzen	939,276
Cutting tool, A. E. Waller	939,359
Dental inlay holder, B. F. Copp	939,476
Dental tooth clamp, G. A. Harper	939,834
Detonator, C. A. Woodbury	939,371
Die, F. H. Hotchkiss	939,505
Die stock, F. E. & F. W. Wells	939,648
Dies, forming, E. D. Boyce	939,468
Disk drill, S. E. Davis	939,812
Display bin, A. H. Plumer	939,546
Display box, A. & J. Eichhorn	939,234
Display box and tray, E. M. Lewis	939,721
Display device, heat operated, J. R. Keller	939,705
Display holder, J. Brauchli	939,942
Distilling alcohols and other volatile liquids, A. G. Waterhouse	939,361
Ditch digging machine, E. Jeschke	939,598
Door fastener, J. Auger	939,785

HOW TO MAKE AN ELECTRICAL Furnace for Amateur's Use.—The utilization of 110 volt electric circuits for small furnace work. By N. Monroe Hopkins. This valuable article is accompanied by detailed working drawings on a large scale, and the furnace can be made by any amateur who is versed in the use of tools. This article is contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 1182. Price 10 cents. For sale by MUNN & Co., Inc., 361 Broadway, New York City, or by any bookseller or newsdealer.

NEW BOOKS, ETC.

RAILROAD STRUCTURES AND ESTIMATES. By J. W. Orrock, C.E. New York: John Wiley & Sons, 1909. 8vo.; 270 pp.; 93 figures. Price, $4 net.

Under the title of Railroad Structures and Estimates, the intention is to cover in brief and concise form the numerous subjects that enter into the Engineer's Estimates of Railroad Building, for the purpose of ready reference, as to general construction and cost, on a business rather than a technical basis. As it is impossible to give the data to suit all conditions, the weights, quantities, and cost are given in detail in most instances, and may be varied as desired.

FRAMING. By William A. Radford. Assisted by Alfred S. Johnson, A.M., Ph.D., and Bernard L. Johnson, B.S. Chicago: The Radford Architectural Company. New York: Industrial Book Company. 12mo.; 388 pp. Price, $1.

To the carpenter especially, and to all others interested in wood in a structural way, this is a most important subject. The framing of a building has been likened to the skeleton of the human body. It is important that it be put together properly and connected up in the right way. The whole stability and success of the edifice depend on the strength and proper arrangement of the supporting frame. The present work is divided into four heads: (1) Timber framing for houses; (2) barn framing; (3) framing of factories, stores, and public buildings; (4) miscellaneous framing, including strength of timbers and the principles of truss construction. The work, accordingly, will be taken up in this order. In some cases certain subjects of an introductory or explanatory nature will be discussed, although, strictly speaking, they are no part of "framing" and possibly are not done by the carpenter. Yet a knowledge of them will add to the carpenter's equipment, and will help him to do his work more intelligently.

METAL SPINNING. Practical Instructions in a Fascinating Art. By Fred D. Crawshaw, M.D. Chicago: Popular Mechanics, 1909. 18mo.; 72 pp. Price, 25 cents.

Like so many of the other old-time crafts, the one of metal spinning has partially gone into disuse because of commercial competition and the failure of the younger generation of men to familiarize themselves with the handwork of their fathers. In the United States it is only in the larger cities that one finds an artisan who does metal spinning. When such a person is found, he is usually occupied in producing forms out of thin metal that require great care in making and are difficult to produce with the stamp or press. It is believed in some circles, particularly among metal spinners, that the pressing and stamping of metal can never fully take the place of spinning it. The object of this book is to assist amateurs in an interesting art, and also give practical metal spinners additional instruction.

THE SCIENTIFIC AMERICAN BOY AT SCHOOL. By A. Russell Bond. New York: Munn & Co., Inc., 1909. Pp. 338. Price, $2.

