SCIENTIFIC AMERICAN

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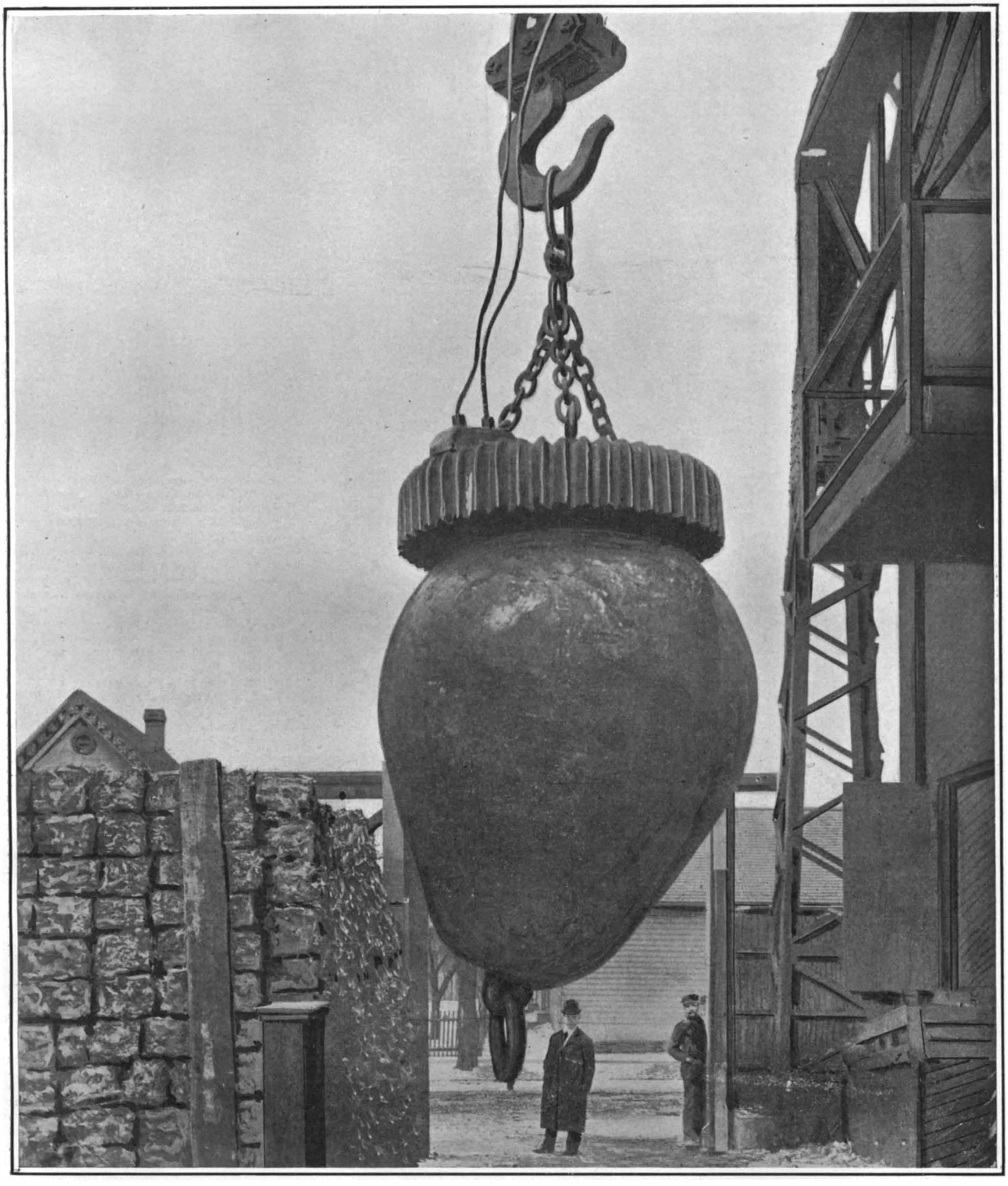

This magnet is 60 inches in diameter and will handle "skull cracker" balls weighing 50,000 pounds.

THE BIGGEST LIFTING MAGNET IN THE WORLD.—[See page 112.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, FEBRUARY 6, 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.

LESSONS OF THE "REPUBLIC" DISASTER.

To the mind of the naval architect and the steamship official, the most alarming feature of the sinking of the "Republic" is the fact that, although but one compartment was penetrated, her bulkhead subdivision failed to keep the ship afloat. Does this mean that the much-vaunted cellular and compartmental construction of modern steamships is inadequate; or does it mean that, although the theory is correct, it has been carried out in practice with too nice a regard for economy of construction, and that watertight bulkheads that are watertight exist only upon the drafting board of the designer and in the carefully-written advertising literature of the steamship companies?

The Scientific American would be the last to play the part of alarmist, except upon the most profound conviction that danger existed. But we are free to confess that there are conditions attending the loss of this ship which render the disaster extremely disquieting, and serve to shake our faith in the watertight qualities of the bulkheads, upon which we rely for the safety of the modern transatlantic liner. Had the "Republic" been an old ship, or had she been built for a company that was hampered by a shortage of funds, and built by a firm that was notorious for the construction of cheap and flimsy vessels, the case would not wear such an ominous aspect. But the "Republic," like all the ships of the famous White Star Line, was built under a system of contracts which is peculiarly favorable to first-class construction. Messrs. Harland & Wolff have an arrangement with the White Star Line, by which they receive, as compensation, a certain percentage on the cost of the completed ship. The vessels turned out by the famous Belfast yard are credited with being equal, if not somewhat superior, to those built by the other leading British yards. Hence, it is reasonable to assume that, in her construction, she represented the most approved methods of steamship construction.

When she started from New York on her fatal trip, she was considered to be practically unsinkable by collision. So numerous were her compartments, so staunchly were her subdividing bulkheads built, that any qualified expert would have confidently asserted that two of her compartments might be flooded without sending the ship to the bottom. And yet the "Republic," as the result of the penetration of a single one of her compartments, now lies in 250 feet of water.

By piecing together the accounts of the disaster given by the officers and crew of the ship, it would appear that the watertight doors leading into the wrecked engine room were all securely closed immediately after it was penetrated by the bow of the "Florida." The engine room was speedily flooded, and probably was soon filled with water to a depth of 35 to 40 feet above the inner bottom. Under such a head of water the pressure against the stretch of bulkhead dividing the engine room from the boiler room would be over a ton to the square foot at the floor level, and over the whole area of the bulkhead for a height of 20 feet above the engine-room floor, the total pressure tending to burst in the bulkhead would be about 1,200 tons. It will be understood that, under such a load, the tensile stresses tending to tear the wall open at the seams would reach a high figure. Such evidence as has come to hand indicates that it was the bulkhead astern of the engine room that failed, the settling of the ship by the stern pointing to a gradual invasion of the after portion of the vessel by the inflowing water. If this be the case, it is not unlikely that the bulkhead failed by a starting of the seams; for in this case the inflow of water would be gradual; a fact which would account for the long period of time that the ship remained afloat.

It has long been our impression, that if there were a weak point in the construction of modern steamships, it was to be found in insufficient riveting and in the inadequate amount of stiffening worked into the bulkheads. The ordinary construction is to use a 3/8 or 7/16-inch plate, stiffened by 3 x 3 or 3½ x 7-inch angles, according to the size of the ship. We do not know what weight of plating and reinforcement was used in the "Republic," but it is certain that such construction as we have indicated above would never be used by a hydraulic engineer, if he were building a dam or a lock gate, or flat-sided tank, to withstand a head of 40 feet of water or more. It should furthermore be borne in mind that the "Republic" was favored by a practically calm sea. Had the ship been rolling and scending in a heavy Atlantic gale, the strain upon the bulkheads would have been correspondingly greater; and it must be regarded as one of the most fortunate features of this disaster, that it happened in such quiet weather.

If the loss of this noble ship leads, as in our opinion it should, to the creation of expert commissions to investigate the question of bulkhead construction, and draw up standard specifications for the same, the loss of the "Republic" will be, after all, but a small price to pay for the restoration of that sense of security in transatlantic travel which the sinking of this thoroughly up-to-date ship has unquestionably shaken.

In closing this article, we wish to add our tribute to the splendid discipline and devoted attention to duty which marked the conduct of the officers and crews, both of the stricken vessel and of the ships which were summoned by wireless telegraphy to their assistance. Capt. Sealby and his officers and crew lived up to the best traditions of the transatlantic service. In serving as the direct means of the rescue of the thousands of souls concerned in this mishap, wireless telegraphy has added greatly to its prestige. It should be made compulsory by law upon every passenger steamer that travels the frequented routes of the Atlantic Ocean.

FRANCE AND THE AEROPLANE.

If the record of the past year is a safe criterion, France is about to take as prominent a part in the development of the aeroplane as she did in the improvement of the automobile. Although the invention of the automobile is by no means to be ascribed to the French alone, no one will grudge them the credit of having been the first to develop the machine to a point of speed and reliability at which its rapid commercial success was assured. Similarly, we may expect that the great enthusiasm and liberality with which they have taken up the problem of mechanical flight will result in the production of an aeroplane, which, in reliability, speed, and range of action, will be as perfect as those automobiles in which the French astonished the world a few years ago by winning 300-mile road races at speeds of over 50 miles an hour. We say this without any disparagement of the good work that is being done, on a much more limited scale, in this country; indeed, we must ever remember that the most brilliant flights of the past year were achieved by an American-built machine of a purely American design. The strong position held by the French people lies in the widespread enthusiasm with which they have taken up this new form of locomotion, the large number of intelligent men who are building and trying out various types of aeroplanes, and lastly, the great liberality with which the art is being stimulated by the offering of attractive prizes.

Speaking of Wright's successes, it might be mentioned here that the official account of his longest flight, made on the last day of the year, which has recently come to hand, shows that the closed circuit over which the flight was made was marked out by three flags which formed an isosceles triangle, the two long sides measuring 1,000 meters each and the base 200 meters. The circuit thus formed measured a little over 1 1/3 miles. The total official distance, measured exactly on the sides of the triangle, and allowing nothing for the turns, was 76.5 miles, which was traversed in 2 hours, 18 minutes, 33 3/5 seconds, at a speed of 30.95 miles per hour. But it should be borne in mind that, in order to make the turns, Wright was obliged to keep well outside the triangle; and it is fair to assume that the 168 turns served to bring up the total distance covered to fully 90 miles, and the average speed to over 35 miles per hour.

Evidence of the great hold which the new sport has taken upon the French people is afforded by the fact that the French company which bought the Wright patents has in hand orders for the construction of thirty-three machines. The Voisin brothers, builders of the type of aeroplane used by Farman and Delagrange, and also M. Pelterie, have several orders on hand, and outside of these three firms there are other less well-known builders, to say nothing of the private individuals, who are constructing machines ready for the forthcoming season.

It is estimated that altogether some $300,000 will be offered for contests during the coming year. One of the latest is a single prize of $2,000 which has been placed at the disposal of the Aero Club of France. It is to be open to all types of flying machines, and to dirigibles not exceeding 1,200 cubic meters capacity. The prize will be won by covering a 105-mile course. The most notable aeronautic meeting of the year will be held at Brescia next September, when prizes to the amount of $20,000 will be offered. The leading event will be a trial for a distance of 93.2 miles over a quadrangular circuit, to be laid out on a plain comparatively free from villages, trees, or other obstructions. It is also announced that the abandonment of the Grand Prix race for automobiles has rather encouraged than otherwise the promoters of the Anjou Flight Cup, the contest for which is to take place from Angers to Saumur and back, a total distance of 80 miles. It has even been suggested that the place of the motor car Grand Prix be taken by a big aeronautic meeting to be held some time in September.

Finally, the offer by the Daily Mail of a $2,500 prize for the first crossing of the English Channel during the year 1908 by an aeroplane has been extended by that journal to the present year, and the amount of the prize has been increased to $5,000. In view of the fact that Wilbur Wright has covered in a single flight a distance between three and four times as great as that which separates the French and the English shores, there is no question of his ability to win this prize, should he be willing to take the risks involved. The chief, and practically the only risk, would be that of the stopping of the motor; and the danger of alighting on the sea might be eliminated by fastening a couple of light racing shells to the runners below the planes, and choosing a perfectly calm day for the attempt.

THE "TRUST" SYSTEM AS APPLIED TO SCIENTIFIC RESEARCH.

An interesting development in modern scientific investigation and research is the general tendency to apply the principles of efficiency and concentration and organization used so effectively in American manufacturing industries. The fundamental methods which the great corporations or trusts have developed for the successful conduct of their businesses, seem equally applicable to scientific work. The benefits of adequate capital and a well-organized plant, together with a spirit of co-operation rather than competition, can be seen in a number of important scientific institutions in the United States.

With adequate equipment in the way of laboratories, observatories, apparatus, and instruments thus made possible, there comes the bringing together of men working in the same or allied fields, so that they coöperate harmoniously without waste of effort or inadequate treatment of any individual features of an investigation, due to the limitations of a single worker. The investigation when completed stands as the united and matured thought of a great institution. While every individual receives due credit for his share, it is as a part of a large and most useful whole. The tendency, therefore, is not to destroy individualism or initiative in scientific work, but to raise its standard, and to insist that the finished product shall represent everything that modern science can contribute to the particular subject. The result is that to-day all the greater, and especially many of the newer scientific institutions, are able to point with pardonable pride to valuable discoveries and investigations by members of their staffs, which even when measured from the utilitarian standpoint show a direct and important return for the capital invested.

Thus the recent study of the sun spots at the Mt. Wilson Observatory of the Carnegie Institution, made possible only by a special astronomical observatory and magnificent instrumental equipment, has brought more to our knowledge of this department of solar physics than has been gained by all previous observations. The explorations and studies of the American Museum of Natural History have produced results in the way of collections and scientific information more than commensurate with the scale of the expeditions; while such a great discovery as the anti-serum treatment for cerebro-spinal meningitis, developed at the well-equipped Rockefeller Institute for Medical Research, is but one indication of the usefulness of this institution. Indeed, it is most interesting to realize that the best scientific men have been only too anxious to apply modern business methods to their work, and without the sacrifice of scientific ideals in their search, to meet the tests of a practical and utilitarian age.

Modern scientific institutions of the type mentioned are a source of inspiration to the individual worker, because they are able to provide him with means for the adequate development of some investigation which can be shown worthy of support and encouragement.

ENGINEERING.

As an evidence of the thoroughness which marks the practice of the United States Steel Corporation, it may be mentioned that they are about to institute a new departure in steel works practice by establishing near Duquesne, Pa., a special bureau for scientific research. Systematic experimental work will be carried on in the laboratory which is to be built, with a view to improving the processes of steel manufacture as practised by the many constituent companies of the corporation.

In the recent opening of a new wireless post office station at Bolt Head, on the Devonshire coast, England, the postmaster general said that the principal objects in erecting the station were to carry out the obligations thrown on the post office by the radiograph convention of 1906, and to make sure that other parties to the convention live up to their obligations. The most important object, however, was to carry out the deliberate policy of the post office of preventing the growth of any form of monopoly in wireless telegraphy.

The Aeronautical Society of Great Britain has recently acquired a plot of experimental ground, which measures about one-half a mile square. Although the greater part of it is level, a certain section contains several steep mounds, about 50 feet in height, which are well adapted for experiments in gliding flight and the testing of new models. Ultimately, a well-equipped laboratory is to be erected, containing a whirling table and other experimental plant. The society is by no means a new one, having been in existence over fifty years.

The excavation of the New York State barge canal is being done on some sections by machines of unusual capacity. Conspicuous among these is a bridge conveyer, sometimes known as the grab machine. It consists essentially of a cantilever bridge, 428 feet in length and 90 feet in depth, supported on two traveling towers, and a grab bucket of truly Cyclopean dimensions operated from the cantilever. The bucket weighs 17 tons empty, and its jaws, when extended, are 20 feet apart, and measure 10 feet in width. The capacity of this huge maw is a dozen cubic yards or from 12 to 15 tons at each bite. The jaws crunch together with an ultimate closing power of 137 tons.

The Committee on Water Pollution of the Merchants' Association of New York city have submitted a plan for dealing with the sewage, which is at present causing intolerable conditions along the water front. It is proposed to pass all sewage through screens or catch basins, and all the ordinary flow through larger tanks, where over fifty per cent of the remaining solids will settle to the bottom. The sewage, as thus clarified, will be pumped overboard into the remaining section of the original sewer. The resulting deposits would be either pumped into tank steamers and carried twenty miles into the open sea; or passed through filter presses; or dried in rotary separators. The entire cost of the scheme would be about $32,500,000.

A plan for a freight and passenger subway for Manhattan Island has been submitted to the Public Service Commission by Mr. McBean, who built the Lenox Avenue Subway tunnel beneath the Harlem River. The freight subway proposed by Mr. Wilgus, as illustrated in our recent Engineering Number, was designed for freight only. The McBean subway is designed to permit the entrance into Manhattan of both the freight and passenger trains of the railroads which terminate in Jersey City, and also to provide direct tunnel connection for the railroad systems which now enter New York from the north and for the Long Island trains. He proposes the construction of a union passenger station at Park Row, Cherry and Pearl Streets. Unlike the Wilgus plan, the tunnels would provide for the admission of full-sized freight cars to Manhattan, and the subways would also include a roadway 22 feet in width for automobiles and trucking. The total cost is estimated at $130,000,000.

Prof. Boermel is the author of a design for an earthquake-proof building, the essential features of which are a massive foundation, consisting of a massive bowl upon which is placed a rocking foundation, the radius of whose curved bottom surface is somewhat less than that of the bowl. At its center is a half-spherical pivot, fitting into a cup bearing at the center of the foundation. Upon the rocking foundation is built the house or other desired construction. To prevent the movable portion from canting too freely, and to bring it back to the vertical position after the earthquake shock has passed, it is supported at eight points, near its periphery, by a series of spring buffers, which are bedded in the lower bowl-shaped foundation. The shock of an earthquake is transmitted to the building through the yielding springs, and its interior steel-frame structure is relied upon to take care of any remaining stresses that pass through the springs to the building itself.

AERONAUTICS.

On January 5th a U. S. patent was issued to the Wright brothers on a method of automatically curving the surfaces of a double horizontal rudder when the rudder is operated. The more the planes are inclined, the greater is the curvature (and hence the lifting effect) produced.

King Leopold of Belgium has offered $5,000 for the best treatise on aeronautics to be brought out this year. In this connection it is interesting to note that the New York Public Library has issued a separate catalogue of the aeronautic works on file. There are no less than 556 books in this catalogue, which is very complete and contains nearly every aeronautical volume published up to the present.

The International Sporting Club of Monaco, France, is conducting a flight competition for aeroplanes from January 24th until March 24th for cash prizes amounting to $20,000. Each machine is required to thrice make a flight across the bay and around Cape Martin and to return to the starting point. The total distance of this circuit is about 6 miles. One of the German automobile papers has already published a photograph showing a number of well-known aeroplanes in full flight over the bay. No aeroplanes of demonstrated ability have as yet been entered.

The French Minister of War has recently given out specifications for a new series of dirigible balloons. These specifications are as follows: Speed, 50 kilometers (31.05 miles) an hour to be maintained for 15 hours while carrying six passengers of a mean weight of 165 pounds each; total volume, 6,500 cubic meters (229,547½ cubic feet) as a maximum; total length, 90 meters (295.2 feet); height, 20 meters (65.6 feet); greatest diameter, 13 meters (42.64 feet). The test before acceptance must be made over a 310-mile circuit against a wind of 7 meters per second (15 miles an hour), and must be a continuous flight of 15 hours at an altitude which, for two-thirds of the time, must be greater than 1,300 meters (4,264 feet). The airship must pass over certain fixed points. It must be able to ascend to a height of 2,000 meters (6,560 feet) with safety. A prize of $1,000 will be given to the competitor submitting the best plans, and smaller prizes to the other competitors.

The popular subscription for Count von Zeppelin, the inventor of the huge German airship, was closed on December 24th after a total amount of over $1,500,000 had been raised. Since acquiring the remodeled third airship of the Count, the government has decided to order four new air craft of this type for naval use. Russia has a new dirigible of the von Parseval (German) semi-rigid type, but the first trials with it have not been very successful. Italy's military dirigible has been deflated until spring. Spain has slated an appropriation of 300,000 pesetas ($58,500) for military aeronautics. And to cap all, the House of Representatives at Washington has just granted the total sum of $500,000 asked for by our military authorities besides authorizing two new battleships. By the voting of medals to the Wright brothers last week the Senate as well showed an interest in aeronautics—an interest which, it is to be hoped, will be sustained when the aeronautic appropriation asked for comes to be voted upon.

