SCIENTIFIC AMERICAN

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Vol. C.—No. 11.] ESTABLISHED 1845.

NEW YORK, MARCH 13, 1909.

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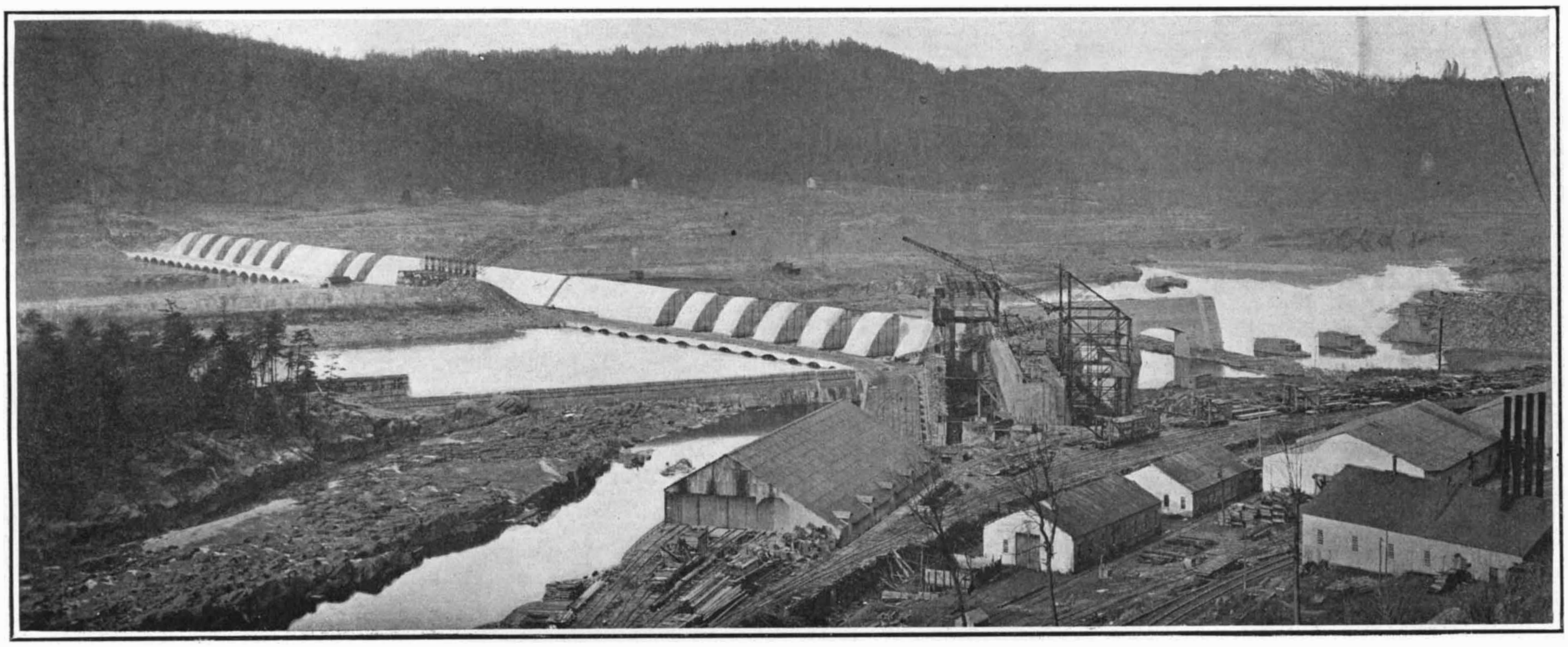
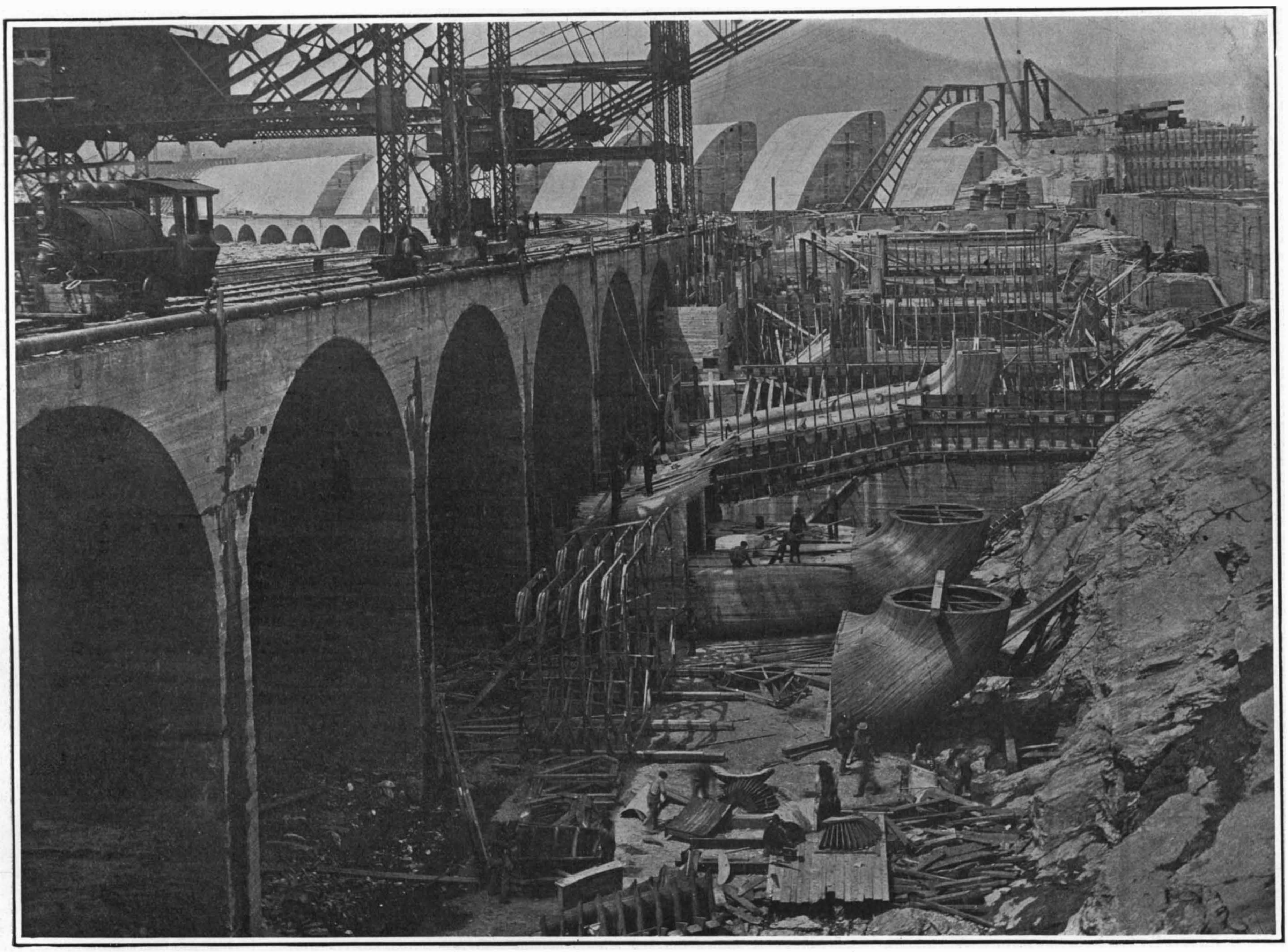


The present appearance of the dam and the partly constructed power house.



Bridge carrying construction line and penstocks being assembled in foreground.

THE M'CALL'S FERRY HYDRO-ELECTRIC POWER PLANT.—[See page 203.]

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ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*,
361 Broadway, New York.
FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York.

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States or Mexico $3.00
One copy, one year, for Canada 3.75
One copy, one year, to any foreign country, postage prepaid, 18s. 6d. 4.50

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) .... $3.00 a year
Scientific American Supplement (established 1876) .... 5.00 "
American Homes and Gardens .... 3.00 "
Scientific American Export Edition (established 1878) .... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MARCH 13TH, 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.

A TRIBUTE TO ROOSEVELT'S TECHNICAL JUDGEMENT.

Be he Czar, King, or President, there is no executive among the nations in whom catholic interest, broad information and versatile genius are such valuable qualities as in a President of the United States. Certainly it would be difficult to find another head of a great people, who is called into such close touch with so many widely different subjects, and afforded such an unrivaled opportunity to leave the imprint of his personality upon the national life—political, social, technical, and commercial—as the man who for the time being holds the unique position of our President.

Among Mr. Roosevelt's predecessors, there have been men who surpassed him—far surpassed him—in their knowledge of certain special problems that came up for legislation; but in the bewildering variety of subjects of which he possessed more than average knowledge, and in his ability to seize quickly the salient facts of problems with which his acquaintance was more limited, Mr. Roosevelt stands quite alone.

Himself robust, direct, and practical, he prefers the concrete to the abstract; and it was therefore natural that some of the best of his executive work should have been done in connection with questions of a technical-constructive or engineering character. Although Mr. Roosevelt is not by training an engineer, there is little reason to doubt that, had his intelligence and energy been turned in this direction, he would easily have risen to the front rank. In no profession is a true sense of proportion—the ability quickly to separate the essential from the non-essential—more valuable than in that of the engineer; and this quality our ex-President possessed in a remarkable degree and used to most excellent effect. For it is a fact that in all the great engineering problems that called for executive pronouncement and action, almost invariably, as the records of his seven years' presidency show, Mr. Roosevelt recommended legislation which met with the approval of the great body of professional men throughout the country. In proof of this it is sufficient to mention his attitude to the navy, the Panama Canal, and the vast problem of the conservation of our national resources.

There are not wanting proofs, concrete and costly, of the evil of unintelligent and obstinate forcing of lay ideas upon the professional men who design the *matériel* of the United States navy. Mr. Roosevelt's administration has been singularly free from such errors. He was a close student of naval affairs, and he understood the trend of naval development so well that the Department always found in him an appreciative and able advocate of its new designs. He favored the building of battleships rather than cruisers, and of all-big-gun battleships of the largest displacement. He was keenly alive to the value of target practice, and our present splendid shooting is largely due to his powerful backing of the officers who devised and carried through our present methods. To him, moreover, we shall owe, in no small measure, the system of promotion by selection and for merit; to say nothing of the coming reform of our present cumbersome methods of naval administration. It is true that in some details of his naval policy the Scientific American has been opposed to Mr. Roosevelt's recommendations, as, for instance, when he would have placed a seagoing officer instead of the Chief Naval Constructor at the head of the consolidated bureaus; but this has been the rare exception.

It is largely due to the clearheadedness and powerful influence of Mr. Roosevelt that this nation is not now engaged in the Herculean task of digging the Panama Canal down to sea level. There is something agreeable to nature, and therefore attractive, in the idea of a canal through which the water flows from ocean to ocean without obstruction. Mr. Roosevelt evidently thought so; and when his board of foreign and American engineers went down to the Isthmus to examine and report on the matter, he told them that he hoped they would find a sea-level canal to be feasible. The majority of the board reported, as he had hoped, in favor of a sea-level canal; and yet Mr. Roosevelt advocated the adoption of the minority report in favor of a lock canal. His critics called him erratic; but the fact is that, when the arguments in favor of a lock canal were presented, his practical judgment saw that they were unanswerable; and his fearless rectitude led him to condemn at once and strongly the very type of canal for which he had asked. The progress of events has proved the wisdom of his course. The lock canal is being successfully built; and a board of engineers, all experts in hydraulic work, has pronounced it to be the only type that will satisfactorily meet the conditions at the Isthmus.

For many years the professional world has been painfully aware of the unrivaled extravagance with which those great national resources with which the engineer and architect are most closely concerned are being exploited for private profit. They have realized that the nation was living on its capital and rapidly approaching, as far as these resources were concerned, a condition of national insolvency. Here and there, and not infrequently, a note of warning was sounded; but these men had neither the time nor the political vantage ground from which to set in motion the machinery of federal legislation. In President Roosevelt—ranchman, hunter, lover of the forest, rivers, and mountains—was found the very man to appreciate the magnitude of the threatened disaster and awake the nation to its responsibilities. His latest work in promoting the Congress for the conservation of our national resources, forms a fitting climax to his seven years' work in this and allied fields of endeavor.

A CRUISER WITHOUT FUNNELS.

The dispatch recently cabled from England to the effect that a big-gun cruiser is about to be laid down which is to be driven by gas engines and will, therefore, be entirely without smokestacks, has brought so many inquiries to this office, that we have published on another page a digest of the principal work that has been done hitherto in applying producer-gas engines to the propulsion of warships. In view of the fact that the largest engine of this type known to have been successfully tested in any sea-going vessel is of only 500 horse-power, the next largest being an experimental engine of 1,000 horse-power, it is safe to say that the British Admiralty is not committing itself to the immediate installation of producer-gas plants in any first-class warship. The new vessel, to be known as the "Indefatigable," is to be an enlarged "Indomitable"; and as the cruisers of this class carry engines which indicated on trial about 47,000 horse-power, it certainly does not appear likely that the British navy will commit itself to a jump of from 500 to nearly 50,000 horse-power, without a very considerable intermediate period of experimental trials. If the results obtained with the 1,000-horse-power experimental engine are as satisfactory as those obtained with the plant of half the power, we may look for tests with a 5,000 or even a 10,000-horse-power installation, the power being developed upon three or possibly four shafts. But if producer-gas engines were installed on the new "Indefatigable," it would be necessary to develop from 10,000 to 12,000 horse-power on each of four shafts. No such engines exist, even in stationary gas-engine practice, where the maximum size is from 5,000 to 6,000 horse-power.

However, the advantages of the application of the producer-gas engine to warships are so many and valuable as to make it well worth the while of any great navy to spend lavishly for experimental work aiming at the solution of the difficulties attending the problem. The removal of smokestacks would abolish the telltale smoke and render it frequently possible for a fleet to get within range before being discovered. The number of guns that could be carried on a given displacement would be increased and their arcs of fire enlarged. The perils of suffocation, due to smokestacks being torn open by exploding shells, would be completely removed; since the products of fuel combustion would be discharged through an exhaust in the stern near the water-line. Because of the high fuel efficiency, which is 80 to 100 per cent better than that of the ordinary marine steam plant, a ship would be able to steam nearly twice as far on the same coal supply. If the nation which first perfects a large marine gas engine should also possess the facilities and capital to rapidly build a fleet of gas-engine battleships and cruisers, she will gain a lead over her competitors that might take years to overcome.

VENTILATION OF PASSENGER COACHES.

From the description of the seventy-five steel passenger cars recently ordered for the Pennsylvania Railroad, it is evident that the company are in a fair way to secure the fireproof and collision-proof qualities which are sought in the design of the cars. Outside of mahogany window sashes and seat frames, the cars will be entirely free from wood fittings, the total weight of wood in each car being only 300 pounds out of a total weight of 116,000 pounds for the entire structure. The collapse of the car in collision is guarded against by the provision of a central steel box girder 24 inches wide and 9 inches deep, extending throughout the floor framing for the whole length of the coach. This massive construction will receive the full brunt of a collision, and serve as a defense against that disastrous telescoping, which is the most fruitful source of fatalities in accidents of this kind.

It is to the ventilation of these cars, however, that we wish to direct attention. The subject is particularly timely just now, when the traveling public is being put to so much inconvenience through the overheated and stuffy conditions which are the rule rather than the exception on some railroads. In a properly ventilated car the whole of the air should be renewed at frequent intervals; it should be warmed, and the proper amount of moisture should be imparted to it. The mere provision of steam pipes, and the opening of a few ventilators in the roof, will not secure the desired results. The air will be heated, but not properly renewed; and a considerable portion will be endlessly circulated between floor and ceiling, and dried out by steam heat to the point at which it becomes uncomfortable, if not positively distressing.

In the new Pennsylvania coaches the air enters by two hoods on diagonally opposite corners of the car roof. From the hoods it is led down by vertical ducts, placed within the sides of the car, to a horizontal duct adjoining the side sill and running the full length of the car between the floor and the sub-floor. Above the floor, for its full length, along the sides, are rectangular ducts in which are placed the steam heating pipes. The outside air enters the hoods and passes through the ducts beneath the floor, to openings into the duct containing the heating pipes. Here it is thoroughly warmed and is finally discharged into the aisle of the car through outlets provided beneath each seat. The air is liberated through ventilators in the roof, which are furnished with valves that regulate the escape of the air. The forward movement of the car forces the air in under a slight pressure, and the restraining action of the discharge valves maintains this pressure and prevents drafts of cold air passing in through cracks in the doors and windows. The system is an excellent one, being founded on thoroughly sound principles of ventilation; but we would suggest that, if provision could be made for adding the requisite amount of moisture to the warmed air before its admission to the car, its hygienic qualities would be improved, particularly for passengers whose throat and nasal passages are subject to catarrhal and kindred troubles.

A SUCCESSFUL FRICTION CLUTCH.

The clutch, on account of troubles with motors and axles, has not until recently received attention and development. Many types have been evolved, the principal and earlier one still used having the open air engagement, such as the leather-faced cone, the internal expanding type with the leather face, and the external contracting type. They are all subject to the influence of moisture, oil or dirt, which cannot be kept from their facings. The ideal clutch is the multiple-disk type, one in which the working parts are inclosed in a tight case filled with oil, and the uncertainties of the open type are eliminated. The disadvantages of this flat-plate multiple-disk clutch are, however, that the small frictional area which can be attained in the comparatively small space to which the designer is limited, makes necessary large spring pressures in order to transmit the power. The spring pressure in the usual type of flat-plate clutch is generally about 60 pounds to the square inch. This naturally means a greater tendency to undue wear and heating of the plates, with the consequent burning of the lubricant, or, in extreme cases, the warping of the plates. The solution of these problems was obtained in the successful use of a disk for transmitting power by the friction contact of highly lubricated V-shaped wedge plates. The 35 deg. angle corrugated plates give three times the frictional area of equal-sized flat plates, and will, therefore, transmit three times the horse-power, but with one-third the spring pressure, and therefore with one-third the pedal pressure. The clutch is self-contained, and not subject to outside conditions; except that in cold weather the oil becomes thick much in the same way as it does in the motor and transmission. This is easily overcome by using a mixture of half light cylinder oil and half kerosene.

ENGINEERING.

On February 1st the percentage of completion of the six "Dreadnoughts" now building for our navy was as follows: "South Carolina," 78.90; "Michigan," 89.70; "Delaware," 64.10; "North Dakota," 70.60; "Florida," 3.30; and "Utah," 3.10.

According to the last report on the coast defenses of the United States, there are now mounted 376 12-inch mortars and 105 12-inch, 126 10-inch, and 94 8-inch breech-loading guns. There are also 406 rapid-fire guns in position. In addition to these, seven 10-inch, five 8-inch, and 111 smaller rapid-fire guns are ready for armament.

The steamer "Mauretania" is reducing the time of the transatlantic passage on each succeeding trip. On March 2nd she established a new record for the east-bound passage of 4 days, 20 hours, and 2 minutes. The best day's run was 607 miles, and the average speed for the whole passage was 25.28 knots. The best previous record for the east-bound passage, made by the same ship, was 4 days, 20 hours and 27 minutes.

A resolution has been adopted by the Senate for the construction of a memorial highway to be called "The Lincoln Road," which is to extend from Washington, D. C., to the battlefield of Gettysburg, and $50,000 is to be appropriated to defray the expenses of making a survey, plans for construction, and estimates of cost, by the engineers of the United States army. The Lincoln Way is to form one of certain "suitable memorials to commemorate the public services and character of Abraham Lincoln."

The Secretary of the Navy recently reported to the Senate that to keep a first-class battleship in good condition and do the necessary repairs for one year costs $109,856. This estimate represents the average of the cost for repairs of seventeen battleships during the year 1908. It does not, however, include the heavier repairs when a ship is out of commission for remodeling or reconstruction. The coal for the battleships for one year, including transportation and storage charges, cost $5,544,945.

According to Lloyds Register returns for the quarter ended December 31, 1908, the amount of shipbuilding tonnage under construction by the principal nations was as follows: Great Britain, 765,000 tons; Germany, 164,000; Japan, 73,000; United States, 63,000; Italy, 41,000; Holland, 40,000; and France, 39,000. The aggregate of all the countries omitted from this list reaches 66,000 tons, which, according to the Shipping World, is about one-third the work under construction in Belfast alone.

Much of the good work being done by us in the Philippines is little known to the people of the United States. The recently completed scheme for supplying Manila with water is a case in point. The supply is taken from a watershed 140 square miles in extent, being drawn from the Mariquina River, at a point 20 miles northeast of Manila. The works include a 42-inch steel pipe, 10½ miles in length, a concrete tunnel 4½ miles in length, and a reservoir of 50,000,000 gallons capacity. The capacity of the system is 22,500,000 gallons per day, equivalent to 100 gallons daily for each person in Manila.

Realizing that Congress is not disposed, at least for the present, to assist the development of the aeroplane, several leading men of this city have incorporated a company for the purpose of building machines and lending to the new industry that financial backing to which the success of the Wright brothers in France is so largely indebted. The originator of the enterprise is the president of the Aero Club of America, and with him are associated several wealthy members of the Aero and Automobile clubs. This is a step in the right direction; and the aeronautical world in this country will welcome the venture as one which meets the most pressing need of the aeronautical situation, as it exists in the United States to-day.

Excellent progress is being made in the erection of the steelwork of the new Manhattan Bridge across the East River, New York. The four wire cables, 21¼ inches in diameter, are strung. The cast-steel saddles for the support of the suspender cables, and the cables themselves, are in place; and the work of building out the floor system has commenced. Practically all of the steel for the latter is now on hand in the local storage yard. It is expected that this, the largest and heaviest suspension bridge ever built, will be open for foot-passenger and vehicular traffic by the close of the present year. This will be accommodated by one 35-foot roadway and two 11-foot sidewalks. On the same level, that is to say on the lower deck, provision is made also for four surface trolley tracks. On the upper deck there will be four rapid-transit tracks. Unfortunately, in the case of this, as of other bridges across the East River, the structure, after its completion, will probably have to wait many months, and possibly years, before any rapid-transit connections are made by the transportation companies on either side of the river.

ELECTRICITY.

A novel form of current collector is to be used on the cars of the South London Railway, which is now being electrified. Bow collectors will be fixed on the roof of each car, and will be provided with aluminium contact strips. In each strip there will be a groove filled with lubricating material. This will tend to reduce wear on the trolley wire, and when the aluminium strip wears out, it can readily be renewed.

An enormous hydro-electric undertaking is being considered in France. The plan is to dam the Rhone below the rapids, some 13 miles from the Swiss frontier, and utilize the water in a fall of 230 feet. The entire upper valley of the Rhone would thus be formed into a long, narrow lake. The plant would generate 240,000 kilowatts, half of which would be transmitted to Paris, about 280 miles distant, at a tension of 120,000 volts. It is estimated that this work would cost about $16,000,000, and could be completed in seven years' time.

In order to increase the efficiency of mercury vapor lamps, quartz tubes are used in place of glass tubes. A very interesting method of making these tubes has just been patented. A carbon mold is imbedded in granulated quartz, and then heated by passing a current therethrough until the quartz is fused about it. The tube is now cooled, and by means of an electric arc the carbon is burned off, leaving a quartz shell. At each end of the shell potassium is combined with the quartz to form gas, into which platinum terminal wires may be sealed.

An interesting form of dry battery has recently been invented, which is inactive unless exposed to a beam of light. The cell consists of a glass tube in which a platinum strip forms one electrode, and an amalgam of potassium and sodium the other. The air is exhausted from the tube, leaving a high vacuum. When the amalgam is exposed to a strong light, a current flows from the platinum to the amalgam through the vacuum tube. The internal resistance of this cell, which is known as a "photo-electric cell," is about 75,000 ohms.

The towns of Emden, Wilhelmshaven, and Leer are soon to be furnished with electricity from a power plant near Aurich, in which peat alone will be consumed. At present a small power station has been erected in which a 200-horse-power engine is supplied with steam from two boilers. One of these boilers is fired with air-dried compressed peat, and undried peat is used with the other. It is hoped that the experiment with undried peat may prove successful. The station, when it is completed, will contain three 1,800-horse-power steam turbines.

The present methods of wiring a building were criticised in a paper recently read before the Glasgow Section of the British Institute of Electrical Engineering. The introduction of metal filament lamps leads to the expectation that lower voltages will be used for the wiring of buildings, thus making possible a cheaper system of installing the circuits. It was suggested that a metal-covered cable should be invented which shall be soft enough to be rolled up into coils for delivery and to be unwound and straightened for use in the building. The metal covering could be used as the neutral wire, or in isolated work as the return line.

The city of Budapest has a news telephone service with which news items, music, etc., are transmitted to the various subscribers. At about nine o'clock in the morning a buzzer is sounded for about fifteen seconds, after which the correct time is announced. Then the subscriber is told the programme of the day, which is carried out on a time schedule. First there are stock quotations and news items; then the parliamentary news, closing prices of stocks, the weather forecast, etc. Toward evening the subscriber can listen to music at the cafés or gardens, and in the evening to the Royal Opera or one of the theaters. The service costs $7.31 per year.

About seventeen years ago the Wizard of Menlo Park startled the world by carrying on telegraphic communication between a moving train and stations along the railroad without any wire connection therewith. The system employed was to mount a board covered with tinfoil edgewise on the car roof. The tinfoil formed part of a local telegraph circuit, which inductively affected the telegraph wires that paralleled the track, and in this way the messages were made to "leap" from the train to the telegraph lines. The recent experiments on the Lake Shore Railroad, where messages were exchanged between an operator on a fast-moving train and operators in Toledo, Elkhart, and Chicago, were of a different character; that is, the Hertzian waves were used, which transmitted the messages directly to the receiving stations, and not to the telegraph wires along the track. The value of such communication between trains and railway stations was illustrated at the very outset of the experiments. On one of the trains a truck broke at some distance from Chicago, and by means of wireless telegraphy a repair train was called from Elkhart.

SCIENCE.

Luther Burbank has succeeded in organizing a company to assist in marketing his products. In this way he hopes to make his more important discoveries practically and more widely useful.

Arunds has discovered that pyrogallic acid and certain substances belonging to the class of tannins have the power to prevent the decomposition of solutions of hydrogen dioxide (peroxide of hydrogen). The addition of very small quantities of these substances completely arrests the decomposition of the solution. A three per cent solution of hydrogen dioxide to which a little tannin was added showed no sign of decomposition six months afterward.