One of the most interesting and helpful of recent books for boys was "The Scientific American Boy," by the accomplished author of the present volume, in which was described the adventures of a youth of mechanical turn of mind with his companions in a vacation season. Mr. Bond now carries the story further, places his hero in boarding school, and invites his readers to enjoy his later adventures, and profit by them as well. It is pre-eminently a boy's book for boys, for boys with sound bodies and healthy minds, who like to be out of doors and making things with their hands—just the kind of boys one reads about and would like to have or know, but who sometimes seem rather scarce when one scans the list of one's boy acquaintances. Mr. Bond has been more fortunate than some of us, for his boys are fine young chaps, full of life and vigor and endowed with mechanical turns of mind that must have given some of their elders pause. But at all events they are not prigs, but good, wholesome boys of the right sort; and if one does not meet them in the streets every day, it is good to know there are such young people and to read about them in Mr. Bond's agreeable pages. The book is not at all a history of school life, but might be scientifically described as an essay on surplus energy. It deals, not with what the boys did in school hours, but what they did outside of them. These, of course, are the real hours of a boy's life, the time in which he is free and unrestrained, in which he seeks to please himself and work off some of that boy energy that is sometimes not always so appreciated by his elders as it might be. So the book brims over with good nature and ingenuity and with the breath of outdoor activity. If the mechanical performances of these young fellows seem sometimes a bit audacious, we may rest assured, with the author's certificate, that they never did anything boys of real earnestness and ingenuity could not have accomplished. The careful parent may perhaps be disposed to pause a little at the flying machine, but—read Mr. Bond and find out what happened. The book is agreeably written with a fine sympathy for boy life and boy activity. It abounds in practical ideas and suggestions, and will prove a veritable boon to the parent

who wishes to interest his boy in the value of thinking and doing. The numerous illustrations are extraordinarily helpful and practical.

HANDY MAN'S WORKSHOP AND LABORATORY. Compiled and edited by A. Russell Bond. New York: Munn & Co., Inc., 1909. Pp. 467. Price, $2.

This is a book of first-rate importance and interest, and is a notable contribution to practical work from the office of the SCIENTIFIC AMERICAN. It is a book that not only aims to be practical, but which is practical from cover to cover. It is a collection of ideas and methods, of ways to do things, of what to do and how to do it as proposed, tried out and tested by resourceful men, both amateur and professional. It contains, in short, upward of a thousand ingenious "kinks," ideas, and hints, useful to the household, attractive to the mechanic, and interesting to everyone who loves to tinker and make articles of use and value, or in whom the spirit of experimentation is inbred. Unlike many books of this kind, however, this is no collection of scientific experiments. In fact, it is not an experimental book at all, but a treatise of useful things. It is not concerned with theory, but with fact. It deals, not with what will give curious results, but with achievements of real value and utility. And this it does in the most direct way possible. The descriptions of methods are concise and clear, and at every point they are supplemented with drawings and diagrams, many of which are in the form of working drawings that show, in a very precise and definite way, just what to do, and how to do it. There are 370 such illustrations in the book, very clearly drawn and lettered, and illustrations that illustrate in the best sense of the word. The origin of the book is a department established some time ago in the SCIENTIFIC AMERICAN, devoted to the interests of the "Handy Man." A flood of suggestions poured in from a multitude of sources, and the best of these have been reproduced in the present volume. It is, however, in no sense a reprint from the SCIENTIFIC AMERICAN, since much of its contents is now printed for the first time. Mr. Bond has devised a book that will very successfully appeal to a very wide circle. The amateur workman is attracted by the opening chapter on fitting up a workshop. Both he and the professional mechanic will find a host of suggestions on the greatest diversity of topics in the next chapter on Shop Kinks. Both again will be interested in the very valuable chapter on the soldering of metals and the preparation of solders and soldering agents. Here is a long list of formulas for solders of tried and tested accuracy. The professional mechanic is especially appealed to in the fourth chapter on the Handy Man in the Factory, while still another class of readers will be interested in the fifth chapter on the Experimental Laboratory. Electricity is very fully treated in the sixth chapter, and the householder will find a wealth of suggestion in the numerous devices described in the seventh. The sportsman will be helped with the hints of the eighth chapter, while the final chapter on flying machines is of the greatest possible present-day interest. It is, in short, a book of the widest general interest, and both editor and publisher are to be heartily congratulated on the success obtained in this very valuable publication.