Mr. James Gordon Bennett has offered to the Aero Club of France an aeronautic prize consisting of an International Aviation Cup for aeroplanes and all other heavier-than-air machines. The offer was made to the Aero Club through Count de la Vaulx and Mr. Cortlandt Field Bishop, and it was accepted with enthusiasm by the club. This new cup, which is valued at $2,500, is to be transferred by the Aero Club to the International Aeronautic Federation, and the first contest will be held in France this year. Besides the cup, Mr. Bennett has given three prizes of $5,000 each, which will be awarded during the first three annual events. The International Aeronautic Federation now has two international cups, one for spherical balloons and another for flying machines. This new event will be a long-distance contest upon a previously-determined course, either in a straight line, in a broken line, or in a closed circuit. The winner of the contest will be the one who covers the complete course in the shortest time. Each year, before the end of January, the International Federation is to draw up the rules of the annual event, based upon the progress made up to that time. The club which is charged with organizing the event is to conform to the programme elaborated by the Federation. From the outset, the event will be open to aeroplanes of all kinds, on condition that they can show previous experiments which are noteworthy and conclusive. The cup event may be held every year between May 1st and November 15th, and the date is to be fixed by the club holding the cup before the 1st of April. The event is to be held in the country of the winning club, and for the first year it will be held in France under the auspices of the Aero Club, which will receive the entries for the contest.

SCIENCE.

From Madrid comes the report of a shower of meteorites near Burgos on December 27th, 1908. Five of the meteorites, which set fire to a farmhouse, were collected. They were found to weigh from 2 to 11 pounds each, and to have a crystallized internal structure, while the surface was covered by the blade crust which is characteristic of meteorites and is produced by the partial fusion of the outer layer by the heat generated in traversing the earth's atmosphere.

In a communication to the French Academy of Medicine, Dr. Ménétrel reported on some clinical observations relating to the eradication of birthmarks by treatment with warm air (110 deg. to 120 deg. C.) He was accidentally led to the discovery of this method in treating a patient by hot applications for a refractory case of facial neuritis. In the course of this treatment he observed the discoloration of a birthmark on his patient. It has been previously observed that birthmarks yield to treatment with radium. This, however, must be used with great caution.

The water produced by the melting of glacier ice in summer flows down through crevasses to the bottom of the glacier and, forming a channel by erosion, emerges often as a large stream. In the Arctic regions these phenomena take place on a very large scale. The Danish expedition to the northeast coast of Greenland, conducted by Mylius and Erichsen, discovered and explored vast caverns thus formed by glacial streams. Some of these caves are 60 or 70 feet in height and more than a mile long. In winter the streams cease flowing but the caverns or tunnels remain ready to receive the streams of the following summer.

The Referee Board of Consulting Scientific Experts appointed by President Roosevelt to pass finally upon the pure food decisions of Dr. Harvey W. Wiley, Chief Chemist of the Department of Agriculture, has reversed the findings of Dr. Wiley, and given it as their opinion that benzoate of soda is not harmful to health. The findings are based on triple experiments, which were carried on over four months and which were very similar to those conducted by Dr. Wiley with his special "poison squad" of young men. The report is signed by President Ira Remsen, of Johns Hopkins University; Russell H. Chittenden, director of the Sheffield Scientific School of Yale University; John H. Long, professor of chemistry in the medical school of the Northwestern University; and C. H. Herter, professor of physiological chemistry in the College of Physicians and Surgeons, New York.

Bananas were first imported into Europe on a large scale from the Canary Islands. Until a few years ago they successfully met the competition of the Antilles and the coast of Africa. But a disease has spread in the banana cultures, and exportation has fallen off in alarming measure. As the banana figures prominently in the food of the town population of England, the British government appointed a commission to investigate the causes of the degeneration of this useful plant. According to the report of this commission, the planters have only themselves to blame; they have given the soil no rest for years past, nor practised any rotation of crops. Confident of the proverbial richness of their soil, they have applied no fertilizers. The enfeebled plants have fallen a prey to a disease known as *Cloesporium masarum*, which is gradually gaining a foothold in all plantations. The report closes with the observation that the disease is successfully fought by a proper application of fertilizer to the soil.

G. A. Haffner in German patent 201,976 claims a process for the manufacture of matches with invisible heads. Two methods are described. According to the first, the ends of the match stalks are roughened, placed in powdered sulphur, and heated to 120 deg. C. or more. According to the second method, the end of the match is treated with a mixture of nitro-hydrocarbons and stearin or paraffin or petroleum. Suitable igniting materials are then introduced into grooves or holes suitably prepared in the wood. These grooves may be impregnated with solutions, of which the one contains potassium chlorate or chromic acid, the other barium chlorate. In place of the chromic acid metallic salts may be used, such as nitrates, acetate, or organic nitro compounds. Their purpose is to prevent the efflorescence of the chlorates and to increase the sensitiveness of the match. The mass of the match-head consists of 100 parts potassium chlorate, with or without 20 parts of barium chlorate; 50 parts of a mass prepared by fusing together 30 parts of sulphur, 25 parts of powdered zinc, 15 parts potassium bichromate. To this is further added 10 parts of powdered glass, coloring matter, and a suitable quantity of water. The striking surface should be painted with a mixture of 15 parts dextrine, 1 part gum tragacanth, 25 parts hyposulphite of lead, 20 parts lead peroxide, 10 parts antimony trisulphide, 2 parts of glass, and 100 parts of water. To this mass 1 to 2 per cent of amorphous phosphorus may be added.

THE INDUSTRIAL USE OF THE LIFTING MAGNET.

BY W. FRANK M'CLURE.

Although the lifting magnet is by no means new, during the last two or three years in particular its uses have multiplied to such an extent that many new and widely different types have been designed to handle the multitudinous shapes of metal produced. The magnet is fast being adapted to handle all forms of iron and steel from iron dust, scraps, or small junk to weights of 20,000 pounds. In fact, the world's largest magnet will lift as much as 50,000 pounds. Thus the toy magnet of our boyhood is converted into a useful instrument in the workshop.

Used at first chiefly in carrying iron and steel to and from cars or storage piles, the lifting magnet is now utilized in breaking up imperfect castings, in holding sheets of metal in position while being riveted in the construction of ships, in lifting a "sow and pigs" at the furnaces, also as a gigantic broom to sweep both the large and small pieces of iron, and in many other ways. A half dozen kegs of nails may be seen traveling through the air, held by magnetic lines of force despite the wooden coverings of the kegs. Even two or three men are sometimes lifted from the ground, their feet resting upon a metal sheet, which is firmly held by the magnet.

Lifting magnets are usually operated from an electric overhead traveling crane, but they may also be operated from a locomotive crane. Within the magnet are coils with which the service wires are connected, just as an incandescent lamp is connected to service wires. The winding is, of course, insulated. When the magnets handle hot material, they are wound with fireproof wire. The movements of the magnet are directed by the operator of the crane. The opening or closing of a switch, turning the electricity on or off, causes the magnet to pick up or release its load.

The 20,000-pound weight referred to as a typical large lift made by magnet power is in the form of a "skull cracker ball," used to break up imperfect metal that is to be remelted. The magnet used for this lift is 52 inches in diameter, and its weight 4,800 pounds. It requires 4 feet 6 inches headroom. When this great weight has been lifted high in the air and the current is turned off and the "skull cracker ball" has fallen, the magnet again picks it up easily and quickly without any assistance from anyone on the ground.

This type of magnet consumes an average of 35 amperes at 220 volts for excitation, which is the equivalent of ten electrical horse-power. It is used also in the handling of iron and steel in many other forms, as illustrated in several of the accompanying photographs, and is the invention of Arthur C. Eastwood. Ten years ago the magnet was used chiefly in handling plates and billets.

The amount handled depends much on the shape of the material to be lifted. In the case of the 20,000 pounds, the lift of course is in one great compact ball, though some weights are elongated rather than round. In the case of sand-cast pig iron, where many different pieces must cling to the magnet or to one another, the load lifted by the magnet in unloading cars, for example, is 1,700 to 1,800 pounds. This load is slightly increased in handling from stock piles instead of cars, by 100 pounds. Also 100 pounds more machine-cast pig iron can be handled than sand-cast.

Again, the amount lifted in some cases depends upon whether the material is in an indiscriminate pile or stacked evenly. In accordance with this, as well as the dimensions of each, the average lift of billets or slabs runs from 1,200 to 12,000 pounds.

As a rule, a man on the ground is not necessary where a lifting magnet is employed, for the reason that there are no chains, slings, or hoisting blocks to be fitted about the weight to be lifted. However, there are a few instances where a ground man facilitates the work of the magnet. One of these is in the lifting of an ingot, say of 6,000 pounds. If a ground man places the magnet, two of these ingots can be lifted; otherwise only one at a time. For if two ingots are to be lifted simultaneously, they must be in proper position, on account of their weight, for the magnet to grip them in the right place.

In picking up scrap material with this same magnet, 1,400 to 1,600 pounds of what is known as "busheling scrap" will cling to it, while with loose tin scrap but 500 to 700 pounds is the average lift. Of miscellaneous junk dealer's scrap the lift ranges from 600 to 1,100 pounds, and boiler-plate scrap 1,000 to 1,400 pounds. Loose tin scrap is particularly difficult to handle. Tin is non-magnetic, and by tin scrap is meant the tinned sheet iron used for cans, etc.

Instead of the round magnet just described, a rectangular magnet is used in lifting a "sow and pigs" at the furnaces. When thus lifted from the sand they are not white hot, but just a dull red. Hot metal in the form of billets is also lifted by a special magnet to a conveyer, and taken to where it is sheared or cut into shorter lengths or to where it may be stamped out by a hydraulic press into car wheels and finished upon a lathe. A rectangular type of magnet is also used for holding steel plates in place to be riveted in the construction of ships. For two or three years past a number of these magnets have been in use at the imperial shipyards in Yokohama, Japan. The magnets are fastened to an I-beam, and are mounted on rollers, so as to be adjustable along the beam for different-sized plates. The flat type of magnet will also pick up metal sheets, perhaps two to six at a time, one under the other, the number depending on their thickness. These may be dropped by the magnet one at a time at the will of the operator, if he is skilled in throwing the switch at just the right intervals.

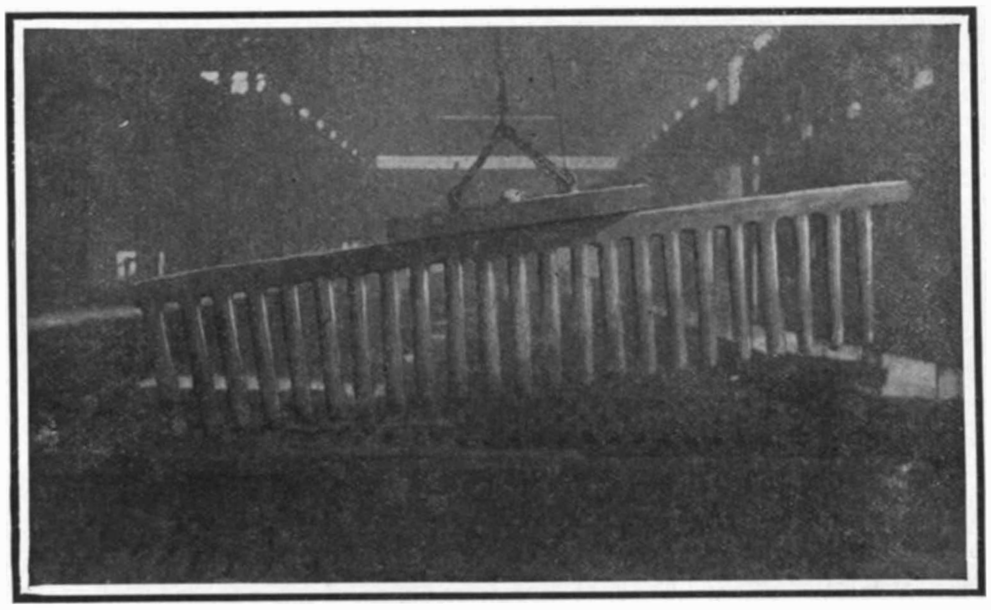
Another interesting sight is afforded in the lifting of a very long metal sheet by one magnet applied at the sheet's center. The ends of the sheet may dip down to an angle of 45 degrees, and still the sheet be held tightly by the magnet.

The use of the lifting magnet makes it possible to pile scrap iron in storage piles of unusual height with ease. It is not uncommon to see storage piles of this kind 25 feet high, and the work of piling is done with great rapidity. In loading from wagons to storage piles, the work of hours when done by hand is reduced to a few minutes by the use of the magnet.

With the 52-inch magnet previously referred to, 600 to 800 tons of scrap are easily handled in a day of twenty-four hours at an open-hearth furnace, even when four hours are allowed for delays. When thus operated day and night, the magnet takes the place of fourteen laborers. If operated with a specially fast crane, the amount handled is still further increased.

In the loading of charging boxes at the open-hearth furnaces the use of the magnet effects a notable economy. Even the small amount of material which falls outside the boxes is later picked up by the magnet, and in the cars it cleans up even the smallest chips and metal dust. The cost of handling melting stock used in these furnaces, both from cars to stock piles and from the piles themselves to the charging boxes, has been reduced from eight cents a ton with hand methods to two cents, and where handled only once, to less than one cent, where the magnet is used. Also at the blast furnace cast house the small metal particles known as "shot" are removed from the beds of sand by simply sweeping the magnet over the bed; otherwise, the sand would have to be riddled.

The magnet mentioned as the most powerful in the world is 60 inches in diameter and will handle "skull cracker balls" weighing 30,000 to 50,000 pounds.



Magnetically lifting a "sow and pigs" from sand in a blast furnace cast house.

Lifting six kegs of nails.

Magnet handling wire scrap.

THE INDUSTRIAL USE OF THE LIFTING MAGNET.

A Wireless Apparatus for Airships.

The latest invention for sending and receiving wireless messages is an outfit small enough to be carried and successfully operated aboard a dirigible airship. Such an apparatus has been perfected by the United States Signal Corps under the direction of Lieut. Lahm.

Ever since the Marconi wireless method came into existence, the U. S. Signal Corps has kept abreast with the science of transmitting and receiving messages through the air, and some time ago it perfected a wireless apparatus that weighed about two hundred pounds and could be transported on a packmule for field service. This was a great advance over the Morse system, where it was necessary to string wires and then restring them as the army progressed. With the advent of the airship, however, it became necessary to devise some means of wireless telegraphy to be installed on them, if such craft were to be successfully used in time of war. To this end Lieut. Lahm has been working with all his ingenuity for a long time.

His apparatus had to be made extremely light, for the weight-carrying capacity of the dirigible is limited. Then, too, provision had to be made to guard against the airship's catching fire from the sparks when the apparatus was in operation; besides, ground wires and receiving poles had to be considered. All of these obstacles were overcome, and the completed wireless outfit for airships weighs only seventy pounds, including the batteries necessary to work it. The whole apparatus is so compact, that it occupies only a space as large as a small steamer trunk.

To do away with the danger of the airship's catching fire from sparks, provision was made for confining the sparks in a wooden box and a glass case, so that there is absolutely no danger from that cause. The network of the wires which support the car of the airship, it was discovered, could be quite successfully used as the "ground" wires; and, instead of the very tall pole necessary on ground stations to catch the radiations when messages are sent and received, the simple expedient was adopted of dropping a wire some three hundred feet long from the airship, so that the waves instead of being caught above a station, are caught below. While such an apparatus seems like a mere toy, it has a working radius of ten miles.

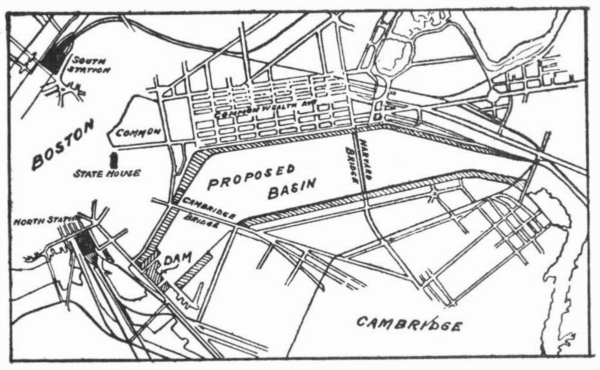
With all our scientific accuracy, we do not seem to be able to secure from the manufacturers of electric apparatus any idea of the time in which a motor running at full speed in one direction will reverse to full speed in the opposite direction. There ought to be some reason for that lack of knowledge. Such information would be very useful to engineers.

THE IMPROVEMENT OF THE CHARLES RIVER AT BOSTON, MASS.

BY EDWARD C. SHERMAN, ASSOC.M.AM.SOC.C.E.

The Charles River, after flowing about sixty miles in a very circuitous route through eastern Massachusetts, finally finds the ocean at Boston. In the early days of the Massachusetts colony it served as the principal highway of the region, and it was not until it had ceased to be useful as a highway that dams for the development of power were built across it. The tidal estuary of the river extends from its mouth at the United States navy yard at Boston Harbor to the Watertown dam, a distance of about seven miles.

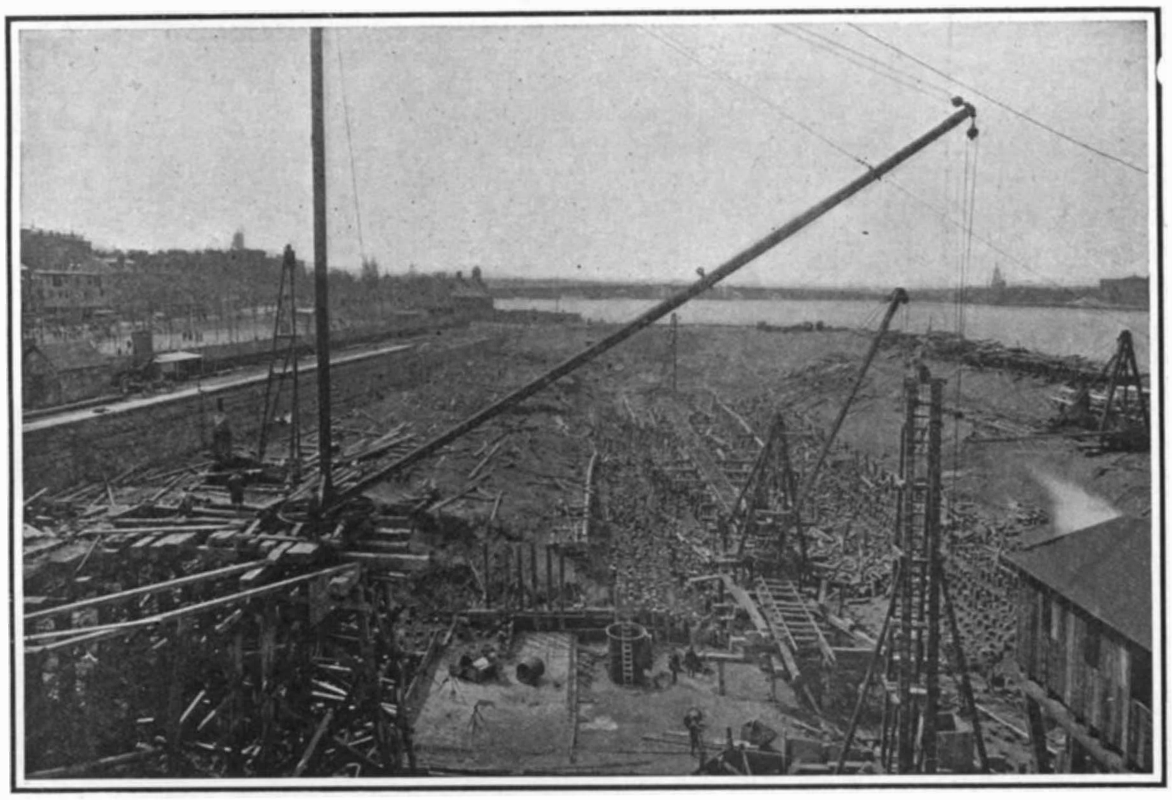
The sanitary condition of the basin, which received a considerable part of the sewage of Watertown, Cambridge, and Boston, began to attract attention a good many years ago; but it was not until the last decade of the nineteenth century that popular feeling began to be aroused, and the city of Cambridge began laying out and constructing an extensive park system along its side of the basin. Agitation for the construction of a dam to keep out the tides and to keep the offensive mud flats covered, first discussed nearly fifty years ago, was renewed, and reports favoring its construction were made to the Legislature in 1894 and 1896 by the combined boards of the Metropolitan Park Commission and the State Board of Health. It remained, however, for the able and exhaustive report of the Committee on the Charles River Dam in 1903 to convince the Legislature and the people of the sanitary need and æsthetic desirability of the dam, and in that year the Charles River Basin Commission was appointed and authorized to do the work. The site selected was that of the Craigie Bridge, a pile structure nearly one hundred years old, which was in such bad condition that it was on the point of falling into the river. It was decided to build a wide dam which would serve as a roadway across the river in place of the bridge, and which would provide an additional park, of great value to the crowded tenement districts which lie on both sides at this end of the basin. The bird's eye view of the dam, and of the river basin beyond, shows how these things were accomplished. A little way above the dam is seen the new three-million-dollar Cambridge Bridge, and farther up stream, the Harvard Bridge. The Charles being a navigable stream, it was not permissible to obstruct it until the lock was completed; and a lock was essential, since the basin is held at a constant level about 7½ feet above mean low water, while the tidal range is about ten feet. This makes it necessary for vessels at low tide to lock up, and at high tide to lock down into the basin. The lock is built of concrete, resting on spruce piles, of which a veritable forest was driven through the soft silt of the river bottom into the firm hardpan underlying it. An idea of this inverted forest may be gained from the illustration, which shows the excavation inside the coffer-dam within which the lock was built a few weeks after concrete was first placed. Most locks are required to hold back water in only one direction, and consequently the so-called mitering gates, swinging on hinges like enormous doors, may be used. But this Charles River lock is obliged at high tide to keep out the ocean, and at low tide to retain the fresh water in the basin, so that gates of a type new to the United States were designed. They are rolling caisson gates, that is, each gate is a big hollow steel caisson mounted on trucks, which is opened by rolling it on steel rails back into a recess in the lock wall. One of these gates in place weighs 325,000 pounds, and its design involved problems that would be met with in designing a bridge, a steel car, and a battleship.