A commercial process for the separation of hydrogen from water gas consists in passing the latter, which is essentially a mixture of hydrogen and carbon monoxide, through a cylinder filled with inert material through which trickles a solution of cuprous chloride. The carbon monoxide of the water gas is dissolved by this solution and the hydrogen alone passes on to the collecting apparatus. The dissolved carbon monoxide is subsequently extracted from the copper solution by pumping *in vacuo* and is burned under the water-gas generator, which is of special construction.

Prof. Edward C. Pickering of Harvard Observatory and the Rev. Joel H. Metcalf earnestly appeal to the astronomers of America to co-operate in taking up the work of following the movement of newly-discovered asteroids, which has been abandoned by the United States government. For two or three years much useful work was done by the observatory in following the asteroids discovered by Mr. Metcalf. Some of the asteroids will soon come to opposition. Unless the ephemerides for them are computed they cannot be found, and there is danger that they will be permanently lost.

In 1900, Prof. Lowell published his conclusion, based on observations of the occultations of the third satellite in 1894, that the atmosphere of Jupiter is of great height and produces a refraction of 8 min. Chevalier has recently noted an interesting phenomenon, which also appears to be due to refraction by Jupiter's atmosphere. In the occultation of a star by Jupiter, the star does not vanish exactly at the point on the planet's limb toward which it had apparently been moving a few seconds previously. In other words, the star appears to deviate from its course just before occultation. M. Esclangon, of the Bordeaux Observatory, thinks that this apparent deviation is caused by horizontal refraction by Jupiter's atmosphere.

The word "kerosene" seems to have been first used in United States patent No. 12,612, of March 27th, 1855, granted to Abraham Gesner, of Williamsburg, N. Y., and assigned to the North American Kerosene Gas Light Company. In the preamble to his specification Gesner states that he has "invented and discovered a new and useful manufacture or composition of matter, being a new liquid hydrocarbon which I denominate 'kerosene.'" So far as we are aware, and so far as the Patent Office examiners are aware, this is the first instance in which the word "kerosene" was suggested as a trade mark or a name for what was then generally called "rock oil."

Calcium is not a new metal, but it has hitherto been confined to the laboratory. It now appears ready to go forth, like aluminium, and assume an important place in industry. Numerous uses have already been suggested. At the time of the great rise in the price of copper it was proposed to make electric wires of calcium. Its immediate promise, however, is in metallurgy, for calcium is an excellent reducing agent. According to a paper communicated to the British Association for the Advancement of Science, calcium is very efficient in refining metals, reducing oxides and sulphides, eliminating dissolved gases, and combining with impurities to form less injurious compounds. Calcium is a silvery white metal, easily oxidizable in moist air, very malleable and a good conductor of heat. Its hardness is equal to that of aluminium.

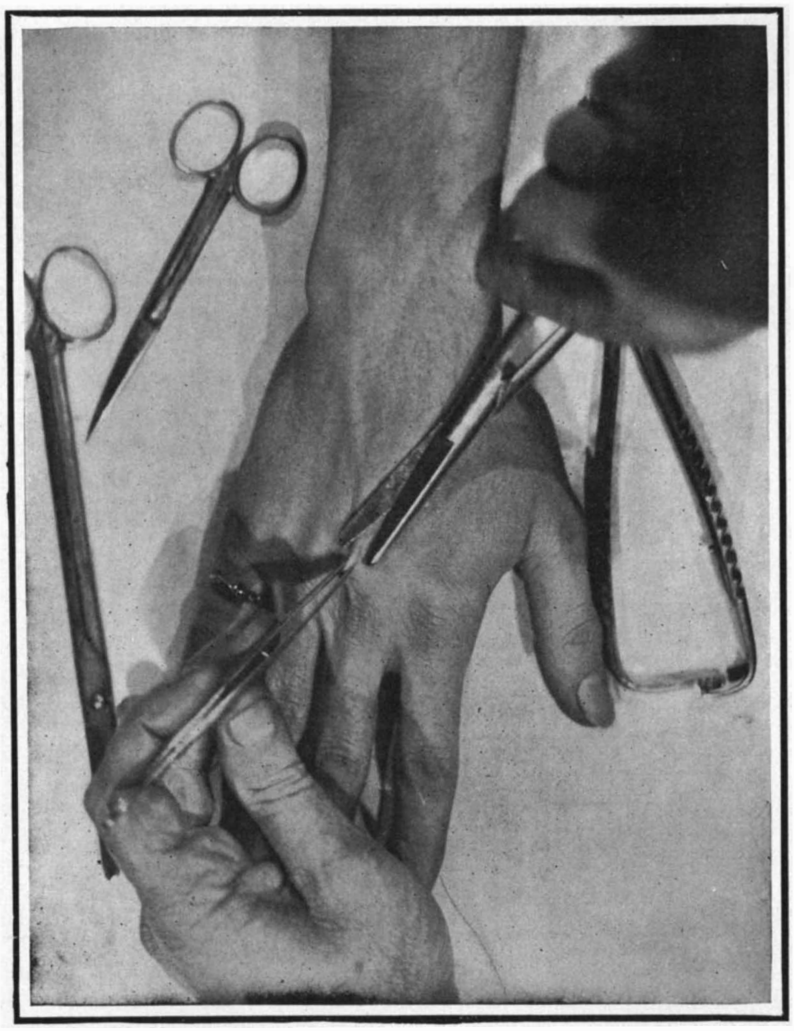
A new explosive is made by mixing perchlorate of ammonia with an organic substance containing tannin. The perchlorate may be partly replaced by nitrate of ammonia or common saltpeter. Myrobolan and divi-divi are suitable organic ingredients. A good explosive mixture consists of 36 parts of myrobolan and 64 parts of perchlorate of ammonia. Nearly half of the perchlorate may be replaced by saltpeter. The proportions are by weight, and all the ingredients should be pulverized before being mixed. The new explosive is well adapted for use in coal mines as the temperature produced by its explosion is too low to ignite either coal dust (choke damp) or marsh gas (fire damp). It is advisable to convert the mixture into a plastic mass by the addition of fish glue, oil, or, preferably, agar-agar. The explosive is very powerful, yet it is not easily ignited by shocks and can be handled with safety.

THE PROJECTOR IN SURGERY.

The operating rooms of our hospitals are commonly arranged with a bank of seats at one side for the accommodation of students who desire to witness the operations. Situated thus to one side, and at some distance from the operating table, the students cannot see much of the actual manipulations of the surgeon, and have little or no opportunity to study his technique. The favorite few who are allowed on the floor are more fortunate, but even they are obliged to peer over the shoulder of the surgeon, and dodge the attendants, in their effort to witness the operation. Furthermore, they are apt to prove quite a hindrance to the operating surgeon. With a view to lessening the students' difficulties, the bank of seats in some operating rooms is made very steep, so that from the upper tiers the students can look over the heads of the surgeons and attendants, and thus obtain what practically amounts to a bird's eye view. But there is a serious objection to such amphitheaters. Dust is the surgeon's greatest enemy; for on its wings disease may be carried into the open wound and infect the patient. It is bad enough to have a body of unsterilized students in the operating room. But when they are perched high up above the patient, the scuffling of feet or even the slightest motion of the body will dislodge dust, which is quite liable to settle down on the region of the operation. The danger of infection increases directly in proportion to the number of persons in the operating room. And on this account many prominent surgeons will not permit students to witness their operations.

In order to enable the embryo surgeon to study the work of the skilled masters in the profession, although debarred from the room, Dr. Charles H. Duncan, who is prominently identified with St. Gregory's Hospital in this city, has devised an apparatus which, without interfering in the least with the operating surgeon, will project a bird's eye view of the operation on a screen in the next room. This projection will show the work life size or larger, if desired, and a lecturer may explain the operation as it progresses without disturbing the surgeon.

The general construction of this apparatus is shown in the accompanying engraving. About 18 inches above the heads of the operators is a large disk, fitted near its periphery with a series of electric lights. There is a large central opening in the disk, over which is an inclined mirror adapted to reflect the scene below into a second vertical mirror, which in turn reflects the light into a lens. The latter focuses the scene upon a suitable screen in the adjoining classroom. Two mirrors are required, so as to project the image right side around. Their arrangement is shown in plan in the small line drawing. The students are separated from the operating room by a wall or soundproof partition, and in an opening in this wall the screen is located. Projecting through the wall is a hand wheel, which permits of focusing the screen, while another hand wheel is arranged to allow of throwing color slides before the lens, permitting the lecturer to intensify such colors as will show up the various parts more clearly. The ring of incandescent lamps throws a strong light on the patient, so that the image cast on the screen is perfectly distinct.

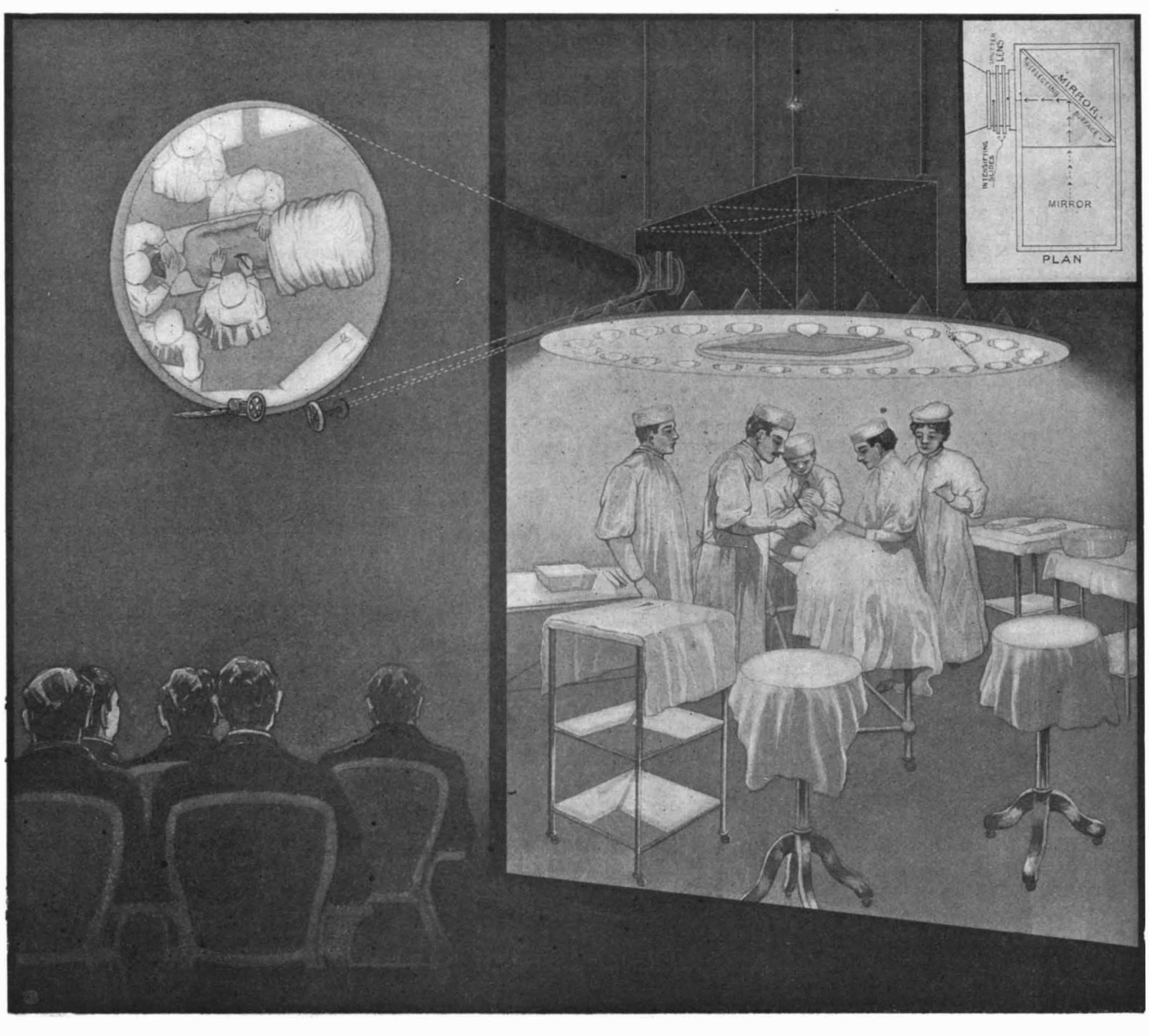


Photograph of an operation taken by means of the projector.

The students can witness every movement of the surgeon, and study in detail his methods of performing the operation, or respecting the feelings of patients who are sensitive to the gaze of the young doctors, the screen can be curtained off to show only the part operated upon.

Of particular value is this apparatus for taking photographs of surgical operations. When the surgeon comes across an interesting or rare phenomenon, a photograph of the same may be taken, making a record which can be preserved for future lectures or treatises. Dr. Duncan has tested his apparatus in an experimental way, and the accompanying illustration of a hand is reproduced from a photograph, taken by exposing a sensitive plate at the point where the screen is located. Heretofore the fear of infecting the patient has hampered the use of the camera in making records of operations. At Johns Hopkins University some successful photographs have been taken of important operations; but the utmost precautions had to be observed, to prevent dust from being dislodged from the overhanging camera, and infecting the patient. With this apparatus there is no such danger, because the portion that overhangs the scene of the operation is fixed and permanent, while moving parts, such as the shutter, the diaphragm stops, the plate holder, etc., are either located to one side, or else are situated above the disk in which the lights are contained.

One of the most important advantages of this system is the fact that moving picture records can be made of important operations. At present, when a great surgeon dies, his technique dies with him; for there is no way of graphically preserving to posterity the methods he pursued. But by means of a moving picture film, an invaluable record of his work could be preserved for all time. A surgeon who was called upon to perform a rather unusual operation could study the moving picture record of the work of noted surgeons in similar cases, and thus prepare himself to perform the work to better advantage.



The projector permits students to witness surgical operations without entering the operating room.

THE PROJECTOR IN SURGERY.

A New Method of Identifying Criminals.

A novel method of identifying criminals with absolute certainty has been devised by Professor Tamassia. When comparing the veins on the back of both hands, a striking diversity will be observed. Far more important, however, are the differences noted in the hands of different persons. In order to cause the veins to stand out more distinctly, the wrist should be bandaged for a short time. Their courses can then be photographed. Owing to the size of the hand, it is far easier to discover slight diversities than in minute prints of finger tips. Nor can any voluntary alteration of the vein tissues be feared, unless the hand be seriously injured.

GAS-DRIVEN BATTLESHIPS AND CRUISERS.

A dispatch cabled from England, to the effect that the British government is about to lay down a large "Dreadnought" cruiser which will be driven by producer-gas engines, and will be without the customary funnels, has caused no little interest, and has brought several inquiries to this office regarding the truth of the statement. We may as well state at the outset that, in our opinion, it is very improbable that the British government is about to do any such thing; and this, in spite of the fact that successful experiments have been carried out with producer-gas engines installed on an old gunboat of the British navy.

The ever-recurring rumors of the construction of a gas-driven battleship or cruiser are, no doubt, ultimately traceable to a paper read a few years ago before the British Institution of Naval Architects by James McKechnie, Chief Engineer for Vickers, Sons & Maxim, in which he made a comparison between the 16,350-ton steam-driven battleship "Dominion," of the British navy, and a design of his own for a battleship of the same displacement driven by producer-gas engines. At that time no such ship existed, and no such ship exists to-day except on paper. The comparison, however, coming from such an eminent authority, is reliable; and, in view of the possibilities of the future, is of great value and interest. We reproduce three views of the ship. The many advantages of her design will be at once apparent. In the first place, although she is between 3,000 and 4,000 tons smaller than our own "North Dakota," she carries the same number of 12-inch guns, and these guns are mounted all on the upper deck, which is unincumbered either by smokestacks or superstructures. The comparison of weights, etc., of steam, gas, and oil machinery for a 16,000-horse-power battleship, which is given in the accompanying table, speaks for itself. The data for the steam engines are those of the exact weights, etc., of the engine, boilers, etc., of the "King Edward" class of battleships of the British navy.

COMPARISON OF WEIGHTS, ETC., OF STEAM, GAS, AND OIL MACHINERY FOR 16,000-HORSE-POWER BATTLESHIP.

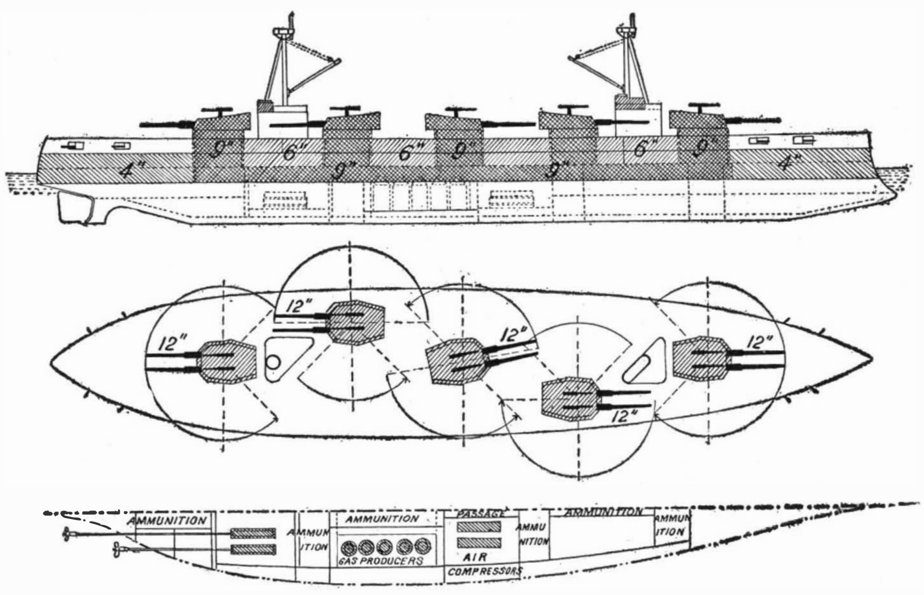
	Steam Engine.	Producer Gas Engine.	Oil Engine.
I.H.P. available for propelling the ship	16,000	16,000	16,000
Weight of machinery including usual auxiliaries, but not deck machinery	1,585 tons *	1,105 tons †	750 tons ‡
I.H.P. per ton of machinery	10.1	14.48	21.33
Area occupied by machinery, engines and boilers or producers	7,250 sq. ft.	5,850 sq. ft.	4,110 sq. ft.
Area per I.H.P.	453 sq. ft.	366 sq. ft.	257 sq. ft.
Fuel consumption in pounds per I.H.P per hour:			
At full power	1.6 lbs.	1.10 lbs.	0.6 lb.
At about ¼ full power	1.66 lbs.	1.15 lbs.	0.75 lb.

* Includes water in boilers.
† Includes water in jackets and piping, but not coal in producers.
‡ Includes water in jackets and piping.

The plan shown provides a two-cycle gas engine, which may be worked either by producer gas or heavy oil. The compressed-air plant may be located in any part of the ship, and coal may be stored in the bunkers and oil in the double bottom. The gas machinery is divided into three groups, accommodated in six compartments. The ship is driven by four 10-cylinder vertical gas engines, coupled to four propeller shafts. The gas producers occupy the two center compartments, and in the forward compartments there are four sets of air compressors driven by gas engines.

The advantages of the gas system in solving the always difficult problem of placing the magazines to the best advantage, is shown by a study of the half plan of the ship; for it will be seen that each of the main magazines is located immediately below the pair of guns which it is intended to serve, and that there is communication between the various ammunition and shell rooms. This enables the ammunition to be readily distributed throughout the ship on one level. Hence, if any turret were put out of action, its ammunition could be transported below the armored deck for the service of other turrets.

The abolition of boiler uptakes and funnels enables the turrets to be so disposed, *without increasing the length of the ship,* as to admit of all the ten guns being fired on either broadside, and of six guns being concentrated ahead or astern. The advantages of the use of gas engines may be summed up as follows: It makes possible the carrying of a much heavier armament, and the use of far wider arcs of fire. The machinery is lower in the ship, and is, therefore, better protected. As the power per unit of weight of fuel consumed is greater, the radius of action is proportionately increased. When Mr. McKechnie comes to speak of the future (the paper was written some few years ago) he is properly conservative, reminding us that "it must be borne in mind that the largest marine gas engines as yet installed are of insufficient size, and much experimental work must be done before any application to a costly battleship will be warranted."



Armament: Ten 12-inch; eighteen 4-inch guns.

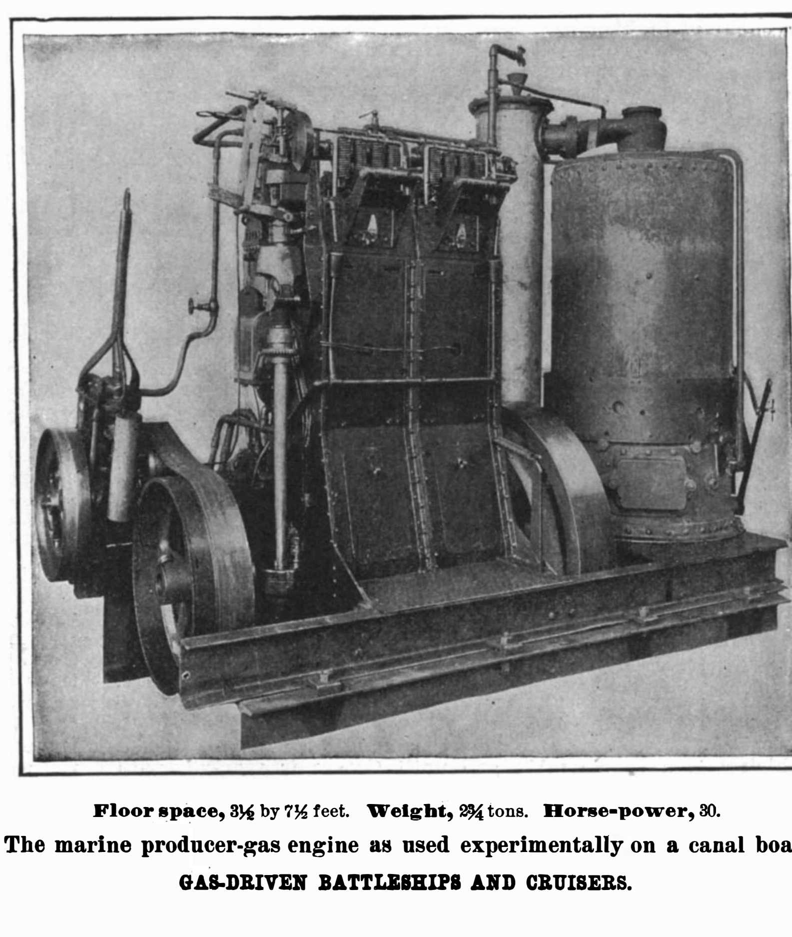
Outboard profile, deck plan, and hold of design for a 16,350-ton gas-driven battleship

In comparison with the task of driving a 16,000 or 20,000-ton battleship by gas power, the applications which have already been made to marine work, and particularly naval work, are very modest indeed. Probably the best-known system of producer-gas engine for marine purposes is that known as the Capitaine, an illustration of which is herewith presented. The plant, which is of 30 horse-power, was illustrated and fully described in our issue of March 4, 1905, about which time it had accomplished successful demonstrations. It consists of a generator, cooling and scrubbing apparatus, and the engine, all mounted upon a single foundation. The floor space occupied by this installation is 7 feet 6 inches in length by 3 feet 6 inches in width, and its weight is about 2¾ tons. The cylinders are 27 inches in diameter by 11.02 inches stroke, and the normal speed of the engine is 200 revolutions per minute. To determine the suitability of the Capitaine system for small powers, the Thornycroft firm of Chiswick, London, fitted a canal barge with a 2-cylinder, 35-horse-power engine, which was sent on an extended trip over the English canals. She left Brentford, fully loaded, and towing two ordinary canal barges, which she took to Birmingham. After giving various demonstrations there, she went on to Manchester, where further trials were had, then worked her way back to the Thames, Oxford, and returned to Chiswick after being away for about sixty days. The total fuel consumed on the round trip, and the various demonstration runs made at different places, was 5.05 tons, the engine having been under way for forty days during the two months. Producer-gas engines of small power have also been fitted on canal boats or other small vessels both in France and Germany, and in every case, as far as can be learned, the plant has shown all those advantages of light weight in proportion to power, and high fuel economy, which characterize producer-gas engines.

Of the success of marine gasoline engines, it is scarcely necessary to speak, so familiar are they to the reading public. It is the ideal motor for launches, high-speed racing craft, and the type of low-powered cruising cabin boats which has become so enormously popular during the past few years. Also, it has found an increasing field of usefulness as an auxiliary for sailing craft, large and small. The present practical limit of size for gas engines seems for marine purposes to be from 500 to 550 horse-power; for above that size the difficulties of cooling become very serious. For naval purposes, the work with the gas engines has been confined to ship's launches, although Yarrow has turned out some successful gasoline torpedo boats of small power, and last year two river gunboats of 250 horse-power were built by the same firm for work on the Danube. Of the excellent service of the gasoline motor as a drive for submarines, it is not necessary to speak in detail.

The most important work that has been done in developing a producer-gas engine for naval purposes is that of the Beardmore Company on the Clyde. The experiments resulted in the construction of two units, one of 500 and the other of 1,000 horse-power. The first of these was applied to the old British gunboat "Rattler," of 715 tons displacement. The old reciprocating engines and boilers were removed, and a 500-horse-power Capitaine producer-gas engine and auxiliary plant substituted. The 500-horse-power unit was the largest size in which the piston could be used without water-jacketing. The engine is of the vertical, 5-cylinder type, working on the Otto cycle, and the gas producer uses bituminous coal. The displaced steam machinery weighed 150 tons, whereas the gas plant substituted weighed only 94 tons, a saving of about 66 per cent. The trials of the ship lasted for eight days, during which several short runs of 45 knots or less total length were made. The fuel consumption averaged 6.46 cents per knot at an average speed of 10.5 knots per hour. The absence of noise and vibration in the engine room was noticeable; and the fuel consumption, as compared with that for the steam engines of the same power, was about 50 per cent less. A similar plant of 1,000 horse-power has been constructed, and is now undergoing tests.