CONCRETE POTTERY AND GARDEN FURNITURE. By Ralph C. Davison. New York: Munn & Co., Inc., 1909. Pp. 196. Price, $1.50.

The publishers' statement that this is a new book on a new subject is very true. Neither concrete pottery nor concrete garden furniture is in itself new; but a book dealing with their making by the amateur has not heretofore been published, and hence this volume amply supports the claim of novelty made for it. Readers of American Homes and Gardens have already acquired some familiarity with Mr. Davison's guidance in this fascinating art, and while the articles he contributed to these pages have been reproduced in this book, they have been given a new form and much new and additional matter has been added to them. The illustrations have been greatly increased in number, and the whole given the form of a practical handbook. Books on handicraft of any kind are apt to fail, more or less, in the inadequacy of their directions. The author, too, often knows so well what to do and how to do it as not to realize that those who have not followed the work before may not quite follow what are supposed to be careful directions. Mr. Davison has been fully alive to this misfortune in books of this kind, and has, therefore, taken especial pains to make his descriptions most accurate and detailed. No other method is, of course, really feasible; but it is seldom this sort of thing has been so well done as in his pages. The careful text is supplemented with illustrations as carefully made and lettered, so that the book is a genuine handbook of craftwork, thoroughly practical in every part, and admirably adapted to its special purpose of explaining every portion of the work involved in the production of the various articles described. Mr. Davison has opened up quite a new field for the amateur. The materials required are abundant and cheap; the methods, in the simpler pieces at least, easy and devoid of difficulties. And the work is not only pleasant, but the results are agreeable and decorative. The author thoroughly knows and understands his subject, and has the gift of imparting his knowledge to his readers.