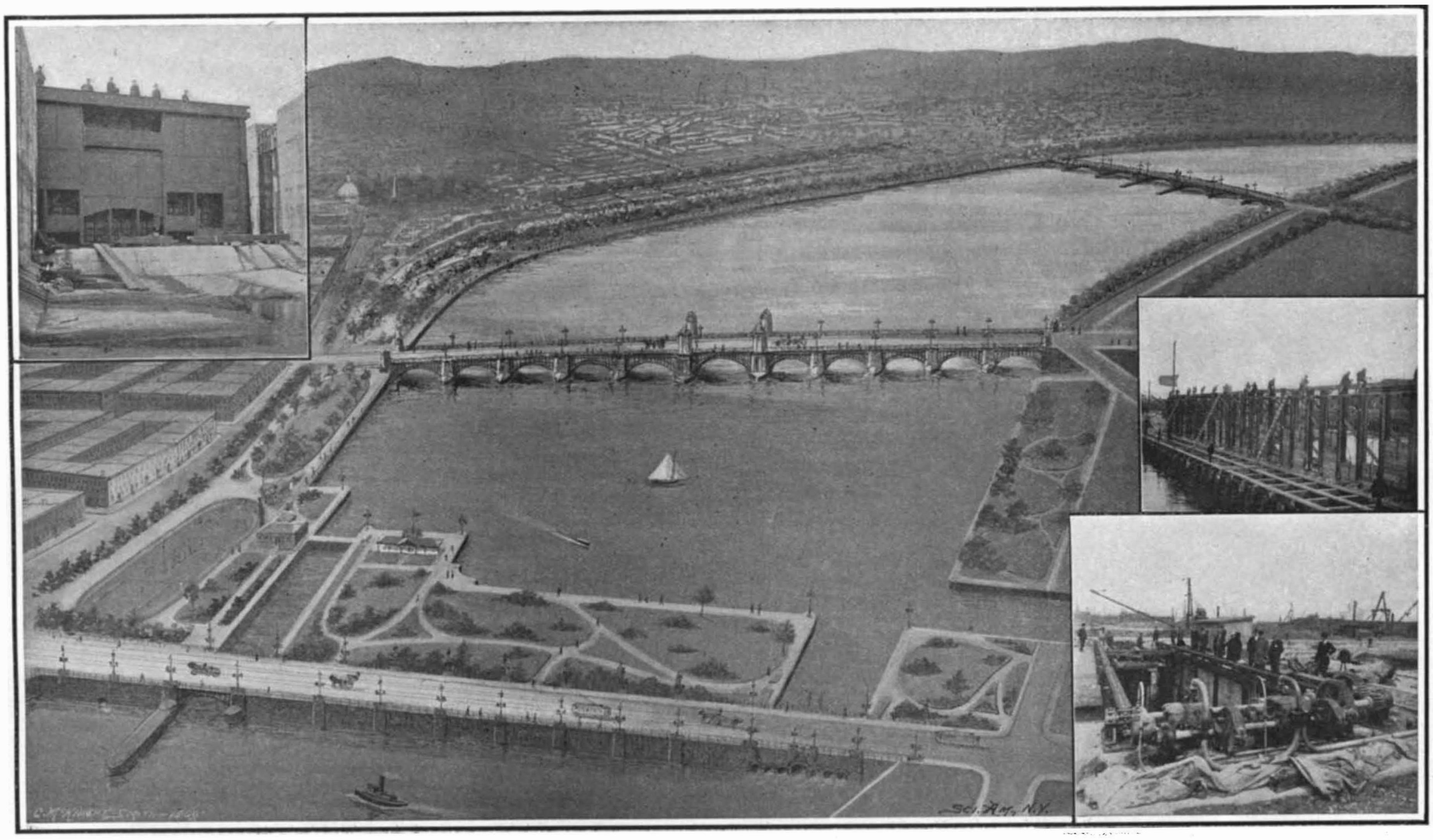
Plan showing location of the Charles River basin.

One of the most interesting features of these gates is the chamber around each of the trucks on which the gate moves. This chamber is open at the bottom, but air tight at the top, and acts on the principle of a diving bell. The space is such that a man may stand between the axles of the truck some 25 feet below the level of the water outside the gate, and the air pressure in the chamber being sufficient to keep the water from flowing in from underneath, he may walk with the gate as it is moved slowly along, and be in a position to clean or inspect the track over the whole course. The gates may be used as enormous sluice-gates if necessary, being opened enough to draw the basin down in time of flood, if by any chance the regular sluiceways should be insufficient. In that case the pressure on one of the front bearings, which are set in the lock masonry, might be 560,000 pounds.

The operating machinery for one of these gates, which may be called upon to pull it open under some head, can exert a pull on



Foundations of lock.



Upper lock gate. **Charles River dam and basin.** **Closing shut-off dam.** **Lock gate machinery.**

THE IMPROVEMENT OF THE CHARLES RIVER AT BOSTON.

the operating chains greater than the tractive force of the largest and most powerful freight locomotive used on the Boston & Maine Railroad. Each machine consists of two 50-horse-power electric motors, with a train of gears transmitting their power into two endless chains working over sprocket wheels. The gate is attached to the chains by a whiffletree, or equalizing beam, and moves in or out of the recess according to the direction of rotation given to the motors.

The lock is filled and emptied by means of bronze-mounted iron sluice-gates, electrically driven, which are mounted upon the lock-gates. These filling gates are readily seen in the illustration, which shows the upper lock-gate, the smaller of the two, as it looked from inside the lock before any water had been let in.

The whole operation of the lock is controlled from a room in the top of the tower of the house over the downstream lock-gate recess. Electric gages show the operator, at a glance, the water levels in the basin, the lock, and the harbor, and indicate to him at once what gates may be moved. Throwing a switch opens or closes the filling gates, while glowing lamps tell him when they are in the desired position. The drawbridge is raised or lowered and the lock-gates are moved by the manipulation of electric controllers of ingenious design. All of this apparatus is so interlocked and protected by automatic limit switches and cutouts as to be practically "fool proof."

While the lock was being constructed at the Boston side of the river, the "sluices" were being built at the Cambridge side in a much smaller and more shallow coffer-dam. These sluices form the outlet for the river, and are of sufficient size to carry off a larger storm flow than has yet been recorded. Each is provided with a positive sluice-gate, electrically operated, which will always be closed when the tide is higher than the established basin level, and opened at low tide sufficiently to keep the water in the basin drawn down to that level. There are eight sluices, each 7½ feet by 10 feet, four on each side of a larger passageway, which is designed to serve as a lock for small boats, for which it would not be desirable to operate the big lock.

The tidal range at Boston averages about ten feet, and twice every day 2,416,000,000 gallons of salt water flowed from the harbor into the basin and out again. With this enormous quantity of water ebbing and flowing, it was impossible to deposit the earth to form the dam and have it remain in place, so that a shut-off dam, which could be closed all at one time, had first to be constructed. This dam shows in the larger bird's eye view, extending from the lock in the foreground to the sluices on the other side of the river.

As soon as the lock was completed so that vessels might pass through it, all river traffic was transferred thereto from the old channel. Then, across the river, bents of piles were driven and braced, and a line of 6-inch yellow pine sheeting was driven between the coffer-dams in which the lock and the sluices had been built, forming a solid timber wall clear across the river. This sheeting was cut off, as fast as driven, at about 3½ feet below mean low-tide level. The lock and the sluices were left wide open during this construction, so as to relieve the shut-off dam as much as possible by allowing the tidal currents to pass through them. The sheeting was cut off as evenly as possible, so as to make a close joint with the gates which, as an additional precaution, had a piece of rubber hose nailed to the bottom edge.

On October 20, 1908, at a signal from Governor Guild, the ropes holding the gates were cut, and seven seconds later they were all in place. The wedges for holding them down were then driven, and a few minutes later a large number of dredges were busy heaping earth against the structure. While the work at the dam was progressing, the new Boston Embankment, extending about 1½ miles upstream from the new Cambridge Bridge, was being built. It varies in width from 100 to 300 feet. Before it was begun, and before the dam prevented the mud flats from being exposed at low tide, the river bank was most unsightly. Even in the Back Bay region, where live many of the oldest and proudest families of the Old Bay State, the shore of the river was disgraceful.

This is all being changed, and in a few years, when trees have grown, the beauties of the Embankment will excel those of the Charlesbank, which was built many years ago.

Mention has been made of the sewage which formerly found its way into the river. Most of this is now discharged elsewhere, but still in times of heavy storm, when the sewers have been filled to their utmost capacities, some overflows have poured their sewage into the river. It was feared that when the basin had become a fresh-water lake, even this diluted discharge might be objectionable and unsanitary, and to avoid the danger which pollution would bring, marginal conduits have been built on both shores to take the surplus into tidewater below the dam.

All of the masonry structures required for this improvement of the Charles River have had to be built on piles, and many acres of forest have been called upon to furnish them. Could all the piles used in the work be laid end to end they would extend 100 miles, and the sheet piling used would have sufficed to build a plank walk one inch thick and two feet wide from Boston to Worcester.

With the tidal currents stopped, the water in the basin is gradually becoming fresh. In the midst of a great city is a lake where skating and ice-boating may be enjoyed in winter, and on whose waters will soon float one of the largest fleets of motor boats in the world. The work is being carried out under Mr. Hiram A. Miller, M.Am.Soc.C.E., as chief engineer.

A SENSITIVE THERMOMETER.

BY PROF. S. A. MITCHELL, COLUMBIA UNIVERSITY.

The delicate researches carried out in the science of physics have demanded an exceedingly sensitive instrument to measure small quantities of heat. The most accurate thermometers at present in use can hardly be relied upon to more than one-hundredth of a degree, an accuracy sufficient for most chemical experiments, but not satisfactory for the more refined physical investigations. There are many methods used for determining temperatures which differ in principle and in the accuracy attained. In measures of a line on the earth's surface, such as are carried out by the United States Coast and Geodetic Survey, where it is desired to know the length of a base accurately to about one part in a million, it is necessary to know the exact lengths of the measuring bars, and these have been determined with great precision, by combining together two rods of different metals, as zinc and iron, and finding the temperature by measuring their differential expansion. This, however, is more for the purpose of determining the average temperature throughout the measuring bars than an attempt to increase the accuracy of the temperature determination. Degrees of heat are thus measured by the expansion of the mercury and its measurement in a glass tube, or by the increase in the length of one rod over the other.

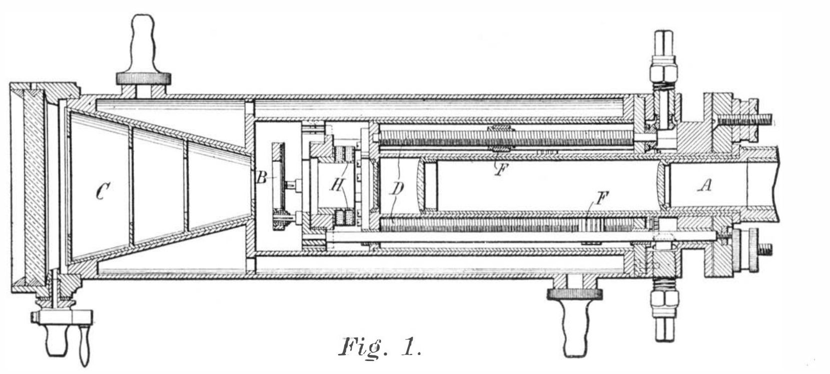


Fig. 1.

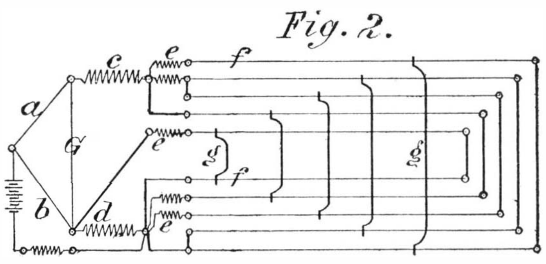


Fig. 2.

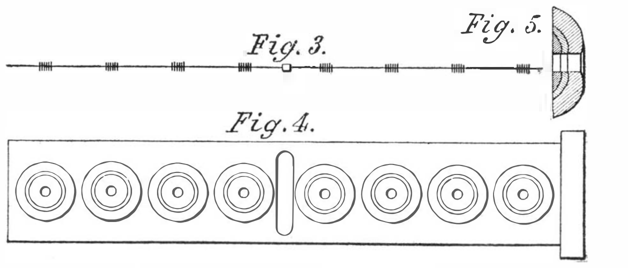


Fig. 3. Fig. 4. Fig. 5.

A SENSITIVE THERMOMETER.

A totally different principle for measuring the amount of heat is that involved in the thermopile. This consists of a pile of plates of bismuth and antimony, insulated from one another and joined up to a galvanometer. When heat strikes the thermopile it alters the resistance offered to an electrical current passing through it, and this change of resistance is measured by the galvanometer. The thermopile surpasses the thermometer a hundredfold in the accuracy of measures of small quantities of heat.

Still another method is that involved in the radiometer, which all are familiar with in opticians' show windows; the small vanes blackened on one side, inclosed in a glass case exhausted to a partial vacuum, persist in rotating as long as the sun's rays fall upon them. Though ordinarily considered merely as a toy, the radiometer in skilled hands becomes a much more refined thermometer even than the thermopile. Prof. Ernest Fox Nichols of Columbia University has been able to detect and measure differences of temperature as small as one-millionth part of a single degree, or even more accurate than that, to the ten-millionth part of a degree! Such accuracy is sufficient for most physical investigations. To attain this degree of sensitiveness, it is necessary to make the vanes exceedingly small and light and suspend them on a fine delicate quartz fiber.

The only instrument for the measurement of heat more sensitive than the radiometer is the bolometer, the invention of the late Prof. Langley. In his hands and in those of Prof. C. G. Abbot, the director of the Atrophysical Observatory at Washington, the bolometer has been brought to a very high degree of refinement, and with it many exact observations have been made, one of the most important of which is the measurement of the heat of the solar corona at the recent eclipse of the sun on January 3, 1908. As is well known, the bolometer consists of a thin metal strip or strips forming part of a Wheatstone bridge, for the electric balance of which a very sensitive galvanometer is used. By decreasing the sensitiveness of the galvanometer, the bolometer as a measurer of heat has been made more and more delicate, till at the present time it is possible to divide down to the one-hundred-millionth part of a single degree, or in other words to measure the heat of an ordinary candle at the distance of four miles! But it is a far cry from the first invention by Prof. Langley in 1880 to the finished product of Prof. Abbot. If the bolometer had been a commercial enterprise, the splendid improvements in it would have been cornered by a long list of patents; but in scientific work all comers are permitted to emulate and copy as they please.

The complete bolometric apparatus consists of three separate parts: The bolometer proper, the resistance for balancing the Wheatstone bridge, and the galvanometer. In order to procure a metal strip thin enough for use in the bolometer, a piece of silver-coated platinum wire is drawn fine and hammered to the desired dimensions; the silver is then removed by nitric acid and the naked platinum strip carefully soldered upon its copper frame. The strip used is about half an inch long, 1/400 inch wide, with a thickness one-fourth its width! For the sake of symmetry, a second strip of platinum as nearly as possible like the first is used to one side of the absorbing strip, but shielded from the radiation by a diaphragm. This forms the second arm of the Wheatstone bridge. Two coils of wire joined with the two bolometer strips and the battery circuit form the third or fourth arms of the bridge. Measures are made by balancing up the current as it flows through the separate arms of the Wheatstone bridge, and then noting the deflection of the galvanometer needle when the heat to be measured falls on one of the bolometer strips.

Those who have ever used a galvanometer to measure an electrical current know the difficulties involved in causing the needle to remain quiet or in "balance." When the sensitiveness of the galvanometer is highly increased, these difficulties multiply, but in spite of this, Prof. Abbot has devised and made a wonderfully remarkable set of resistance wires for balancing the galvanometer. All are included in a cylindrical case shown in Fig. 1, three inches in diameter and fifteen inches long. The energy from the source under investigation enters through the left end, and after passing through diaphragms in the conical piece *C*, falls on the bolometer strip at *B*. These two strips are joined up electrically with coils placed at *H*, and these in turn with wires forming part of the slide wire resistances. (The detailed scheme of these wires is shown in Fig. 2.) Sliders *F* work on screws *D* turned from without. The arrangement for two out of the five slide wires is shown in Fig. 1. Small keys fitted on the outside make it possible to turn the sliders quickly from one end of their run to the other. The galvanometer (shown at *G* in Fig. 2) is always balanced by the use of the first three slide wires. A glass plate at the left of the figure and another between *D* and *H* makes it possible to have the bolometer strips in a vacuum, by exhausting the air through a cock seen at the left below. Water may be circulated around the coils. Thus they may be kept at a constant temperature by joining up with two cocks shown one above, the other below. An eyepiece may be inserted at *A*, so as to examine visually the source of energy, such as a star, which is focused on the bolometer strip *B*. With this, the exceedingly tedious operation of balancing is rendered very simple and rapid, and the whole process is at all times under the perfect control of the observer. This simplified balancing apparatus is one of the best of the many improvements devised by Prof. Abbot. The galvanometer ordinarily used is a modified Thomson reflecting instrument consisting of 48 magnets arranged in eight groups of six each, shown in Fig. 3, and with sixteen coils as in Fig. 4, the arrangement for each coil being as in Fig. 5. On the glass stem carrying the 48 magnets there is a small mirror. The whole system is very light and weighs no more than 10 milligrammes. With atmospheric pressure in the bolometer case, a deflection of 1 millimeter on a scale at a distance of 1 meter is produced by a current of 5×10^{-9} ampere. With the air exhausted to 0.2 millimeter pressure, a current of $2 \times 10^{-12} \left(\frac{2}{1,000,000,000,000} \right)$ ampere can be recognized with certainty. Such a galvanometer was used by Prof. Abbot and the writer in a recent attempt to measure the heat of stars.

To measure the heat of the solar corona at the total eclipse of 1908, a bolometer was mounted at the focus of a concave mirror 20 inches in diameter and only 40 inches in focal length. A glass plate three millimeters thick was fixed close to the bolometer between it and the mirror so as to limit the radiator to waves less than 3μ in length. About 4 inches in front of the bolometer was a self-closing blackened metal shelter so that the bolometer was exposed to radiation only when this shelter was open, and between this shelter and close to the glass plate was a special screen of thin asphaltum varnish which, when interposed in the beam of light, cut off nearly all the visible part of the radiation, while transmitting nearly all of the infra-red rays that can pass through glass. The bolometric apparatus was carefully set up on Flint Island in the Southern Pacific by Prof. Abbot and was in perfect adjustment on the day of the eclipse. Many improvements were made over the apparatus used in 1900 at the eclipse at Wadesboro, N. C., chief among which were that one mirror replaced seven, that radiations were limited to those transmissible by glass, and that a direct means was at hand for comparing the radiations from the sun, sky, and corona.

In the SCIENTIFIC AMERICAN July 25, 1908, was shown how nearly the observers came to adding another disappointment to the already long list of eclipse failures through clouds coming at an inopportune moment. For fifteen seconds before totality it was raining. In spite of the nerve-racking moments of preparation, Prof. Abbot's measures with the bolometer were beautifully carried out, with the following interesting results, where the radiations are compared with that of the noon-day sun. On the same scale where the strength of the solar heat is the large number 10,000,000, that of the moon (i. e., reflected solar radiation) is only 12; or in other words, the sun shines with an intensity 800,000 times that of the moon. Again, on the same scale, the intensity of the corona at 1.5 millimeter from the sun's limb is represented by 13, at 4 millimeters from the limb by 4, and at 12 millimeters no deflection whatever was recorded by the galvanometer, i. e., the corona has no measurable intensity. (Zero intensity was likewise observed from the middle of the moon during the eclipse.) From these figures it appears that the corona of 1908 equaled only the moon in brightness—the most brilliant part of the inner corona, and that this brightness decreased very rapidly.