Outside of the saving of weight, as shown in the comparison by Mr. McKechnie, and in the recent tests of the gunboat "Rattler," there is a saving of fuel consumption which, in the best producer-gas engine, is fully 50 per cent as compared with a good average steam plant, and of from 25 to 30 per cent as compared with the most economical steam plant. But it will be seen that a great advance has to be made in the size of the producer-gas engine before it can be successfully applied to a modern first-class battleship or cruiser. The power developed in the engine room of such ships will aggregate from 25,000 to 45,000 horse-power. Before 45,000 horse-power can be developed, even on four shafts, it is evident that much experimental work must be done to increase the size of the individual marine gas engine above the 500 horse-power at which it now stands. But as the size of the unit increases, the piston and piston rod increase to a point at which it becomes necessary to provide some system of water cooling; and this problem must be effectually solved before the risk is taken of applying the new form of motor to a ship calling for from 25,000 to 45,000 horse-power in the engine room.



Floor space, 3½ by 7½ feet. **Weight,** 2¾ tons. **Horse-power,** 30.

The marine producer-gas engine as used experimentally on a canal boat.

GAS-DRIVEN BATTLESHIPS AND CRUISERS.

Preserving Vinegar.—5 parts 80 per cent vinegar essence, 8 parts purified wood vinegar, 3¼ parts common salt, 1/10 part nitrate of potash; 1/3 part sulphate of potash; 50 parts good, young wine, 1½ part starch sugar or honey, 40 parts water.

Correspondence.

A TYPOGRAPHICAL ERROR CORRECTED.

To the Editor of the Scientific American:

I notice that you published my communication of January 14th. I feel much indebted for your kindness, but I beg to be allowed to call attention to an error, undoubtedly typographical, in which 11 (eleven) appears instead of 44 (forty-four).

My authority for this value of 44 (forty-four) hours for the mean interval which elapses between a solar outburst and the terrestrial response is Svante Arrhenius, while he again ascribes it to Ricco. An exposition of this matter by Prof. Arrhenius may be found in the Scientific American Supplement for January 11th, 1908, No. 1671. Wilfrid S. Griffin.

Pittsfield, Mass., February 16th, 1909.

A PECULIAR OPTICAL PHENOMENON.

To the Editor of the Scientific American:

Your readers may be interested in a description of the unusual, beautiful phenomenon seen in Salem, Va., on February 8th at 10:45 P. M. At about that time, I observed a filmy cloud arising in the east and covering the moon. The moon's rays seemed caught into four bundles, like the light from a searchlight or stereopticon. At a distance of about ten degrees from the moon these seemed to be shown on a screen as an irregular circle of rainbow colors having the red nearest the moon. The patches of rainbow were above the moon, to its right and left. The one below was beneath the horizon. Around all this was a circular rainbow, having the violet inside, I think, with a radius of some twenty degrees, just large enough to inclose Jupiter comfortably. A half-hour later a student noticed the same without color and with the images right and left complete circles like the moon istelf, while the upper one was elliptical. Charles C. Grove.

Salem, Va., February 16th, 1909.

DID THE "REPUBLIC" CARRY SEARCHLIGHTS?

To the Editor of the Scientific American:

I have read page after page in the New York daily papers, concerning the collision between the steamships "Republic" and "Florida," but not one word have I found in regard to any searchlights carried on either of them. Is it possible that the owners of the ocean liners are so utterly careless of the value of human lives and of their own costly steamers, that they do not have a powerful searchlight mounted above the "crow's nest" on each and every ship? If they do not, it is an amazing thing. Even during a dense fog at night, the beam from a powerful searchlight, such as is used on a battleship, will penetrate to a distance sufficient to warn two approaching steamers of their proximity and relative positions, and so reduce the chances of collision, with all the horror that follows such a calamity.

That only six lives instead of six hundred were lost in the recent collision, is because of fortunate conditions existing at the time; but the consequences of that calamity are none the less horrible to the relatives and friends of those six victims.

G. Waldron Bartlett, M.D.

Bensonhurst, N. Y., January 27th, 1909.

THE AIRSHIP OF THE FUTURE.

To the Editor of the Scientific American:

In your issue of January 23d a letter is published under the heading "Aeroplanes in Warfare," in which the extreme view is taken that the flying machines of to-day might be determining factors in the event of war. This conclusion is open to serious question, first because the flying machine is at present more vulnerable than the object it would destroy, owing to the facts that it keeps reasonably close to the earth and is large enough to be a good target, besides being only controllable as yet in a very modest way and under favorable weather conditions. Great improvements can naturally be made, but the size and carrying capacity are necessarily limited, since (to quote from a recent magazine article) "its weight increases as the cube of the dimensions, while its supporting surface only as the square." It is more than doubtful that any important practical results can come through any of the heavier-than-air machines of which the public has any knowledge.

It by no means follows that aerial navigation is an idle dream, for the airship that can navigate the air as the steamship does the sea will probably soon appear; but by that time balloons and flying machines will have taken their place among the relics of the past. The real airship of the future will no more be limited as to size and carrying capacity than the steamship is. It will be able to choose such atmospheric level as is most favorable, whether it be high above the clouds or near the earth. It will not be limited to a mere fifty-mile trip, but be capable of a sustained voyage of days at a speed of perhaps one hundred miles per hour. Then we will have aerial navigation in the commercial sense, and an airship that might be a determining factor in the event of war. Until then it would be wise to keep our present means of defense.

New York, January 25th, 1909. C. A. McCready.

STRESS IN A VACUUM BALLOON.

To the Editor of the Scientific American:

As inventors frequently propose the construction of a vacuum balloon, to secure buoyancy without the use of gas, it may be desirable to estimate the strength of material required to resist crushing, say in a spherical balloon.

The unit stress in the wall of a thin hollow spherical balloon subject to uniform hydrostatic pressure, which is prevented from buckling, is given by equating the total stress on a diametral section of the shell to the total hydrostatic pressure across a diametral section of the sphere thus:

$$2\,\pi\,\gamma\,t\,S = \pi\,p\,\gamma^2$$

in which S may be the stress in pounds per square inch, p the hydrostatic pressure in pounds per square inch, γ the radius of the sphere, t the wall thickness.

The greatest allowable mass of the shell is found by equating it to the mass of the displaced air, thus:

$$4\,\pi\,\gamma^2\,t\,\varsigma_1 = 4\,\pi\,\gamma^3\,\varsigma_2/3$$

in which ς_1 is the density of the wall material, ς_2 the density of the atmosphere outside.

Now assuming $p = 15$, $\varsigma_1/\varsigma_2 = 6{,}000$, for steel and air, the equations give:

$S = 3p\,\varsigma_1/2\varsigma_2 = 45 \times 6{,}000/2 = 135{,}000$ pounds per square inch as the stress in a steel vacuum balloon.

For aluminium ς_1 is less, but the permissible value of S is also less in about the same proportion.

The last equation shows that for a given material and atmospheric environment, the stress in the shell or wall of the spherical balloon is independent of the radius of the surface. It is also well known that the stress is less for the sphere than for any other surface. Hence no surface can be constructed in which S will be less than $3\,p\,\varsigma_1/2\varsigma_2$. The argument is easily seen to apply to a partial-vacuum balloon, since a balloon of one nth vacuum will float a cover of but one nth the mass and strength.

The above result was obtained on the assumption that the shell was prevented from buckling; as a matter of fact, it would buckle long before the crushing stress could be attained. We must conclude therefore that while a vacuum balloon has alluring features, the materials of engineering are not strong enough to favor such a structure. Perhaps it is nearer the truth to say that such a project is visionary, with the materials now available. A. F. Zahm, Ph.D.

Washington, D. C., December 26th, 1908.

THE EARTHQUAKE IN ITALY.

To the Editor of the Scientific American:

In the January 23rd issue of the Scientific American, page 82, is an article on the recent earthquake at Messina. I desire through your correspondence column to call attention to a few facts concerning seismic disturbances that the writer appears to have overlooked.

In the first place, he states that the Messina earthquake happened "through the operation of a mechanical necessity." Just what this might be is not clear.

Indeed, an earthquake, instead of being a "mechanical necessity," is a process in planetary evolution by which the earth's crust is continually settling on account of the secular leakage of the ocean's water through fissures in the former's bed, thereby causing an enormous pressure of steam on the surface crust of our planet. These earthquakes are confined to the thin upper shell of the earth, and originate at a depth of only a few miles. (The earth is in a state of unstable equilibrium, since its diameter is longer through the equator than through the poles, causing a stress and strain in localities.)

This fact, together with the grinding and settling of the superficial rock strata, gives rise to the terrible world convulsions, one of which we witnessed in southern Italy.

It is believed by some scientists that in this way great quantities of sea water will some day rush into the heated bowels of the planet, and shatter the earth by a colossal explosion, such as the moon underwent in remote ages past.

Mr. Murray further states that the localities of earthquakes and volcanoes are different, but here he is fundamentally wrong. Everyone knows that these two manifestations of internal activity are not only due to a common cause, but they are to be found in the same localities. To cite a few examples: Mount Etna is but 32 miles from the devastated Messina. Herculaneum and Pompeii (two buried cities which were more than once visited and finally destroyed by disastrous earthquakes and volcanic eruptions combined) nestle close under the smoking crater of Vesuvius. The earthquake at Kingston, Jamaica, which occurred, if I am right, on December 24th, 1906, was followed by a devastating "tidal wave" which swept over the city.

The disaster at Martinique on May 10th, 1902, when the top of Mont Pelé was blown off by a terrific explosion and lava rained down upon the stricken city of St. Pierre, was accompanied by slight quakes.

The eruptions from the volcanoes Mauna Loa and Kilauea (in the Sandwich Isles) and Krakatoa in the Strait of Sunda are nearly always combined with severe earth tremors.

According to Mr. Murray, the terrestrial heat is slowly declining because of radiation into space, but the earth does not radiate heat as the sun or stars; it is surrounded by a cool crust, through which practically none of its inherent heat penetrates.

Ninety-nine and seven-eighths per cent of the heat on the earth's surface comes from the sun and is absorbed by the atmosphere. Nor does it follow that the bulk of the earth is diminishing on this account, but the crust is sinking in places and rising in others. (See "The Earth a Failing Structure," by John F. Hayforth in Scientific American Supplement No. 1677.) Earthquakes are not caused by the shrinking of the earth's crust, but by the settling of the rock strata. This is directly caused by the seepage of sea water into the earth's interior, where it is converted into steam at a high pressure. This steam finds an outlet at the point of least resistance, and so we have a volcano. The continual discharge of matter undermines the surface crust, which settles unexpectedly. The fact that volcanoes and earthquakes are in the same localities and near the sea supports this theory.

As to the distribution of earthquakes, the points of greatest activity lie in a zone encircling the earth on lat. north about 37 deg.

According to Major de Montessus de Balore, etc., the greatest number of earthquakes in any one country on the earth in the last fifty years is Italy, with 27,700. Japan is a close second with 27,570. There is a considerable gap until Greece is reached, with 10,300. It might be mentioned that San Francisco, the scene of the April 18th, 1906, quake disaster, is in lat. N. 37 deg. 47 min., while Messina is in lat. N. 38 deg. 9 min.—certainly very close.

Mr. Murray assures us that the moon was "once the center of great volcanic activity." This statement, when examined in the light of recent discoveries about our satellite, is not tenable. The multitude of craters with which the moon is pitted are not of a volcanic origin. The lunar craters, far from being shaped like the average volcanic craters on this earth, have their floors level with the general lunar surface, and in nearly every instance there is a cone in the center. On the earth there are about 3,000 craters of all sizes, from Mount Vesuvius down to little craterlets. On the visible five-eighths of the moon turned toward us are 33,000 craters, as against 3,000 on the earth.

Many writers assume a special form of volcanism on the moon adapted to the physical peculiarities of that orb, and thus imagine that they have got over the difficulty. But the terrestrial craters are never more than 4,000 feet deep, as compared to an average depth of 12,000 feet for lunar craters. Take two lunar craters, Albategnius and Clavius. Three or four smaller craters are grouped around and impinge on the rim of the main crater. Fragments from a meteor in falling would very likely scatter over the crater formed by the main body of the meteor, and thus make craterlets.

All the craters in the Mare Humorum, Mare Nectaris, and around crater Tycho literally honeycomb that quarter of our satellite. But when we come to the Mare Imbrium and Mare Serenitatis, all of the few craters there are filled to their rims with the liquid matter of a giant meteor, which, striking the Mare Imbrium with terrific force, splashed over a wide part of the moon's surface, filling up the craters formed previously. (See Prof. G. K. Gilbert's address before the Philosophical Society at Washington on December 10th, 1892, and published in abstract in Astronomy and Astrophysics for March, 1893.)

Donald P. Beard.

Nevada City, Cal., January 29th, 1909.

CURIOSITIES OF NUMBERS.

To the Editor of the Scientific American:

In a letter signed by Dr. G. Vacca, which was published in your issue of December 19th, 1908, on the question of whether any number (or all numbers) can be expressed by the difference between two squares, a very positive denial is made as to the truth of the proposition. Also the unqualified statement is made that "none of the numbers of the form $4n + 2$ can be expressed as the difference between two squares." This last statement, if made without any qualifying conditions, is certainly erroneous. A formula which will solve the problem for all classes of numbers (odd, $4n$ and $4n + 2$) may be developed as follows:

Let X be the difference between two squares.

Let L be the lesser of the two numbers to be squared.

Let D be the difference between the two numbers to be squared.

Let $L + D$ be the greater of the two numbers to be squared.

Then $(L + D)^2 - L^2 = X$.

$$2LD + D^2 = X.$$

This last equation, when arranged to show the value of L in terms of X and D, yields a formula as follows:

$$\frac{X - D^2}{2D} = L.$$

A mere inspection of the equation $2LD + D^2 = X$ will show that D must be a divisor of X such that D^2 is less than X. It is also plain that as D may be the difference between two consecutive numbers, the unit must be considered as a divisor.

Using the above formula, and taking any number, which it is desired to express by the difference between the squares of two numbers, for X, and with D as any perfect divisor of that number as shown above, the lesser of the two numbers L is easily determined. Then this lesser number L plus their difference D is the greater of the two numbers.

As for example, it is desired to express the number 21 by the difference between the squares of two numbers. It has two perfect divisors 1 and 3 whose squares are less than 21. Either of the two may be used for D; say 3 is taken. Then it will be as follows: $\frac{21 - 3^2}{2 \times 3} =$ 2, the lesser number. $2 + 3 = 5$, the greater number. $5^2 - 2^2 = 21$; or if 1 had been used for D, it would have resulted thus: $11^2 - 10^2 = 21$.

Applying this formula to the series of numbers 6, 10, 14, etc., will give results that show that it is true that these also may be expressed by the difference between two squares. As all numbers in the form of $4n + 2$ are multiples of 1 and 2, it follows that each may be expressed in this way by either one of two pairs of squares; in some cases by more. It will work out as follows:

$6 = 3.5^2 - 2.5^2$ also $2.5^2 - 0.5^2$.
$10 = 5.5^2 - 4.5^2$ also $3.5^2 - 1.5^2$.
$14 = 7.5^2 - 6.5^2$ also $4.5^2 - 2.5^2$.
$18 = 9.5^2 - 8.5^2$ also $5.5^2 - 3.5^2$ also $4.5^2 - 1.5^2$.

The question then arises whether fractions are ever admissible in the discussion of the properties of whole numbers. It seems plain that they should be admitted in cases where they are necessary to prove the truth of a general statement as to whole numbers; as, for instance, in the very simple statement that "the square of any number equals four times the square of half of that number." $N^2 = 4\left(\frac{n}{2}\right)^2$. The fact that in all cases where N is an odd number, the N divided by 2 has a fractional termination, does not disprove the proposition at all. It is true regardless of the fact that fractions enter into the solution. Likewise, in the proposition that all numbers may be expressed by the difference between two squares, the fact that numbers in the form of $4n + 2$ can only be expressed by the difference between squares of numbers having a fractional termination, does not disprove the proposition. It is true in all cases.

This is sent with apologies for offering anything so simple to the Scientific American.

Frank Newcomb.

Beeville, Texas, January 15th, 1909.

AERONAUTICAL NOTES.

THE AERONAUTIC SOCIETY AEROPLANE.

It was announced on March 3rd at a meeting of the Aeronautic Society by Lee S. Burridge, the president, that he had concluded a contract for the purchase of a $5,000 aeroplane for the Society's first public exhibition this year at Morris Park.

The contract is with Glenn H. Curtiss, of Hammondsport, N. Y., member of Dr. A. Graham Bell's well-known Aerial Experiment Association, who, in the Association's aeroplane, the "June Bug," built at his factory, has made many successful flights at Hammondsport, chief of which were those of July 4th last, when he won for the first time the SCIENTIFIC AMERICAN trophy.

Arrangements have also been made with Mr. Curtiss for him to give public demonstrations of flight for the Society at Morris Park. The Society is converting the old race-track into a first-class aerodrome. The grandstand will accommodate thousands of spectators who will undoubtedly gather there to see Curtiss fly, and to witness the aeroplane races which will take place.

The Aeronautic Society is thus the first aeronautical body in America to purchase an aeroplane.

The first public flights by Mr. Curtiss in New York city are to be made at Morris Park early in the month of May.

In describing the new machine, Mr. Curtiss states that it will be in many ways different from the aeroplanes made for the Aerial Experiment Association. The main surfaces, of about 30 by 4 feet, will be parallel and not arched as in the "June Bug." It will have front and rear rudders controlled entirely by the aviator. The transverse stability will be maintained automatically by a new device. There will be many features that are novel, although not untried. The weight will be about 600 pounds, which is much lighter than the average of the machines now flying. The aeroplane will be capable of lifting 200 pounds. The engine will be a 4-cylinder, water-cooled motor of 25 horse-power, which experience has taught is sufficient. The propeller, of 5½ feet diameter and the same pitch, will be mounted upon the engine crankshaft at the rear. The frame of the aeroplane will be of spruce wood and the surfaces of rubber-impregnated silk.

The aeroplane will be mounted upon a 3-wheeled chassis, and it can be started either by running along on the ground under its own power or by being jerked suddenly forward by a falling weight, as is the Wright machine. It will have a speed of over 40 miles an hour, and Mr. Curtiss expects to make several new records with it.

A NEW AERONAUTIC MANUFACTURING COMPANY.

Immediately following the news of the purchase of an aeroplane by the Aeronautic Society came the announcement last week of the formation of a $300,000 company organized by Mr. C. F. Bishop, the president of the Aero Club of America, for the manufacture of aeroplanes and dirigibles. A. M. Herring, the aeroplane inventor who is under contract to supply the government with a 2-man machine by next June, has a large interest in the new company, to which he will assign his American patents upon automatic stability devices, etc., when they issue. G. H. Curtiss is also a principal stockholder, and for the present the aeroplanes and motors will be built at his plant at Hammondsport, N. Y. The aeroplanes to be produced are to have all the improvements devised by Herring and Curtiss, and they are to sell at $7,500 each. It is also proposed to build gliders for $600. Capt. T. A. Baldwin will attend to the manufacture of dirigible balloons, several of which will be constructed shortly. The co-operation of the leading experimenters in both lighter-than-air and heavier-than-air apparatus should do much toward furthering a rapid development of aeronautics in America.

An Important Reduction of Magnetic Observations.

The variation of the magnetic needle with time and place is a matter of such vital interest to the navigator and the land surveyor, not to mention the scientific investigator, that the study and publication of data bearing on this phenomenon regularly must be undertaken under government or other auspices that will insure accuracy and completeness. The navigator must have information which will enable him to correct the courses as indicated by his compass, and the surveyor in running the lines of a piece of land as given in an old deed or other description must be able to allow for the change in direction of the old compass bearings. Therefore much practical importance attaches to the work of the Division of Terrestrial Magnetism of the United States Coast and Geodetic Survey, and this among persons interested has been heightened by the recent publication of "United States Magnetic Tables and Magnetic Charts for 1905." In past years it has been the custom of the Coast Survey to prepare magnetic charts for some period in advance of the date of issue, but the greater attention recently paid to magnetic studies makes it evident that the secular changes on which such charts are prepared are none too well understood in detail. Accordingly it was decided to prepare tables and charts for the year 1905 corrected to that date with all possible precision, and in the light of observations rather than the estimates. The work involved in this volume was under the direction of Dr. L. A. Bauer, who in the fall of 1906 resigned from the Survey to become director of the Department of Terrestrial Magnetism of the Carnegie Institution, and the great development into a harmonious and comprehensive plan under which magnetic research has been and is being carried on by these two agencies is in large measure due to his efforts.

Terrestrial magnetism aside from its practical application, represents an interesting aspect of modern science. Ordinarily we conceive of the processes of nature as involving long periods of time, as in the formation of continents or in the evolution of animal forms, or at the other extreme some sudden cataclysm as an earthquake, so that when a series of natural phenomena involving a swift and ceaseless change in so short a period as five or ten years is occurring, as in the earth's magnetism, it is indeed difficult to realize and understand it. In fact the problem becomes more difficult in the development of present-day science. In the early part of the nineteenth century a famous scientist remarked that once discovered the laws of nature were simple, but to-day that statement hardly can hold where a wealth of data obtained by observation and experiment often shows conclusively that the laws of nature are complex to an extreme. Thus in looking at charts of equal magnetic declination, inclination and intensity it will be noted that the lines showing these quantities are very irregular and are not the smooth flowing curves by which the distribution of the earth's magnetic force on land once was indicated.

Local and other conditions, shown by a number of observations, are such that to-day the irregular curves are the normal ones, and those that are regular either must be dismissed as conventional drawings or considered as based on an inadequacy of observation. The work recently published gives tables of the observed magnetic elements at many points in the United States as far as available and their values reduced to the date January 1, 1905, from observations made at over 3,300 stations, over two-thirds of which were occupied by the Survey from 1899 to 1906.

These stations averaged about 31 miles apart with an average of one for every 973 square miles. The observations were made on a common system and instrumental errors so far as possible were eliminated. In addition observations were made at sea from the vessels of the Survey. The charts accompanying the tables show declination, inclination, horizontal intensity, vertical intensity, total intensity, magnetic meridians, and secular motion and horizontal intensity secular variation curves.

The Current Supplement.

The current SUPPLEMENT, No. 1732, opens with a strikingly illustrated article on three bird habitat groups which have recently been mounted in the American Museum of Natural History. One group shows the duck hawk and its nest on the Hudson Palisades. Another group illustrates bird life in the New Jersey Hackensack Meadows in August; and the third shows part of a colony of white egrets of South Carolina. Other articles that deserve to be mentioned are those entitled "New Process for the Impregnation of Timber," "Vacuum Distillation," "A Model Atom," "Chemical Effects of Magnetism," "Limit to the Number of Marine Organisms." Dr. H. Decker writes instructively on the subject "Man as a Machine." An estimate is made of the available coal supply of the United States. Percy Longmuir contributes an article on Alloys. Hudson Maxim's imaginative article on the "Warfare of the Future" is concluded. Somewhat allied is the article on military tactics and the dirigible airship. Prof. Reginald Fessenden contributes by far the most important article in the SUPPLEMENT, namely, that on wireless telephony, in which he traces its history and present status. G. K. Gilbert's admirable study of Earthquake Forecasts is concluded. The usual Engineering, Science, and Trade Notes are also given.

A Chance for Rubber Heel Inventors.

The inventor of a well-known, widely-advertised rubber heel for shoes has expressed a desire to examine patents covering rubber heels, or even mere ideas. Inasmuch as many readers of this journal are inventors of rubber heels, it will give the Editor pleasure to place them in communication with this manufacturer. Inquirers should send in printed copies of their patents to be forwarded, if their ideas are patented.

THE M'CALL'S FERRY HYDRO-ELECTRIC POWER PLANT.

BY WILLIAM ALLEN.

A most notable hydro-electric engineering project is being carried out on he Susquehanna River. It is an interesting fact that this water course, although one of the most important in the United States, has been literally running to waste. Although the river drains an area of nearly 30,000 square miles and is 350 miles in length, as yet the power developed from it has been so small as to be insignificant in comparison with what can be obtained by the plant we have referred to.

In a distance of 60 miles examined by engineers, it is estimated that this river would afford over 400,000 electrical horse-power, were a series of dams and generating stations installed where sites are available. The McCall's Ferry dam, as it is termed, has been built on this section at a site where it is calculated fully 150,000 horse-power can be developed. While the river is very wide at this point, an island dividing it into two channels enabled the builders to construct a barrier where the volume of water and the current at flood height might otherwise have rendered the project impossible. As it is, plans had to be made with a view to resisting the force of the ice fields which come down the river with the spring freshets, also to provide for the great difference between the height of the river at high water and at low water, which at times is no less than 30 feet. The total width of the Susquehanna at McCall's Ferry is nearly 3,000 feet, consequently a barrier of these dimensions had to be erected. As the photographs show, the dam is an imposing structure. In height it ranges from 60 feet to 100 feet, while its width at the bottom is no less than 68 feet, tapering to the crest in a parabolic curve. An idea of the amount of material in the work is given when it is stated that nearly 400,000 cubic yards of concrete were set before it was completed. As the illustrations show, it is of the ogee type, designed especially to withstand the ice packs, also the debris which is brought down on flood currents in addition to the great volume of water.