Door lock, combination, Brown & Roberts	939,210
Doubletree, four-horse, M. McEvoy	939,534
Dough mixing machine, C. Chambers, Jr.	939,392
Draft appliance, O. Atkinson	939,378
Dredge, C. W. Diehl	939,227
Dress shield, R. S. Kleinert	939,712
Drilling machine, J. W. Green	939,907
Drinking fountain for birds, fowls, and animals, W. B. Gething	939,493
Drinking glasses, bowls, cups, spoons, etc., labial protecting means for, L. Jancey	939,698
Drinking vessel, sealed, J. C. Schleicher	939,554
Drip receiver, H. O. Bessette	939,202
Drum batch mixer, W. R. Tuttle	939,762
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Educational device, A. S. Kilroy	939,515
Egg box, folding, C. T. Bloomer	939,661
Egg tester, J. W. Billings	939,205
Electric conductor coupling, J. L. Hinds, 939,501,	939,689
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Electric machine for ignition purposes, magneto, Vandervell & Hoffman	939,357
Electric motor, alternating current, J. T. Schaaff	939,331
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Electric transmission of messages, G. Sellers	939,339
Electrical currents, apparatus for strengthening weak, A. Pollak	939,625
Electrical transmission of graphic messages, G. Sellers	939,338
Elevator feed wheel, liquid, J. F. Barker	939,380
Embroidering machine, J. Brunnschweiler	939,471
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Engine ignition device, explosive, A. F. Clarke	939,805
Engines, combustion device for doing away with exhaust gases in combustion, K. & E. Lehmann	939,844
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Envelop, safety, R. Hasel	939,949
Excavating machine, D. W. Miller	939,731, 939,850
Expansion bolt, Vernon & Morningstar	939,457
Explosive engine, A. J. Cole	939,669
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Eyeglasses, S. J. Clulee	939,668
Fabrics, machinery for manufacturing textile, W. Bowker	939,467
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Fan, electric motor, N. A. Locke	939,723
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Faucet and hose coupling, H. P. Towle	939,931
Faucet hose coupling, H. P. Towle	939,932
Feed box, A. D. Myers	939,533
Feed water injectors, attachment for, C. Phillips	939,310
Feed water regulator, C. Brent	939,889
Fence clamp, A. C. Harrison	939,835
Ferrule, waste, J. Klein	939,711
Fiber cleaning apparatus, J. K. Toles	939,569
Fifth wheel, J. Herby	939,254
Film dryng machine, F. B. Thompson	939,350
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Filter, J. W. Hammett	939,497
Filter, water, Hisey & Wardle	939,418
Finger ring, L. E. Sadler	939,864
Fire alarm test apparatus, J. G. Nolen	939,292
Fire escape, J. E. Andrews	939,375
Fire pail, air-tight, C. F. Crane	939,220
Fire protection signal system, Nolen & Shepherd	939,293
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Float coupling, C. Dargent	939,397
Flue, metallic, L. D. Armstrong	939,652
Fluid pressure regulator, F. H. Brown	939,470
Flushing tank, C. C. Lindley	939,521
Fly screen, E. Curtiss	939,395
Folding seat, W. G. Winans	939,937
Folding table, Forbes & Singer	939,824
Forging press, C. Mercader	939,920
Frangible receptacle, J. L. Watson, Sr. & Jr.	939,572
Fruit cooling apparatus, M. W. Groom	939,685
Fruit cutter and squeezer, D. H. Mosteller	939,615
Fruit packing device, F. B. Pease	939,740
Furnace, W. B. Merkel	939,526
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Furnace charging apparatus, blast, W. & A. Crooke	939,671
Furring strip, F. E. Sagendorph	939,749
Fuses of projectiles, safety device for the, E. Schneider	939,447
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Game element carrier, coin controlled, R. F. Pendleton	939,306
Garment, P. B. Sherman	939,871
Garment holder, C. C. Livingston	939,606
Garment presser, C. A. Friedrich	939,408
Gas burner, B. A. Geurink	939,242
Gas burner, self-closing, C. A. Johnson	939,263
Gas generator, acetylene, F. J. Moss	939,614
Gas manufacturing apparatus, B. Loomis	939,282
Gas or oil burner, O. J. Heindel	939,415
Gas producer, G. L. Morton	939,288
Gas regulator, M. Graetz	939,684
Gasoline apparatus, storage, H. E. Grant	939,596
Gasoline supply, strainer and separator for, G. M. Schebler	939,551
Gate, F. B. Tice	939,568
Gear, transmission, W. S. Hovey	939,914
Gear, variable speed transmission, E. P. Cowles	939,589
Gears, draw bar and yoke attachment for draft, Bundy & Acker	939,390
Gearing for stentering machines, A. E. Simpson	939,959
Gearing, frictional, L. C. Arnaud	939,653
Generator and mixer, E. R. Wilson	939,779
Glass cutting tool, J. Lamb	939,843
Glazier's point, C. A. Buffat	939,796
Governor, N. C. Bassett	939,656
Governor for internal combustion engines, W. M. Power	939,923
Grain separator, W. P. Silver	939,449
Graphophone horn and record case, combined, W. Smith	939,753
Grass cutting device, W. S. Hayden	939,837
Grate, C. F. Butler	939,945
Gun carriage for field ordnance, J. A. Deport	939,399
Gun stock, L. F. Kennedy	939,707
Hair tonic, F. W. E. Muller	939,431
Hame and trace connection, F. F. Hodges	939,420
Hame fastener, G. W. Rever	939,321
Hammer, pneumatic, H. H. Grobes	939,828
Handle, G. A. Schehr	939,332
Hat carrier, G. H. Wheary	939,364
Hat holder, W. T. Truitt	939,352
Hat protector, W. J. Stewart	939,874
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THE WELLCOME TROPICAL RESEARCH LABORATORIES AT KHARTUM.

(*Continued from page 375.*)

under the direction of Dr. C. N. Wenyon, proto-zoologist to the London Tropical School of Medicine, and proved such a complete success that the work in this direction is being considerably developed.

Entomology is another very promising science that has claimed considerable attention in these laboratories. There is an immense field in the Sudan for an economic entomologist, and the scope and variety of the work done is almost bewildering. There are pests of every kind infesting every living being and plant, and the task of reducing these would at times seem almost hopeless. Every year taxes, aggregating large sums, have to be remitted owing to the ravages of *Aphis sorghi* and other pests. Fatalism, natural indolence, and improvidence often prevent the natives, unless supervised, from taking those active measures so necessary in cases of insect infestation of crops. These labors have also a direct bearing on tropical medicine, as results have abundantly testified.