These measures are most exceedingly interesting to the astronomer, and taken with other observations of the corona lead us a step nearer to solving the mystery of the beautiful crown of glory about the sun which can be seen only in the few fleeting moments of a total eclipse. What have we already found out concerning the corona? First, the spectroscope shows the bright "coronium" lines which indicate that the corona in part consists of an incandescent gas; second, the spectrum also shows the dark Fraunhofer lines, and accordingly the corona consists in part of matter in a finely divided solid or liquid state which can reflect ordinary sunlight. The corona, for some reason or other, assumes different shapes which depend on the number of spots on the sun, being square when spots are at a maximum, but with a long fish tail on either side of the sun's diameter when spots are at a minimum. What is the meaning of this connection between spots and corona? At the eclipse of 1901, Perrine found a big disturbance in the corona immediately above a large sun-spot, and a long thread-like prominence emanating from the same region. What is the explanation? The Swedish scientist Arrhenius explains these matters by assuming that the corona is an electro-magnetic manifestation, and that the sun's rays exert a pressure on the finely divided matter of which the corona is composed, with the result that the small electrified particles are driven away from the sun, forming the corona. (This same theory explains the formation of comets' tails, and the aurora borealis.) It is a most beautiful theory, and one which we are ready to accept as soon as it is based on the solid truth of observational facts. But such a time has not as yet come. With our present knowledge, how are we best to explain the action of the corona of the sun so as not to take too much for granted? The observed facts discovered by the spectroscope together with the newer measures of the corona obtained by Prof. Abbot lead him to believe that the brightness of the corona is due mainly to the reflection of ordinary sun rays by matter close to the sun modified to some extent, however, by radiation of incandescence and perhaps also luminescence.

Correspondence.

MR. LARSEN'S PHOTOGRAPHS OF LIGHTNING.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 12 there appeared an article by Mr. James Cooke Mills, describing certain experiments made under the auspices of the Smithsonian Institution by Mr. Axel Larsen. As the impression is given in this article that many new facts have been ascertained from these experiments, I cannot let it pass without a word of protest. In the first place, lightning has been photographed with a moving camera, and the multiple nature of the discharge shown many times in past years; the dark flashes have been photographed almost from time immemorial, and the spectrum of lightning was secured by Prof. Pickering several years ago.

The cause of the dark flash has been known for the past ten years. Mr. Clayden showed that feeble flashes always came out dark on the plate if the plate was subsequently fogged by a feeble light of any sort. This light usually comes from the clouds illuminated by other flashes, or in some cases from a faint twilight sky. Mr. Clayden obtained the effect in the laboratory with electric sparks. If the fog is produced before the spark is impressed, no reversal takes place. The theory advanced in Mr. Mill's article, that the dark flash emits very short wave lengths, which decrease the sensibility of the plate, is absolutely false. There is nothing peculiar about the light from lightning except the brevity of its duration. A very brief flash of sunlight impressed upon a photographic plate, which is subsequently fogged by feeble candle light, will come out dark, as I showed nine years ago. I made at the time a rather extensive investigation of the Clayden effect, and found that it was due to the fact that an intense light of very brief duration, a light shock I called it, decreases the sensibility of the photographic plate. Reversals were obtained with shocks of as long duration as 1/1000 of a second, though in this case the intensity of the fogging light and the time of development had to be very carefully regulated. With shocks of a duration of 1/10,000 of a second, reversals could be obtained without difficulty. A full description of the experiments can be found in the Astro-physical Journal for June, 1903; still earlier experiments in the Journal of the Philadelphia Photography Society, November 8, 1899. R. W. WOOD.

Johns Hopkins University, Baltimore, Md.

THAT AEROLITE AGAIN.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 7 last appeared a letter from myself giving an account of the supposed flight of a great meteor over the section of Tennessee lying between Tullahoma and Altamont or Beersheba in the eastern part of the middle section of the State—which occurrence happened at 10 o'clock A. M., September 8. The noise and vibration caused by the flight of the meteor were so great, and were noted over such a wide territory, that the matter was deemed by me and others to be worthy of being noticed in the press, especially as such notice might lead to the discovery of fragments of the meteor, in case any of them reached the earth.

In your issue of November 28, E. B. Hoyte, in a letter dated November 14, Nashville, says among other things: "He" (myself) "declares that from his position the crash of the impact was as a great explosion of dynamite accompanied by a slight vibration of the earth." And again, "I find that on September 8, at about 10 A. M., a shipment of dynamite was exploded at Wartrace, Tenn., on the N. C. & St. L. Railway"—which was near Estill Springs, where I was at the time.

A reference to my communication will show that I did not say that the sound was that of an explosion of dynamite. I did not express that opinion, but only said that, among the many causes (indicated) by different persons, some thought at the time that there had been an explosion of a shipment of dynamite. I did not myself think anything of the kind, and did not say that I did. Persons came to and fro from Wartrace to Estill, and no one spoke of such an explosion. I think I can safely say that no explosion of a shipment of dynamite took place at Wartrace, or at any other point within at least fifty miles, or indeed in the State.

I took the trouble last week to make sure on this point, and, among other things, wrote to the postmaster at Wartrace. I inclose to you his reply, in which he says that no such explosion has taken place.

In your issue of December 12, a letter signed A. M. Button, dated Waterford, N. Y., says that he, Mr. Button, was at Winchester, Tenn. (near Estill Springs and Tullahoma) on September 8, and at 10 A. M. that day saw what appeared to be a large pyramid of yellowish white flame passing with great speed high up in the sky, followed by a sound such as I described.

I will add that soon after I wrote my original letter to you, I learned that at least a dozen reliable men in that vicinity, whose names I heard, reported that they saw the object very much as Mr. Button describes it.

PARK MARSHALL.

Nashville, Tenn., December 25, 1908.

ARE FILTERING BEDS CORRECTLY CONSTRUCTED?

To the Editor of the SCIENTIFIC AMERICAN:

I do not believe that you can expect very much from a person who says: "I have never studied engineering in any of its branches, but I believe that our engineers are entirely wrong upon a subject which has been studied for years and years, and upon which millions of dollars have been expended." For this person to be right and the engineers wrong is certainly against the rule. I therefore expect to be corrected, and ask you and those of your readers qualified to give an opinion on the subject to kindly point out wherein I am mistaken in my ideas, and I thank them in advance for the same.

The question is: Are our filtering beds constructed correctly or on correct principles? I believe they are not, and these are my reasons, and also a possible remedy:

The object for which filtering beds are constructed is to furnish pure water, and not to obtain all the foreign matter held in suspension by the water, and then when you have obtained the same, to know that you have something that you absolutely do not want and some pure water. As far as I know, and in a general way, filtering beds are constructed by placing conducting pipe having broken joints on the bottom of a reservoir, or by covering them with some suitable material having perforations, and upon this layers of broken stone of large size, broken stone of smaller size, gravel, coarse sand, and lastly a bed of fine sharp sand. These several layers to be about one foot in depth, but the last one from three to five feet. Water having foreign matter in suspension is pumped upon this bed and allowed to pass through, and the water then used for final distribution through the city's mains. When one portion of water has passed through another is pumped on, and so on until the surface of the bed becomes clogged or choked up from the foreign matter held in suspension, and which has accumulated from day to day for a variable time, according to the condition of the water. The surface of the bed is then scraped off, and either washed and replaced or is replaced with entirely new sand. This bed certainly catches all the foreign matter held in suspension, and if this was the object for which it was constructed, it would work to perfection; but as the object is to furnish pure water, it does not furnish all the pure water, but only a portion. The object is to furnish all the pure water, and no foreign matter or dirt. The water placed upon the filtering bed must pass through the same; there is no other outlet. Now, if the water could pass through the filtering bed, and at the same time have an outlet for the foreign matter held in suspension, then there would be no accumulation of foreign matter.

Therefore, as a remedy I would suggest that instead of building a reservoir and placing conducting pipe on the bottom thereof, the conducting pipe be placed directly on the bottom of the source of supply, be it lake, river, or whatever, and then cover them in the same manner as described above. Then the water would pass through the filtering bed just the same, and the foreign matter held in suspension would follow the lines of least resistance, and flow over the filtering bed. In this way there would be no accumulation of foreign matter held in suspension, and it would not have to be removed from time to time. You would obtain all the pure water and none of the foreign matter held in suspension, for which you have no earthly use any way unless it was as a fertilizer, and then it would be a mighty expensive article. There would be no trouble caused by the ice in winter, and would therefore not require covering or housing. Nor would there be as much wear and tear on the valves of the pumps caused by the sand and other matter. In the cost of construction there would be no expense for the land on which the filtering bed is located, in itself a large item in many cases. Neither would it cost anything for paving the bottom and the sides and the retaining walls. Nor would it cost as much to place the several layers of stone, etc., in place in the lake or river as it would if placed in a reservoir on the land. The size of the filtering bed I would suggest to be proportioned for every million gallons of water to be used every twenty-four hours, to be one acre of surface. This would cause a flow through the filtering bed at the rate of about one yard a day. When the current in the lake or river is only one mile a day, the proportion in the flow would be one to seventeen hundred, that is, the water would flow one thousand seven hundred times faster over the filter than through the filter, and where this was the case, there would surely be no depositing of foreign matter on the filter, at least I so do think it. Now, if I am right in my ideas, there is no reason whatever why all the cities in the United States, and all over the world for that matter, located on the shores of our many lakes and on the banks of our rivers, could not have all the pure water they wanted at a cost no greater than that of the mere pumping of the same, and in some cases not even as much; that is, filtered water could be had for less money than it would cost to pump unfiltered water, of course not considering the first cost of installation.

It is only upon the ground that exceptions prove the rule that I venture to make the foregoing statement, and I hope that in rendering judgment, my judges be not unmindful of leniency and mercy.

PAUL F. BUSSMAN, M.D.

Buffalo, N. Y., December 24, 1908.

[You suggest that by placing filter beds (underlaid by the usual outlets) "directly on the bottom of the source of supply, be it lake, river, or whatever," the clear water would pass out just the same, and the foreign matter would be held in suspension and "*flow over*" the filter beds. Now, the foreign matter eliminated by filter beds is largely so light and impalpable that it would be little affected by flow; and if there were enough current for water to pass through the beds, *some* foreign matter would be retained in them. Your speaking of "flow," however, presupposes a current, and does not mention what would happen in the case of a lake with *no* current. In this case surely the action of the filter beds would be exactly the same as in reservoirs, with the exception that after the cost of draining a lake in order to lay conduits and filters in its bed, the same expensive process would have to be gone through to change the filtering material. In the case of a river, supposing the flow to retard the deposition of foreign matter, the filters must necessarily be placed in a deep and consequently fairly still part, exactly where detritus from the banks brought down by every flood would accumulate, rapidly choking the filter. The whole point, however, is that your principal object seems to be to prevent the accumulation of foreign matter in the filter beds; and if the filtering material does *not* catch and accumulate foreign matter, what is the object of having it at all?—ED.]

The Great Drydock at Pearl Harbor, Hawaii.

BY ELMER MURPHY.

The drydock at the naval station, Pearl Harbor, Hawaii, is to be the largest ever constructed by the Navy Department. Its over-all length is 1,195 feet, whereas the longest dock previously constructed, which is at Philadelphia, is 799 feet over all, and the Puget Sound drydock, recently contracted for, is 863 feet over all.

The width between coping will be 130 feet, and the depth over flue blocks at mean high water, 32½ feet. An innovation, so far as American docks are concerned, is that there will be four caisson seats, two, as usual, at the entrance to the drydock and two others near the middle of the dock, dividing the main structure into an inner and outer dock. There will be two steel caisson gates, and the arrangements will be such that, with a ship in the inner dock, the outer dock may be filled and emptied independently, thus allowing the ship upon which the most extensive repairs are to be made to remain in the inner dock, while ships with minor repairs are being docked in rapid succession in the outer dock. By floating the inner caisson from the drydock, ships of greater length than any now in existence or planned could be docked. A trapezoidal form of head has been designed for this dock, different from any hitherto considered. It is arranged so that three destroyers may be docked side by side, extending to the very head end of the dock, and leaving room for three other small craft in the inner dock.

The draft over sills at mean high water will be 35 feet, which is more than any other dock excepting the one at Puget Sound, where the great variation in tides required a draft of 38 feet. The conditions of depth at Pearl Harbor are such that the largest battleship may enter the dock at any stage of the tide. Concrete will be used throughout in the walls and floor. Granite lining will be used only at the caisson seats, at the coping at entrance and at the material slides. The conditions for the use of concrete are believed to be more favorable at Pearl Harbor than at any point in the United States, on account of the equable climate and absence of frost.

A marked improvement over all previous docks has been developed in connection with the dock for Pearl Harbor, in that the working floor will be absolutely level from end to end, giving a level working surface, free from the usual obstructions, such as bilge block slides, docking keel-block bearers, bilge-block chains, temporary electric wires, temporary compressed-air lines, etc. The attempt has been made many times previously to accomplish this object, but never with success. It has been accomplished in this case by an entirely new design for bilge-block bearers and docking keel-block bearers. The bearers are made in the shape of cast-iron boxes imbedded in the dock floor, with top flush with the concrete. The wide flanges on the top form the bearers for the keel blocks and bilge blocks, and a slot is provided through the top of the box to take the anchor bolts for the keel blocks and the holding-down device for the bilge blocks. The cast-iron box is large enough also to take the chains for the hauling of bilge blocks across the floor of the dock while a ship is being placed. Another most important function of the cast-iron boxes is to drain the floor. The water passes through the slots, and flows along the sloping bottom of the boxes, and is discharged into four large longitudinal sub-floor drains. These, in turn, carry the water into the drainage chambers near the middle of the dock. The inner dock and outer dock each have an independent system of longitudinal drains and a drainage chamber. Three 54-inch pipes with gate valve pass from each drainage chamber into a common wet chamber outside of the drydock structure. The four 54-inch suction pipes from the pump well, which is close by, open into the wet chamber, thus removing water which flows in from either one or both of the drydocks. The slots, cast-iron boxes, and drains have been so designed that the velocity of water while being pumped will be sufficient to remove any silt which may have collected.

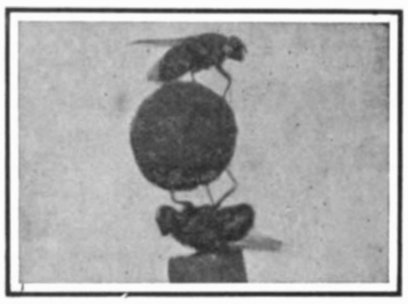
The system of cast-iron boxes with slots and longitudinal floor drains will also be used for filling the dock. Four filling culverts, two on each side of the drydock, having inlets in the quay wall at the entrance of the dock, are connected with the longitudinal drains in the inner and outer docks in such a manner that either dock may be filled independently of the other. The water will be discharged into the dock body through the slots, having thus an upward velocity on entering and being uniformly distributed over the entire floor. This is much superior to having the water enter at the ends or sides with a velocity sufficient to cause harmful movements of the ship. Sixteen flights of stairs extend from the coping to the floor. This number is liberal, in order that the workmen may enter and leave the drydock with expedition. There will be 539 keel blocks, extending from the entrance to the head of the drydock. These are for the purpose of carrying the weight of the ship when the dock is pumped. Two lines of docking keel blocks will extend on either side of these to take the weight of turrets, etc., of battleships. The pump well will be located near the middle of the dock and about 30 feet away. It will be of octagonal shape, and will contain four 54-inch pumps.

A track for a 40-ton crane will be built around the drydock structure, with the inner rail close to the edge of the coping. The total length of the rails in this track will be within a few feet of one mile. The construction of the dock will necessitate the disposal of 350,000 cubic yards of material. This will be utilized in filling some of the low areas on the station property. The depth of the excavation will be 58.5 feet. This is more than the height of an ordinary four-story building. The total amount of concrete to be used in the dock is approximately 120,000 cubic yards.

THE PHYSICAL ENERGY OF THE HOUSE-FLY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

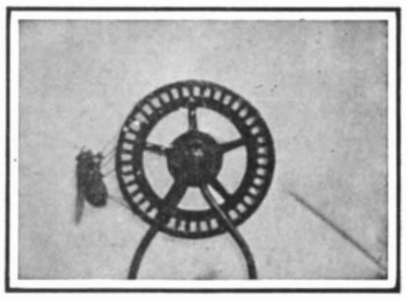
Mr. Frank P. Smith, a member of the Quekett Microscopical Club, has added to our knowledge of the fly by a series of highly interesting moving-picture films,



Bluebottle fly balancing a cork ball upon which another fly is simultaneously preserving its balance.

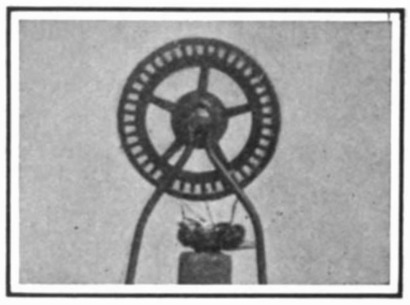
which pictorially give some idea of the highly-developed organism and the physical energy of the common house-fly.

Although Mr. Smith makes no claim to being able to train the domestic fly, yet at the same time he has



A fly walking up a revolving wheel.

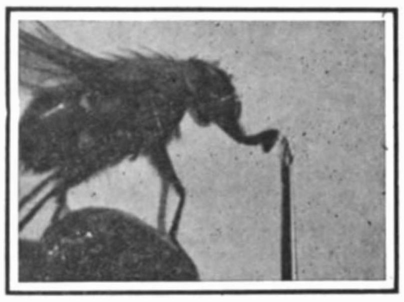
succeeded, as the accompanying illustrations testify, in causing it to accomplish some curious evolutions—a result due not so much to any development of intelligence as to the deception of the insect. The flies used for the purpose of chronophotographic investiga-



Bluebottle fly turning a revolving wheel.

tion were especially bred and reared to secure large, clean, newly-merged insects.

Flies and kindred insects are equipped with a highly-developed breathing apparatus. Instead of depending upon a single tracheal tube, as do human beings and



Eating honey from a pin held in the hand.

THE PHYSICAL ENERGY OF THE HOUSE-FLY.

animals, for the inhalation of air, these insects are provided with a complex network of passages extending to all parts of the body. The outcome of this arrangement is a very rapid oxygenation of the blood fluid, with an attendant enormous development of physical energy.

To demonstrate the extent of this development, a series of popular photographs were secured, some of which are of a humorous character. The species illustrated is the familiar domestic bluebottle, which, because of its size, is more particularly suited to the purpose. In one case the fly is seen lying on its back or seated in a diminutive chair, supported or held in position by a thin band of silk passed round its waist. In this position it held and played, or juggled, with a number of articles of relatively large size, such as small dumb-bells and weights, or nursed a smaller fly without any apparent effort. A certain degree of restraint was imposed, but in the case of revolving the small wheel, the insect was allowed complete freedom. In order to revolve the wheel, the fly was made to try to walk along its periphery. An ingenious device was prepared, the object being to cause it to desist from its natural inclination to fly, and to induce it to walk up the side of the wheel. A dark box was fitted with a small door of very thin glass attached to an escapement similar to that of a pendulum clock. When the fly was first imprisoned in the box, it instantly attempted to effect an escape through the glass door with a frantic buzz. Every time it struck the glass it received a slight tap on the head from the escapement. At first such results only increased its fury, but in a short while, owing to the continued tappings upon its head, it would become more tractable. Finally, instead of attempting to escape by flying, it would make an effort to achieve its object by walking up the wheel. While in this tractable condition the photographs were secured. The entomologist, however, found it quite impossible to depend upon the results of the incarceration in the box, since very often a fly that had been under instruction for several days, upon removal to the wheel outside immediately took advantage of its liberty and flew away.

In another instance the fly is shown lying on its back supporting and turning or juggling a ball three or four times its bulk, upon the upper side of which is another fly, which also maintains its balance upon the moving spherical surface. This action, as well as that of turning the wheel, Mr. Smith attributes to the insect's illusion that it is really walking upon a fixed surface. In another instance the fly is shown merely balancing a cork ball. It is noticeable in these various accomplishments that the fly brings its wonderful proboscis into play for the purpose of guiding and partially of preserving the balances of the various moving substances. This is strikingly shown in the case where one bluebottle prone on its back is supporting another balanced acrobatically upon its upturned legs.

The Current Supplement.

Erichsen's tragic Greenland expedition is made the subject of a handsomely illustrated article which opens the current Supplement, No. 1727. Major George O. Squier contributes an article on ships in air and water, and shows the general relations between the two. Franklin Van Winkle in an article entitled "Pressure of the Atmosphere on Liquids" writes on the conditions of equilibrium in liquids of the same and different densities. The psychogalvanic reflex is a peculiar physical manifestation of mental processes in the form of a change in the electrical properties of the skin. This change occurs whenever the subject feels emotion, and it can be detected and measured with a sensitive galvanometer. By this method the irritability of the human mind may be electrically measured. James H. Baker contributes a good article on chain and chain making. The ultimate internal combustion motor and its probable fuel is discussed by Thomas White. An interesting process of color photography has been brought about by Chéron in Paris. The process is described and illustrated by our Paris correspondent. In a review of the eleventh Paris Automobile Salon, the general tendencies of the construction for 1909 are summarized, and particulars are given of some of the most notable models exhibited. H. B. Macpherson writes instructively on protective mimicry in bird life.

Fuel gas analyzers have been investigated by the committee on power generation of the American Street and Inter-urban Railway Engineeering Association, which recently reported that they were of unquestionable value where continuous records are kept. In order to get the best indication of furnace conditions, the committee recommends putting the gas collector as close as possible to the point where combustion ceases in the line of circulation. The collector should be a ¾-inch or 1-inch pipe, with the end capped and provided with ⅛-inch holes at frequent intervals along the side, but not so many that their combined area equals that of the pipe. Experience indicates the best results are secured with a recording analyzer in the main flue, supplemented by an indicating instrument connected into the breeching of each boiler, and so placed that the fireman can read it. The most common error in the operation of furnaces, which a CO_2 recorder shows, is stated to be the admission of too much air.