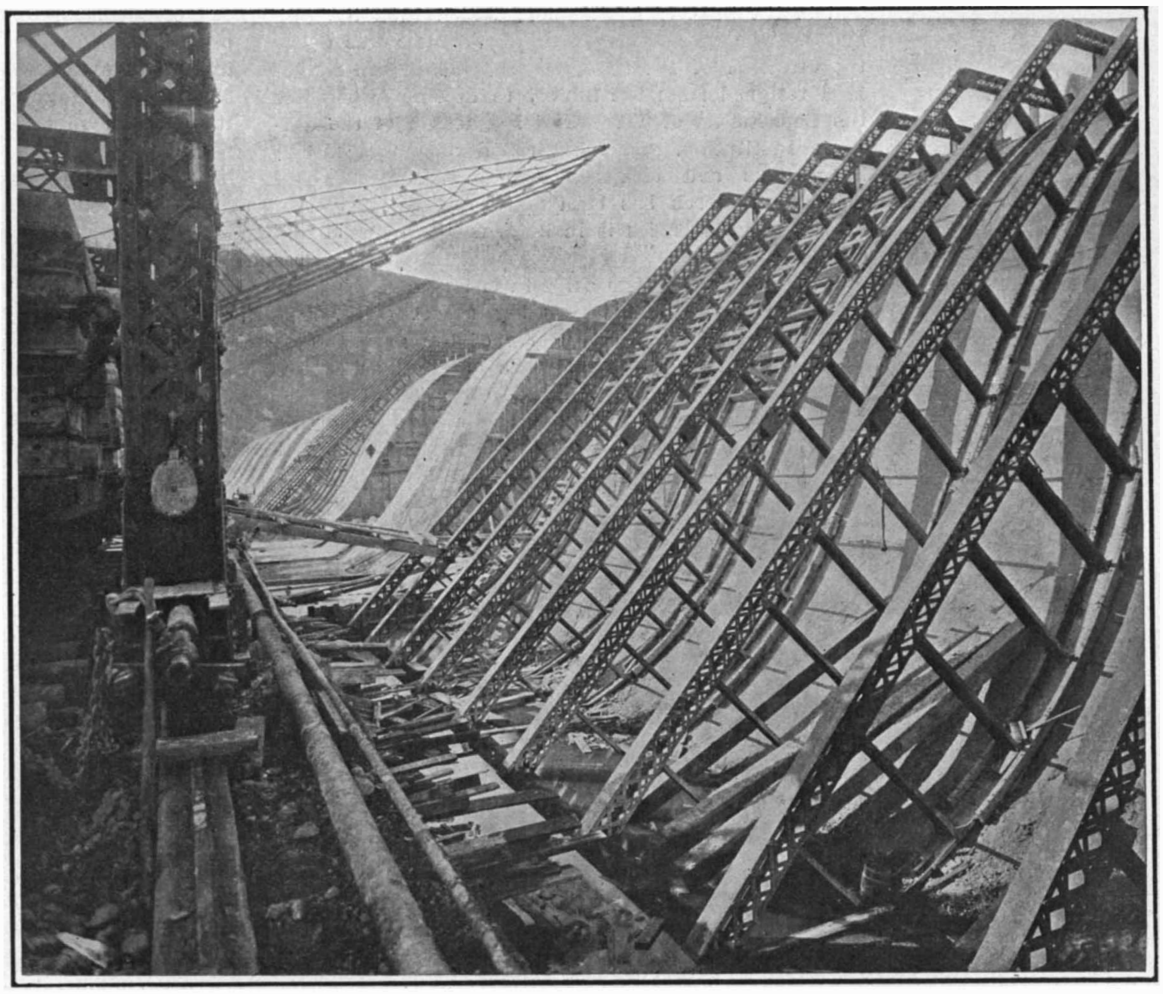
For a distance of 2,650 feet the McCall is a dam of the weir type. Consequently, it is believed that the annual flood will carry the floating matter over it without doing damage, since the river reaches such a height in flood time that the depth of water on the crest of the dam will at times be fully 15 feet. The sides of the barrier, however, have been constructed of a special thickness, and are considerably higher than the weir section, being built at such an angle that they do not offer direct resistance to the water course. In fact, the engineers have taken advantage of curves and angles wherever possible, so as to divert the force of the flood current.

The building of the main dam and the power canal necessitated much preliminary work, owing to the difficulties of placing a barrier across this water course. It was necessary for the false work to be of the most substantial character, and one of the first steps was the construction of another massive viaduct nearly across the river. This outlay alone was $200,000, because the bridge was 2,000 feet in length with a width of 50 feet, on which were laid four railway tracks. The work was necessary in order to furnish a site for the concrete and other supplies and for the mechanical conveyors which transferred the material into the bridge forms. Although the viaduct was in itself a structure which might be considered permanent, it was only built for the purpose of facilitating the construction of the dam in lieu of wooden and other false work, and was later destroyed.

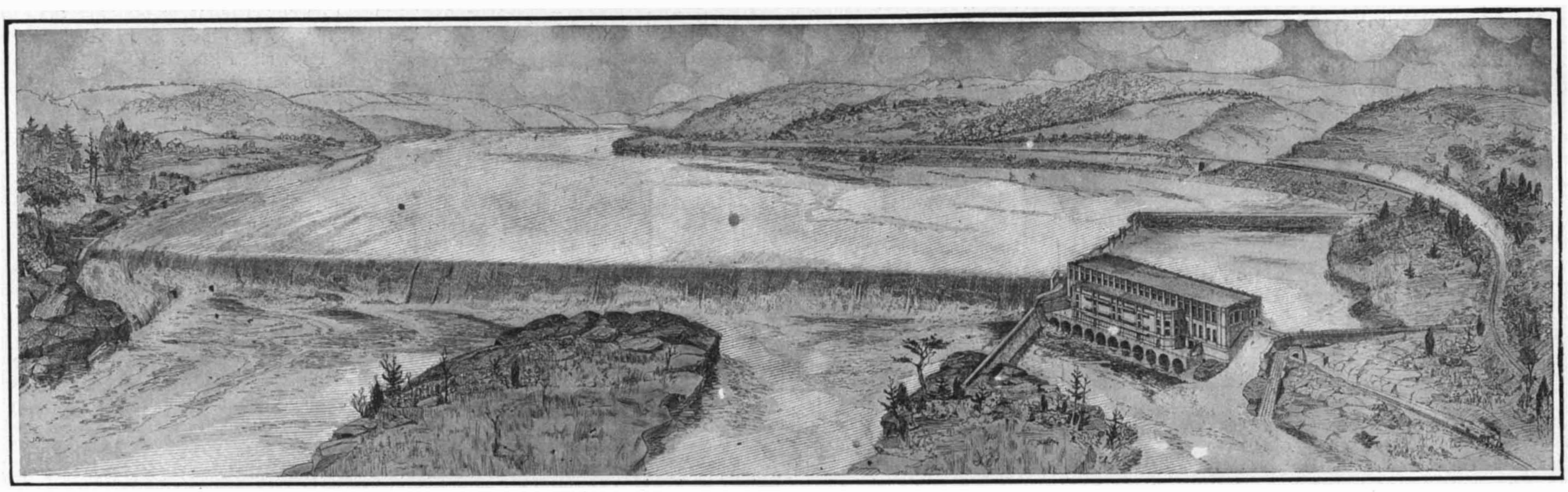
It was necessary to build a cofferdam of unusual strength to meet the emergency. Work was begun upon this from the east side of the river, and the water diverted from a section of the channel about three-fourths of a mile in width. Here the permanent structure was taken up, the barrier being formed in piers with a space of about 50 feet between each. After this section was completed, a second cofferdam was built from the west side, and the operation was repeated. Thus the dam in sections extended across the river, but owing to the method of construction, the spaces between the piers, left to allow the water to flow through during the work, are easily being closed, as operations can be carried on without hindrance from the rise and fall of the river. The plan of building the cofferdam was to construct huge timber cribs, 16 feet by 35 feet, their bottoms being modeled to fit the river bed, which were floated down by means of heavy cables and then sunk in position 10 feet apart. The spaces between the cribs were then closed with stop-logs, and the whole upper face of the dam sheathed with planks and with dirt. Dump cars pulled by small engines, which ran out over the cribs, brought the dirt from the island.

For the mixing of the concrete to be used in building the main dam and power house, the company erected a large plant. Eight Smith mixers with a capacity of 2,000 cubic yards a day were in a building 200 feet by 50 feet. The mixers were placed under chutes connecting with bins above, which contained the crushed stone, sand, and cement used in the mixing. There were 32 of these bins in all. Next to the concrete plant a store house for the cement was erected. All the drills and the hoists on the derricks were worked by compressed air, furnished by two 350-horse-power Corliss engines. In the same engine house was installed the dynamo that furnishes the entire works, houses, etc., with electric lighting and telephone service.

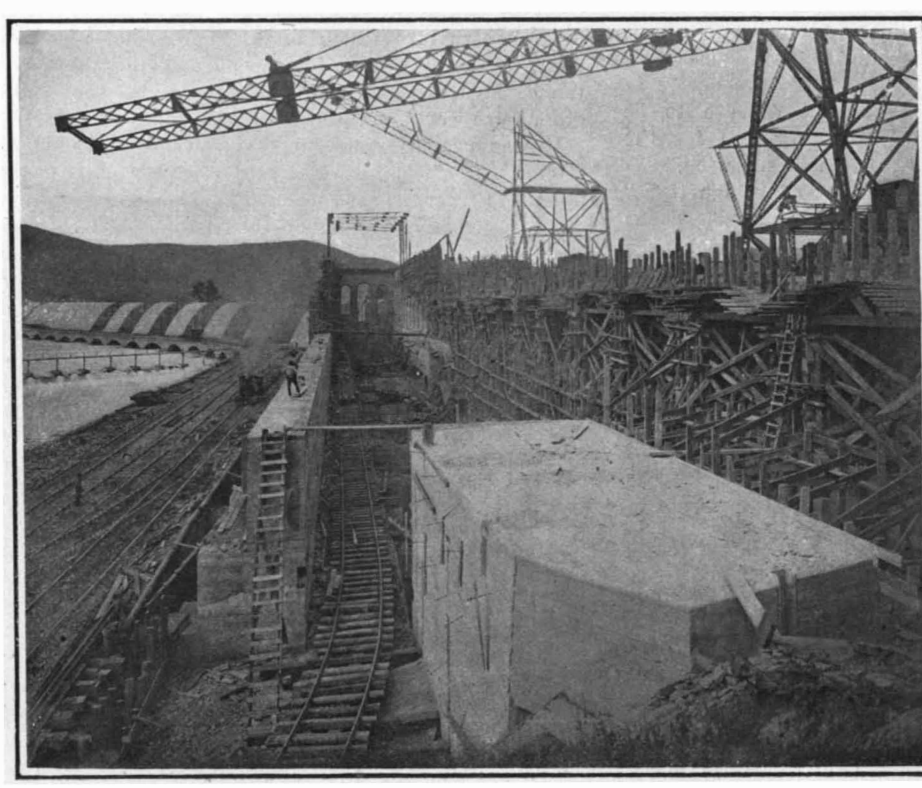
At Conowingo, 14 miles below McCall's Ferry, the company opened two immense quarries, giving employment to 400 men. The quarries are about a mile apart, one having a rock face 2,000 feet long, and the other a rock face 1,000 feet long. Both quarries are adequately tracked, and the rock as it is taken from the quarries is swung out over the tracks on large cables and then dumped into cars. These cars are drawn by engines to a large stone crusher, which the company has erected near the railroad station at Conowingo. The sand for the concrete is dredged from the bottom of the Chesapeake Bay off Elk River, and brought to Port Deposit on a fleet of ten barges. As soon as it arrives at the company's dock at Port Deposit it is taken from the barges by two suction pumps and dumped into the waiting cars, which haul it up to McCall's Ferry, a distance of 21 miles. The power house, which contains the electrical installation, is 80 feet by 500 feet and is equipped with ten Swiss twin-turbine motors, parallel outward flow, each with a capacity to generate 13,500 horse-power. The water which turns the wheels of the turbines passes through ten large conduits to the wheels at the rate of 16,000 gallons a second. After turning the wheels, this water is discharged into the old river bed below the dam. The main difference between this plant and the ones at Niagara lies in the fact that no wing dam had to be built, and that the water furnishing the power, instead of passing to the turbine wheels through conduits, drops down into rectangular pits in which are located the turbine wheels. This installation will give the McCall's Ferry plant the largest capacity of any in the United States with the exception of those at Niagara Falls. The size of the power house can be appreciated by noting its dimensions. It is one of the most complete of its kind in the country, being equipped with permanent electrical apparatus for lifting and transferring parts of generating units and other heavy machinery which may be in-



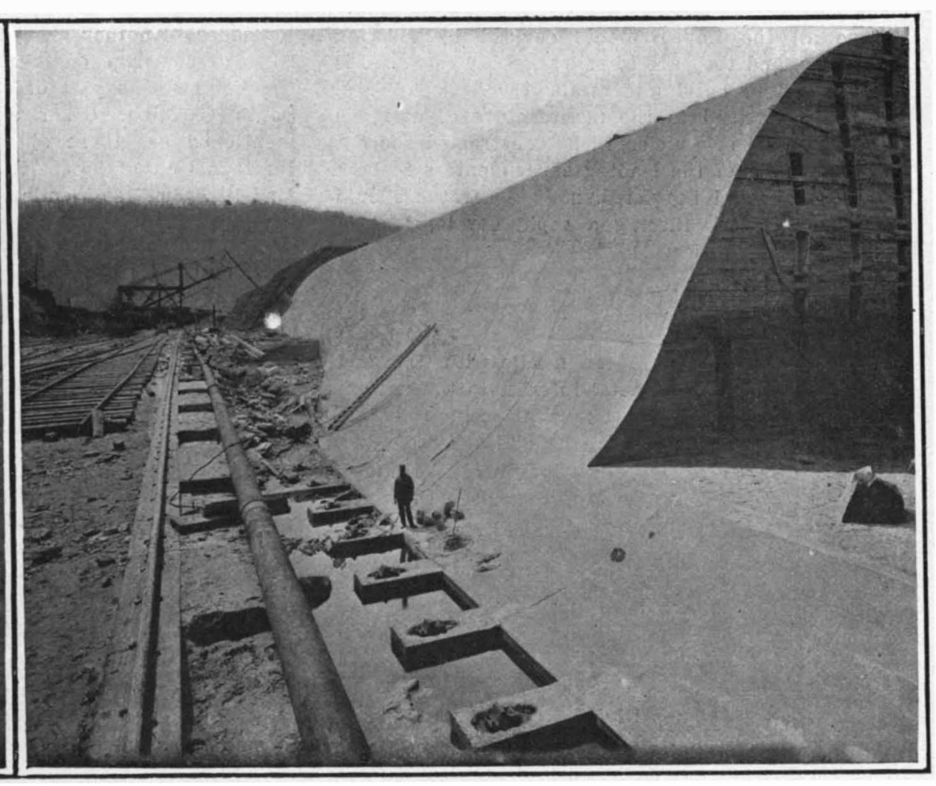
View showing the steel forms used in molding the face of the dam.



View of the McCall's Ferry dam and hydro-electric power plant as it will look when completed.



Details of the power house construction, showing conveyors and concrete molds.



Section of dam complete, showing proportions as compared with the size of a man.

THE M'CALL'S FERRY HYDRO-ELECTRIC POWER PLANT.

stalled in future. The lifting and conveying mechanism is operated by an individual motor plant.

Within a radius of 75 miles from the site of the project are situated a number of manufacturing centers, including the cities of Baltimore, Washington, Harrisburg, York, Lancaster, and Philadelphia. With the present system of electrical transmission for power, the current can be conveyed to any of these points. Consequently, the location is adjacent to a very large source of consumption, saying nothing of an extensive mileage of street and interburban railways, which it may furnish with current. Although the current will have to compete with steam, as fuel in this part of the country is sold at a very low price, owing to the proximity of the soft coal mines, the calculations of the electrical engineers are that electrical power can be generated and supplied to any point in the entire territory at a lower cost than steam power can possibly be generated, owing to the character of the generating machinery and the low cost and abundance of the water power.

The plan of the promoters to serve such a wide field with electric power, in spite of the competition due to the low price of steam coal, will be followed with interest, for the reason that nearly all of the generating stations recently built on water-power sites have been in sections where it was impossible for industries to be supplied with coal or other fuel except at a very high price, usually far in excess of the rates paid by manufacturers in the radius of McCall's Ferry for fuel.

Altogether, the project represents an investment of about $10,000,000. It has been taken up after an investigation made by Mr. William Barclay Parsons Mr. Cary T. Hutchinson, and other noted experts. The work was done under the general supervision of Mr. Hutchinson.

TEST OF THE BELL TETRAHEDRAL-CELL AEROPLANE IN NOVA SCOTIA.

The accompanying photographs show Dr. Alexander Graham Bell's aeroplane "Cygnet II," which was recently tried in Nova Scotia. The construction of the "Cygnet I" has already been described in our columns, this being on the principle of the tetrahedral kite. Dr. Bell's idea is that the difficulty experienced in aeroplanes composed of a few large planes, of maintaining the center of air-pressure coincident with the center of gravity, may be overcome by dividing the supporting and guiding planes into as large a number as possible of tetrahedral cells; as the center of air pressure upon any one pocket cannot move outside the area of that pocket, the center of pressure of the whole structure cannot move over a proportionally larger area.

This system of construction has the further advantage that the size of the machine may be indefinitely increased with an increase of weight only directly proportionate, whereas in machines composed of a few large planes, the necessary strength of construction causes the weight to increase as the cube of the dimensions.

In December, 1907, Dr. Bell tested the "Cygnet I" by towing it as a kite above Lake Bras d'Or, near Baddeck, N. S. Upon that occasion the late Lieut. T. E. Selfridge went up to a height of 168 feet, and remained aloft for seven minutes. He was greatly impressed with the stability of the kite and the feeling of security he had when in it. An illustrated account of this test was published in SUPPLEMENT No. 1681.

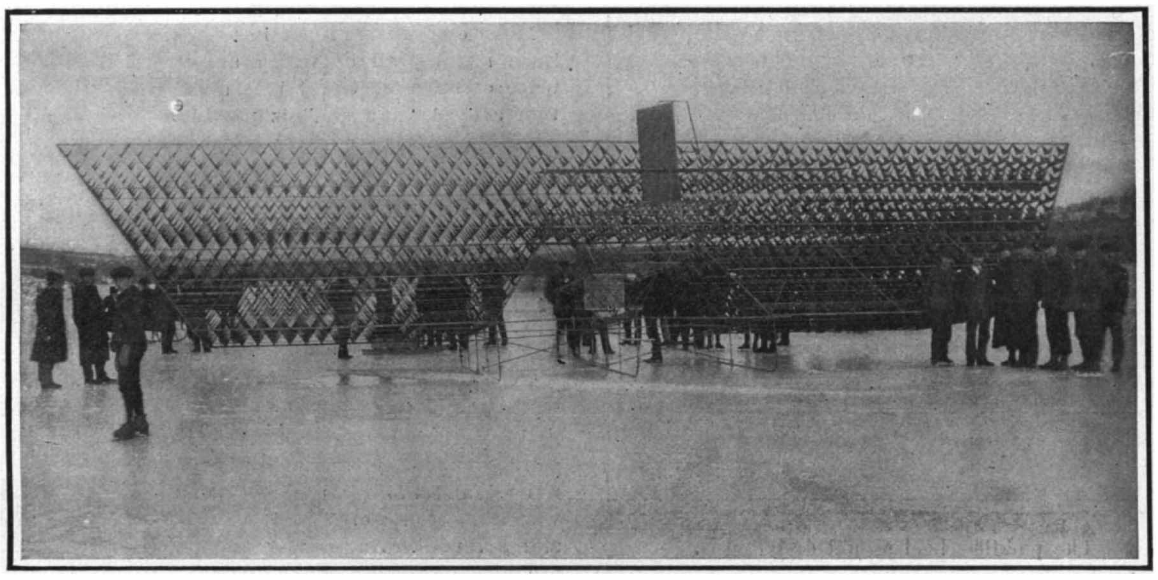
The "Cygnet II" is larger and somewhat different shaped than its predecessor. As can be seen from the photographs, it is composed of a great number of tetrahedral cells, or V-shaped surfaces. The 8-cylinder V motor and radiator are mounted upon the rear of a triangular frame extending through a cut-away part of the aeroplane, at the center, while the aviator's seat is at the front of this frame. The motor, of 3¾-inch bore by 4-inch stroke, develops 35 horse-power at 1,000 R. P. M. It drives the large propeller by means of sprockets and chain. The propeller makes 1,500 R. P. M. to 1,000 of the motor. This engine will develop 50 horse-power and it weighs complete, but without water, 202 pounds.

A double-surface horizontal rudder and a single vertical rudder are arranged upon a bamboo frame that projects out in front. Both rudders can be operated by a single steering wheel. The aeroplane is mounted upon three runners for the purpose of testing it upon ice.

It was not supposed that the power of the engine would be enough to start the machine or even to maintain a sufficient speed to support it in flight, but it was proposed to determine, by observation of the difference between the towing force required to keep the machine suspended with and without the engine, how much power would be required in free flight.

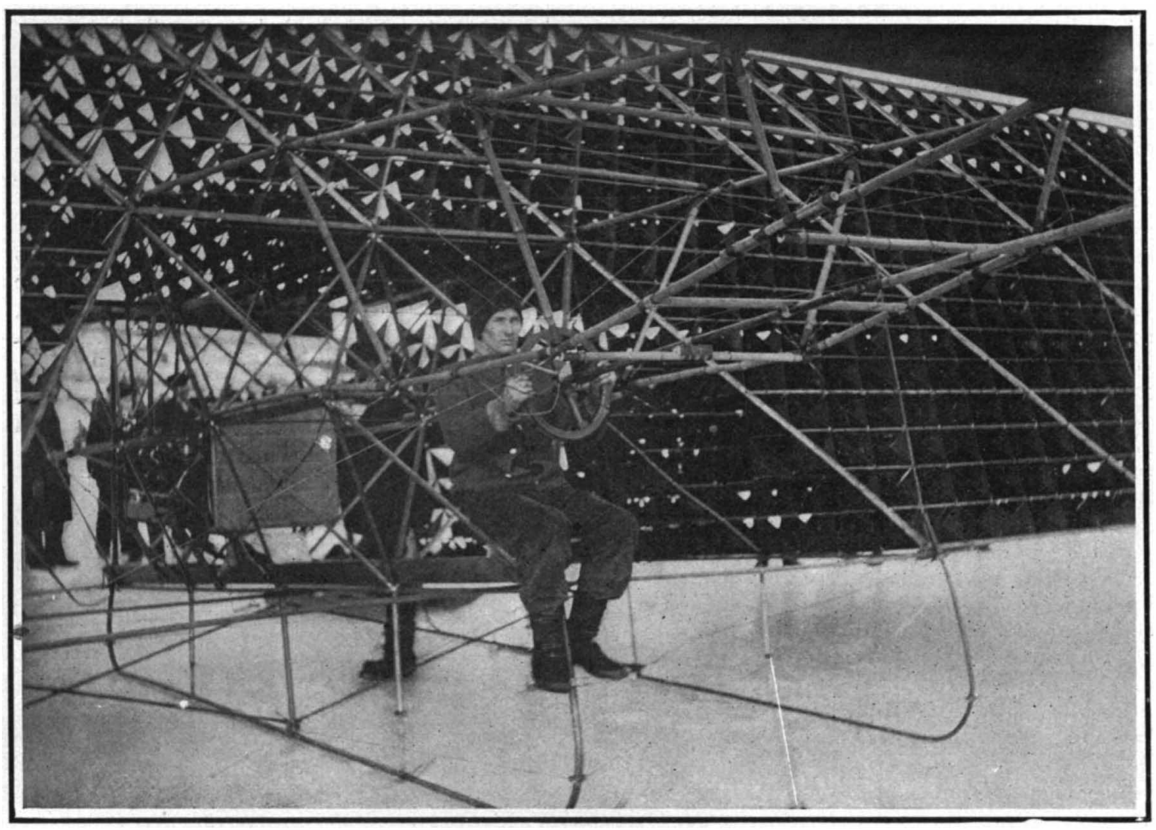
Unfortunately, however, the propeller shaft sheared off early in the trials and no positive data were obtained. That the fault was not with the engine was sufficiently proved by the later success of the latter in the aeroplane "Silver Dart" to which it was transferred.

After having previously made over a dozen practice flights at Hammondsport, N. Y., Mr. J. A. D. McCurdy flew completely around Lake Bras d'Or, a distance of about 4½ miles, at a speed of about 40 miles an hour and at an elevation of about 30 feet, on February 24th. A trial flight of half a mile made the day before was the first to be made by any motor-driven aeroplane in Canada. Mr. McCurdy is anxious to compete for the SCIENTIFIC AMERICAN Trophy, and he may attempt to make the 25-kilometer flight required before he returns.



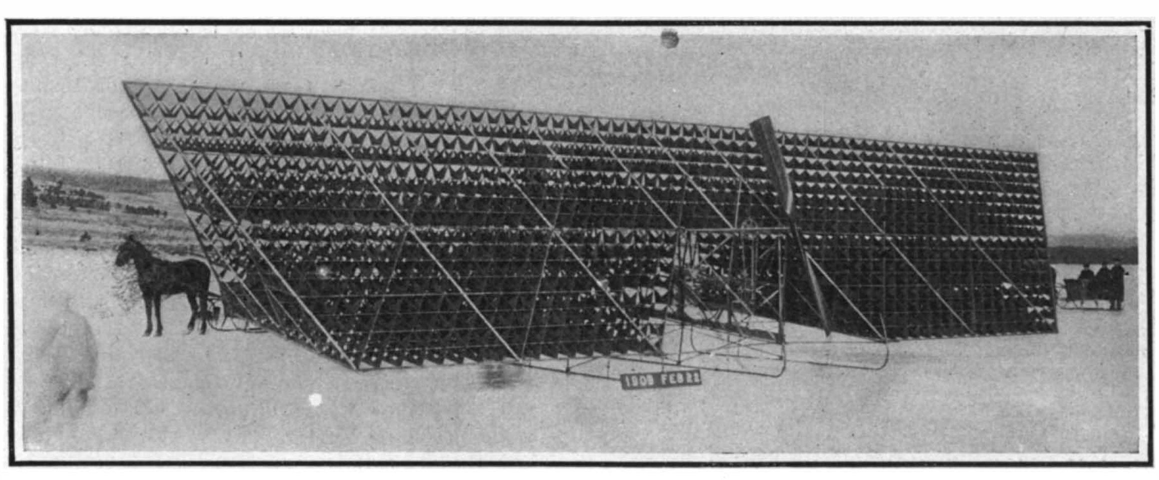
Front view of the aeroplane, showing horizontal and vertical rudders, radiator, and steering wheel.

The machine is mounted upon runners placed below its central portion.