In the field of anthropology very valuable work has been accomplished. The laboratories are recognized as a working place for fellows of the Carnegie Research Fund; and on the recommendation of the director, Dr. A. MacTier Pirrie was appointed anthropologist to the Institution. In addition to his medical qualifications, Dr. Pirrie held a special degree in anthropology, and was particularly well versed in physical work. Although he labored under the great disadvantage of not knowing the country, he undertook and successfully completed remarkable journeys into the totally unknown Burun country, which lies between the White Nile and Abyssinia. He lived and moved among the tribes inhabiting this territory, and his method of handling the natives was highly appreciated by the government. By his free movement among them he was able to acquire extensive data of their life, manners, and customs of the most highly prized character. Unfortunately, these expeditions proved fatal to the young, enthusiastic investigator. During one journey he contracted an indigenous disease propagated by the parasite of kala-azar. He was prostrated and invalided home to Scotland, but died six months later before he had the opportunity of setting out the results of his work. His notes and observations, as well as those of archæological and ethnological aspect, were worked up by competent authorities, and have thrown much light upon a people and their country about which nothing has previously been known.

The chemistry section has received as much attention as tropical medicine, for it has an important bearing upon the commercial development of the country. The principal fields of investigation in this direction have been Sudan gums, food-stuffs, and seeds, as well as water supply from the Blue and the White Nile and wells. The study of gums has been particularly exhaustive. The Sudan has extensive forests of gum trees; in fact, such constitutes one of its staple products. Inquiry showed that comparatively little was known about gums, so that great attention was concentrated upon this subject. After some four years of labor, the laboratories have made some valuable additions to the chemistry of this commodity, and it is hoped that their labors may result in placing the Sudanese gum industry upon a sound basis.

Unfortunately, on May 11th, 1908, the laboratories suffered a heavy calamity in a fire, which breaking out in the photographic dark room, practically gutted the building, except the library, directors' room, and one or two other departments. Not only was a very large quantity of equipment destroyed, but all the trypanosomiasis specimens were lost, together with the records of two years' work on the subject. Nearly all the paraffin blocks prepared during the previous

(*Concluded on page 383.*)

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(*Concluded from page 381.*)

eighteen months, and containing the imbedded organs of fowls dead of spirochætosis, were lost, and thus a far-reaching investigation has been temporarily arrested, and it has not yet been possible to replace the material. Upon the receipt of the news of the catastrophe, Mr. Henry S. Wellcome, to whose munificence the Institution was due, immediately offered to replace the lost equipment; and through his generosity the laboratories were completely refitted and re-equipped with the most modern appliances, so that work could be resumed with the minimum delay. Consequently, so far as general usefulness goes, the Institution was only temporarily crippled.

Work is now again in full swing, and it should be pointed out that there is a very large field to be covered yet. If the various countries interested in the exploitation of the continent could establish similar laboratories to this in their respective territories, it would soon become a white man's land, and through concerted action the terrible maladies which at present arrest development would be completely subjugated.

ARTILLERY FOR AIRSHIP ATTACK.

(*Concluded from page 373.*)

is clamped tight against the axles. The third type of cannon is of a much heavier build than the two which precede, seeing that in this case it is designed to be mounted on shipboard, and hence the weight does not need to be reduced as in the other cases. It is of a considerably larger caliber, this being 10.5 centimeters (4.2 inches). In most of the details it is designed on the same lines as the second type. It is intended to be mounted generally upon torpedo boats or swift cruisers, and naturally the gun can be brought into service as an ordinary cannon in cases where it is needed. For the gun proper, the weight is 3,080 pounds, while the support weighs 3,520 pounds, giving a total weight of 6,600 pounds for this type. Like the former, the angle of elevation is 75 degrees at a maximum. The projectile, weighing 40 pounds, has an initial speed of 2,300 feet per second. A horizontal range of 44,500 feet is reached in this case, and we have the unusual height of 37,620 feet.

The present types of gun were given a series of tests by firing upon captive balloons, and two of our engravings illustrate this feature. In one case we observe the balloon, which has not been hit by the shot, and this can be clearly seen by the trail of smoke which shows the path of the projectile. In the second view is represented the effect which takes place when the projectile strikes the balloon, and we have the detonation of the grenade and at the same time the explosion of the gas and the destruction of the balloon.