PRESENT CONDITIONS IN THE PANAMA CANAL ZONE.

BY A LAY CORRESPONDENT.

The excavation of the Panama Canal and the construction of its huge dams and locks is not alone the most stupendous engineering undertaking of modern times, but the preliminary work necessary to prepare the way for this enterprise has been fully as great. Never before in the history of the world has any government undertaken a more difficult task than ours to make fit for habitation an unsanitary district. In a little over three years' time, and at a distance of two thousand miles from the base of supplies, a small country or state has been organized; towns and villages built; and a decrepit railway converted into a modern double-track system. All this has been done in addition to, and much of it contemporaneously with, the actual construction of the canal itself. These things in themselves constitute a formidable task; but greater works than these have been accomplished. The canal zone, once a veritable pest hole, has become a sanitary district. Yellow fever, once the scourge of the Isthmus, has been unknown there since May, 1906; and the death rate is now lower than in many cities of the United States. The difficult problems of engineering, sanitation, feeding and housing employees have been satisfactorily solved. Many millions of dollars were expended in this work, and two cities, Colon and Panama, were renovated, paved and provided with waterworks and sewers and other improvements. To appreciate how tremendous has been the task, one must reflect that this work was done two thousand miles away from the base of supplies, and the locality furnished practically nothing. Lumber, machinery, nails, paint, engines, cars, plumbing materials, furniture, cooking utensils, food, all had to be shipped entire, or in parts ready to be put together, and adjusted after it reached the Isthmus. It was necessary to erect extensive machine shops in which to assemble and erect ready for use the various engines and machinery received at the ports.

What has been the result? With but few exceptions, people who have visited Panama agree that affairs are conducted on a business-like basis, that the Isthmus is becoming more and more safe as regards disease, and that the hospital system is surpassed by none. The supreme achievement has been the routing of yellow fever. It is well understood that the disease is carried by the Stegomyia mosquito, and so successful have been the government's methods of extermination that this particular mosquito has been practically driven from the Isthmus. Cases of fever cannot enter from outside because of a rigid quarantine. Other mosquitoes are fought by rigidly-enforced sanitary methods. Houses are carefully screened; stagnant water is not allowed to accumulate; streets are regularly cleaned; fumigation is carried on; and as a result not only yellow fever but malaria has been brought under thorough control.

The rapidity with which these things have been done is part of the marvel. At Culebra, built upon bluffs overlooking the great cut, is a town of five thousand inhabitants which has sprung up in three years time. It has a sewage system and pure water. Other sanitary towns have arisen out of piles of lumber deposited in forlorn looking jungles. When the Americans took the canal they obtained possession of about two thousand buildings, many houses for employees, some good hospitals and machine shops. The excavating machinery and much of the rolling stock for the railroad was too old-fashioned and out of repair to be of much use. Nevertheless the $40,000,000 paid for French rights, privileges and property has been considered a fair sum.

The principal engineering features of the Panama Canal are so well known to the readers of the SCIENTIFIC AMERICAN, that it will be sufficient to give here merely a brief recapitulation. The total length of the canal from deep water in the Atlantic to deep water in the Pacific is about 50 miles. Ten miles of this, however, consists of deep channels dredged through the harbors at either end, the total length from shore line to shore line being about 40 miles. The plan of construction is to build a series of massive dams not far from each shore of the Isthmus; create a large artificial lake between them; connect the lake with each ocean by canals, and a series of locks by which shipping will be raised or lowered from the canals to the lakes as thus formed. Commencing on the Atlantic side, the canal is dredged for 4½ miles through the shoal water of Limon Bay to the shore line. Two and a half miles beyond the shore it reaches the site of the Gatun dam, a huge earthen structure a mile and a half long, over half a mile wide, and 180 feet in height, which will serve to impound the waters of the Chagres River, and form a lake of over 100 miles area and 30 miles in length, whose level will be maintained at an elevation of 85 feet above the sea. The first 7 miles of the canal, from deep-sea soundings to the Gatun dam, will be at sea level, and the 85 feet difference of level between the canal and the lake will be overcome by a series of double locks in three flights, one set of locks being used for ascending and the other set for descending vessels. These locks will be 110 feet wide and 1,000 feet in usable length. They will be built of reinforced concrete, and because of their great dimensions will far exceed any construction of the kind yet built. For the first 11 miles of their progress through the Gatun Lake, ships will have from 80 to 50 feet depth of water, and from 500 to 1,000 width of channel through which to navigate. As the lake narrows down between the hills which inclose the Chagres River, the canal will decrease in width to 800 and 500 feet until it reaches the Culebra range of mountains, through which it will pass, still at the Lake level of 85 feet above the sea, by a channel with a maximum width of 200 feet. This 200-foot channel will be about 8 miles in length. On the Pacific side of the mountains, at Pedro Miguel, descent will be made by a single lock to an artificial lake formed by a dam at Miraflores, a point about 2 miles farther on toward the Pacific. At Miraflores descent will be made by two locks to Pacific sea level, and from that point to deep water, a distance of 9 miles, the canal will be excavated to a uniform width of 500 feet. The minimum depth for the whole canal will be 41 feet; hence, on the day of its opening, which will probably take place in the year 1915, it will be capable of accommodating the largest ships afloat, including the "Lusitania" and "Mauretania" and the two giant White Star boats, over 900 feet in length, which are being built at Belfast.

Now that the full excavating plant has been delivered at the Isthmus, excavation is proceeding at a rate that was never dreamed of, even in the most sanguine estimates of the engineers. During March of last year, about 3½ million cubic yards was excavated; and it is possible that an even greater maximum will be obtained in the dry season of the present year. The excavation will be completed long before the locks and dams are finished. The examination by bore holes and test pits has shown the character of the ground for both dams and locks to be favorable, and it is probable that the Commission of Engineers, which is now at the Isthmus with Mr. Taft, will report in favor of completing the canal upon the plan which we have outlined above.

As the Isthmus of Panama is situated in the Torrid Zone, it has a tropical climate with little variation, the average daily range being from 72 to 86 degrees in summer or winter. The summers are trying to strangers on account of the humidity in the rainy season. The Canal Zone proper is 10 miles wide and about 45 miles long. The cities of Colon and Panama are not under American jurisdiction, save in the matter of sanitation; but there are numerous small towns of from one hundred to five thousand inhabitants under the direction of the United States. Exclusive of Colon and Panama, there are about 50,000 people on the Canal Zone. About six thousand of these are American employees, and fifteen hundred of them are American women and children.

Though much of the business is transacted in Washington, the Isthmian Canal Commission has its headquarters on the Isthmus. The work is done under several departments, and employees are assigned to their respective departments immediately on reaching the Isthmus. Clerks, bookkeepers, stenographers, typewriters, surgeons, physicians, foremen, blacksmiths, bricklayers, carpenters, train conductors, diamond-drill setters, engineers, firemen, ironworkers, masons, painters, plasterers, plumbers, quarrymen, tinsmiths, wiremen, are among the many who find positions on the Isthmus to-day. Men who have specialized are desired, and there is no demand for unskilled American labor. The laborers come from the Isthmus, West Indies, and southern Europe. Many of the skilled employees have to pass a civil service examination.

Most of those employed on the Panama Canal sail from New York, though steamers run from New Orleans and the Pacific ports. They are furnished free steamboat transportation, and are advised to carry light-weight clothing. Khaki is extensively used for work dress, and white linen for evening wear. When the employee gets to Panama, he finds buildings constructed on the best principles of sanitation. That food may be preserved and shipped properly, there are refrigerator plants on the government steamers, cold storage plants at the ports, and refrigerator cars on the Panama Railroad. In this way food is transported under continuous refrigeration from the United States to dwellings in Panama.

Hotels and mess houses have been established along the line of the canal, and some fifteen are conducted for the white employees. It is not intended to make any profit on these, but to give good food, cooked and uncooked, at cost prices plus the actual cost of transportation. It is calculated that for thirty cents a high-grade employee can obtain a meal, and a laborer can get one for ten cents. A course dinner at a hotel costs from fifty to seventy-five cents. One of the worst problems that faced the Commission was the feeding of the unskilled laborers, who are largely recruited from the blacks. There seemed no food at a price low enough to induce them to eat. Cooked food at ten cents a meal and uncooked food at a less price were both refused. After several experiments food was cooked and given them, and they ate it heartily. It was decided to pay them a certain rate per hour and their board. This not only solves the problem, but, it is hoped, will increase their ability to withstand disease. These are not the only provisions made by Uncle Sam for his people, for nearly four hundred separate houses and thirteen large buildings have been constructed for married couples, and there are several buildings where bachelors are housed free of charge. These are partially furnished and fuel, electric light, and water are given free. The problem of a supply of drinking water has been solved by the construction of reservoirs at different points along the Canal Zone.

All employees are allowed free medical, surgical, and hospital attendance, and practically every religious denomination is represented. Chaplains hold service, visit the hospitals, and are now urging the erection of buildings which can be used as churches and for lodge purposes. The public school system is essentially American. American teachers are employed, American school books and songs are used, and the flag floats over every school house. Realizing that the white people would be thrown entirely on their own resources for entertainment, the Commission is building a clubhouse or recreation hall in each of the villages under the jurisdiction of the United States. These structures—those in Culebra, Empire, Gorgona, and Cristobal are finished—contain a parlor, card room, billiard and writing room, and assembly hall. Each has a library of five hundred volumes, and weekly and monthly periodicals and newspapers are subscribed for. A comprehensive plan has been devised whereby the Commission working with the Young Men's Christian Association manages these buildings, and good entertainments are given, the entertainers coming from the States and ranking with those employed by first-class lyceums. There are also many social, athletic, and literary clubs among the employees.

The canal will be open in 1915. It will have cost us probably not less than $300,000,000; but its commercial and military value, the prestige which will accrue to the United States, will yield a rich return for this outlay of time and capital.

Museum of Safety and Sanitation.

Announcement has just been made of the acceptance of the treasurership of the Museum of Safety and Sanitation by Frank A. Vanderlip. An executive office for the administrative and promotive work of the Museum has been opened at the United Engineering Societies' Building, 29 West 39th Street. Notice of competition for the SCIENTIFIC AMERICAN medal will be given in ample time in these columns.

A committee on plan and scope includes Prof. F. R. Hutton, chairman; Dr. Thomas Darlington, Commissioner of the Health Department of the city of New York; P. T. Dodge, president of the Engineers' Club; William J. Moran, attorney-at-law, and Henry D. Whitfield, architect.

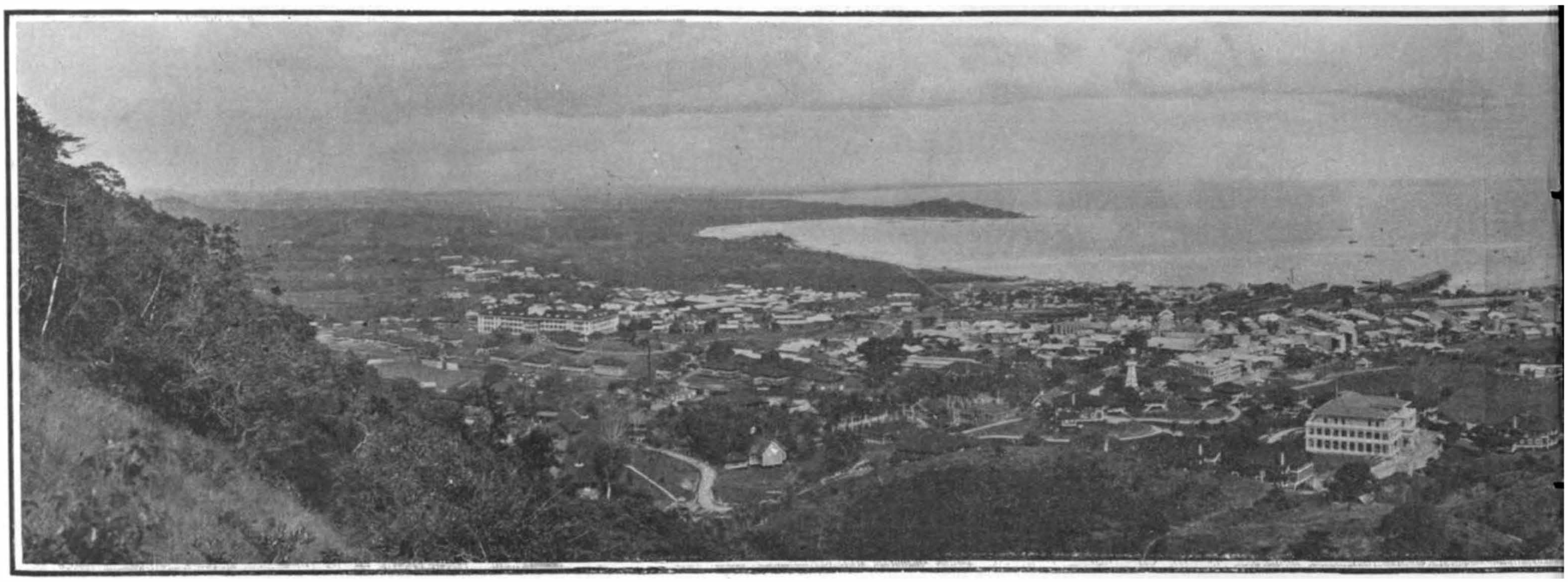
Plans are being pushed along practicable lines to prevent the enormous loss of life and limb to American life and labor, through the Museum of Safety and Sanitation, where safety devices for dangerous machines and preventable methods of combating dread diseases, may be demonstrated. Charles Kirchhoff, editor of The Iron Age, is the chairman of the Committee of Direction; T. C. Martin, editor of The Electrical World, vice-chairman, and Dr. William H. Tolman, director.

The Death of Luke Kavanaugh.

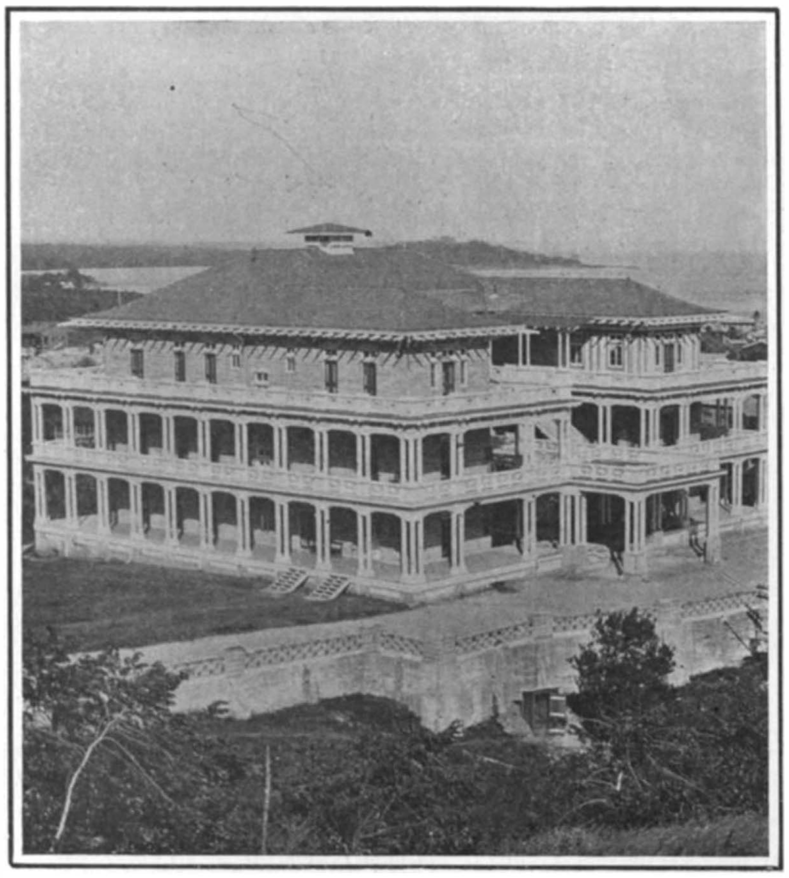
Luke Kavanaugh, inventor and mill owner, died at his home in Waterford on January 24 after a brief illness. He was born in 1825 in Dublin, Ireland.

In 1862 he invented the movable-bladed knitting burr, which was used by every knitting mill in the world and was one of the principal causes of making Cohoes the greatest knitting mill center in the world. This patent he followed with others in 1863, 1864, and 1871 on improvements on knitting machinery. In 1867 he established the Bishopton knitting mill at Cohoes.

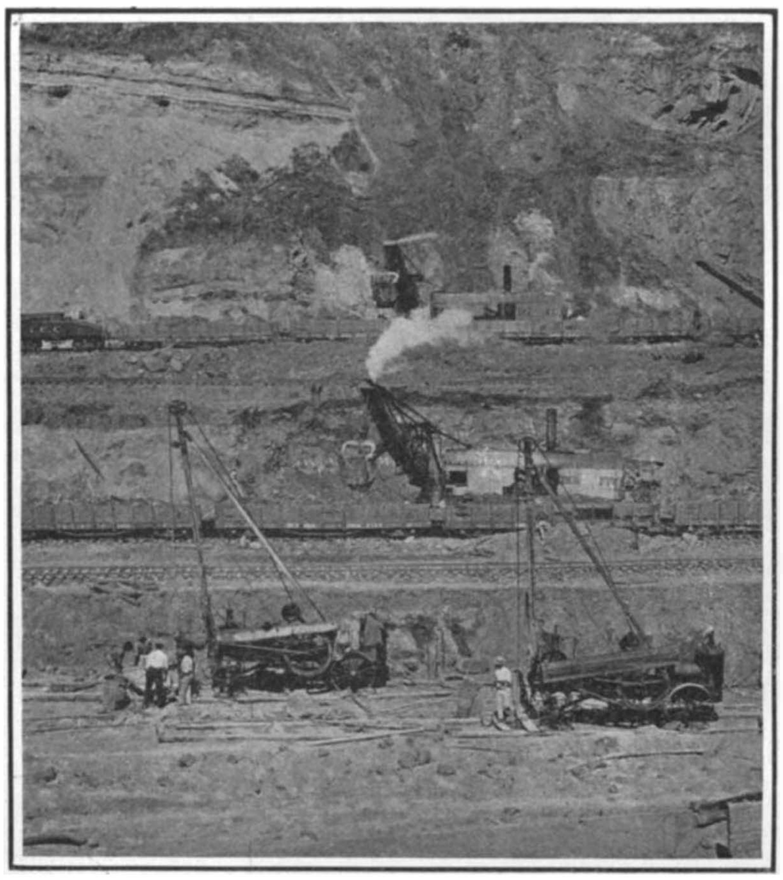
Short and odd lengths of lumber is the subject of a brief bulletin sent out by the United States Forest Service. It is stated that 25 per cent of the felled trees are never hauled from the woods simply because specifications of builders and architects cling to conventional lengths, whereas the actual construction is such as easily to use the short and odd lengths. The work of a prominent architect was examined and it was found that 40 per cent of the siding on frame buildings was under 6 feet in length. It was found that in cutting and grading finished lumber generally 5 to 10 per cent was bound to come in lengths under 10 feet, of which all under 6 feet is burned and all over is sold at reduced prices. This bulletin asks for closer specifications, better understanding of the timber situation as a help to the lumbermen and for the preservation of the lumber supply.



City of Panama and harbor from Anc

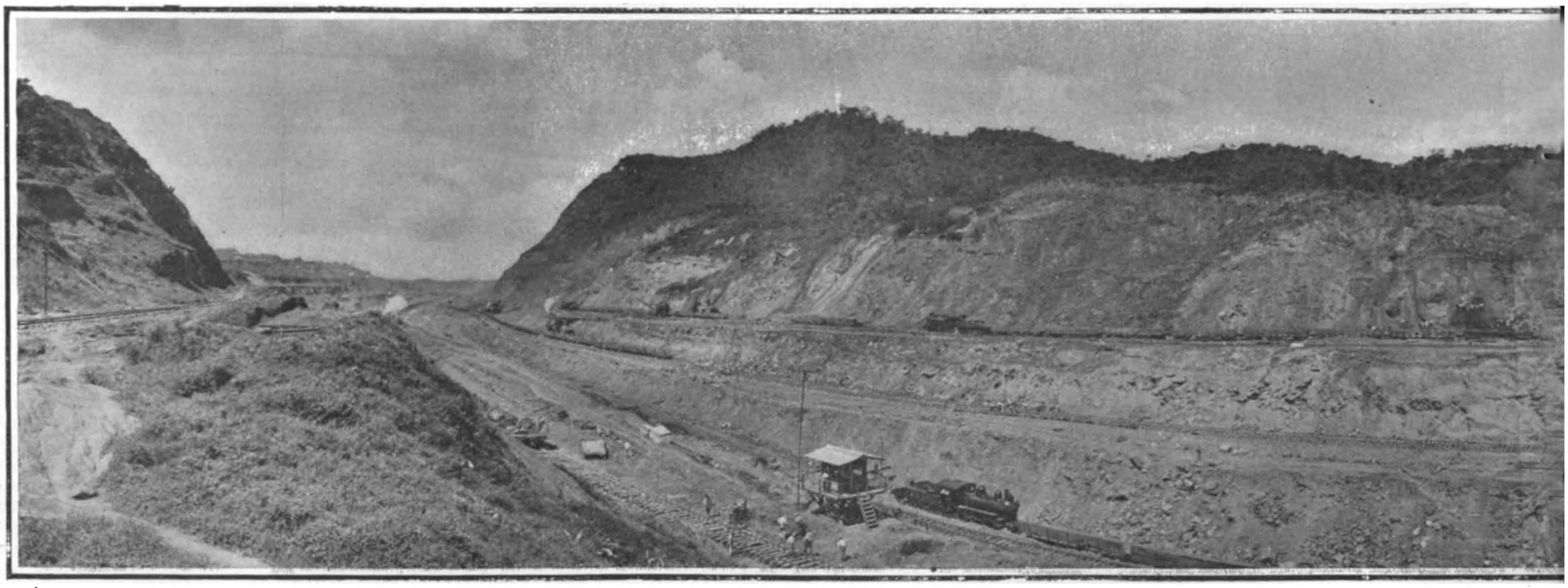


New police headquarters at Ancon.