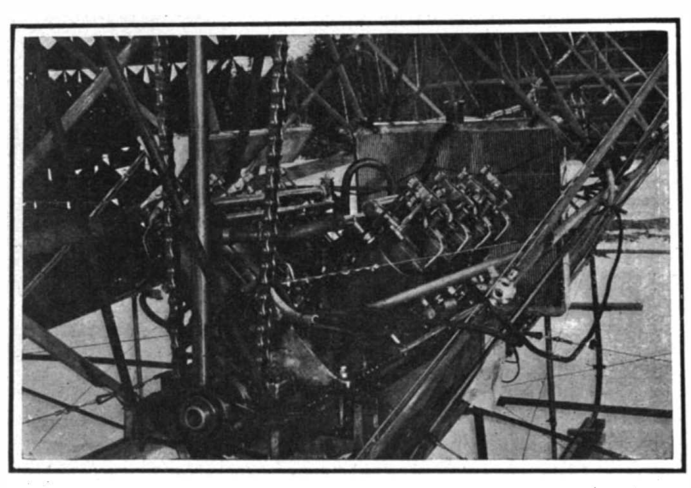
The aviator and power plant of the "Cygnet II."

Much of the framework is constructed of bamboo. The aviator sits at the front end of a triangular body frame while the motor and radiator are located at the rear of this frame.



Rear view of the aeroplane, showing its shape and the arrangement of the tetrahedral cells.

The large wooden propeller is chain-driven from the 8-cylinder engine placed below.



The 50-horse-power, 8-cylinder water-cooled Curtiss motor.

The valves are of the concentric type, mechanically operated. Copper water jackets are used.

FIRST TEST OF THE BELL TETRAHEDRAL-CELL AEROPLANE "CYGNET II" IN NOVA SCOTIA.

A WIRELESSLY-CONTROLLED TORPEDO.

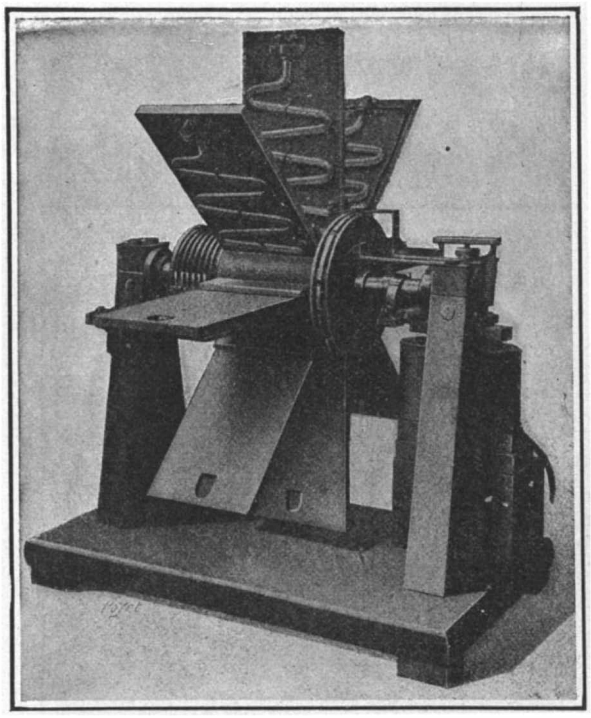
The attempts made by Tesla in this country, by Orling at Stockholm, and by Armstrong at Portsmouth to control torpedoes by the wireless transmission of impulses, have recently been repeated in France by an engineer named Gabet, who seems to have attained more satisfactory results.

In appearance Gabet's torpedo resembles the standard Whitehead. Above it a float or longitudinal buoy is supported, which serves to carry the aerial and to serve as an indicator of the torpedo's direction of travel and its position. The length of the torpedo proper is 29½ feet; its weight is 8,800 pounds; its explosive charge is 1,980 pounds.

The experiments recently conducted at Chalons were limited to tests of buoyancy and stability. More rigorous trials, which will reveal any inherent defect in maneuvering ability, will be conducted at Paris on the Seine.

The torpedo necessarily includes in its construction a means for operating propelling and steering apparatus by wireless signals without interference. The main feature of the controlling mechanism is a kind of paddle wheel, which closes the proper electric circuit by bringing the corresponding blade of the wheel into horizontal position. The wheel is driven by a pawl attached to the armature of an electromagnet, each closure of the magnet circuit bringing the blade into the position occupied by the preceding blade. By sending short impulses, the operator can bring the blades successively into horizontal or contact position, and stop the rotation when the desired blade has reached that position. Obviously, several other blades besides the right blade are brought into the contact position during this process. To prevent the closure of the corresponding circuits, and to permit only the right blade to complete a circuit, Gabet delays the electrical action of each blade, so that the unrequired blades may turn without electrically disturbing the mechanism. Only the proper blade is held in place long enough to complete its circuit. To this end, each blade carries a serpentine glass tube containing a little mercury. When the blade is in its uppermost position, the mercury naturally collects at the lower end of the tube. When the rotation of the wheel carries the blade below the axis, the mercury naturally flows down to the outer end of the tube. If a blade is arrested in the contact position, it is slightly inclined downward, so that the mercury winds slowly from one end to the other or contact end of the tube. Five seconds elapse for the transit. Hence if the impulses are made at intervals of less than five seconds, none of the circuits that operate the torpedo is closed until the desired blade has reached the contact position, and has been allowed to remain there longer than five seconds. Each operating circuit terminates in one of the rings shown on the axis of the wheel.

If the wheel has eight blades, two can be used to make and break the circuit of the magnet which drives the wheel and six to accelerate, retard, or stop the torpedo, and to turn its rudder to the right or left, or to hold it straight. As each blade arrives at the contact position, a light flashes up so that the operator on ship or shore can follow the torpedo's behavior. Five seconds are always allowed him to correct mistakes.



The paddle-wheel signal distributor. (Eight blades.)

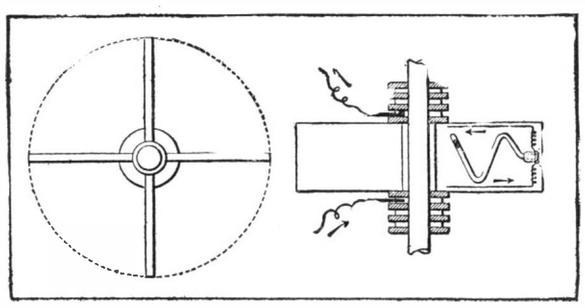
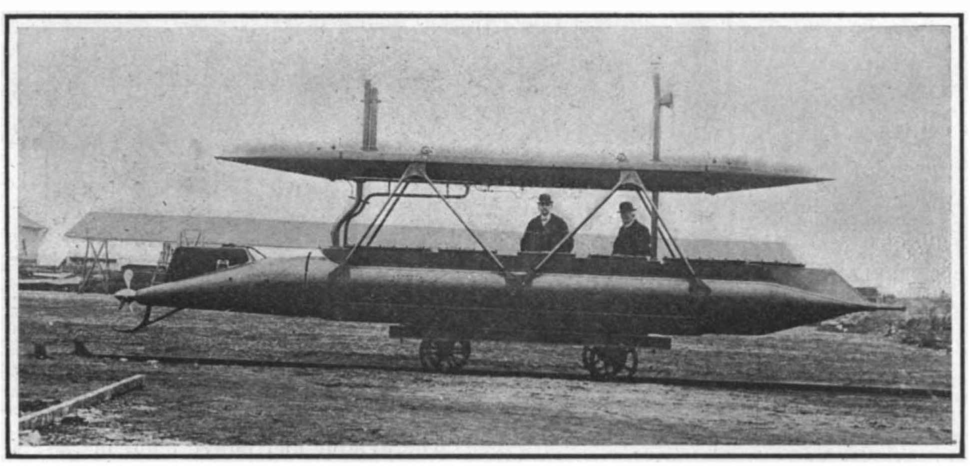
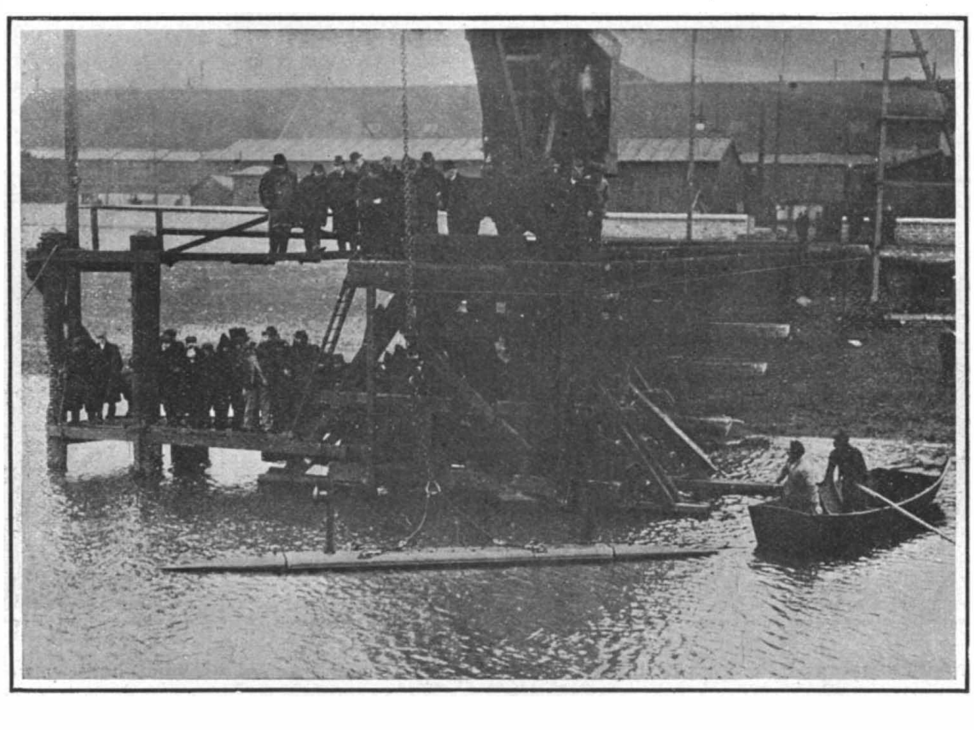


Diagram of a distributor with four blades.



View showing method of attaching float to torpedo.



WIRELESSLY-CONTROLLED TORPEDO, WITH FLOAT AT THE SURFACE.

Valuable Postage Stamps.

Postage stamp issues of the Canal Zone, Porto Rico, the Philippine Islands, and Cuba have recently had a decided influence on the stamp values, owing to the fact that collectors have found odd issues among these stamps. Many new prices will be placed in the 1909 catalogue for the first time.

Among these are the stamps of Puerto Principe, the chief of these rarities being the orange-brown stamp surcharged "3 Cents" on a Cuban stamp of the denomination of 3 milesimas. This stamp has been erroneously quoted by some of the foreign catalogues at $30, although recently a specimen sold for $87, and is now catalogued in this country at $100. The new quotation on the used 3-milesimas orange-brown stamp of the same issue, with the "3 Cents" surcharged, but with the letters on the surcharge upside down, is worth to-day $75. The 5-cent surcharge on the unused 1-milesima orange-brown stamp is now catalogued for 1909 at $75, and the same stamp which has been used for postage holds to the same value as the unused. Of the Puerto Principe blue-green stamps with the black surcharge very few were quoted in the catalogue for 1908, but the book for 1909 will show many new prices far above the previously quoted ones. Among these the used 5-cent surcharged on the 2-milesimas blue-green stamp is quoted at $65, and the 5-cent on 4-milesimas blue-green stamp is quoted at $100; the 3-cent surcharged on the 1-milesima blue-green stamp is listed at $30; the 3-cent on 2-milesimas blue-green at $40, and the same stamp showing the misspelled surcharge "eents" for "cents" has by its rarity been boosted to $60.

Many errors were made in the printing of the Canal Zone stamps, all of which are valued highly. The price of the used 5-cent blue stamp, with the inscription spelled "Panaam," is placed at $20 in the new catalogue. Another stamp of the same kind, but with a final "A" raised, is to bring $25, and a third with a bar at the bottom is valued at the same price.

The greatest attraction to the collector of the surcharged Cuban and Canal Zone stamps is their very recent issue, and careful watch of correspondence often enables a collector nowadays to pick up a rare specimen of these makeshift stamps which happens to be floating around.

The recent changes that have been made in the value of the Philippine stamps are marked. The one real slate-blue stamp of 1854, showing the misspelled word "Corros," is now recorded with a value of $80 unused and $75 for the used ones. The 5-cent pale vermilion stamp of 1855 is now listed at $65 unused and $27 used. Another error stamp is the 8-cent on the 100-milesimas carmine stamp of 1879, with the inscription, "Coreros." This stamp is listed at $3 used and $15 unused. The Philippine stamps of 1881-8 issue, with the surcharge inverted, are now quoted at good prices. The 20-cent on 8-cent brown inverted surcharged stamp is listed at $10, either used or unused, the 2-cent on 24 8-cent ultramarine inverted surcharge stamp at $20, and the 10-cent on 2-cent carmine inverted at $12.50, unused.

Quite a number of substantial increases have taken place in the value of certain Chinese stamps. The unused 3-cent red stamp of the 1877 issue, with $5 surcharged in black, advanced from $25 to $40. Of the Chinese 1873-5 issue, the 16-cent green stamp surcharged "3 Cand" (candareens) is now placed in the catalogue at $75, unused. The 8-cent gray-blue stamp surcharged "1 Cand" is likewise valuable, having recently been catalogued at $60 in either the used or unused condition. The Chinese 12-cent light brown stamp, with "1 Cand" surcharged of the 1877 issue, is priced at $75 unused and $65 used. A variety of the Chinese recent issue of 1893, 5 cents in denomination, blue and black in color, with the black inscription inverted, when unused is valued at $30.

That man is prone to error is shown by the many mistakes made in the engraving of plates and the printing of stamps. It would seem an utter impossibility for so many slips to happen where a work is checked and proofed by a great number of persons, and it only goes to prove the old saying that the man that never makes a mistake does not exist.

Electrolytic Reduction of Indigo.

An attempt to reduce indigo to indigo white by the electrolysis of a solution of sodium carbonate containing finely divided indigo in suspension having proved unsuccessful, the failure was attributed to the possible recombination of the nascent hydrogen atoms into inert molecules, before coming in contact with the particles of the indigo.

The correctness of this theory was proved by the success of the experiment when a conducting powder, graphite or metal filings, was mixed with the indigo. The caustic soda which is set free by electrolysis aids in effecting the com- powders are too coarse or insuffi- but its practical application pre- In theory, the process is perfect, plete solution of the indigo-white. sents certain difficulties. The mixtration by and suspension in the ture of the conducting powder and indigo must not be so intimate or so compact as to prevent its peneliquid. The electrodes must be of uniform character and must possess a moderate degree of conductivity, as otherwise the reduction takes place only at the edge of the cathode, and the yield is diminished. It is diminished, also, if the ciently mixed. About 4½ kilowatt hours are required for the reduction of 1 pound of indigo.

The Editor of Handy Man's Workshop will be glad to receive any hints for this department and pay for them if available.

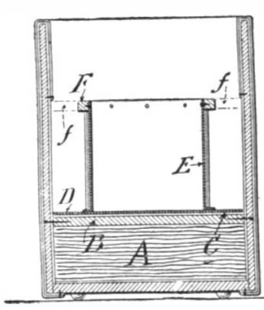
ANNOUNCEMENT.

Several letters have recently been received from readers of Handy Man's Workshop asking for articles on special subjects. The editor desires to keep in touch with the requirements of all who are interested in this department of the Scientific American, and as far as he is able is glad to respond to any suggestions they may offer. The instructions for making a brass furnace, and the two articles on fireless cookers, published below, have been prepared in response to special requests. The editor has been asked to publish directions for making a small flash boiler for use with a 1-horse-power engine. Possibly some of the readers of this department could furnish good practical suggestions on this subject.

A CHEAPLY-CONSTRUCTED FIRELESS COOKER.

BY EDWARD THORPE.

A cheap and efficient fireless cooker was made by the writer as follows: A box measuring 34½ inches long, 12 inches wide and 16 inches deep inside measure was bought from the grocer. After lining it well with newspapers lapped at the corners and tacked in place, a bed of newspapers *A* was placed on the bottom to a depth of 4 inches. The false bottom *B* was then nailed above them, and a sheet of asbestos placed upon it.

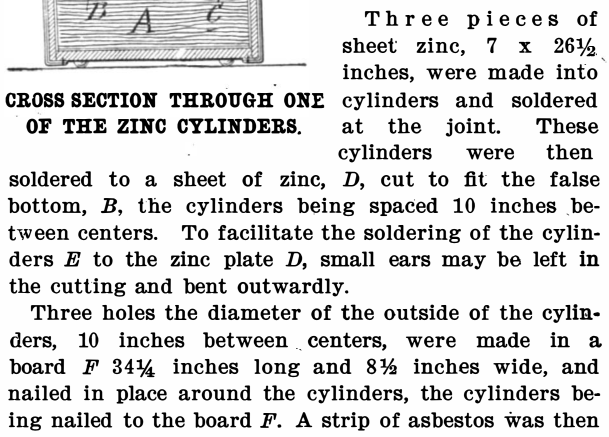


CROSS SECTION THROUGH ONE OF THE ZINC CYLINDERS.

Three pieces of sheet zinc, 7 x 26½ inches, were made into cylinders and soldered at the joint. These cylinders were then soldered to a sheet of zinc, *D*, cut to fit the false bottom, *B*, the cylinders being spaced 10 inches between centers. To facilitate the soldering of the cylinders *E* to the zinc plate *D*, small ears may be left in the cutting and bent outwardly.

Three holes the diameter of the outside of the cylinders, 10 inches between centers, were made in a board *F* 34¼ inches long and 8½ inches wide, and nailed in place around the cylinders, the cylinders being nailed to the board *F*. A strip of asbestos was then wrapped around each cylinder and tied in place with string.

The space around the cylinders was now well packed with sawdust, *K*, and the small strips of wood, *f*, were inserted and nailed to the box to complete the shelf *F*. Three half bricks, *G*, and three enameled-ware pails 5 x 6½ inches covered by an old feather pillow, *H*, which in turn was pressed firmly over the pails by a hinged lid, *L*, held closed by a suitable fastening, completes the cooker. To improve the appearance of the box the outside, with the exception of the bottom, was padded with paper tacked in place and covered with cretonne. Handles placed at the ends were found useful as well as ornamental. The novelty and efficiency of this cooker lies in the use of the half-bricks, *G*, which being placed around the gas burner, or on the stove with the pail resting on them, while bringing the contents of the pail to the boiling point, absorb considerable heat (the hotter they get the better). They are then used as shown in the illustrations.



A CHEAPLY-CONSTRUCTED FIRELESS COOKER.

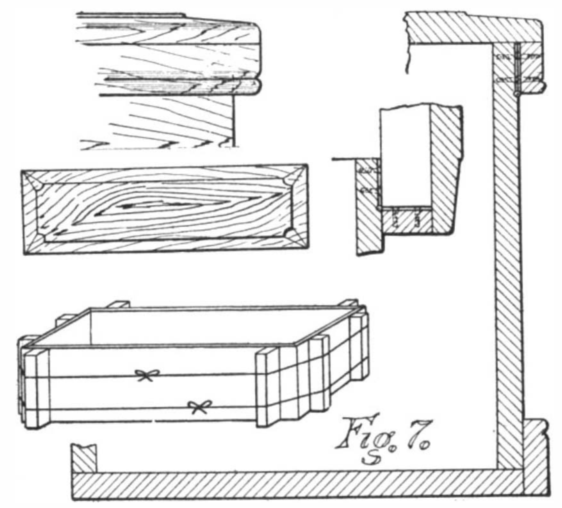
FURNISHING THE WORKSHOP.—IV.

BY I. G. BAYLEY.

(Continued from the issue of February 27th.)

A SHOULDER CHEST.

When called to do outside jobs, it is very necessary to have some suitable box or chest in which to carry a few tools, either in the hand, on the shoulder, or on the back if a bicycle is used. The writer is acquainted with a mechanic who took more interest in making his shoulder chest than any other furnishings of his shop, claiming that it would be an advertisement of what he could do if called upon.

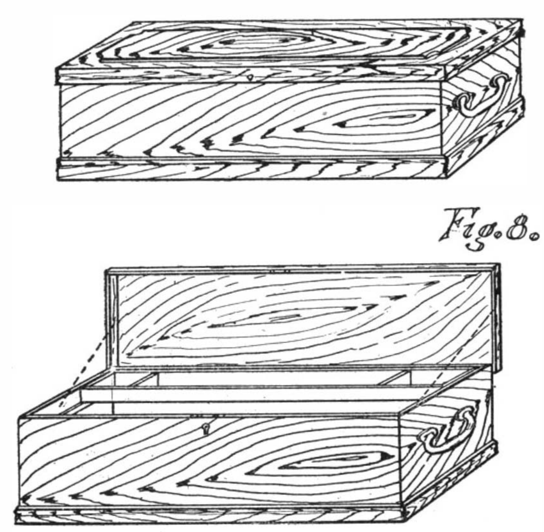


CONSTRUCTION OF THE CHEST.

The chest is illustrated in Fig. 8, and detailed in Fig. 7. A trunk strap was put through the handles and thrown over the shoulders, when he mounted a wheel to go to his job, or the strap shortened to make a comfortable handle, if within walking distance of his employment.

The chest should be made from half-inch stuff; chestnut being a good wood, on account of the grain showing off to an advantage when the finished article is given an oil polish.

Select a prettily-grained piece of board, sufficiently large to cut the whole box. The sides are to be marked out in such a way that when the chest is put together, the markings of the grain will match all round, as seen in Fig. 8.



THE SHOULDER CHEST.

The detail view, Fig. 7, gives a general idea of the construction, and needs but little explanation. The board from which the sides and ends are cut is 8 inches wide by 7 feet in length, accurately divided into four parts, 9 inches and 2 feet 9 inches long, and the edges chamfered 45 deg., when they should be nailed together with long fine nails, and glued. The beaded finishing strips, top and bottom, are cut in the same manner. The top strip is 1 inch deep, and the bottom 1½ inches. The strips of wood from which they are cut are 7 feet 4 inches long. Allowance must be made for the saw cuts, both in the sides and the strips. The bottom is made from a plain board, 9 inches wide by 2 feet 9 inches long. The top is ⅝ inch thick, 10⅛ inches wide, and 2 feet 10⅛ inches long with a panel ⅛ inch deep, gouged at the corners and chamfered down to ⅜ inch all round, 1½ inch from the edge, as shown in the illustrations. When the mitered edges of the sides and the finishing strips are glued, they can be held until perfectly dry, by an arrangement of blocks and cords, as shown in Fig. 7. There should be a clearance space between the lid and the box, all around, of about 1/16 of an inch. The corners throughout should be nicely rounded, so that there will be no sharp edges to annoy one when carrying the chest.

Hinges and a flush lock should be nicely let in the front and back, as shown in detail in several of the views. The hinges must be attached to the box first, and then to the lid, when open full. A neat brass chain will prevent any accident of the lid opening too far. The handles should be fairly strong, and attached very securely to the ends of the chest. A neat tray, 3 inches wide by 1½ inches deep, of ¼ or 3/16-inch stuff, is made to fit the chest.

(To be continued.)

AN ELECTRICAL FIRELESS COOKER.

BY FREDERICK E. WARD.

The so-called "hay-stove" or fireless cooker has now become so popular and its advantages so well known that it is hardly necessary to call attention to them. One serious drawback to its general use, however, is the fact that the food to be cooked must first be heated up to the boiling point on a stove of some kind before it is placed in the cooker. This is not only inconvenient, but in warm weather it goes far to defeat one of the important objects of the fireless cooker, namely, the elimination of heat from the kitchen.

Wherever there is a supply of electric current available it is quite feasible to combine the electric heating and fireless cooker principles in such manner that the food may be placed in the cooker cold and the current be turned on for about fifteen minutes to heat it up, for which time the cost for electric power will be only about three cents.

In its general construction such an electrical fireless cooker may be made as shown in the sectional view, where *A* is an ordinary stone crock with cover, imbedded in a suitable heat-insulating packing, *B*, such as mineral wool, and covered with a mattress, *C*, of the same material, the whole being contained in the wood box, *D*, having a hinged cover, *E*. For an average-sized cooker an ordinary four-gallon stone crock, which measures 10½ inches in diameter inside by about the same in height, will be found to be well adapted to the purpose.

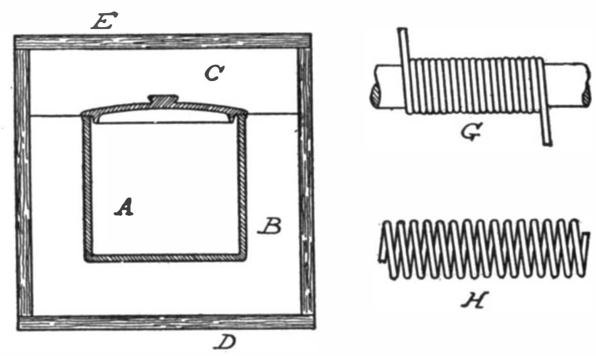


Fig. 1.—SECTION OF THE ELECTRIC COOKER AND METHOD OF MAKING THE HEATING COIL.

To make the electrical heating element suitable for use on a circuit of about 110 volts, procure 70 feet of bare No. 18 "30-per-cent nickel" German-silver wire. Such a piece of wire should have a resistance of about 12 ohms, so that when connected to the mains about 9 amperes will pass, and the heater will thus consume about 1,000 watts. As 70 feet of the wire will weigh only 1/3 of a pound and cost but a few cents, it is advisable to buy a pound of it, so as to have a couple of extra pieces on hand to use when repairs become necessary.