Alcohol vs. Gasoline Engines.

Almost any engine with a well-designed carbureter will run as well with alcohol as with gasoline, except for a difference in ease of starting and in certainty of operation at low speeds. By using alcohol in an alcohol engine with a high degree of compression the fuel-consumption rate in gallons per horse-power hour can be made practically the same as for gasoline in a gasoline engine of the same size and speed. An alcohol engine with the maximum compression for alcohol will have 30 per cent more available horse-power than a gasoline engine of the same size, stroke, and speed, and the weight per horse-power may be less. Tests with mixtures of gasoline and alcohol showed no gain in efficiency over gasoline or alcohol alone. Diluting gasoline with water did not affect fuel economy.

With alcohol the case was different, but with dilutions up to 80 per cent alcohol the effect was so slight that 80 per cent alcohol is a cheaper fuel than 90 per cent if it can be had for 15 per cent less.

Stamp mortar, M. P. Boss	939,208
Starting and separating gate, R. V. Jones	939,703
Steam generator, F. N. Tilton	939,759
Steam trap, Singer & Pratt	939,450
Steam trap, N. English	939,667
Steering gear, R. S. Riley	939,323
Stirrup, safety, J. L. James	939,697
Stoker for furnaces, mechanical, F. W. Seyboth	939,869
Stone cutting machine, W. F. Meyers	939,528
Stone fluting machine, G. N. Williams, Jr.	939,577
Store service credit system apparatus, C. F. Kettering	939,267
Stove, L. Moore	939,529
Stove, Choltus & Jeannesson	939,890
Superheater for use in connection with vulcanizers and other apparatus, J. Berliner	939,956
Surfacing machine, A. H. Whatley	939,363
Surfacing machine, F. R. Allen	939,373
Suspender check, F. B. Hawes	939,687
Suspenders, G. M. Edgarton	939,898
Suspending device, portable, C. F. Redman	939,318
Sweeping compound, Wolfgram & Klausman	939,369
Syringe or the like, C. P. Leyner	939,520
Syringe, vaginal, E. H. Keske	939,266
Table lock, extension, J. A. Barbrake	939,379
Talking machine, W. W. Wooster	939,781
Tape, T. P. Himes	939,839
Telegraph sending machine, J. A. Hulit	939,507
Telegraph system and apparatus, T. B. Dixon	939,401
Telegraph transmitter, B. F. Bellows	939,383
Telegraph transmitter, G. M. Goddard	939,683
Telemeter, H. Wild	939,366
Telemeter rod, C. E. Flanagan	939,489
Telephone attachment, H. R. Palmer	939,439
Telephone system, F. E. Summers	939,756
Temperature regulating apparatus, J. M. Pullen	939,858
Thermostat, H. G. Geissinger	939,957
Thread cop, A. N. Chartier	939,667
Thread cutting mechanism, filling, E. H. Ryon	939,445
Thread cutting tool, W. Murchey	939,735
Tie holder, A. A. Felix	939,678
Time lock, E. M. Benham	939,384
Tire antislipping attachment, M. J. Frambach	939,491
Tire, cushion, W. E. Marengo	939,524
Tire fastener, L. M. Nelson	939,619
Tire for vehicle wheels, elastic, B. M. de Sa	939,327
Tire, pneumatic, J. L. Maitland	939,428
Tire protector, F. R. & C. R. Colvin	939,474
Tire, resilient, W. H. Rowling	939,638
Tire, vehicle wheel, T. Midgley	939,610, 939,611
Tongue, draft, T. Pojar	939,547
Tonnage equating machine, J. M. Daly	939,222
Tool, F. H. Gruer	939,496
Tool, pneumatic, C. Christiansen	939,803
Toy, J. B. Bowman	939,586
Track sanding device, E. L. Larson	939,718
Track supporting device, overhead, Neller & Louden	939,618
Traction device, M. E. Schmidt	939,334