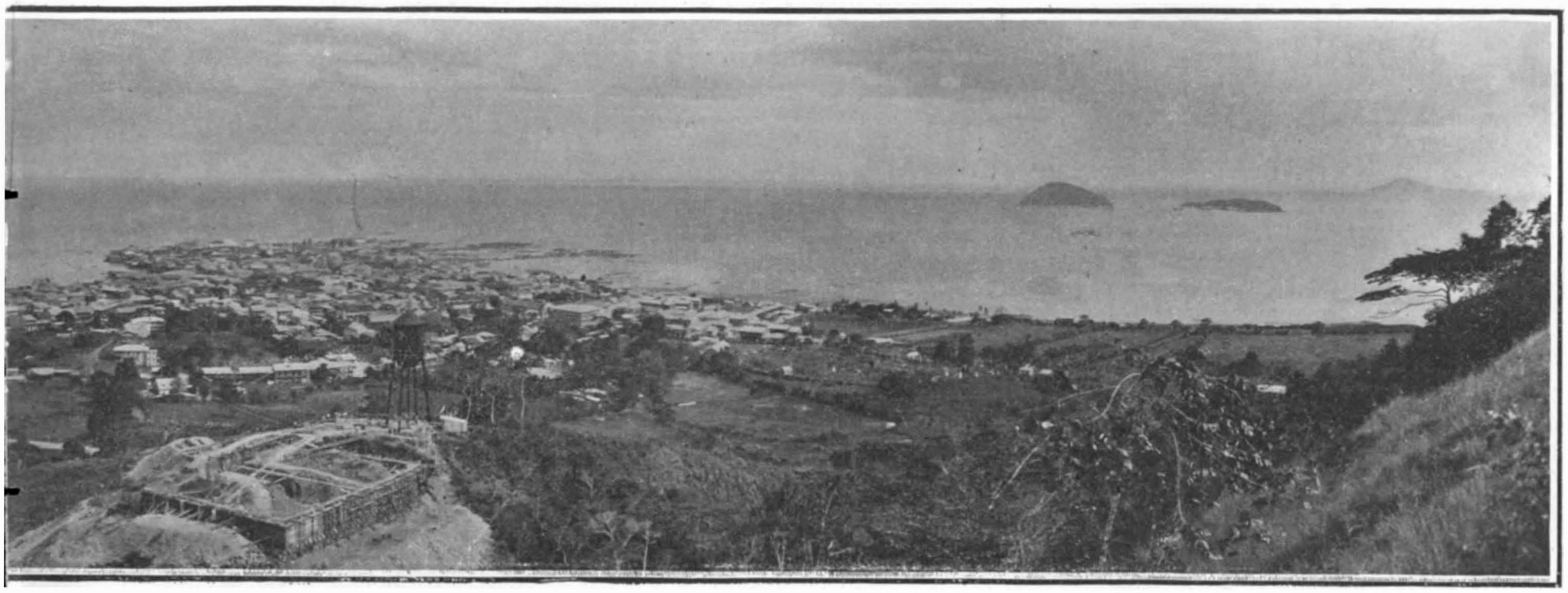
Steam shovels and dump cars in one of the big excavations.

Test pit sunk to determine charac below Miraflores d



Panoramic view of the great Culebra cut through the

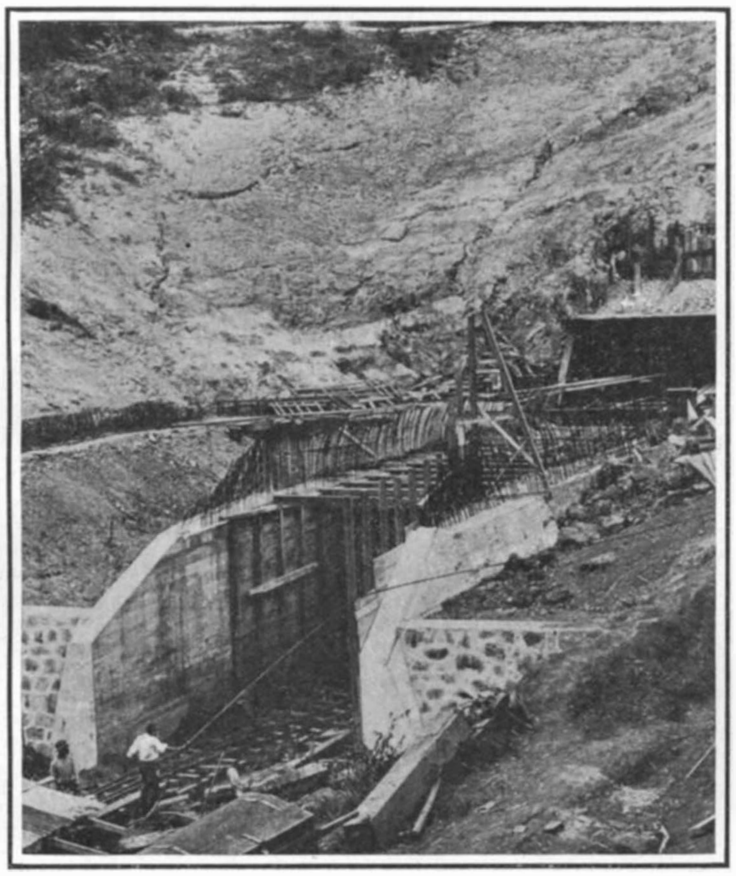
PRESENT CONDITIONS IN TH



New concrete reservoir. Pacific entrance of canal is to the right of these islands

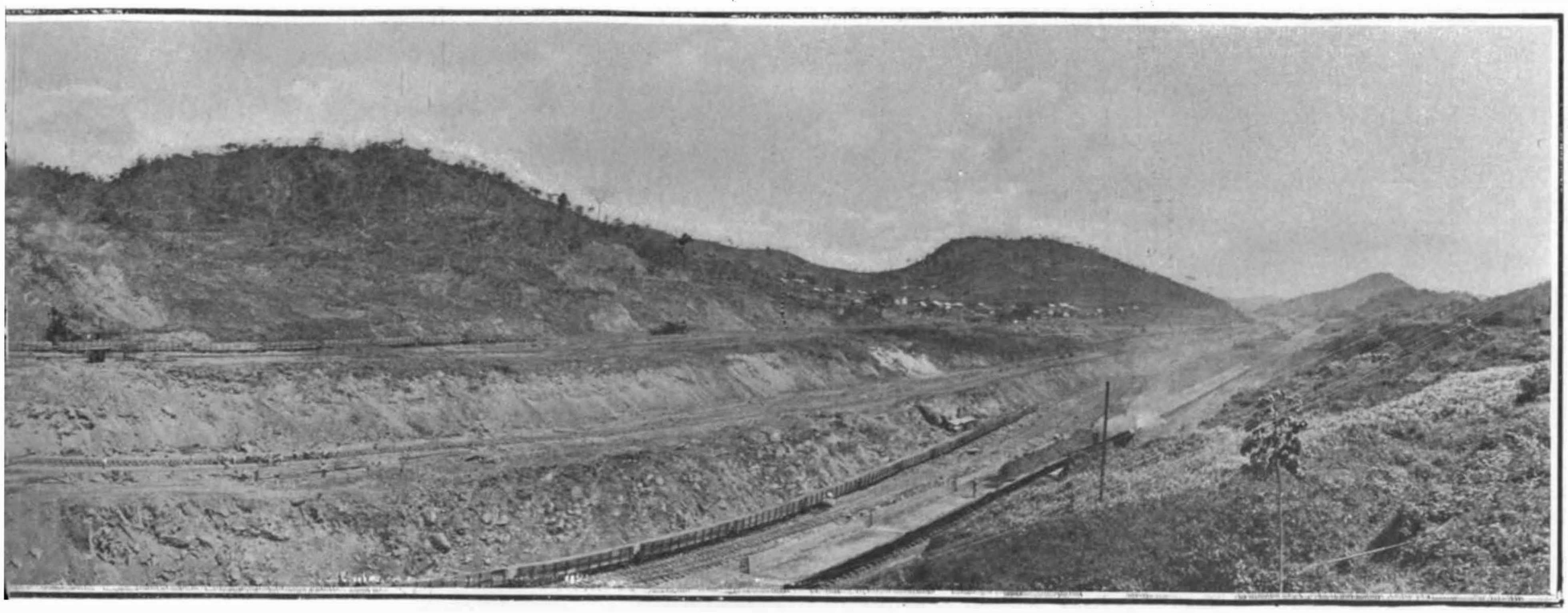
n Hill looking toward the Pacific.

er of foundations
m.



South end of Miraflores tunnel, where slides have occurred.

One of the better class residences in Panama.



stretch between Gold Hill and Cucuracha is sliding, necessitating much extra excavation. Cucuracha village.

nountain divide between the Atlantic and Pacific.

PANAMA CANAL ZONE.

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

FURNISHING THE WORKSHOP.—II.

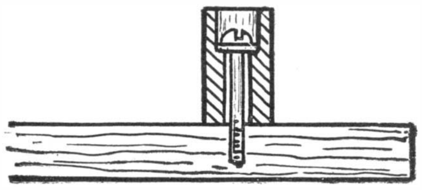
BY I. G. BAYLEY.

(Continued from the issue of December 19, 1908.)

DESK OR DRAWING TABLE.

A shop should be furnished with some kind of a writing shelf or desk, and since it is often necessary to make sketches or accurate drawings of details, a drawing board and desk combined will answer well. Very often an old drawing board can be obtained, which can easily be trimmed up, and made into a drop-leaf arrangement secured to the wall. A good size is 23 by 31 inches, which will accommodate a standard-size sheet of paper, but on account of the construction in this case, the width had better be 24½ inches.

Soft pine, free from knots and well seasoned, should be procured, and accurately planed and glued together along the joints. Two battens running across the grain of the board should be secured to the underside,

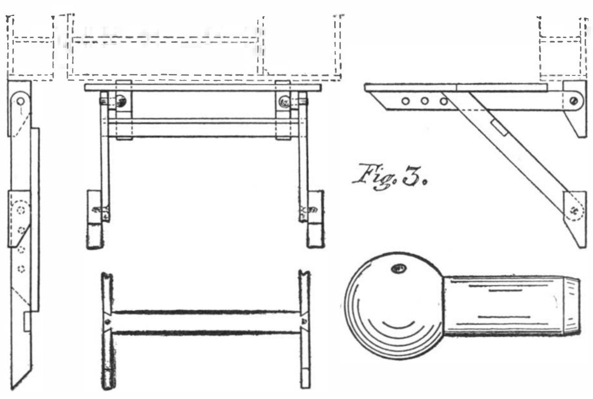


HOW THE BATTENS ARE SECURED TO DRAWING BOARD.

by means of round-headed screws, sunk in below the surface, and bearing upon iron washers. (See sketch.) The holes should be bored larger than the screws, the hole in the washer being the same size. This will prevent the board warping, and it is very easily constructed. Make the board 1 inch thick; the battens and braces also; the cupboard from ¾-inch stuff; and the shelves, pigeon-hole partitions, and small cupboard of ½-inch material.

Fig. 3 is drawn to scale, showing the front and side views. The cupboard (see Fig. 4) is 6 inches deep outside measurement, and 3 feet in length. The shelves are 4½ inches apart, making the total height 16 inches. The small cupboard is 9½ inches square inside. It should be furnished with hinges and lock. A small block of wood, tacked in the corners, will prevent the door closing too far inside. The pigeonholes can be either plain or furnished with drawers, and the general design altered to suit individual tastes, but an arrangement of some kind in which to keep pens, ink, pencils, writing material, smaller and finer grades of tools, notes, sketches, books, and clippings from the press or magazines. Nothing can be more useful to a boy than a place to keep all such things, for accumulate they will.

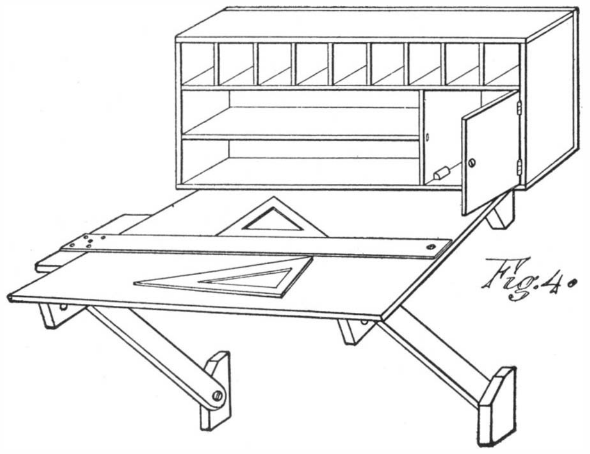
The brackets upon which the cupboard rests, and to which the battens are connected, and also the brackets at the foot of the braces, can be made from 2 by 3 stuff cut 7½ inches in length, and secured firmly to the wall of the shop. Make the battens and braces 1 inch by 2½, of hard wood, secured to the brackets with



DETAILS OF THE DRAWING BOARD.

large screws, the holes being a trifle large in the battens, and the screws not driven all the way home. The cross-brace is dovetailed into the supporting braces, as shown in Fig. 3. The length of the battens and braces is 2 feet 4 inches and 2 feet 1 inch, out to out, beveled to an angle of 45 degrees at one end and rounded at the other. Care must be taken to secure the fixed ends not more than 1¼ inches from the near edge of the wall brackets, or the board will not close up properly when folded against the wall, as shown to the left of Fig. 3.

Three holes for adjusting the board at several angles are bored 2½ inches apart, the first one being 4½ inches from the end. A round peg, shown in larger detail in Fig. 3, is made to fit the holes, and kept from getting lost when the board is down, by a short length of wire attached to a staple in the underside of the board. Make the bottom of the cupboard about 3 feet 6



GENERAL VIEW OF THE DRAWING BOARD AND CUPBOARD.

inches from the floor, which will give about an inch clearance for the braces when the board is down, out of use.

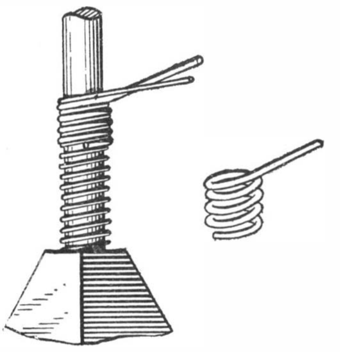
The working edge of the drawing board should be trued up for the butt end or head of the T-square to work against. In selecting a T-square, sight along the working edge, to see that there are no imperfections, and select one where the blade is on top of the head, so that the triangles will slide over it. A T-square, two triangles, triangular scale, and a small set of instruments can be purchased at a very reasonable cost.

Fig. 4 gives a fairly good idea of how the board and cupboard will look when complete. If much sketching or laying out is to be done, a high stool will be found convenient.

HOW TO WIND A SPACED COIL SPRING.

BY CHARLES LURCOTT.

When it is desired to wind a spring with a coil spaced a uniform distance apart, a simple method is to use a former or guide, made of wire which is as thick as the space desired between the coils. The accompanying cut shows how this is done. The guide consists of a few coils which are spaced the requisite distance apart, and one end of the wire projects outward tangentially. The spring is then wound on the arbor between the turns of the guide. As the wire is fed on the arbor it is crossed over the extending end of the guide, in the manner shown, so that it presses inward against the coils of the former. As the arbor is turned the guide is automatically fed along the arbor, and the coils of the spring are uniformly spaced by the coils of the former.



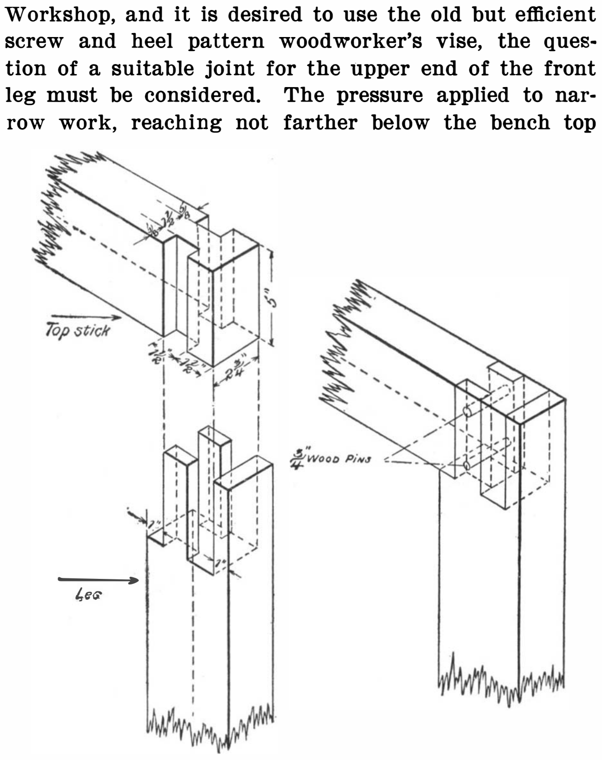
HOW TO WIND A SPACED COIL SPRING.

A JOINT FOR THE WORK BENCH.

BY C. A. PITKIN.

When constructing the bench for the Handy Man's Workshop, and it is desired to use the old but efficient screw and heel pattern woodworker's vise, the question of a suitable joint for the upper end of the front leg must be considered. The pressure applied to narrow work, reaching not farther below the bench top than its own thickness, tends to draw the front leg from position, and one soon finds he has a loose and "rickety" joint.

None of the usual mortise or dovetail joints are satisfactory, but the one shown below is very powerful and cannot be drawn from place. The detail drawing shows its construction and proper proportions. After the glue has set, two ¾-inch wooden pins should be driven in the holes.

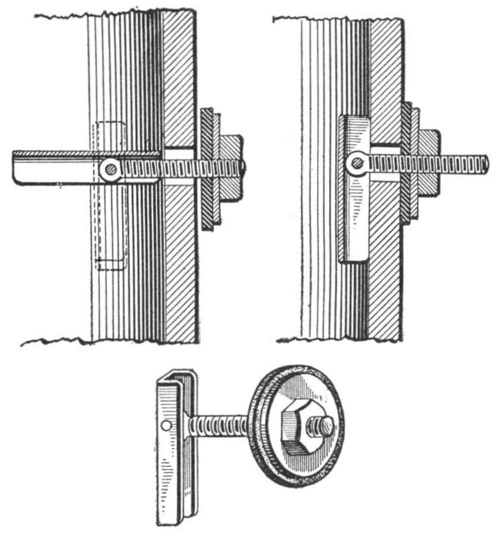


JOINT FOR HANDY MAN'S WORK BENCH.

PATCH FOR KITCHEN BOILERS.

BY T. FAGAN.

When by reason of rust, corrosion, or any other agency, the shell of the kitchen boiler is punctured, the problem of stopping the leak should not cause Handy Man any worry. A little device like that shown below can readily be made, and it will effectually and permanently close the hole. It consists of a square-headed brass machine screw, with head flattened and pierced to receive a pin, whereby it is pivoted between the walls of a channel-shaped brass bearing piece. The opposite end of the screw is fitted



PATCH FOR THE KITCHEN BOILER.

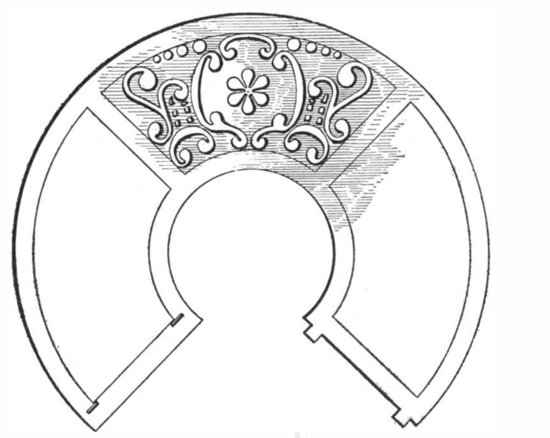
with a leather washer, a broad metal washer slightly curved to fit the contour of the boiler, and a nut.