To form the heating coil, first anneal the wire by heating it to a dull red (but not white) heat in a suitable fire or gas flame, and after allowing it to cool form it into a helix by winding it closely on a metallic rod 5/16 inch in diameter and about 36 inches long. See Fig. 1, *G*. It is best to do this winding in a lathe if possible, as hand work is not only tedious, but the coil is likely to be uneven. After winding slip the

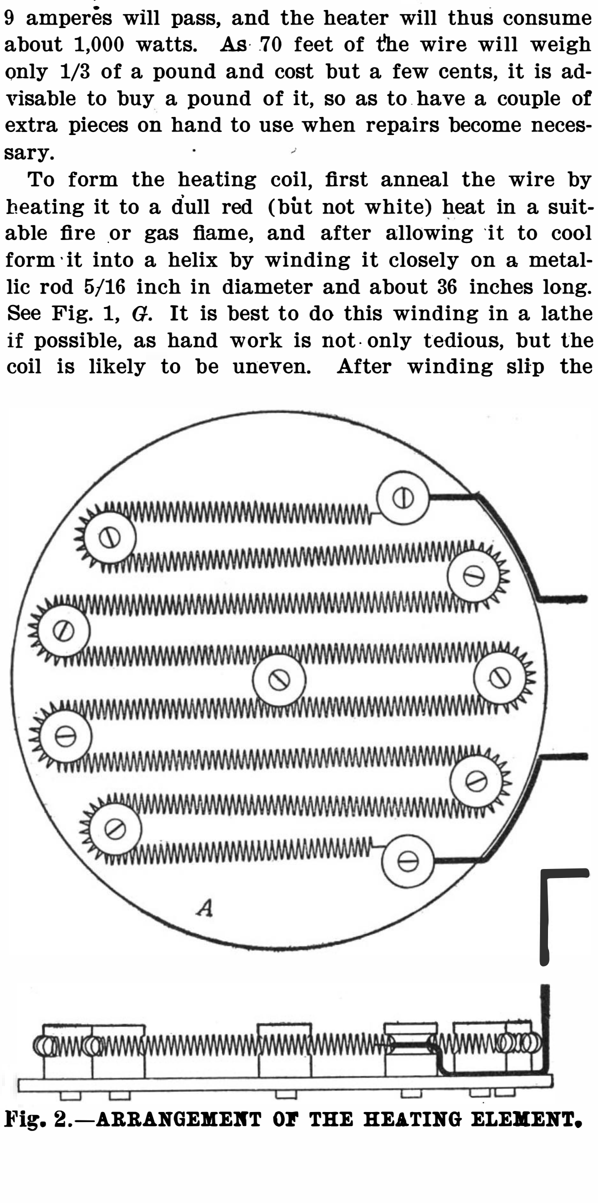


Fig. 2.—ARRANGEMENT OF THE HEATING ELEMENT.

helix off the rod, take hold of one end in each hand and stretch it to a length of about five feet. This will separate the individual turns of wire so that they look something like Fig. 1, *H*.

The support for the heating coil, Fig. 2, *A*, should be made of a piece of asbestos board or magnesia board ¼ inch thick and of such a diameter as to fit easily in the bottom of the crock—in this case about 10¼ inches. If the asbestos or magnesia boards cannot be obtained, a good substitute may be found in slate, or in a disk of 1/16 inch thick sheet iron covered on top with several thicknesses of asbestos building paper. Ten porcelain insulators, each about 1 inch in diameter by 1 inch high and having a shallow groove near its upper end, should be fastened to the base with flat-headed stove bolts in the positions shown. When stretched on these insulators zigzag fashion, the heating coil will be retained in the grooves by its own elasticity. For the electrical connection to the heater use two pieces of No. 14 white asbestos-covered copper wire, each about two feet long. Attach these to the German-silver wire by twisting the ends, and tie them securely to the end insulators with wire. Place the heater in the bottom of the crock and bend the terminal wires close up against the inside of the latter and over the edge, so as to be out of the way of the cooking vessels that are to stand on the porcelains. The outer ends may be attached to a double-pole knife-switch mounted on the side of the cooker.

The electrical connections to the house circuit must be of a substantial character. Do not try to connect the cooker to a lamp socket or with small lamp cord—neither will carry the current safely. If no baseboard receptacle has been provided in the kitchen, wire all the way back to the panelboard with No. 14 rubber-covered wire and provide a pair of inclosed 10-ampere fuses. It is well to remember that it will be necessary to move the cooker occasionally, so that it is worth while to make provision for easily disconnecting it.

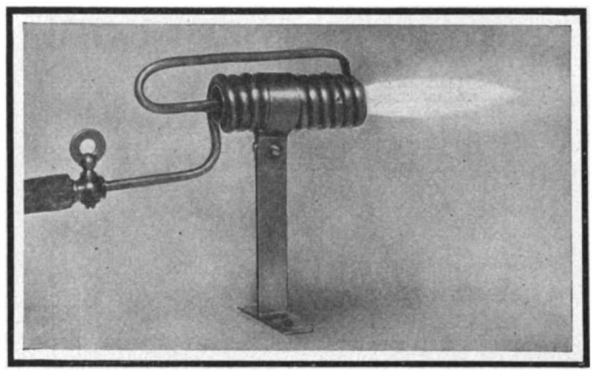
The operation of a cooker made as described is very simple. The prepared food is put in a covered tin vessel of suitable size and placed on the heater in the bottom of the crock, after which everything is closed up tightly. The current is then turned on for ten to twenty minutes, depending on the quantity and kind of food to be cooked, after which the cooker will keep hot for several hours. A little experience soon teaches one how long to keep the current on, and then the whole operation becomes as easy as the boiling of an egg in the old-fashioned way. In the cooking of roast meats it is well to apply the current a second time for two or three minutes after an hour has elapsed.

No danger of fire is to be anticipated from a cooker made and installed as described, but it is almost self-evident that if one were to forget to turn off the current both the food and the heating coil would soon be destroyed, since the heat is generated very rapidly and has no means of escape. To guard against such a mishap, procure about a foot of ⅛ inch brass or copper tubing and a very small whistle. Arrange the tube so that one end opens into the crock alongside of one of the connecting wires while the other end passes out through the wood case. To the outer end solder the whistle in such manner that it will be blown by steam escaping from the crock. With this device in working order, if the current be left on too long the steam escaping from the food will sound the alarm in good time.

HOME-MADE BLOWPIPE.

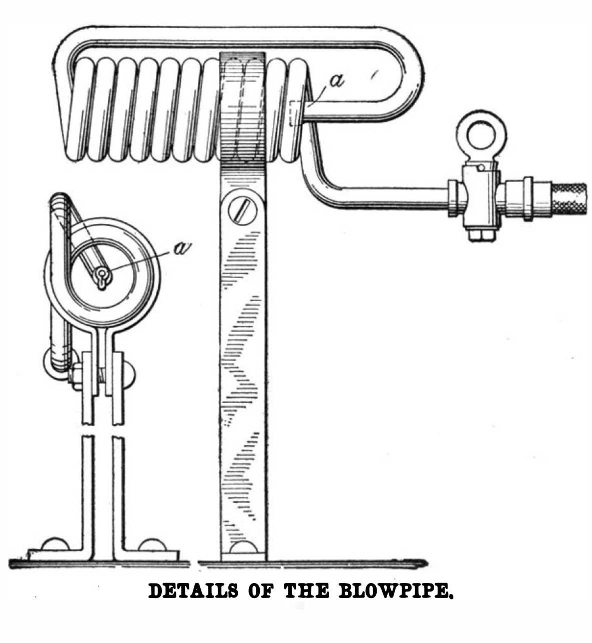
BY F. D. SWEET.

The blowpipe shown in the accompanying illustration will be found a very useful adjunct to any mechanic's workshop. For tempering tools, heating soldering irons, brazing, and melting metals in a crucible, it answers the purpose of the more expensive outfits, which the amateur as a rule does not feel able to invest in. Furthermore, there are no bulky air tanks and pumps to take up room, which to most amateurs means a great deal. The one illustrated can easily be carried in the pocket, so it is evident that the space required is indeed small. To construct one of this size, about 6 feet of copper or brass tubing 5/16 of an inch outside diameter will be required, also 2 feet of band iron about 1/16 of an inch thick by ¾ of an inch wide. Before bending the tubing to the required shape, it is necessary to fill it with lead or sand to prevent buckling. Either of these will be found to give good results, though for the smaller sizes of tubing lead is preferable. It is not advisable



THE BLOWPIPE IN USE.

to attempt pouring the molten lead in the tube, as it cools too rapidly. The safest way is to use wire solder. A piece two or three feet longer than the tube will as a rule be enough. The lower end of the tube will have to be closed by hammering it down. Insert the wire solder, hold the lower end of the tube over a flame to melt the solder, at the same time pressing the wire slightly. Move the tube slowly over the fire and it will quickly melt the lead, and one may feel sure there are no bubbles. To form the coil, use a round bar about ⅞ of an inch in diameter. A broom handle will prove useful. It is best to reduce the nozzle *a* slightly, to increase pressure of the gas as it becomes heated in the coil. After this is done, and the coil assumes the shape shown, we can proceed to remove the lead, which may be easily done by heating over a fire until the lead melts, then by shaking slightly it will run out and leave the tube clear. The valve may be dispensed with, and a rubber tube from a convenient gas jet may be slipped on.

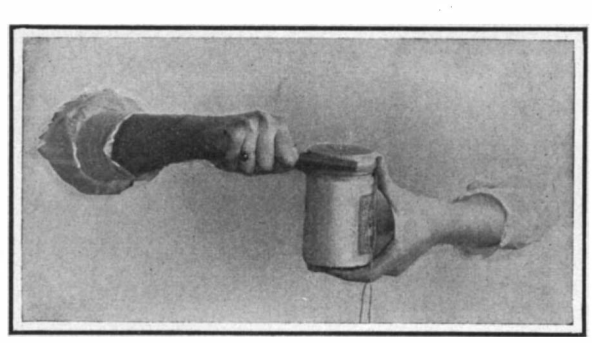


DETAILS OF THE BLOWPIPE.

UNSCREWING A TIGHT JAR TOP.

BY A. R. VAN DER VEER.

The writer desires to thank the Handy Man's Workshop for a suggestion that was printed in the issue of November 7th, 1908. The item referred to is the description of an improvised pipe wrench, consisting of a lever passed through a loop of rope, which is coiled about the pipe. When recently called upon to unscrew a jar cover that resisted all other efforts to loosen it, the writer bethought himself of the rope and lever pipe wrench. A length of strong twine was procured, and coiled double around the cover. Through the loop in the end of the doubled twine, a



UNSCREWING A TIGHT JAR TOP.

stick of wood was inserted. Then with the thumb of the left hand pressing lightly against the twine to prevent it from slipping, it was an easy matter to pry open the cover with the right hand in the manner illustrated in the accompanying photograph.

CONSTRUCTION OF A SELENIUM CELL.

BY J. CARLTON PAULMIER.

The materials required for the construction of a selenium cell are as follows: Twelve feet of spring brass ½ inch wide, 1/16 inch thick, two small machine screws, two 3-inch bolts and nuts, a piece of thin mica 6 x 12 inches, ¼ ounce of selenium, a small piece of thin board, some wood screws, and a piece of glass about 3 x 3 inches.

From the brass cut 40 pieces 3 inches long, and drill a hole to take the bolts, ⅛ inch from one end. Also make up 39 washers by cutting pieces ½ inch long and drilling holes in the center. From the mica cut 39 pieces 2½ inches long by ⅝ inch wide. Take half the brass strips, place a washer between each, pass a bolt through the holes in the ends, and screw up the nut. Do the same with the rest of the strips, and you have two sections of the cell.

Now slide one section into the other, tighten up the nuts, and place in a vise. File down and polish the edges of the strips so as to form a perfectly smooth surface on one side.

Next separate the two sections again, place a piece of the mica between each strip, so as to insulate one section from the other, then assemble as before, being careful to get the top surface perfectly level and smooth.

Take another piece of the brass, 4½ inches long; ½ inch from each end drill and tap a hole to take the machine screws, and bend up ¾ inch of each end. Use this piece to clamp the two sections together in the center, being careful to insulate it from them. After making sure that the sections are properly insulated from each other, the selenium may be applied as follows: Hold the brass over a flame until the selenium melts freely, then rub the stick of selenium over the polished surface. If the brass is hot enough the selenium will adhere readily, but if too hot it will burn off. After applying the selenium, and while it is still soft, pass a knife blade lightly over the surface. This removes the surplus selenium, and leaves a thin smooth coating.

Now bake the cell in an oven for one hour, having the temperature just below the melting point of the selenium. Then take out and allow to cool in the open air.

Make a box with a glass cover, and wedge the cell in this with small pieces of wood. Fasten two binding posts in one end, and connect each binding post to one of the sections. The cell is now complete.

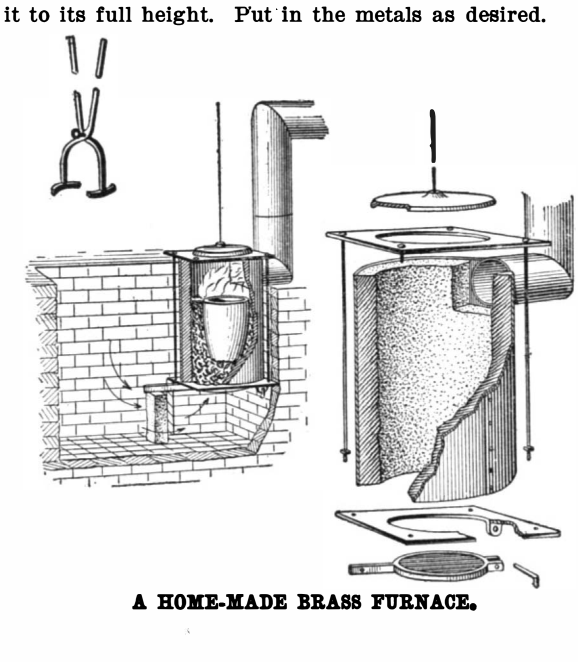
The advantages of this type of cell are that it is easy to get the top surface of the brass strips perfectly smooth; and as the insulation is of mica, there is no danger of burning it and thus spoiling the cell. It is not necessary to tin the edges of the brass strips, and it is better not to do so, as the solder used in tinning is apt to melt and run between the strips, short-circuiting the cell.

HOME-MADE BRASS FURNACE.

BY ALBERT F. BISHOP.

The accompanying sketches show how the amateur can make a brass furnace. One of the views represents the furnace set up in the pit, which is best made by bricking up, leaving room enough in front for removing ashes and clinkers. The grate is held up by placing a brick under the front projection. It is important to have the draft warmed before entering the furnace at the bottom. The pit produces this result. The form of the tongs and crucible are outlined, although they are pretty well known. Another view represents the parts separated. It will require three patterns; one pattern for the rings with about a 10-inch hole, made of wood about 7/16 of an inch thick and 13 inches square. Put a lug underneath for hanging the grate. This pattern will answer for top and bottom. The cylinder is made of heavy sheet iron, joint riveted. Cut out an opening near the top for the stove pipe, which can be attached to any ordinary chimney.

The diameter of sheet iron is 12¾ inches and height 20 inches. Fill up the inside of the sheet iron with fireclay even with the hole in top ring, which should be 1¼ inches thick; but it would be much better to make the lining thicker if the furnace is to be used a great deal. The cover on top should be cast iron, cast from a pattern about ½ inch thick and 11¼ inches in diameter, with a small flange on the bottom edge and an iron rod put in the center standing up about 3 feet high. Grate pattern should be about 9¼ inches diameter outside, with ordinary straight bars, and with lugs as represented in the sketch. Four 5/16 inch rods will answer to clamp the rims together. Project the brick outward for the bottom ring to rest on while building the pit. This will take the weight of the furnace. In operating, start a coal fire in the bottom of the furnace, place the crucible on the fire, then pack coal around it to its full height. Put in the metals as desired.



A HOME-MADE BRASS FURNACE.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

WRISTLET.—R. N. THOMAS, Shenandoah, Iowa. The body of the wristlet is composed of an approximately rectangular sheet of flexible material such as leather, and the two straps are connected with the sheet by means of slits. The rivets are prevented from contact with the skin by the straps passing thereunder. Only one rivet is needed for each of the portions, and no additional material is required for attaching the buckles.

SKIRT.—W. EPSTEIN and S. EPSTEIN, New York, N. Y. The aim in this instance is to provide a skirt or petticoat provided with an expansible and contractible waistband for use in fitting different sized waists, and arranged to form the desirable dip at the front and to dispense with the undesirable slit or placket at the back.

Electrical Devices.

CONTROLLER FOR ELECTRIC MOTORS.—R. L. MUNSON, Seattle, Wash. The invention is in the nature especially of that form of controller of compact limits and portable character known as starting-boxes, the same being also capable of use as "phase splitters." An object is to provide a starting box which can be either dust proof or of ventilated pattern in which easy access may be had to the resistance coils for conveniently inspecting, repairing or replacing the same.

CIRCUIT-CLOSER.—W. E. HUBBARD, Dennis, Texas. The special object of the invention is to provide a timer or circuit closer for the ignition system, in which both of the terminals are not only insulated from each other, but are also insulated from the engine frame. In this patent stray currents cannot deplete the battery and the minimum amount of electricity may be employed.

DISK-INSULATOR.—L. STEINBERGER, New York, N. Y. This invention enables several disks of insulating material to be locked together upon a pin independently of the support for the pin; enables the disks to fit together watertight without undue strain upon their material; provides the disks with corrugations of various kinds for providing increased surface for surface leakage; facilitates drainage of moisture to render it harmless; enables certain disks to be screwed directly together independently of the support; enables the disks to be readily removed; and provides an insulator disk as an improved article of manufacture.

CIRCUIT - CONTROLLER. — S. HOLLAND, Park River, N. D. In the present patent the invention relates to ignition devices for multiple cylinder explosion engines, and its object is the provision of a new and improved circuit controller, arranged to permit of varying the time of the contact, to take up wear to a minimum, and to prevent oxidation of the contracting parts, thus insuring at all times perfect ignition of the explosive charge.

ELECTRIC-CORD RETRIEVER. — W. O. REW, Eureka, Cal. The construction comprises a reel or spool upon which the cord is wound, and the invention resides especially in the construction of the reel, which facilitates the attachment of the electric wires and the arrangement for conducting the current to them through the device. It also resides in the mechanism for controlling the rotation of the reel and locking it so as to adjust the length of the pendent cord.

Of Interest to Farmers.

CULTIVATOR.—J. T. MILLER, West, Texas. The object of this invention is to provide improvements in cultivators, whereby the plows can be quickly and conveniently set to any desired pitch for use in deep or shallow plowing, and without requiring the loosening of bolts or like cumbersome manipulations.

COTTON-CHOPPING MACHINE. — E. A. MCREYNOLDS, Stanford, Ill. This invention has reference to a class of implements employed for use in removing alternate equal portions of growing rows of cotton plants, to permit access to the blocks of plants left remaining, and promote their growth by subsequent cultivation around the plants.

TAPPING DEVICE FOR COTTON-PRESSES.—S. S. RAY, Maysville, Ga. The device is preferably used in those balers having rotary bale chambers which can be swung under the tamping device and the cotton packed down into one chamber, while the cotton in the other chamber is being compressed by a hydraulic plunger or other suitable means.

CHECK-ROW PLANTER.—O. BROWN, Morrison, Iowa. The more particular purpose here is to provide a type of planter, in which the spacing apart of the hills in the general direction of travel of the planter is done, without the necessity of a stationary actuating wire. Means are provided which are controllable by the automatic action of the machine for varying the spaces between the hills so as to render the same suitable for land surfaces of varying conformity as the machine passes over such surfaces.

HARVESTER.—C. M. MCCORMICK. La Junta, Colo. The invention relates more particularly to machines for harvesting crops such as sugar beets, and the like. Specifically, it relates to one having a topper for removing the tops or leaves of the beets, and including means for severing the leaves which lie upon the ground as well as the standing beet tops from the roots. Mr. McCormick has invented another harvester and the object of the improvement is to provide an apparatus for use for sugar beets and the like in which the plow can be operatively and inoperatively arranged in a plurality of positions in which a feeder is provided for laterally displacing severed beet tops or other foreign bodies from in front of the plow, as the latter travels along.

SEED-PLANTER.—W. A. ROCKWELL, Harriman, Tenn. In the present patent the improvement pertains to the plunger attachment of the rotatable seed wheel, also to means for use in governing the discharge of seed from the hopper and the wheel. The invention is not limited to corn or peas, but is available for planting oats in drills, also for planting sorghum, cane-seed, beans, etc.

SEED-BOX.—A. G. YATES, Friend, Neb. The box is such as is used in connection with seed depositing implements. The object of the invention is to produce a box having means for dropping different numbers of seed or seeds of different sizes. The seed-box is particularly applicable to corn-planters.

GATE.—P. H. WILSON, Talent, Ore. This swinging gate is of a type usually termed a farm gate and employed for guarding openings into fields from a roadway. The object of the invention is to provide novel details of construction for a gate, and afford means for manually opening the gate in opposite directions.

SHOCK-LOADER.—E. PITCHER, Verona, N. D. The loader is designed to continuously pick up grain shocks and discharge them on a delivery mechanism while still in an upright position, and by the mechanism convey them to a wagon. In this manner of gathering up the shocks they are not roughly shaken, and much grain is thereby saved from waste.

COTTON-CHOPPER.—S. T. HOGAN and F. KNETSCH, JR., Creedmooe, Texas. When the machine is drawn through a field gearing means rotate the shaft, thus swinging the blade of a hoe into and out of contact with the ground. A lever raises or lowers the front end of the frame to cause the hoe to cut more or less deep in the ground and another lever moves the frame longitudinally to keep the frame alined with respect to the cotton row regardless of the position of the tongue. The frame is tilted both vertically and longitudinally with respect to the tongue for the purpose of adjusting the depth of the stroke of the hoe and to adjust the transverse position of the impact.

Of General Interest.

MULTIPLE COLOR AIR BRUSH.—E. J. FRAZIER, Buffalo, N. Y. The invention relates to certain improvements in sprayers or atomizers in which a plurality of containers are employed, whereby any one of a plurality of different fluids may be sprayed from a single device and under the influence of a single air jet. It is primarily designed for spraying paints and colors, where it is desired to frequently change the color employed.

APPARATUS FOR APPLYING INTERNAL MASSAGE.—F. L. TALCOTT, New York, N. Y. The invention is designed for the cure of inflammation of the prostate gland, whether of an acute, sub-acute, or chronic nature, and relieving all symptoms arising therefrom. The result is accomplished through the agency of water, or other fluid, at the proper temperature, which by a succession of intermittent hydraulic pulsations is made to impart a massage effect, without the water actually coming in contact with the walls of the passage into which the instrument is inserted.

FIRE-ESCAPE.—P. NIGRO, Clarksville, Tenn. The frame is placed on the wearer's shoulders with the opening engaging the neck, and the crossing of the straps on the back. The free ends of the strap are then brought upwardly under the arms and to the opposite shoulder and into engagement with the buckles, the belt being buckled around the waist. The wearer now engages the loops with the hands and is prepared to leap, the air imprisoned beneath the fabric material serving to uphold the wearer and break the force of the fall.

POTTERY ORNAMENTATION. — A. L. ROCK, Yokohama, Japan. The ornamentation is arranged to produce a permanent glass bead effect on porcelain vases and other pottery articles, in such a manner that the colorless transparent glass beads are fused in position on the body of the pottery article by a fusing pigment which produces color effect in any predetermined design.

SHOW-CASE.—A. C. UCKER, Everton, Mo. The inventor's object is to provide a showcase which is open at the bottom and in which is disposed a frame with shelves, the frame being readily removable through the opening in the bottom of the case and being held yieldingly within the case by means of a spring catch.

MOLD.—L. DIAZ, Habana, Cuba. The invention relates to the manufacture of tiles, flags and like articles, and its object is to provide a new and improved mold, arranged to permit of quick opening of the mold frame, for removal of the pressed article, and to allow convenient handling of the mold plate or die.

DETACHABLE HOOK FOR SHAFT-WORK. —C. O. VOWELL, Red Lodge, Mont. The object of the invention is to provide a hook which may be used as a safety device for the protection of the lives of miners who are carried up and down a shaft. It is equally applicable to certain types of elevators which are drawn up and down a shaft by means of cables attached to the upper part of a cage and which pass over pulleys at the top of a gallows frame.

PROJECTING APPARATUS.—V. E. MELLRE, New York, N. Y. The invention involves a box or cabinet, having a plurality of mirrors arranged upon the inner surface of the walls of the box, so that the light rays from the bodies will be reflected and converged through a lens carried in one wall of the box so as to project the image upon the screen.

Hardware.

HOSE-CLAMP.—P. E. ERICKSON, Port Chester, N. Y. In this patent the object is to strengthen hose clamps at points subjected to the greatest strain, i. e., points where the nut for the screw is applied, and the bearing for the inner end of the screw; and further augment this strengthening by locating the screw as close to the perimeter of the clamp as practicable.

BRIDLE AND THROAT-LATCH SNAP.—B. L. MILLER, Yazoo City, Miss. The more particular object of this inventor is to provide a device which may be applied to throat-latch straps, to slide thereon and snap into engagement with the straps, to more quickly and conveniently secure the latter in the adjusted position on the horse's head, without the use of the ordinary buckle.

TOOL-HOLDER.—G. F. KRIEGER, Grand Rapids, Wis. This holder has an adjustable member which will enable a tool to be clamped adjustably upon the tool holder in any desired position, the construction being such that the tightening of the clamping means for holding the tool upon the adjustable member also operates to secure the adjustable member upon the body of the tool holder.

AUTOMATIC WINDOW - LOCK. — A. N. DAVIS, New York, N. Y. In the present invention the improvement has reference to locks that are used upon windows, sliding doors and analogous closure members, the special purpose of the inventor being to increase the adaptability and uses of a lock of this kind by changes in its structure.

PAPER-CLIP.—C. W. SANDERS, Chicago, Ill. The clip is made of suitable spring wire and can, if desired, be made in various sizes, the usual size being about one inch square, and it may be plated or otherwise finished. The bar is so arranged that papers can fold over the same readily, whichever side of the clip is upward, the arrangement of the bar being the same.

SECTIONAL STAND.—F. G. GRIMLER, Buffalo, N. Y. The invention resides in an improved means by which the several movable members or units of the stand are held in assembled relation; also in improvements in certain species of units themselves, together with means for detachably holding the lamp socket at the upper end of the stand. It is an improvement in stands disclosed in Letters Patent formerly granted to Mr. Grimler.

LOAD LIFTING AND RELEASING DEVICE.—M. C. MYERS, Oroville, Cal. In this instance the invention is an improvement in devices in the nature of tongs adapted for lifting a load such as bales, packages, logs, weights, and various other articles. The improvement relates chiefly to means attached to the tongs proper for gripping and releasing a load.

NUT-LOCK.—C. H. FERGUSON, Jersey City, N. J. This invention relates to certain improvements in nut locks, and more particularly to a special construction whereby an ordinary nut may be locked to an ordinary bolt or to a second nut, without necessitating any changes whatsoever in the construction of either the nut or the bolt.