Train switch, electrically actuated, J. Y. Porter	939,626
Tramways, point operating mechanism for, T. N. Atkinson	939,939
Transmission mechanism, temperature controlled, H. H. Taylor	939,566
Trap, P. Elfstrom	939,818
Tripod, J. M. Pullen	939,859
Trolley head, T. R. Stam	939,564
Trolley head, J. J. Bennett	939,658
Trough. See Eaves trough.	
Trousers stretcher, E. N. Hallett	939,831
Truck, J. F. Fierke	939,406
Truck bolster, J. J. Byers	939,946
Truck, car, C. S. Shallenberger	939,870
Truck, hand, A. B. Kerndl	939,600
Truck, lifting, A. A. Ake	939,783
Trucks, blocking device for, Lattneer & Robinson	939,518
Trunk, wardrobe, G. H. Wheary	939,575
Tube mill lining, G. H. Rotherham	939,637
Tube welding apparatus, Dicke & Klinkmann	939,591
Tubing, apparatus for making spiral, E. T. Greenfield	939,244
Turbine, C. A. Kaiser	939,514
Turbine, J. H. Felthousen	939,821
Turbine, internal combustion, gas, G. E. Dod	939,229
Twine making machine, C. Kieren	939,268
Twine take-up, J. B. Eastman	939,233
Typewriter attachment, A. C. Kendrick	939,265
Typewriter carriage stop mechanism, M. B. Sargent	939,640
Typewriting machine, C. B. Yaw	939,579
Typewriting machine, E. E. Barney	939,583
Typewriting machine, A. T. Brown	939,587
Umbrella, folding, X. J. Zoller	939,842
Valve, T. J. Hendricks	939,499
Valve, J. L. Fitts	939,893
Valve, air, J. W. Ledoux	939,277
Valve device for corrosive liquids, W. H. Smith	939,927
Valve, regulating, B. Blumel	939,792
Vault closure, Myers & Poister	939,922
Vegetable cutter, Myers & Kahne	939,951
Vehicle body, E. W. Crosby	939,478
Vehicle wheel, L. Garnier	939,681
Vehicle wheel, T. Hubscher	939,695
Vehicle wheel, spring, E. Murray	939,432
Vehicles, fore carriage of, J. Schmitt	939,555
Vending machine, coin controlled, E. F. Spaulding	939,563
Violin, F. O. Fish	939,486
Vise, quick acting woodworking, W. Y. Mentzer	939,284
Voltaic high-current arcs, production of, H. Pauling	939,442
Voting machine, Stacy & Julius	939,755, 939,929
Voting machine counter construction, C. F. Currey	939,674
Vulcanizer, F. E. Smith	939,842
Wagon bed, C. B. Tillery	939,758
Wagon, dumping, J. Heberling	939,414
Wagon, dumping, T. Wright	939,782
Wall and constructing same, composite, J. H. Magdiel	939,726
Warp stop motion, electric, J. Regan	939,924
Washing machine, W. C. & L. R. Simmons	939,340
Washington machine gearing, A. Van Wormer	939,645
Water closet disinfecting devices, valve for, J. Kneen	939,424
Water gage, H. H. Vaage	939,673
Water heater, electric, Levy & Blanchard	939,605
Water motor, J. Hubmann	939,506
Web coating machine, W. A. Daniels	939,396
Weighing machine, W. W. Rosenfield	939,747
Wet machine, W. White	939,469
Wheels, manufacturing metal, G. Kowarsky	939,714
Whip socket, R. Habekost	939,246
Winding mechanism, self, Blodgett & Atkinson	939,791
Windmill tower, W. Hopper	939,504
Window operating mechanism, swinging, J. S. Gourlay	939,412
Window screen, H. B. Wilson	939,780
Wire reel and mounting therefor, F. P. Murphey	939,616
Wire splicer, I. G. Huston	939,509
Wire stretcher, J. F. Ball	939,787
Wood blight composition, J. W. Lafer	939,273
Woven fabric, T. B. Dornan	939,230
Wrench, E. C. & G. W. Rea	939,317
Wrench, D. Mallory	939,728
Wrench, P. Bartok	939,788
Wrench, L. G. Van Ormer	939,879
Yarn cleaner or slub catcher, G. W. Foster	939,490

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