The illustration shows how the device is applied. The puncture is enlarged sufficiently to admit the bearing piece. The latter is swung into alinement with the screw and passed through the hole. The overhanging part of the bearing screw should be longer, and hence heavier, than the other portion, so as to make the bearing piece swing to a vertical position as soon as it clears the inner surface of the boiler shell. The screw will then be retained by the bearing piece, and the nut can be screwed up to clamp the leather against the outer surface of the shell. This done the projecting part of the screw can be cut or filed off.

ANOTHER METHOD OF MAKING METAL LAMP SHADES.

BY FRED G. WARNER.

Lamp shades, electric-light shades, shades for drop lights, and shades for candelabra can readily be made as follows: The material should be sheet brass, in thickness ranging from 1/40 of an inch to 1/64 of an inch according to the size and character of the work. If the shade is to be quite large and to contain glass or other heavy materials, it is necessary to use the heavier brass or that of 1/40-inch in thickness. In light work



METAL LAMP SHADE.

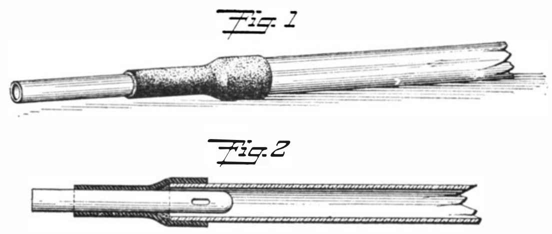
like that of the candelabrum shades, the 1/64-inch brass is more desirable.

To make the candelabrum shade it is necessary first to draw the pattern on paper. Then, placing the paper upon the brass, an outline of the pattern should be made with a very soft pencil. With a heavy pair of scissors this pattern can be cut out of the brass, but it is impossible to cut any design in the brass pattern with the scissors without wrinkling the metal. The neatest way is to burn out the design with nitric acid. First the design should be drawn upon the brass pattern with a soft pencil. Then the pattern should be heated over a stove. While the shade is still hot a piece of wax or ordinary candle is rubbed over both sides of the brass. The heat of the brass melts the wax and forms a thin wax coating. When the brass becomes cold, the design, which shows through the wax, is traced with a pointed instrument. The parts of the brass which are to be burned out are scraped free of wax. The shade is then immersed in nitric acid. The acid eats through the exposed brass and the required design is very cleanly cut out.

The lamp, electric, and drop-light shades are made in the same way. Without much expense or trouble these larger pieces can be improved by placing different colored glass behind the designs.

STOPCOCK OF GLASS TUBING.

A small stopcock may be easily made out of two glass tubes and a rubber sleeve. The outside diam-

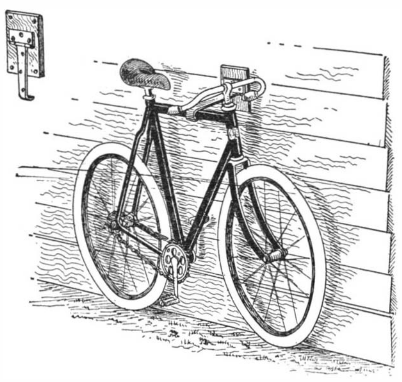


STOPCOCK OF GLASS TUBING.

eter of one tube is smaller than the inside diameter of the other. The end of the smaller tube is softened in the flame of a Bunsen burner and closed. With a file a small slot is cut in the side of this tube. A piece of rubber tubing is fitted over the two glass tubes, as shown in Fig. 1. The smaller tube is not held so tightly by the rubber sleeve as is the larger tube, and it will slide quite readily therein. When the smaller tube is drawn outward, the rubber sleeve covers the slot therein, preventing the passage of liquids or gases through the two tubes. To open the cock, the smaller tube is forced inward, as shown in Fig. 2, and the liquids or gases can then flow freely through the two tubes by way of the slot in the smaller tube.

SIMPLE SUPPORT FOR BICYCLES.

A very convenient device which may be attached to the side of a house or any other support, to hold a bicycle, is shown in the accompanying drawing. It



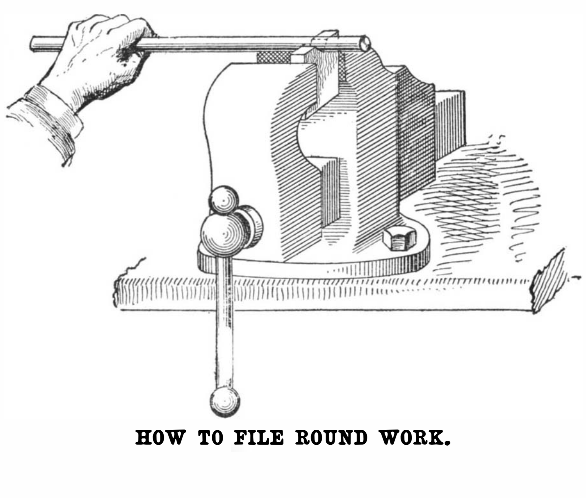
SIMPLE SUPPORT FOR BICYCLES.

consists of a gate hinge with one leaf secured to a block. The block is nailed to the side of the house. The other leaf of the hinge, which should be a very long one, is bent over at the end to form a hook. This is caught over the upper horizontal bar of the bicycle frame. The bicycle wheels are placed close to the house, so that the upper part leans outward, and is held from falling by engagement with the hook.

HOW TO FILE ROUND WORK.

BY A. V. SEARING, JR.

It is an easy matter to file the ends of round rods if a piece of wood with a notch cut in the top is placed in the vise, as shown in the cut, and the rod revolved toward you as the file is run over it. The file will make a steady, smooth cut, and will not chatter if the notch is of the right depth. This simple trick seems to be but little known. Usually the mechanic tries to rest the rod he is filing between the partly open jaws of the vise, but this makes a very unsatisfactory chattering support, which is quite sure to mar the work.



HOW TO FILE ROUND WORK.

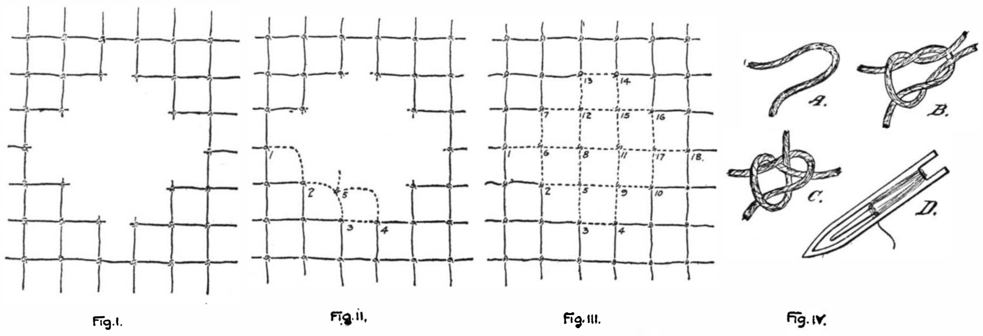
HOW TO MEND A HAMMOCK OR FISHING NET.

It is safe to state that not one per cent of persons using a hammock or handling a fishing net know how to mend them, should they get torn or damaged in any way.

Whether the tear is a large or small one, the meshes or small squares of which the net is made must be cut out, until a symmetrical figure is made, as shown in Fig. 1; i. e., there must be a single square or mesh and a double one on opposite sides of the tear.

Fig. 2 shows the commencement, and Fig. 3 the tear completely mended.

Always commence in the middle of the double mesh, and end in the opposite one. Each successive stitch and knot is numbered, from 1 to 18, as clearly shown in Figs. 2 and 3.



HOW TO REPAIR A HAMMOCK OR FISH NET.

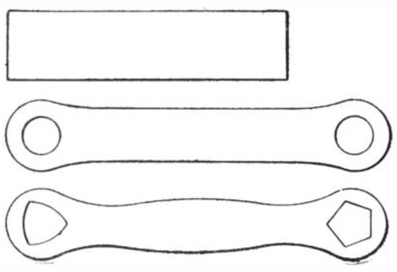
The knots are formed by pinching the meshes, as at 5, for instance, into a loop, as shown in Fig. 4 at *A*. Then threading the cord through the loop, a knot is made, either a flat or true lover's knot, as shown at *B*, or better still a fisherman's bend knot, as shown at *C*. The latter is not only easier to make, since it only passes through the eye once, but it will not slip so easily.

If the tear is a large one, it is well to make a needle, as shown at *D*, which is made from a piece of thin wood, about 5 or 6 inches long by ¾ of an inch wide, cut out as shown. The cord or twine is wrapped around this needle, and as the stitches and knots are being made, is unwound.

A FIRE-PLUG WRENCH.

To prevent mischievous boys, or any other persons, meddling with the fire plugs of the city, special wrenches are made, different from the ordinary hexagonal wrench which can be found in almost any home. The making of these wrenches is interesting and instructive, and is done in the following manner:

A piece of steel, a little thicker than the finished size of the wrench, and the same width as the two ends, is drawn out to the proper length. A hole is punched in each end having a diameter the same as the inside of the shaped hole in the finished article. The next step is to make a three-cornered drift pin having a tapered or barrel shape, so that it can be more easily driven through the round hole. The other end has a five-sided or pentagon-shaped hole, a drift pin being made for it likewise, of the proper shape.



A WRENCH FOR FIRE PLUGS.

The handle is shaped and the whole given a finished appearance. The three successive stages are illustrated in their proper order.

HOW TO SOLDER ALUMINIUM.

BY WILLIAM HOOPER, E.E.

There is no solder which operates with aluminium in the same way that ordinary solders operate with copper, tin, etc. There are two reasons for this.

First. Aluminium does not alloy readily with solders at temperatures as low as the other metals require, and it is consequently necessary, in soldering aluminium, to use a much higher temperature. Furthermore, aluminium alloys with lead only with great difficulty and with but a small proportion of lead at that; consequently lead solders are useless with aluminium.

Second. The surface of all aluminium is covered with a thin invisible coating of aluminium oxide. This coating forms instantly on the surface of aluminium and is very refractory, and its presence is responsible for the high resistance of aluminium to corroding agents, since, although aluminium itself is soluble in a great many chemical compounds, this protective coating of oxide is insoluble in almost everything excepting hydrofluoric acid. While in general this coating of oxide is beneficial, in that it forms a perfect protection to the aluminium underneath, it is, by reason of its efficiency in this particular, responsible for the principal portion of the difficulty which occurs in soldering aluminium, as naturally no solder will alloy with aluminium oxide.

In soldering aluminium, therefore, it is necessary that this oxide must be removed before the soldering can take place; and as it forms again instantly after removal, it is necessary that the removal of the oxide and the covering with solder shall be simultaneous. In soldering other metals, the oxide can be removed chemically. With aluminium this is not possible, and it must be removed mechanically by abrasion.

Bearing these facts in mind, it will be readily understood how aluminium soldering must be done. All the surface to which it is intended that the solder shall adhere must first be tinned. This is accomplished by heating the metal to a temperature above the fusion point of the solder used, and then rubbing the surface with a stick of the solder, thus rubbing the oxide off the surface with the solder itself, and covering the exposed points with melted solder, all in the same motion. In order to make sure that the tinning is thorough, it is better to rub the surface with a steel or brass scratch brush while the solder on this surface is still molten. This insures a thorough job of tinning. After the edges to be united are thus tinned, they may be sweated together with pure block tin, with the aid either of a soldering iron or blast lamp.

With regard to the composition of aluminium solders, zinc appears to alloy with aluminium more readily than any other metal available for the constituent part of the solder; consequently all solders which will readily tin aluminium contain zinc in varying proportions. The solders which we have found to be most satisfactory are composed usually of tin, zinc, and a very small proportion of aluminium. These solders do not run very freely nor fuse as readily as ordinary solders, and it is necessary, as stated above, to use a higher temperature—so high in fact that extreme difficulty is found in using these solders with a soldering iron, and it is generally necessary to use a blast lamp.

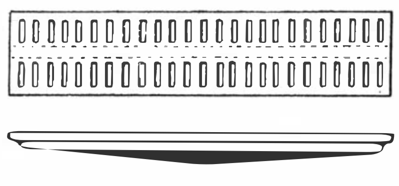
Another thing which must be borne in mind is that solder will not flow into an aluminium joint, even when tinned, by capillary action as it does into copper or tin joints, and it is therefore necessary to place on the surfaces to be united all of the material necessary to sweat them together before the edges are brought into contact. In soldering aluminium joints, it is necessary that both the tinning and sweating shall be most thoroughly done; otherwise the joint will not be durable.

On account of the presence of zinc in the tinning solder, the solder is decomposed by moisture, and unless the work is so well done that the joint is absolutely waterproof, it will not be durable. The quality of the workmanship has more influence than anything else on the permanence of the work.

STRAIGHTENING BUCKLED CASTINGS.

It is a rare occurrence for a long casting to leave the molds perfectly true and level. When cooling off in the sand, they often buckle out of shape. It is necessary, as in the case of drainage cover castings, for instance, to have them level, so that when the horses and vehicles pass over them, they will not tilt or shake. These castings are usually straightened in the blacksmith's shop in the following manner:

Take, for example, a grating like that shown below, which is used by street railways to allow the surface water to drain into the sewers, and which has to fit very snugly the recess of the trap box in which it lies. The casting is placed in the fire, and heated to a dark cherry red, when it is taken out and placed upon the anvil upside down. Two blocks of iron, about the size of a half brick, are placed at either end of the casting, and a section of car rail the length of the casting is placed on top. A couple of clamps are slipped over the rail and casting, in the center or where the buckling of the casting appears. The bolts of the clamps are then screwed up, at the same time using the wrenches with a quick turn, until the hollowness of the grating is about one-eighth of an inch more than necessary, which is tried by means of a straight edge. When the clamps are removed, the hollowness will be gone, and the casting will be found to be perfectly level.



STRAIGHTENING BUCKLED CASTINGS.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

BATTERY-PLATE.—G. B. Rinehart, Ashland, Wis. The invention relates to battery plates, the more particular object being to produce a type of plate suitable for use in storage batteries, and perhaps in some instances in dry batteries, the arrangement of the plate being such as to hold the active material in place.

ELECTRIC TRAP FOR RATS, ETC.—J. T. Norris, Troy, N. C. In this case the invention relates to improvements in traps for the extermination of rats and other vermin and has for its object to produce a simple, cheap and efficient means of ridding houses of rats and other pests, which can be easily handled and moved about as necessity requires.

TROLLEY.—E. H. Green, Emeryville, Cal. The trolley shown in this patent is provided with a contact roller, and in connection with the roller the inventor provides a guard at each end, the guards being given a downward and forward curve, the arrangement being such that either cross wires or wires running crosswise with the conductor are engaged with facility so that the roller is lifted and prevented from damaging the wires.

Of Interest to Farmers.

MANURE PULVERIZER AND LOADER.—J. N. Frost, Arlington, Mass. In a general way the invention is carried out by the provision of a carriage on which the pulverizing mechanism is mounted. This mechanism is fed by an elevator arranged at the rear end of the carriage, and the mechanism discharges upon a conveyor leading to one side of the carriage, the mechanism, elevator and apron all being driven from a motor mounted on the carriage.

COTTON-CLEANER.—A. L. Treese, Jennings, Okla. This invention concerns itself especially with providing means for ejecting the treated cotton from the device; the invention further provides means for treating the cotton with the boll to remove the boll and dirt, and it is also adapted for treating the cotton without the boll when it is simply necessary to clean the cotton.

DOUBLE-RAKE.—R. M. Kenney, Clinton, Okla. The more particular purpose here is to provide a vehicle body with two sets of rake teeth operated to some extent independently, and to further provide the body with a turntable whereby the horses used for drawing the body may be turned around without materially disturbing the relative positions of the rake members, so that one of the rake members may be filled and afterward practically turned to the rear in order to allow the other one to be filled.

BEATER.—H. C. Jarr, Plummer, Minn. The invention has reference to threshing machine beaters, and particularly to a beater comprising parts rotatable about different axes so that one is eccentric with respect to the other, and a plurality of adjustable teeth carried by one of the parts and controlled by the other so that the teeth have a constant angularity when the parts rotate, that is, the teeth are always at the same angle.

HARROW ATTACHMENT FOR CULTIVATORS.—J. F. Barbee, Grand Island, Neb. The device is capable of being applied to any ordinary cultivator and be readily applied to or removed from the cultivator and is suitable for use in working a variety of crops such as corn in rows or hills, oats and other small grain, and can be used in planting as well as in cultivating, as it assists in covering the seed and pulverizing the soil.

HARROW ATTACHMENT FOR PLOWS.—J. F. Barbee, Grand Island, Neb. The particular feature is the manner in which the device is attached to the frame of the plow or other implement, whereby side draft is avoided. The harrow is attached so as to follow the mold board of the plow closely and so act on the soil at the best time, that is immediately after it is turned. By means of levers the slant of the harrow teeth and also the relation of the harrow frame to the plow frame may be varied to suit the work or other conditions.

Of General Interest.

PROCESS FOR MOLDING TOOTH-CROWNS AND THE LIKE.—S. Shimura and Y. Minagawa, No. 20 Gofuku-cho, Nihombashi-ku, Tokyo, Japan. This invention has reference to new and useful improvements in processes for use in molding tooth-crowns and the like and the object consists of obtaining a perfect occlusion, securing thereby a permanency of the cusps in crowns and bridges and also obtaining a perfect and easy fit of the gold inlays.

PIANO-PEDAL MOUNTING.—H. Sandner, Union Hill, N. J. The intention in this case is to produce a mounting which will be very simple in construction, and which will operate effectively to support the pedal pivotally in such a way that it will move very freely, yet so that it will be held securely and adjustably.

AIR-SHIP.—W. Rumble, New York, N. Y. The purpose of the inventor is to provide a casing surrounding the propeller and in connection with the car, having means against which the current generated by the propeller acts, tending to revolve the casing, and the car to which it is connected, in the same direction as the propeller, thus compensating for the reactionary force developed in driving the propeller.

PACKING-BOX.—M. H. Longfellow, Portsmouth, Ohio. The purpose here is to provide a knock-down or collapsible metal box constructed and arranged so that its parts can be rapidly and easily assembled or knocked down and compactly bundled for transit to and from distant places, and so that it can be made as light as possible for protection to the goods in transit.

TILE.—A. S. Janin, New York, N. Y. The invention pertains to tiles for walls, floors and similar purposes, and its aim is to provide a tile having a symmetrically curved outline arranged so that similar tiles can be readily interlocked to prevent displacement in any direction and to present a highly ornamental surface.

WELL-PACKER.—W. H. Kesselman and L. P. Kesselman, Parkersburg, W. Va. The invention relates to well packers and more particularly to packers used in connection with oil, gas, and artesian wells, for use in preventing the flow of fluid of any kind into the well from an opening effecting communication between the well and a pocket or cave adjacent thereto.

PAPER-ROLL CARRIER, GUIDE, AND CUTTER.—C. R. Hotchkiss, Water Valley, Miss. The object in this instance is to provide a device which affords a convenient support for a paper roll, permits a detachment thereof from said support, provides a guide for the free end of the paper, means for moving the end portion beneath the guide, and means for cutting the portion of paper that is projected at the end of the guide from the portion that is held beneath the guide.

VENTILATOR.—R. F. Hunter, Bellefonte, Pa. The ventilator is self-regulating, and will admit an ordinary current of air, but prevents the entrance of strong currents. An ordinary current of air passing in an upward direction will have no effect on the damper, but should a stronger current take place, the damper will be swung into a position depending upon the strength of said current, a strong one completely closing the damper. Means are provided for diminishing the circulation of dust.

SOLIDIFYING PROCESS FOR INGOTS.—E. P. Cuinat, Steel Works, Unieux, Loire, France. This process is for use in solidifying ingots having a fluid interior which consists in spraying the side walls thereof to produce a sudden cooling, and to form a hard external shell, and simultaneously pressing said shell inwardly upon the soft interior to weld together the inner parts of the opposing side walls at a high temperature.

DENTAL IMPLEMENT.—C. C. Murray, Huntingdon, Tenn. Mr. Murray's invention is an improved implement or tool for use in inlay work. In carrying out the invention he employs a hollow conical metal body having a hole in the apex for reception of the pin which is to hold the wax model, and the body of the cone is provided with a handle and a clasp adapted to secure the pin detachably.

TUBE.—P. J. Grouvelle, E. H. Arquembourg, and L. J. Joret, 71 Rue du Moulin Vert, Paris, France. The invention comprises a tube having gradually decreased capacity from its ends toward its center, the sides of the tube having depressions, the cross sectional area of which gradually increases toward their longitudinal center. The mode of manufacture consists in producing the contracted or minimum section of the square tube by inwardly stamping the face of this tube according to a predetermined shape.

CHARGE FOR USE IN TREATING IRON AND STEEL.—M. L. Bricker, Cleveland, Ohio. More particularly the invention involves a novel charge or flux designed to be added to the molten iron or steel, and which will serve to increase its fluidity, drive off sulfur and other impurities, and to render castings made from the iron or steel stronger, of closer grain and without blow-holes often occurring.

BUCKLE.—J. F. Young and F. A. Libby, Morristown, N. J. This invention is an improvement in buckles, more especially designed for use in the traces of harness, heavy straps, and other stiff materials in connection with which buckles are used. It is often difficult to withdraw the free end of a strap of this nature from the keeper and disengage it from the tongue of the buckle in view of its small flexibility. The improvement overcomes this difficulty.