PACKAGE-FASTENER.—W. M. CLEAVELAND, Highlands, N. C. The purpose here is to provide a device, for convenient and reliable service, as a means for releasably securing a cord or band in wrapped condition upon a package of mail matter or other material it is desirable to temporarily secure, in a manner which will permit the package to be quickly opened and re-fastened.

BELT-FASTENER.—P. A. HUDSON, New York, N. Y. The object of this inventor is to provide an improved belt fastener, more especially designed for fastening the ends of laminated leather belts, fabric belts and other belts securely together and without danger of unduly weakening the laminations of the weave. The prongs are preferably of a length corresponding to the thickness of the belt.

LOCK.—V. BILY, New York, N. Y. The invention pertains to locks such as used on doors. It relates especially to that type of lock in which the lock may be unlocked from the outer side of the door by means of a key, which may be opened by means of a sliding knob or similar means on the inner side of the door.

SAW-HANDLE.—F. L. BLOMQUIST, La Honda, Cal. The handle is of the detachable class. The aim is to provide a construction which affords a light handle that may be readily mounted upon the heel of a saw blade, and be quickly secured thereon in a reliable manner, and be readily released and removed from the blade.

Heating and Lighting.

GAS-BURNER.—G. S. ANDREWS, Butler, Pa. The main objects here are to facilitate the movement of the gas-delivery nipple in a lateral direction and about a turning plug having horizontal axis; to provide closer connections between mixing tube and nipple; to utilize the tube for normally preventing the lateral movement of the nipple; to provide for regulating inflow of air to tube; to provide an improved form of tube; to provide for lateral adjustment of chimney and mantle-carrying part, and to provide a regulating plate at which the burning takes place.

PERFECT RADIATOR.—O. T. BROWN, New Vienna, Ohio. By changing the position of slides, the fluid circulates through greater or lesser travel. By arranging the slides, a portion of the tubes might be cut out from the direct travel of the fluid. Tubes are spaced apart a sufficient distance, so that air can circulate freely, and every part of the radiator is accessible without dismantling or dissassembling. In damage to one or more tubes, such tubes can be closed without interfering with the fluid flow through the remaining tubes, thus permitting a closure of a leaking tube without loss of time in repairing.

HEATING-STOVE.—E. B. COLBY, Montclair, N. J. The invention relates to stoves and furnaces, and the object is to provide a stove which is simple and durable in construction, cheap to manufacture, very economical in the consumption of coal and other fuel, and arranged to provide an exceedingly large amount of heating surface.

Household Utilities.

BEDSTEAD.—H. A. SEARS, Portland, Ore. The object here is to provide a device which is constructed in sections, the foot section being adapted to be lowered so as to constitute the foot rest of a chair, and a head portion being adapted to be raised so as to form a back rest, manually operable means being provided for moving these sections into the desired positions.

MOP-WRINGER.—J. SANTIN, El Reno, Okla. One object of this improvement is to provide a wringer which is adapted to carry a pail or other receptacle for water or the like, by means of which a mop or similar device can be thoroughly wrung out and freed from adhering water, and which is operable by the pressure of the foot upon a suitable foot-board.

FLOAT-VALVE FOR FLUSHING-TANKS.—W. N. LONG, Eugene, Ore. It is the purpose in this case to provide a very quick acting valve, and one that when opened will divert the water to the bottom of the tank, and which when closed will be perfectly concealed, the operation of opening and closing the valve being automatic.

TABLE ATTACHMENT FOR BEDSTEADS. —MARY E. COWDREY, Arlington, Ga. The invention is an improved attachment for bedsteads and cribs for use in supporting a table over the bed. The attachment may be readily applied to, or removed from bedsteads, cots, and cribs and may be easily adjusted higher or lower as required by conditions.

REFRIGERATOR.—G. MEY, Prinzenthal, Near Bromberg, Germany. In this apparatus the water drawn off say for cooking, washing, drinking, etc., in passing through the main pipe cools the refrigerator, and arrives through an extension pipe into the ejector, where it sucks in the air through another pipe and drives the air toward the refrigerator through an air pipe. Both cooling and ventilation are thus carried out without cost.

FRYING DEVICE.—J. RENNER, Rockwell City, Iowa. The invention has reference to cooking utensils and it has for its object the provision of a frying device which will prevent the grease from becoming scattered over the kitchen floor; one which can be constructed at little expense and one which is economical in use.

Machines and Mechanical Devices.

ICE-MACHINE.—J. B. MCCALL, Colorado, Texas. The invention is an improved apparatus for use in the manufacture of ice in small quantities, more especially designed for those living in sparsely settled sections and isolated places, where they are unable to, or cannot reasonably, obtain a supply of ice from regular manufacturers.

MIXING AND KNEADING MACHINE.—R. T. GRIFFITHS, Pittsburg, Pa. In view in this invention is a construction embodying a pail provided with handles, a cross-bar on which the mixing and kneading are journaled, engaging with the handles and held against lateral movement thereby when seated on top of the pail, and means for binding the bar to the top edge of the pail, holding it from displacement in a vertical direction. A crank is provided for the device, and a cover for the pail to engage over the handles and a U-shape clamp to hold the pail in fixed position.

VARIABLE-SPEED DRIVING MECHANISM. —R. M. RUCK, 44 Thurloe Square, South Kensington, London, England. One object of the invention is to render a mechanism of this kind available for use on motor vehicles and in connection with other machinery driven with high-speed engines, in such manner that the velocity of the transmitted motion may be varied (say) from a maximum to *nil* and beyond the latter so as to obtain reversal, yet without the necessity of interrupting the running of the engine or altering its speed or direction of rotation.

PUMP.—L. K. Pulliam, Pensacola, Fla. The invention relates more particularly to that type of combined engine and pump in which there is employed a single cylinder having a piston therein, the space at one side of the piston serving as a power chamber and the space at the opposite side of the piston serving as a compression chamber.

WATER-POWER BLOWER.—J. L. Ware, Terry, Miss. The invention relates to a blower for use in connection with the forges of machine shops and other metal working plants of a similar nature. The object is to provide a combined blower and water motor having comparatively connecting parts. It may be readily taken apart and reassembled.

SAND-FEED FOR STONE-SAWING MACHINES.—J. M. Owens, Oolitic, and J. A. Rowe and E. E. Mitchell, Bedford, Ind. The invention provides a feed in which there is a tank at higher elevation than the sand box parallel therewith, there being a plurality of outlets for the tank and box, those for the box having openings therein, above which are disposed the lower terminals of the tank outlets respectively, the tank having an overflow which leads into the box, and the box also being provided with an overflow, the outlets from the tank and from the box being commanded by valves.

ATTACHMENT FOR SEWING-MACHINES.—E. J. Miller, Shamokin, Pa. More particularly the invention relates to attachments such as are adapted to be removably secured to the balance wheels of the machines, and each of which consists of a frame having a grinding rim formed of emery, carborundum, or the like, arranged thereon, and adjustable means for removably securing the frame to any ordinary balance wheel.

ATTACHMENT FOR TYPE-SETTING MACHINES.—H. A. Armstrong, New York, N. Y. The attachment is particularly useful in connection with linotype machines having movable metal pots. One object of the inventor is to provide an attachment which comprises a signal bell, a float arranged within the metal pot of the machine and controlled by the metal level therein, and mechanism operable by the member, and serving to sound the bells when the member is in a certain position owing to the falling of the metal to a predetermined level.

AUTOMATIC LOCKING-RECEPTACLE.—J. W. Carter, Turnersville, N. Y. The receptacle is especially useful as a holder for milk bottles and the like, where there is a constant danger of unauthorized removal of the bottles after they have been delivered. An object of the invention is to provide a receptacle having means for automatically locking the same when an object has been placed therein, and which necessitates the opening of the door or the like, to permit the release of a trigger to unlock the device.

MOUNTING FOR BOTTLE-WASHER BRUSHES.—A. N. Davis, New York, N. Y. The invention relates to bottle washer brushes, the more particular object being to improve the mountings of such brushes. The brushes are actuated in the usual manner, the water being caused to flow through a spindle, the interior of the bottle being effectively washed. The operation completed, the withdrawal of the cleaning device from the bottle causes the brushes to be forced toward each other for an instant, and they spring backward into normal position immediately afterward.

UNIVERSAL JOINT.—J. Elkan, New York, N. Y. The improvement pertains to the transmission of power, and its object is to provide a joint, which is simple and durable in construction and arranged to permit of running shafts at any desired angle one to the other, and of changing the angle to suit existing conditions.

MECHANICAL MOVEMENT.—W. H. Gaskill, Wilson, N. Y. The invention refers to mechanical movements, and more particularly to an automaton mechanical movement suitable for simulating the motions displayed by an animal or a man in walking. It is of peculiar value in relation to propelling vehicles, for steering the same, and for use in sporting devices and in toys.

REVERSING-GEAR.—A. N. Woods, Corvallis, Ore. The object of the invention is to provide a new and improved reversing gear for traction engines and other power vehicles, and arranged to permit convenient and quick reversing for driving the vehicle in the desired direction.

CASH REGISTER AND INDICATOR.—J. F. Parker, Kansas City, Mo. A distinctive feature in this case is a bank of keys provided for registering and indicating the nine different amounts, in cents, ending with the numeral "5" such as 15, 25, 35, etc. Machines of other classes operate two keys in order to register any of the above amounts, while in the present, the same results are accomplished by one. Another, is the means for indicating amounts so that they are exhibited from the four sides of the register making them visible from any part of the room.

Prime Movers and Their Accessories.

VALVE.—N. B. Creighton, New York, N. Y. The aim in this case is to provide a valve, simple and durable in construction, and arranged to reduce the friction of the moving parts to a minimum, to allow convenient opening and closing of the valve and to permit of interchanging the actuating parts for use on either side of the valve.

ROTARY ENGINE.—C. Ford and D. F. Helmer, Grand Rapids, Mich. While the invention relates more particularly to internal combustion engines, it relates also to improvements to steam engines, and its object is to provide a thoroughly efficient rotary engine with which the full force of the explosive or expansive effort of the explosive or expansive element that is used for driving the engine may be utilized.

ROTARY ENGINE.—G. L. Webster, Midlothian, Texas. When the parts in this engine are arranged and adjusted they engage each other at the proper time. Consequently high or low speed makes no difference in operation, the degree of speed being a question of pressure and strength of material. Any form of governor may be used. Cams for opening and closing the abutment are independently adjustable on the shaft so they may be set with great accuracy to operate.

MEANS FOR INJECTING WATER INTO THE CYLINDERS OF COMPRESSORS.—A. E. Jones, Via Volosca, Fiume, Hungary. The object of this invention is improvements in compressors for air or other gases and relates more particularly to means for automatically supplying the cylinders with injection water. It comprises more particularly a coil supplied with live steam, arranged in the water circulation jacket of the engine and opening into the cylinder.

Railways and Their Accessories.

WASTE-SUPPORTING ATTACHMENT FOR JOURNAL-BOXES.—R. A. Billingham, St. Marys, Pa. The boxes have lateral grooves in which members of the attachment may be slid, there being grooved lugs disposed at forward ends of the side members to permit of a front waste retaining member being slid into position. The latter has its upper terminal curved outwardly and is adapted to engage the lid of the box, by which it may be pressed inwardly, the upper terminals of the side waste retaining members being disposed in close proximity with the journal to prevent waste from passing around the journal under the brass. The attachment also prevents the waste from working forward and hanging out of the box.

Pertaining to Recreation.

BASE-BALL CURVER.—W. W. Winquest, Brady, Neb. The purpose of this invention is to provide a simple, serviceable and inexpensive ball curver adapted to be arranged on the fingers, and having means for engaging the cover of the ball so that a decided curve may be imparted to the latter in pitching.

GANG FISHING-HOOK.—S. R. Sutton, Naples, N. Y. The hooks are arranged in groups known as gangs. The object is to provide reliable means for loosely coupling together groups of fishing hooks in sequence, so that they will be free to turn or spin at their coupled connections. An improved swivel link forms a portion of the coupling device.

Pertaining to Vehicles.

WIND-SHIELD.—J. H. Sprague, Norwalk, Ohio. More particularly the invention relates to the construction of the frame of the shield and the method of holding the glass in place. It involves a construction of frame in which the glass is resiliently held between oppositely-disposed plates spaced apart, so that the glass will not be broken by undue pressure, yet will be securely held against movement in the frame.

WAGON-REACH.—H. Braun and G. L. Wackerow, Mellette, S. D. The invention relates to improvements in reaches for use on wagon trucks, and the object is to provide a simple, cheap and efficient means for applying the reach members to a truck. The improvement can be applied to practically all of the wagon trucks now in common use at a very small cost, and will add materially to the life of such trucks.

FIREMAN'S TRUCK.—C. Holst, New York, N. Y. In this truck two of the more important features relate to the telescoping mast having improved means for raising and lowering the sections and holding them in adjusted position; and a novel form of bridge that is mounted on a carriage the wheels of which travel vertically on the mast, the apparatus having means whereby the bridge may be raised or lowered to the desired position for the manipulation of a hose carried thereby.

Designs.

DESIGN FOR AN EMBLEM.—B. Martin, Degraff, Ohio. The design includes on a foundation or base, a horse-shoe crossed by a pennant with crossed base-ball bats between the lower ends of the bats, the whole forming an attractive design relating especially to base ball matters and including with the good luck shoe the representation of the pennant and bats and ball of the game.

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.

Notes and Queries.

HINTS TO CORRESPONDENTS.

The full name and address must accompany all letters, or no attention will be paid thereto. This is solely for our information. *All* queries are answered by mail, and a *few* of the selected answers are afterward published in the paper. We cannot undertake to furnish information on matters of personal interest, without reasonable compensation. To answer questions which are not of general interest usually costs us from $2.00 to $3.00 each upward, and this sum should invariably be remitted in such cases. When there are questions involving building or other construction, or when calculations must be made, an estimate of the cost will be furnished upon request. We cannot give answers to examination papers, or decide wagers, nor can we undertake to solve mathematical problems of any description whatsoever. Do not use postal cards.

Queries from this vicinity not answered within fourteen days should be repeated in full. Queries from points more remote will require a longer time.

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Any books on any scientific or technical subject can be furnished. We solicit requests for quotations. The Scientific American Supplements referred to are mailed for ten cents each. Book and Supplement catalogues will be sent free on request. A careful reading of these "Hints to Correspondents" will prevent any misconception as to the uses and will prevent abuses of this column.

(12014) P. H. W. asks: Kindly state why the months of the year are numbered, some with 31 days and some with 30, February with only 28? A. The arrangement of the days of our months is due to two Roman emperors, Julius and Augustus Cæsar. Julius Cæsar revised the calendar, making the common year to have 365 days, and every fourth year to have 366 days. The days of the year were distributed among the months, so that the odd months, beginning with January, had 31 days, and the even months had thirty days, excepting February, which had 29 days in common years and in leap years had 30 days. He also gave his name to the month of July. The months following were named from numerals. Augustus Cæsar followed Julius, and gave his name to the sixth month, August, and in order to get 31 days for it, so that it should be as long as July, named for Julius, he took a day from February and placed it in August. This brought three months with 31 days together. To remedy this Augustus changed September and November to 30 days and October and December to 31 days. Thus our peculiar arrangement of days in the months is because of the vanity of Augustus Cæsar.

(12015) J. P. B. asks: If a mine is from 600 feet to 800 feet deep, and when it reaches this depth it branches in different directions, say several hundred yards in each direction, and it is necessary to force air down to the workers, no matter in what position they may be, can air be forced through a large tube without any trouble to the above tube, say 3 feet or 4 feet in diameter, and air discharged through same, flowing to the 800 foot depth, and conveyed from there in other tubes to its destination? If this is the case, do they have to pump the foul air away, that is, suck it away, at the same time driving fresh air in regularly? The other point is, is the air sucked from below through a large tunnel, or pipe, instead of being discharged from a pump above to the mine below? In which manner is it done, or can it be done either way, by the drawing of the air from below or discharging it from above? In either case, is it necessary to discharge the foul air from the mine? A. There are a number of different systems of mine ventilation, some automatic and some mechanical, and two more or less opposed "schools," one of which argues, "If you get the bad air and smoke out of the mine, the fresh air can be trusted to find its way in;" and the other, "Get your fresh air to the remote places where it is most needed, and it will force the bad air out." If a mine has two shafts connected underground, one of which opens to the surface higher on a hillside than the other, sufficient natural draft will often be provided to ventilate the connecting workings. This condition is often artificially imitated by raising the "collar" of one or other of the shafts on a level, or even by partitioning a single shaft and carrying a sort of chimney higher on one side, leading wooden or metal air ducts from the workings into the bottom of the "uptake" inside, where the warm air rising creates a current assisted by the heating effect of steam pipes down the shaft, and the fresh air flows in automatically. In large mines, especially collieries, with extensive workings, however, the air is almost entirely *blown* in by powerful fans, is conducted in large ducts to the bottom of the shaft, and from there directed through the workings by means of a carefully arranged system of double doors wherever "roads" cross underground, so that there may be a continuous current from the blower all through the workings to the foot of the shaft, whence the up draft is natural. In one colliery visited by the writer, where the shaft is just over half a mile deep and workings extend for two miles from the bottom in a more or less horizontal direction, comprising over 20 miles of "road" in all, 500,000 cubic feet of air per minute is blown into the mine, over 200 horse-power being required to drive the blowers alone. There are systems (for smaller mines) by which using a single blower and pipe the current may be made either suction or inblowing, but none to our knowledge in which both mechanical exhaust of foul air and inblowing of fresh are simultaneously required.

(12016) G. L. asks: What makes the great heavenly bodies and other matter in the universe move? What is the nature of the power or original cause? A. The absolute origin of motion in the matter of the sidereal universe is not positively known any more than the origin of energy or of life, nor is there any likelihood that it ever will be with regard to any one of them. At the same time there are certain developments in progress in the universe, of each stage of which there are numberless repeated instances visible to astronomers with high-power telescopes, of which developments the results will so obviously be planetary systems with a motion similar to that of ours, that we may fairly assume the developments of our system to have been analogous if not identical. These developments commence with a nebula, an immense body of highly-heated gas, revolving inconceivably slowly but unquestionably. Movement having been originated somehow, by molecular attraction or otherwise as may be imagined, its development is comparatively easy. The heavier molecules would attract to themselves the lighter ones, as they observably do in the chemical laboratory, and these small aggregations or nuclei would continually grow by accretion of smaller masses, continually developing motion in every possible direction and resulting in collisions, which again result in increase of size and decrease of number of the individual nuclei as they join each other. Gradually the number of different motions would become less, the resultant attractions being toward the center of the whole system, and this attraction being at first opposed by gaseous expansion, and eventually tending to revolution of the nuclei around the center of the mass. This is most noticeable in the visible nebulæ, the observable form of many and the probable form of most of which is spiral, long streamers of luminous gas containing solidifying parts trailing away from them in all directions. This permits of the more rapid cooling of the gases, their condensation, solidification, all the time with increasing density and decreasing volume, resulting in their increasingly rapid motion as gravitation acts on a mass offering less and less frictional resistance to the gaseous atmosphere in which they move. When the immense eruptive tendency of a highly-heated gaseous body is taken into consideration, the tidal effect produced by the attraction of two such bodies approaching each other without collision is amply sufficient to account for the throwing off of the particles, the spiral form of the nebulæ, and, combined with the centripetal attraction, for the eventual circular or elliptic rotation of the planetary bodies. This theory, whether or not demonstrably correct, is generally considered to be at least *sufficient* to account for planetary and other universal motion.

(12017) W. S. asks: 1. Why is twilight so much longer in England than in Spain or North Africa? Is it true that the period of twilight increases as we approach the poles, and if so, what is the cause of the increase? A. Twilight lasts till the sun is about 18 deg. below the horizon in the evening at any place. The sun in the torrid zone descends vertically in setting, and the duration of twilight is least in this region of the earth. The sun traverses 18 deg. in 1 hour and 12 minutes, which consequently is the shortest duration of twilight in the torrid zone all the year. The path of the sun makes the least angle with the horizon in the northern hemisphere in the summer, and hence a longer time is required to bring the sun 18 deg. below the horizon. Twilight then lasts about 2 hours in latitude 40 deg. north. On the Arctic circle the sun at the summer solstice just touches the northern horizon, and daylight lasts through the 24 hours. There is no night. At the north pole twilight is about 2½ months, or from the middle of January to March 22, when day begins. Duration of twilight can be calculated for any latitude at the sea level by trigonometry. At high altitudes above the sea twilight is said to be of shorter duration than at lower altitudes, due probably to the clearness of the air from dust. We have seen it stated that it is not more than twenty minutes at Quito. 2. Is there any means of determining the voltage and amperage of a current after passing through a Ruhmkorff's coil? Could you give approximately an idea of the voltage and amperage of a current which has passed through a coil that yields a spark of six inches, and that is worked by seven Grove cells (ordinary size)? A. The voltage required to force an electric discharge through air has been determined for various conditions. It is found to be different between needle points from what it is between balls. It varies also with the size of the balls. Between sharp points about 20,000 volts are represented in a spark one inch long, while for six inches about 72,000 volts are required. These voltages have been determined by experiments with alternating currents. With direct currents also many tests have been made, using batteries giving enormous pressures. 3. When lamps are lighted by electricity from alternate-current dynamos, how is it that the light appears constant and does not seem to flicker? I suppose commutators cannot be used with continuous-current dynamos. In the alternate-current machine does not the current enter the lamp alternately by opposite wires? A. An alternating current is the result of an alternating electromotive force, which is conceived to start from zero and rise to its highest point of voltage, then to fall through zero to a point as far below zero as it rose above zero, after which it returns to zero, thus making a cycle of changes. The polarity of the current is reversed while the E. M. F. is below zero. The fluctuation of lamps is not visible under such a current, because the changes are more rapid than the eye can take note of. The shortest interval of time the eye can note is about a tenth of a second, while the alternating current passes through 30 to 60 cycles per second. A commutator can be used with a continuous-current dynamo whose voltage is not too high and current is low enough. The transformation of a direct to an alternating current is usually made by a rotary converter or a motor dynamo. We furnish Sloane's "Electrician's Handy Book," which discusses all such matters, for $3.50 by mail.

(12018) J. W. L. says: 1. Does a gyroscope consume the same amount of energy while rotating in either the vertical plane or horizontal plane? R. P. M. Equal, I think, owing to the fact that while rotating in the vertical plane one side of the rotating part would be moving toward the earth; that the force of gravity on that side should be decidedly below normal, while on the opposite side (which would be receding) the force of gravity should be above normal. Under these considerations would not gravity alone tend to bring the gyroscope to rest? A. The power necessary to maintain a gyroscope in motion would not seem to depend upon the angle made by the wheel with the horizon. Any excess on one-half of a revolution is made up by as great a deficiency in the other half revolution, leaving the mean value the same. 2. Is this not the reason that the moon does not rotate on its axis as viewed from the earth? A. The reason of the moon not rotating upon its axis as referred to the earth is that tides have in the past acted to bring the moon to rest with reference to the earth. See Darwin's theory of tidal evolution in Moulton's "Astronomy." This theory is now quite generally accepted by astronomers. We can send you the book for $1.75 postpaid.

(12019) J. E. W. asks: 1. If at the equator a hole 2 feet wide pierced the earth through its center, and a ball a half inch in diameter were dropped into the hole, I figure that in about nine and one-half seconds, and at a depth of about 1,440 feet the ball would impinge against the east side of the hole, because at that depth the earth would be revolving a little over one-tenth of an inch slower than at the surface; and from that point down to the center the continually decreasing speed of revolution would cause the ball to press continually against the east side. Supposing now, that there were neither air nor friction to retard the ball, would it acquire the same velocity as if it could have fallen without touching the side; and would it rise again to the opposite surface of the earth? A. The best experiments to determine the easterly deviation of falling balls, according to Prof. Young in his "College Astronomy," showed from 160 trials, a deviation of 1.12 inches in a fall of 520 feet into a mine. If a ball were dropped into a hole in the earth it would in time come against the side of the tube and roll down to the center of the earth and pass some distance beyond the center. How far no one can tell, since it depends entirely upon the degree of friction upon the sides of the hole. It could not rise as far as it had fallen, since it could not pass the center with the full velocity due to free fall. 2. If the earth were a hollow sphere inclosing a vacuum, and a rock fell from the inner side, would it not gradually assume a convolute course till it reached a point where its increasing momentum would equal the earth's decreasing attraction, and at that point begin to revolve in a circular orbit? If so, at what depth would this occur? A. If the earth were a hollow shell a rock which had become detached from its interior surface could not fall at all. A body anywhere within such a shell is equally attracted in all directions and has no weight. This is usually demonstrated in textbooks of mechanics. 3. In such a sphere a ball falling from either pole would go to the center direct and rise again to the opposite pole; but if as in the case of the earth, the poles themselves had a slight rotary motion in space, would not the ball be gradually deflected into a circular orbit? A. A ball falling along the polar axis of the earth would not be deviated at all in the time required to fall from the surface to the center of the earth, since the deviation of the pole is very slow and very small.

(12020) T. H. asks: Do any of our planets ever swing beyond the zodiac? If so, which ones, and how far beyond? A. All the major planets have their orbits wholly within the zodiac. The belt of the zodiac was originally taken to be 8 deg. on each side of the celestial equator, simply because with that width it included all the known planets and the moon. Many of the minor planets depart from the zodiac.

NEW BOOKS, ETC.

Vorlesungen über Ingenieur-Wissenschaften. Vol. II. Eisenbruckenbau. By G. C. Mehrtens. Leipzig: Wilhelm Engelmann, 1908. 800 pp.; 970 ill.

It is possible that the mathematics of bridge construction may have been more fully treated in some text book, the details of some particular bridge more fully described in a magazine article, but it is inconceivable to us that the whole subject of iron-bridge building could be more exhaustively treated in the same compass than by the present volume. Many of its pages could be used as text book for the calculation and distribution of strains and stresses in bridge members, but much more of it is as interesting to the amateur as to the engineer. We cannot imagine that any history of bridge building could commence further back and conclude more up-to-date, or include a wider range of examples from the most primitive to the most complex structures. The author begins with pictures from the Bayeux tapestry of Alexander the Great bridging the Euphrates and coins commemorating Trajan's bridge over the Danube, and includes representative work of all leading bridge builders from Vespasian and Maximian to Roebling, Baker, Brunel, and Lindenthal, leading up through twenty centuries to the last word in braced arch and cantilever construction. Mr. Mehrtens even goes outside his title and the above range of period to include all types from natural bridges in the Cordilleras, and bamboo and rattan suspension bridges in Java, from the pyramid of Cheops, the principle of which is illustrated by working drawings, and Hannibal's stone bridge at Barcelona, to the latest developments of masonry and ferro-concrete. Many forms of fastenings and details are illustrated, each new system of strain distribution involved in a bridge described is explained by diagrams, and the reader is conducted through the entire series of operations from the rolling from the ingot of members of various forms to their location in the finished structure. In glancing over the excellent illustrations one cannot help regretting that in the development of the American iron-bridge system, admirably as it was suited to meet conditions nowhere else encountered with the same limitations imposed, the artistic beauty so noticeably superior in many European bridges has had to be to some extent sacrificed to economy and efficiency.

Two Family and Twin Houses. New York: William T. Comstock, 1908. Small 4to.; 127 pages. Price, $2.

This work consists of a variety of designs contributed by leading architects in all parts of the country, showing the latest ideas in planning this class of dwellings in city, village, and suburbs, together with very complete descriptions covering all the latest improvements in sanitation.

Old Edinburgh. By Frederick W. Walkeys. Boston: L. C. Page & Co., 1908. 2 vols.; 16mo.; pp. 380-360. Price, $3.

This is an account of the ancient capital of the kingdom of Scotland, including its streets, houses, notable inhabitants, and customs in the olden times. It is beautifully illustrated with reproductions of old prints and photographs. A charming book of travel, well written and well illustrated.

Reservoirs. For Irrigation, Water Power, and Domestic Water Supply. By James Dix Schuyler. London: Chapman & Hall, 1908. Imported by John Wiley & Sons. Large 8vo.; pp. 573; 281 ill. Price, $6.

This is a second edition revised and enlarged of the original work of the author, well known to all engineers concerned in such work. The rapid development in dam construction since the original publication has necessitated the complete revision of the work in order to bring it up to date, and this having obviously been done with great care, must have involved labor equivalent to, if not indeed greater than, that of writing a new book. Much new matter has been added and some of the old describing practice obsolete or superseded by modern methods has been omitted, the most noticeable addition being that descriptive of hydraulic fill dams, a method of using natural streams for the transportation of material and for the natural solidification of dams of great height at small cost almost unknown at the time of the appearance of the author's first edition. Improvements in photography have also increased the interest of the book, especially to the layman, by the addition of over 200 new illustrations, many of striking and historic dams.

The Mechanical Appliances of the Chemical and Metallurgical Industries. By Oska Nagel, Ph.D. New York: Published by the Author, 1908. 8vo.; pp. 302; 292 ill. Price, $2.

It must be difficult to find a new field for authors and compilers nowadays, but we are unfamiliar with any other work covering exactly the ground of the present. All the machinery used in industrial chemistry and metallurgy from the generation of steam and producer gas to the conveyance and disposal of their waste and by-products, from the crushing of ores to the handling of their residues after cyaniding and filtration, from reverberatory furnaces to sublimation, is critically described and classified, including all kinds of conveying apparatus for solids, liquids, and gases, grinders, mixers, separators, purifiers, evaporators, and dryers. There is a good deal of rather obvious compilation from manufacturers' catalogues, but this in a work of this sort could hardly be avoided, and one of the author's professed objects is to save the manufacturer from the toils of the salesman and the perusal of endless half-understood descriptions by presenting the essentials of the different systems. This he successfully achieves and leavens the work with a few usefully simple formulæ for calculating drafts, etc., and rules for the selection of material and fittings.

The Elements of Physics. In Three Volumes. Volume II. Electricity and Magnetism. By Edward L. Nichols and William S. Franklin. New York: The Macmillan Company, 1908. 8vo.; pp. 303; 196 figures. Price, $1.60.

This is a college textbook, being the second volume of Nichols and Franklin's "Elements of Physics." The volume was originally published in 1896, but has since been entirely rewritten. It differs from other works on the same subject in beginning with magnetism and electro-magnetism and thence leading up to electrostatics. The latter subject is approached from the standpoint of the ballistic galvanometer.

The Physical Properties of Soils. By Arthur G. McCall. Fully illustrated with photographs and diagrams. New York: Orange Judd Company, 1909. 12mo.; pp. 100. Price, 50 cents.

This book is rather suggestive than didactic, telling nothing of the physical properties of soils but giving rules for the carrying out of systematic experiments for determining them; nor does it explain the relation to or effect in agriculture of the physical properties so discovered, the author contenting himself with referring the student to the best works extant on these subjects. As a guide to the student in the most practical methods of pursuing a study as yet little formulated while leaving him free to original research the book should prove of great value.

How to Use a Camera. By Clive Holland. London: Routledge & Sons. Imported by E. P. Dutton. 12mo.; pp. 132.; ill. Price, 50 cents.

The object of the author is to supply up-to-date practical information, useful especially to the beginner rather than a profound treatise, and this he does in a readable and entertaining manner. The advice as to the important matter of selection of the right camera is good, and whereas the artistic eye for the selection of the right subject can hardly be taught, the chapter on that subject will assist many to avoid mistakes. The hints on variation of light and the way to estimate correct exposures are good, as are especially the instructions for local improvement of negatives, by following which many a hopeless picture may be retrieved. Many formulæ are also given for developing, toning, and fixing baths, hints for finishing and for artistic applications of photography. The illustrations, apart from those intended to illustrate defects, are a little disappointing compared with the excellent amateur work nowadays seen in newspaper competitions, and the subject matter is worthy of a better style of publication, the paper being poor and conspicuously different from that of the illustration and advertising pages.

The American Apple Orchard. By F. A. Waugh. New York: Orange Judd Company, 1908. 12mo.; pp. 215; fully illustrated. Price, $1.

Although modestly described as a "sketch" this book forms a very complete treatise on American apple growing and the instruction it contains is given in a very interesting manner. Beginning with the geographical distribution of the industry and the different varieties, the author explains the desirable qualifications of soils for orchards as well as the exposures and wind protection desirable. He proceeds with the causes and effects of winter killing, the preparation of land for an orchard, selection of trees, propagation, times of planting and all the methods of working, discusses the advantages and disadvantages of cover crops, pruning, and feeding the trees, their principal diseases and the protection of them from insects, including formulæ for all the best mixtures for spraying, and concludes with harvesting, sorting, and packing apples for the market. The book makes our mouth water for the apples it describes and makes us hungry for the scent of the soil and the breezes blowing through the apple blossoms, and we should say that any intelligent farmer who has grown anything else should be well equipped for a start in commercial apple growing by its careful perusal.

Foundry Practice. By James M. Tate and Melville O. Stone, M.E. Revised third edition. New York: John Wiley & Sons, 1909. 12mo.; pp. 234; 112 ill.; cloth. Price, $2.

This work is essentially a text-book for the use of students, the work of the shop and of the class-room being carefully correlated in a manner infrequently found in books on foundry practice, which are generally adapted to the requirements of the advanced foundryman rather than to those of the beginner. In this respect the object of the authors seems to have been achieved. The first-named of the authors adds to a life-long experience as practical pattern-maker and foundryman some fifteen years of putting what he has learned in practice into the form of precept intelligible to others and has therefore an ability to explain what he knows rare in the practical operative. His associate has graduated under his instruction and made a special study of foundry chemistry and metallurgy. The result of their joint efforts is an eminently practical work, giving all the essentials and fundamental principles of foundry work, and, without going into details of special processes or machines, covers sufficiently for the student everything from the simplest green-sand molding to the latest machines for handling molds and cleaning castings, concluding with tables of alloys for foundry use. Not the least useful feature is a glossary of foundry terms, given especially to avoid waste of space in needless explanations, and a glance through which prevents any possible obscurity.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending March 2, 1909,

AND EACH BEARING THAT DATE

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

Account keeping means, A. L. Grayson	914,345
Acid, officinal preparation of phosphoric, J. Nicolaidi	914,175
Acids, manufacture of homologues of para-aminophenylarsinic, L. Benda	913,940
Adding machine, J. G. Vincent	913,860
Adding machine carriage mechanism, O. C. Kreis, Jr.	913,738
Adjustable bracket, N. L. Holcomb	914,047
Advertising device, H. P. Turner	913,994
Advertising plates, etc., device for moving, J. Albig	914,217
Air brake system, A. I. Perry	913,972
Aluminium compounds, manufacturing, E. L. Rinman	914,187
Amalgamator, L. C. Laurent	913,902
Animal hopple, Meeks & Harris	914,059
Animal trap, S. A. Wilson	914,000
Arch supporter, instep, E. H. Dunbar	914,027
Automobile clock fastening device, Hurley & Slager	914,280
Autovehicle mixed drive, H. Pieper	913,846
Axes and eye tools, making, C. P. Byrnes	914,240
Bag holder, C. L. Lyon	914,057
Baggage roller, R. F. Slater	913,777
Ball attaching means, F. J. Englen	914,125
Baking pan, etc., O. W. Bruner	914,238
Baking powder, manufacturing, R. Paul	913,762
Baling machine, McLin & Bachman	914,160
Baling press, J. P. Gomes	914,266
Baling press, J. C. Damron	914,336
Balling machine, A. E. Rhoades	913,980
Barber's register, W. W. Gass	914,265
Basket handle, E. G. Hannon	913,885
Baskets, machine for making fruit, J. E. Lyman	914,358
Battery. See Electric battery.	
Battery contact, J. H. Gugler	914,038
Bearing for centrifugal separators, T. S. Patterson	914,181
Bearing, thrust, G. Rennerfelt	914,075
Beating and kneading machine, R. F. C. Rambeaud	913,766
Bed bottom, spring, J. W. Crowell	914,246
Bed pan, sanitary, M. B. Morgan	913,836
Bed plate, F. J. Fleischhauer	914,035
Bedclothes fastener, E. L. Kelley	914,287
Beeswax extractor, O. L. Hershiser	913,889
Bell support, smoke, H. C. Hepler	914,273
Bellows chest, P. B. Klugh	914,351
Belt, conveyer, T. Robins	913,917
Belt shifter, Hinders & Reintsma	913,890
Benzene or its homologues from petroleum, producing, E. A. Starke	913,780
Bicycle frame, A. Levedahl	913,961
Billiard chalk holder, F. Feldmann	914,033
Binder, loose leaf, R. B. Wilson	913,793
Binder, loose leaf, C. R. Nelson	914,063
Binders, means for securing pages of loose leaf, J. S. McComb	913,906
Binding post, C. Barbour	914,327
Blade sharpening machine, R. S. Green	913,954
Blasting charges, machine for fixing, O. F. Malcolm	913,745
Blowing can, A. Eckardt	913,816
Boat, I. Anderson	913,868
Bogie with one or several axles, C. de Bange	913,872
Boiler, W. A. Berry	913,681
Boiler flue cleaner, S. H. Limbert	913,963
Boiler furnace, sectional, C. Phelps	913,844
Bolt anchorage, Cleverdon & De Temple	913,875
Bookbinder, F. G. Kollenberg	913,737
Bottle and jar closure, L. Eschner	914,252
Bottle crate, W. C. Seifert	914,080
Bottle making machine, A. Watts	913,996
Bottle necks and ground glass stoppers therefor, making interchangeable ground glass, C. M. Conradson	914,244
Bottle necks and stoppers therefor, machine for spirally grinding interchangeable spirally ground, C. M. Conradson	914,243

Bottle, non-refillable, D. J. O'Neil 913,840
Bottle, non-refillable, M. Forst 914,129
Box blank making machine, wire bound, R. G. Inwood 913,958
Box lid, journal, W. G. Dunham 914,341
Box making machine, E. W. Myers 913,837
Box making machine, wire bound, Inwood & Chapman 913,896
Brake, R. R. Stein 913,781
Braking mechanism, P. N. Jones 914,284
Branding machine, W. J. Green 913,884
Brick spreader pallet and truck therefor, W. Friberg 914,262
Broiler, B. McCaughey 914,159
Brooder, J. F. & W. D. Craig 913,813
Brooder heater, J. C. Nicholls 914,171
Buckle, L. Eckert 914,029
Buggy top attachment, P. Y. Fullerton 914,263
Bundle wiring machine, J. Pfeffer 914,363
Bundle wiring pincers, J. Pfeffer 914,182
Burglar alarm, electric, A. Bloch 913,684
Burner, E. De Loe 913,706
Burner, A. F. Bauer 913,803
Burner controller, automatic, J. W. Dearing 914,023
Butter manufacture, E. Schou 913,920
Cabinet, J. W. Schauer 914,078
Cabinet, credit, F. J. Peterson 913,911
Cable tramway grip mechanism, R. D. Seymour 913,775
Can making machine feeding mechanism, W. F. Hebrank 913,886
Can opener, E. W. Bishop 913,683
Can stamping machine, C. C. Brown 914,234
Car bolster, H. Pries 914,073
Car brake attachment, G. Frowen 913,719
Car, convertible, E. C. Harllee 913,956, 914,270
Car, dump, F. Hudson 913,893
Car, dump, A. Campbell 914,242
Car, dumping, A. Becker 913,938
Car grain door, freight, E. Posson 913,763
Car heater, E. J. Rauch 914,305
Car loading apparatus, box, F. D. Buffum 914,017
Car, poultry, H. W. Burgett 913,690
Car, railway motor, W. S. Hovey 914,347, 914,348
Car replacing frog, L. Pluard 914,070
Car standard, trip, W. Strathy 913,925
Car steering and governing mechanism, motor, D. H. Coles 914,020
Car wheel removable tire, T. G. Aultman 914,221
Carbid of calcium, preparing, X. Herme 913,887
Carbureter, J. A. Steward 913,857
Carriage, baby, A. J. Adams 914,010
Carriage hood attachment, child's, D. R. Collier 914,114
Case. See Ticket case.
Cash, parcels, etc., apparatus for transferring, E. C. Phillips 913,975
Cash registering till, M. W. Smith 913,779
Catamenial receptacle, Scheller & Haas 913,893
Catching and killing device, A. Tebbit 913,858
Cattle stanchion, R. Grafton 913,723
Ceiling construction, P. Allinio 914,102
Cell, galvanic, B. Jonas 913,898
Cement applying machine, W. F. Lautenschlager 913,829
Cement, making, E. J. Winslow 913,794
Chandelier hook, C. M. Pitel 913,977
Charging the retorts of zinc and other analogous furnaces, E. Dor-Delattre 914,339
Chime whistle, J. Donath 913,707
Chimney attachment, C. Galitz 914,134
Chlorin, apparatus for utilizing, J. W. Aylsworth 914,224
Chlorinated compound and making same, J. W. Aylsworth 914,223
Churn, L. C. Lewis 913,742
Churn, L. A. Smith 913,778
Churn, C. S. McCalman 913,838
Churn, R. E. Sharp 913,986
Cigar machine, R. Annigoni 913,869
Cigar rolling table, R. Annigoni 913,870
Clamp, F. B. Cook 913,699
Clasp, F. W. Seidl 913,854
Clip binder, P. Cohen 913,876
Clock, advertising, J. B. Barnett 914,229
Clod crusher and harrow, combined, W. W. Reichman 913,979
Clothes drier, F. T. Johnson 913,823
Clothes line support, J. Jacobs 914,049
Clutch, friction, A. Charvin 914,112
Coal and the waste materials thereof, apparatus for briqueting fine, G. B. Damon 914,247
Coal and waste materials thereof, briqueting, G. B. Damon 914,248
Cock, automatic cylinder, C. E. Miser 913,965
Cock or valve, W. H. Wakfer 913,861
Coffee urn, O. A. Nenninger 914,302
Colander, O. E. Bohannon 914,014
Concrete block machine, E. P. Auger 914,367
Concrete floor construction, fireproof, J. D. Harrison 913,820
Concrete mixer, portable, B. G. Leake 914,291
Conduit service box, Riddell & Madden 914,186
Cone burner, glass, A. L. Edwards 914,249
Connecting pin, W. Fulton 914,133
Container coating apparatus, F. J. Macnish 913,964
Controlling device, F. D. Howe 914,277
Conveying apparatus, J. H. Gilman 913,948
Cooking utensil, T. P. Aitkin 914,216
Cord connector and rack, W. E. Hill 914,045
Cord for use in cord fabrics, compound, T. Sloper 913,856
Core for making cement conductors, expansible and contractible, M. Engeln 914,032
Corn thinner, C. B. Rhoades 914,307
Corset, F. O. Ginnever 913,883
Corset, R. B. Scognamillo 913,921
Cot, child's, M. M. S. Binney 914,104
Cotton chopper, R. R. Hyland 913,729
Cotton chopper, L. & J. P. Dewald 913,878
Coupling, E. E. Gold 913,950
Cover, F. Richardson 914,185
Crate, poultry, D. Turner 914,323
Crib, folding, C. Ross 914,309
Cuff holder, P. C. Ottinger 913,761
Cultivator, A. Barkley 914,228
Cultivator attachment, D. B. Browning 914,237
Culvert, D. C. Boyd 913,685
Culvert, H. A. Brownell 914,110
Current regulator, alternating, R. S. McLeod 913,757
Design making device, Tolman & Taylor 914,322
Detachable handle, C. B. Post 913,764
Digester, T. J. Hutchinson 914,349
Dipper handle socket, G. W. Knapp 914,352
Discount machine, C. A. Longwell 914,056
Door air controlled lock, sliding, W. J. Martin 913,834
Door and other closures, safety locking device for, H. Rowntree 913,773
Door check, C. P. Dorn 914,340
Door key, I. E. Solomon 913,923
Door lock guard, Anderson & Hansen 913,800
Door locking device, W. W. Cornman 913,700
Door mechanism, F. S. Gallagher 914,135
Door operating device, T. J. Naulty 914,161
Door or other device pneumatic operating mechanism, H. Rowntree 913,853
Door securer, P. A. Thorin 914,204
Door stop, J. M. Patterson 914,179
Door stop and fastener, sliding, G. Homan 913,821
Door stop and retainer, S. L. Mefford 913,748
Draft rigging, C. A. Tower 914,089
Draft rigging, J. F. O'Connor 914,176
Draft rigging, friction, J. F. O'Connor 913,759
Drill chuck, B. B. Farnham 914,255
Drill, ratchet, P. Armstrong 914,012
Drill, rock, J. A. Traylor 913,928
Drill, rock, T. E. Adams 913,932, 914,215
Drum, toy, E. Wolff 913,796
Drying finely divided material, apparatus for, R. S. Kent 914,052
Drying machine, Ryan & O'Toole 913,774
Dumping device, end, Yale & Reagan 914,004
Dye and making same, azo, C. Immerheiser 914,144
Dye and making same, azo, Julius & Fussegger 914,146
Eaves trough, A. Allen 914,218
Electric alarm, T. Norpoth 914,172, 914,173
Electric battery, L. P. Basset 913,936
Electric circuit controller, H. W. Leonard, 914,355 to 914,357
Electric conductor supports, guard for the arms of, Harrison & Burns 914,042
Electric current generator, C. C. Ruprecht 914,311
Electric cut out, T. E. Murray 913,755
Electric fixtures, wall plate for, I. Bond 914,107
Electric furnace, P. L. T. Heroult 913,888
Electric machine rotary members, cooling device for, J. Hissink 914,046

Notice to Contractors.

SEALED PROPOSALS for Power House, Coal Pocket and Conduits construction, including plumbing and electric work, and for Laundry building, construction, including heating, plumbing and electric work, at the Kings Park State Hospital, Kings Park, N. Y., will be received by the State Commission in Lunacy at the Capitol, Albany, N. Y., up to 3 o'clock P. M., on March 24, 1909, when they will be opened and read publicly.

Proposals shall be accompanied by certified check in the sum of $2,000 each for the Power House and Laundry, and the contractors to whom the awards are made will be required to furnish surety company's bond in the sum of $25,000 for the Power House and $25,000 for the Laundry. The right is reserved to reject any and all bids.

Drawings and specifications may be consulted and blank forms of proposals obtained at the Kings Park State Hospital, Kings Park, N. Y., at the office of the State Commission in Lunacy, Room 5212, 1 Madison Avenue, New York City, and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to, and in the discretion of the State Architect, Franklin B. Ware, Albany, N. Y.

NOTE.—This work does not include boilers or other equipment in the Power House, or laundry machinery.
T. E. McGARR, Secretary, State Commission in Lunacy.
Dated February 26, 1909.

Electric power for traction purposes, system for the distribution of, R. A. Weagant 914,365
Electric switch, E. M. Carr 913,809
Electric traction on the surface contact system, D. Suchostauer 913,782
Electrical appliance swivel, Low & Hertzberg 913,831
Electrical circuits, system of controlling the strength of direct currents in, M. M. Osnos 914,177
Electrical controlling device, J. T. Whalen 914,094
Electrical measuring instrument, J. F. Begole 913,939
Electrical switch, Clark & Vlasto 913,810
Electrolytic process of producing compounds, C. E. Acker 914,100
Electrolytic process of producing nitrogen compounds, C. E. Acker 914,214
Electroplating apparatus, G. L. Meaker 913,747
Elevator cage, safety, C. H. Sturgis 914,086
Engine. See Gas engine.
Engine aliner, J. O. Gibbons 914,370
Engine cooling device, explosive, G. Braun 914,109
Engine harvester attachment, traction, J. M. Will 914,097
Engine starter, F. A. Rogers 914,308
Engine wheel, traction, E. L. Van Dolsen 914,324
Envelop, L. W. Simmons 913,987
Envelop, E. Heyer 914,274
Envelop, G. Davis 914,337
Envelop, return, T. J. Sales 913,919
Envelop sealing and stamp affixing machine, Kindig & Wittler 914,350
Excavator, W. Hurst 914,142
Exercising apparatus, A. Zund-Burguet 913,799
Expansion bolt, D. R. Berry 914,103
Eye cup, C. A. Maher 914,295
Eye guard, H. S. Cover, reissue 12,924
Eyelet stay joining machine, F. L. Anderson 913,934
Fare collecting apparatus, J. H. Coleman 913,698
Fare register, J. F. Ohmer 914,361
Feed and litter carrier, H. J. Ferris 913,881
Feed bag, A. R. Hoffmann 913,727
Feeding mechanism, F. Waite 913,929
Feed rack, J. F. Withrow 914,001
Fence making tool, W. S. Guinter 913,725
Fence post, W. H. McWhirter 913,907
Fertilizers, manufacture of, D. Shields 913,922
Fiber and making same, fireproof, McElroy & Ellis 914,300
Fire extinguishing liquid, frostproof, M. Breslauer 914,233
Fire pot, C. F. Coda 913,812
Fireproof material, J. W. Aylsworth 914,222
Fitting table, dressmaker's, V. H. Canham 913,692
Flanging machine, C. L. Finch 914,034
Flakes, making thin metallic, T. A. Edison 914,372
Flat iron heater, J. Hagen 914,267
Floor cleaner, G. W. Ansley 913,801
Floor polisher, J. F. Weber 913,863
Floor scraper or planer, J. F. Weber 913,862
Floor surfacing machine, W. A. Tash 914,202
Flue cutter, H. H. Thornton 914,088
Fluid pressure ram, A. Parfitt 913,970
Fluid substances, apparatus for desiccating, W. S. Osborne 913,760
Flush meter, A. Simons 913,776
Flushing tank, W. F. Adams 914,011
Fodder shredder, E. F. Gibbons 914,136
Folding box, M. Hutchinson 913,894
Fork, olive and pickle, E. F. Menkin 914,060
Fruit picker, H. Tidd 914,205
Fuel, artificial, A. H. Ege 913,713
Furnace, L. P. Cohen 913,697
Furnace, Bailey & Hildebrand 914,226
Furnace, R. H. Sayre 914,314
Furnace feed mechanism, W. C. Robinson 914,188
Furnaces, operating electric, P. L. T. Heroult 914,346
Fuse block, automatic, C. O. Prowse 913,913
Fuse box, electric, T. E. Murray 913,754
Fuse, safety, Hart & Reynolds 914,043
Galvanic battery, B. Jonas 913,824
Gang sawmill carriage and steam feed pressure roll structure, W. L. Miles 914,154
Garment, bifurcated, F. F. Lewis 913,741
Garment hanger and clothes tree, etc., J. M. Hansen 913,955
Garment safety secret pocket, I. Mensch 913,749
Garment supporter, W. P. Kellogg 914,050
Garter, gentleman's, G. J. Hall 914,268
Gas burner, H. A. B. Helander 914,044
Gas burner, E. Schumacher 914,193
Gas engine, C. M. Leech 914,292
Gas engine, J. G. Willet 914,366
Gas generator, J. A. Kenworthy 913,733
Gas heater for water backs, E. M. Kennard 914,288
Gas meter pipe connection, A. Ehebald 914,250
Gate, J. Flinner 913,717
Gear for hoisting machines and analogous uses, reverse, A. Lambert 913,900
Gear, sectional, K. E. Porter 914,071
Gearing for hoisting drums, duplex, A. Lambert 913,901
Generator. See Electric current generator.
Glass drawing apparatus, J. W. Cruikshank 914,117
Glass for open top gas meters, proving, W. T. Drew 913,710
Gold concentrating apparatus, J. H. Montgomery 913,905
Governor for air compressors, E. B. Coup 914,116
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Grinding apparatus bearing, E. Rivett 913,767
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Hammock, metallic, I. Meyer 913,750
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Hat cover, lady's, W. S. Turney 914,206
Hay press, C. L. Bowen 913,873
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Hay stacking apparatus, J. Pate 914,178
Headlight, R. H. Welles 913,997
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Heating apparatus, water, Lyon & Hickok 913,832
Honey extractor, J. F. Kropp 914,290
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Internal combustion engine, rotary, G. Huscher 914,281
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Pressure generating and controlling device, hydraulic, J. W. Nelson 914,163
Pressure generating, controlling, and applying apparatus, hydraulic, J. W. Nelson 914,170
Pressure generation controlling device, hydraulic, J. W. Nelson 914,168
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Switch starter, multipe, H. J. Wiegand, 913,865, 913,999
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Talking machine mechanism, T. Kraemer 913,828
Telegraphy, space, L. de Forest 913,718
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Traction engine, G. R. Goughnour 914,137
Train order delivering device, T. E. McCann 914,158
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Truck, traction, R. Sylvester 913,783
Tube apparatus, pneumatic despatch, C. F. Stoddard 914,084
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Tubes, manufacture of, O. Briede 914,332, 914,333
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