FILE-WRAPPER.—W. R. Harris, Louisville, Ky. The invention is particularly useful in connection with vertical filing systems. It relates to wrappers which comprise backs and covers, between which the papers to be filed can be inserted, and which have removable, centrally-disposed means for fastening the papers to be filed in position. The wrapper prevents the loss of the papers to be filed, keeps them smooth and in good condition, and papers can be filed in it with rapidity and ease. It is of large capacity and is well adapted for use in connection with vertical filing systems.

THAWING-POINT.—A. H. Hakes, Fairbanks, District of Alaska. Means are provided in this invention to force the free end of a hose down tightly into contact with the side of the thawing point to make a steam-tight joint. The point of the thawing-point is inserted in the frozen gravel, driven into the gravel by blows on the striking head, steam meanwhile being admitted through the hose and the opening to the point of the thawing point. After thawing the clamps may be removed from the point and said point left in the gravel until dug out.

SAFETY-RAZOR.—J. H. Flagg, New York, N. Y. The special objects here are to provide a form of handle, whereby the razor may be more firmly held in any desired position: to provide an improved form of lather retainer disposed adjacent the blade but spaced therefrom, and to provide means for supporting the blade and holding it in place.

CAN ATTACHMENT.—R. Dow, Mansfield, Ohio. The invention has reference to means for opening tin cans and other receptacles, and has for its object to provide a novel means for opening sealed cans, which will not require any instrument of peculiar construction by which it may be operated.

Hardware.

SQUARE.—L. V. Shepherd, Los Angeles, Cal. In this square the legs or members are separably connected with each other to allow carpenters, machinists and other mechanics using the square to readily employ the same for its legitimate purposes, and to permit of detaching the members for carrying the same conveniently in a tool chest or the like. The invention is such as shown and described in Letters Patent of the U. S., formerly granted to Mr. Shepherd.

MEASURING-LINE.—G. H. Prier, New York, N. Y. The purpose here is the provision of eyelets or openings at points along the length of the tape or line, said openings comprising end or outer openings and intermediate openings, the latter being arranged in two pairs, with the openings of each pair spaced apart a distance sufficient to permit their being brought into register and forming the tape, when the end openings are in register, into a triangle, ordinarily a right-angle triangle.

HOSE-COUPLING.—B. Morgan, Newport, R. I. The invention has reference to fastening devices in which a band is employed for encircling the parts to be fastened, and having a shoe at one end thereof and threaded for the reception of a nut at the opposite end thereof, said nut engaging with the shoe to hold the ends of the bands together. It is adapted for use in connection with bodies of various diameters.

PLUMB-BOB AND CHALK-LINE HOLDER.—W. N. Cavileer, San Francisco, Cal. The aim of the improvement is to produce a device having means for operating the reel which is contained in the body of the bob, and upon which the cord winds, and to provide an arrangement whereby the part which rotates the reel may be used as a fastener for the line or cord.

Heating and Lighting.

PRISM FOR ELECTRIC LAMPS.—J. C. Zubli, Seattle, Wash. The invention relates to electric lamps used for decorating and illuminating purposes for signs and the like, and the object is to provide a prism for electric lamps, arranged to utilize the rays of light of the electric lamp for giving a brilliant effect.

GAS-PRODUCER.—P. G. Schmidt, Tumwater, Wash. The object of the inventor is to produce an apparatus wherein the depth of the fuel in the decomposing zone of the producer may be regulated, while retaining the same relation between the decomposing zone and the distillation zone and without interrupting the operation of the producer.

ELECTRIC-LAMP SOCKET.—V. E. Extrom and C. H. Grundy, Tomahawk, Wis. The purpose of the invention is to provide a construction for a socket, which will serve to control the flow of current to two lamps by the turning movement of a single key, and thus effect the lighting of either one of two lamps, light both lamps simultaneously or extinguish them together or successively as desired.

REGULATOR FOR PRODUCERS.—P. G. Schmidt, Tumwater, Wash. In this patent the improvement is in regulators for producers and is especially adapted for use in gas producers, and is designed to automatically regulate the admission of air, water, steam, and inert gas to the producer and to properly proportion the mixture.

GAS-PRODUCER.—P. G. Schmidt, Tumwater, Wash. The object of the present invention is to provide an apparatus to be used in gas producers, to remove the products of distillation from the parts of the producer not in the direct line of draft and outside of the zone of decomposition, and to conduct the products into and through such zone.

BURNER.—G. Cosmovici, Bucharest, Roumania. In this instance the invention relates to burners for use in burning fuels, and more especially crude petroleum and its residues in furnaces whereby both the fuel and the sucking medium (steam, air, or the like) are supplied by two superposed chambers.

Household Utilities.

HAT AND COAT RACK.—E. L. Pitts, Yuma, Ariz. Ter. By varying the combination of the guide slots the key of one lock will not operate any other and by changing the position, number and grouping of the slots, combinations can be run to hundreds. Lock and key are correspondingly lettered or numbered so that when one hangs a hat, coat, umbrella, etc., on the hook and pulls down the arm he can remove the key and keep it as a check. In removing garments insert the key, push back the main plate and raise the arm. The key will then be held in the lock until the arm is again adjusted to the locked position.

FLOOR-OILER.—A. Weber, New York, N. Y. One purpose of the inventor is to provide a device particularly adapted for oiling floors, so constructed that when a valve is opened controlling the outlet of oil from a reservoir that is a portion of the device, the oil flowing from the reservoir will be distributed to an absorbent rubber which in turn evenly distributes the oil over the floor surface.

AUTOMATIC ASH-SIFTER.—E. J. Deegan, New York, N. Y. The invention is an ash sifter of simple and convenient form, wherein the nuisance due to flying ash dust is abated so far as practicable, and in which a large proportion of coal and cinders remaining in the ash is extracted by the automatic action of the device.

PAN-LIFTER.—D. S. Gossett, Plover, Iowa. This lifter is such as used in removing hot pans or the like from a cooking range. The inventor's object is to provide a device very simple in construction and which can be quickly applied and removed, and which operates to hold itself in engagement with the pan after having been applied.

BALL-COCK.—F. Clark, New York, N. Y. In this patent the invention has reference to ball cocks such as are used in connection with flush tanks. The object of the improvement is to provide a construction which will enable the valve or cock to operate effectively and substantially noiselessly.

Machines and Mechanical Devices.

AUTOMATIC REFILLING APPARATUS FOR PRESSURE-TANKS.—T. P. Ford and T. B. Ford, New York, N. Y. The invention relates to sprinkling systems for buildings, and its object is to provide an automatic refilling apparatus for pressure tanks, arranged to automatically keep the overhead water tank supplied with water, and to maintain a predetermined pressure on the water in the tank.

CALCULATING DEVICE.—S. B. Lamb, St. Louis, Mo. The invention pertains to devices particularly adapted for quickly and accurately ascertaining the amount of wages or amounts to be paid to employees, and where the scale of wages and the amount of time of employment varies. It can be readily used in connection with time sheets, or a timekeeper's book.

LET-OFF MOTION FOR LOOMS.—H. Herzberg, New York, N. Y. The purpose of the invention is to provide an effective and durable tension device readily applicable to the head of the warp beam of any loom, and which can be quickly and conveniently set to regulate the rapidity at which the warp thread shall leave the warp beam.

CROWN FOR THE WINDING-STEMS OF WATCHES.—H. Axtell, Berkeley, Cal. The object of the inventor is to provide details of construction for the crown and connecting portions of the winding stem, which will reliably indicate when the main spring of the watch is wound up, and prevent breaking of said spring or injuring the winding gears.

LATHE.—A. Schlesinger, Decd., H. Schlesinger, Administrator, Werdohl, Germany. In this patent the invention has for its object a lathe in which two oppositely situated tools or groups of tools become operative alternately upon the forward and rearward movement of the lathe saddle and upon the alternate right and left-hand rotation of the spindle.

CUTTER AND SCORER.—S. M. Langston, Camden, N. J. This is an attachment for machines adapted for use in subdividing cardboard, strawboard, or the like, or in providing the same with weakened lines, whereby it may be folded readily. The invention relates more particularly to that type of attachment in which there is employed a clamping block adapted to be secured to the machine, a frame adjustably secured to the clamping block, and a cutting or scoring disk or wheel carried by the frame.

TORPEDO-LAUNCHING TUBE. — A. E. Jones, Fiume, Austria-Hungary. In the present patent the invention has reference to a safety device for use in launching torpedoes and has for its object to simplify the manipulation of the tube, this being reduced to the opening and the closing of the breech and to acting upon the firing handle.

GLASS MACHINE AND PROCESS.—E. L. Heintz, Coffeyville, Kan. The invention relates to the art of glass making, and the object is to produce a process and apparatus by means of which a glass sheet may be drawn from a mass of molten glass in such a way that the smoothness and uniformity of the sheet of glass will be preserved throughout its entire area.

TYPE-CHECKER. — W. H. Kolvenbach, New York, N. Y. In the present patent the invention has reference to type-checkers, the more particular object being to produce a device somewhat similar in its action to a typewriter, but used for the special purpose of making out checks and the like, and of preserving a record of the same.

PRINTING-PRESS FOR SIMULTANEOUS PRINTING WITH DIFFERENT COLORS.—C. A. LINDMAN, Södergatan 28, Helsingborg, Sweden. The invention refers to a device for printing-presses of the kind for use in printing with different colors at one impression. It is especially intended for rotating presses such as are employed for printing newspapers, and by the use of the invention it is possible, in a simple manner, to insert colored, and therefore particularly conspicuous, advertisements or notices in any part of the newspaper.

SOUND-REPRODUCER.—R. B. SMITH, New York, N. Y. The objects in this case are: To keep the stylus levers true in relation to the record grooves; to mount the stylus levers upon universal joints the axes of which are disposed in different planes crossing each other in a manner favorable for correct movements of the stylus levers; a lessening of the friction of the stylus levers in their respective mountings; and, to simplify the construction and improve the general efficiency of the same.

ARTIFICIAL HAND.—A. F. NELSON, Renton, Wash. Specifically, this invention relates to an artificial hand having a frame comprising an upper arm sleeve or section, and a forearm sleeve or section to which is attached a hand, including both fingers and a thumb together with mechanism controlled by the relative movements of the forearm and the upper arm, for contracting and releasing the fingers and the thumb.

SLICING-MACHINE.—J. F. NELSEN, Milwaukee, Wis. The invention pertains more especially to slicing machines for use in slicing meat or the like, which is constructed to be manually operated and which has a table for use in receiving the meat and a cutter slidably arranged in a frame adjacent to one side of the table and adjustable to vary the thickness of the slices.

PHOTO-EXPOSURE METER.—S. PRATT, Pasadena, Cal. In the present patent the invention has reference to instruments for use in measuring the degree of exposure to light, for instance, in photography, the more particular purpose being to provide a number of uses and involving a minimum of mechanical parts.

COMBINATION-LOCK.—C. H. COHN, New York, N. Y. The lock is readily operated by throwing the bolt and having improved means for holding the bolt in its locked or unlocked position. The case of the lock containing the lock mechanism may be readily removed and replaced in position and in connection with the operating members of the knob which controls the operation of the lock.

Prime Movers and Their Accessories.

ROTARY ENGINE.—A. J. CHARLTON, Bennett, Iowa. This invention is more particularly intended for rotary internal combustion engines. The inventor seeks to improve the form of the rotor and coacting swinging vanes with corresponding casing or cylinder. A gasoline tank connects with an air compressing pump to supply the air for the explosion mixture and is operated by an eccentric or the like on the engine shaft.

ROTARY ENGINE.—F. M. WHITMAN, Tucson, Ariz. Ter. The object of this invention is the provision of a rotary engine arranged to permit convenient reversing and to utilize the motive agent to the fullest advantage. It is not liable to easily get out of order, and can be readily reversed at any time by the operator simply manipulating a hand-lever.

ROTARY ENGINE.—H. C. SCHAEFER, El Paso, Texas. More particularly the invention refers to that type of engine in which there is provided an outer casing or cylinder, and an inner rotatable body eccentrically mounted in respect thereto, and having a sliding blade held in engagement or closely adjacent to the inner surface of the casing or cylinder.

MOTOR.—J. SCHROEDER, Davenport, Iowa. The motor embodies in its construction an oscillatory cylinder provided with a working piston, and having valve-controlled means for use in alternately admitting and exhausting the motive fluid to and from the cylinder at opposite sides of the piston, the valve being preferably actuated from the piston through the usual driving by a segmental gear in mesh with a pinion fixed to the valve and provided with a radial arm through which a valve-rod is slidable, having stop collars.

TURBINE.—A. PETTICORE, Sedro Woolley, Wash. The aim of the invention is to provide improvements in the means for controlling the escape of the fluid, and also in the means whereby the fluid after impacting at high pressure with one rotor may flow through a second nozzle in a partition plate to impact with a second or low pressure rotor.

ENGINE.—R. J. A. PRINCE and J. N. PRINCE, St. Boniface, Manitoba, Canada. The purpose of the invention is to produce a type of engine in which a plurality of pistons are movable relative to each other in a single cylinder, for the purpose of applying power to more than one point upon the shaft, thus effecting an economical use of the expansive medium, avoiding excessive lost motion and attaining many advantages in construction and operation.

Pertaining to Recreation.

GAME APPARATUS.—J. BAUST, New York, N. Y. The construction comprises two members, one fixed, the other supported to axially turn, each having ring-supporting pins normally projecting toward the pins of the other member, with the pins of the fixed member arranged for the carrying of rings preparatory to their passage to the turning member; pins arranged below the members and means for holding the turning member in normal position adapted to be overcome by the weight of the rings and deposit the same on the last-mentioned pins.

PORTABLE FISHING-CASE. — W. H. THORNTON, Crossett, Ark. The invention relates more particularly to such fishing cases as are provided with a receptacle for carrying such tackle as reels, hooks, leaders, or the like, and a cylindrical case mounted thereon and adapted to receive the several sections of a jointed fishing rod.

GAME-BOARD.—A. A. STOCKER, Monroe, Wis. The invention relates to game boards wherein cavities are formed to be occupied by balls rolled by players, the value of the pockets entered determining the score by each player. The game affords amusement and also is useful as an educator in mental arithmetic.

Pertaining to Vehicles.

VEHICLE.—J. W. P. BOETTCHER, Elizabeth City, N. C. The invention is intended particularly for embodiment in buck-board vehicles. Above the buck-board body on a suitable post at about the center, a rocking frame is pivoted on which forward and rear seats are provided between which frame and the rear drive wheel sprocket and chain driving mechanism is provided comprising sprocket and chain and a ratchet and pawl mechanism so arranged that a forward or reversal movement of the vehicle is produced according to the direction in which the seat frame is rocked.

TRUCK.—W. P. RACHAL, Lake Charles, La. The invention comprises a main truck, and an upper platform truck mounted thereon, and articles can be loaded on the latter and rolled from the truck to the car or vice versa at a single operation without handling every piece or article individually, the loaded or unloaded main truck being backed up to the car door so that the platform truck can be rolled on or off the same without being unloaded.

LOCKING WHIP-SOCKET.—C. W. MAYHUGH, Atchison, Kan. In this instance the purpose is to provide a construction for a whip-socket, which may be used for holding the butt end of a whip stock, permitting the whip to be removed for use, and by a quick adjustment of a single part lock the stock in the socket and prevent its removal until the locking mechanism is released by the use of a suitable key.

VEHICLE-WHEEL SLED-RUNNER. — J. KARSSEN, Holland, Mich. This improvement refers to a runner of the type adapted to be secured to the tire of the wheel to which it is applied and wherein the wheel is gripped laterally by the runner-supports while the wheel-tire is carried thereby. The object is to provide a runner which may be applied to a vehicle-wheel with facility.

BARREL-CART.—P. C. JORGENSON, Ledyard, Iowa. The invention relates to carts which are adapted to be used for the transportation of barrels. By a very simple method the parts are so adjusted that a barrel will be closely fitted to the barrel supporter, which is pivoted to the standards of the cart. At any time the device may be used without the cross-bar by readjusting the parts so that the ring will fit a barrel just below its center.

PICK-UP CART.—P. C. JORGENSON, Ledyard, Iowa. The cart is for use, among other purposes, for building and repairing barbed wire fences. Reels of wire may be carried, and at the same time tools and implements may be conveyed in the box, and with the same wheels and standards many similar reels and boxes may be conveyed to places where wire and tools will be of service. The cart may be used to carry materials of all kinds in the boxes, and the rope and other material may be wound on the reel, as may be desired.

VEHICLE-WHEEL.—C. E. HARRIS, Carbondale, Colo. The object of the inventor is to provide a wheel having resilient means for absorbing radial and tangential shocks. One purpose is to provide a wheel having a hub, around the hub a spaced spoke-ring, and intermediate the hub and the ring a pneumatic or cushion shock supporter.

Railways and Their Accessories.

RECORDING - ANNUNCIATOR. — W. B. WOODRUFF, Cadiz, Ky. The intention in this case is to provide a recording sheet driven by a clock, and a recording mechanism driven by the car and operating upon the sheet, the mechanism being provided with indications corresponding to the data to be recorded on the sheet, and being geared to bring the indications into position for recording, at the time the car reaches the point on the road to which the data pertain.

CHAFING-IRON. — V. LABADIE, Dallas, Texas. This invention is a chafing iron for use in vestibule passenger cars, and its object is to provide a device of this character of a construction in which danger of passengers being injured by passing their fingers, hands, etc., between two of such plates while the car is in motion will be eliminated.

SPARK-ARRESTER.—F. J. PIERCE, McCook, Neb. The arrester is arranged to completely arrest the sparks and cinders while the locomotive is running, and means allow of conveniently and quickly cleaning the arrester of sparks and cinders at any time and at the will of the engineer, and using the exhaust steam for drawing the cinders against the arrester or arresting the cinders and for removing the cinders from the arrester for cleaning purposes, the arrangement also permitting of opening the arrester for free draft when firing up.

MINE-CAR WHEEL.—J. T. PARKS and M. T. DAVIS, JR., Charleston, W. Va. The novel features of the wheel reside in the mode of detachably securing the wheel to the axle spindle, and to the lubricating arrangement. The spindle has an annular groove near its outer end and the wheel has a hole leading laterally to the bearing for receiving a pin that enters the groove of the spindle; the pin is held in place by a screw plug. The hub is hollow to form a lubricant chamber and holes lead from the chamber to the bearing.

MEANS FOR FASTENING IN POSITION RAILWAY-SPIKES OR THE LIKE.—G. LAKHOVSKY, 5 Avenue du Bois de Boulogne, Paris, France. The present invention pertains to a metallic filling constituting a kind of divided nut adapted to fix itself in railway sleepers to receive the ordinary spikes employed either for retention of broad-footed rails or for fixing in position the chairs which receive double-headed rails.

SPARK-ARRESTER.—J. E. KNIGHT, Bellingham, Wash. The purpose of the invention is to provide an arrester, that affords an adjustable canopy over the exhaust pipe in the smokestack of a locomotive or other portable engine, whereby a concave deflector is afforded, which is connected with a spark-conductor for the transfer of sparks from the smokestack to a point of discharge, and that, when not in service, may be contracted in diameter so as to afford a draft passage of increased area when fuel combustion is to be effected by the natural draft of the stack.

TRACK-STRAIGHTENER.—M. E. LOEHR, Claypool, Ala. In view in this case is the combination of a cable, a member composed of two principal sections threaded together, one designed to be applied to a rail the other to a cable, clamps for engaging the rail at opposite ends of the cable and having means for locking them to the rail when the cable is placed under tension, and oscillatory means operable in both directions of its movement to separate the sections of the member and force the rail and cable apart.

LOAD-CONTROLLED BRAKE.—J. B. GRAY, C. J. GRAY, and S. B. GRAY, Ottawa, Kan. In view in this invention is the provision of supplementary means for shifting the fulcrums of the braking or floating levers, to compensate for the difference in power required to check the speed or bring the car to a stop when in loaded and unloaded conditions. To this end a device has been constructed, automatic and positive in action, which may be applied to the well-known types of brakes now in use.

TORPEDO-PLACER.—E. P. S. ANDREWS, West Windham, N. H. The invention relates more particularly to such placers as are adapted for the placing of torpedoes or other detonating signals upon the tracks while trains are in motion, and which include supports adapted to be secured on a car and having shoes for engaging the rails, the supports and the shoes acting as guideways to position the torpedoes on the tracks.

LOCOMOTIVE ELECTRIC ALARM SYSTEM.—G. NOREAU, Quebec, Canada. The invention relates to details of construction whereby the efficiency of the signaling mechanism is greatly increased. In operation each engineer before starting tests his local circuit. As two locomotives approach each other, and arrive upon the same portion of the third rail, the means provided complete a circuit which rings the bells upon both, and the warning gives the engineers time to prevent a casualty.

DIE FOR SHAPING COMPOSITION PLATES.—J. P. WRIGHT, Newark, Del. This inventor molds the plate into an article which is purposely distorted in order that the natural tendency inherent in the plate to straighten out, may correct the distortion and leave the finished article as nearly as possible in its ideal shape. It is difficult to confer upon the finished plate the exact form needed, as in one plate distortion is greater than in the other. He finds, however, that it is highly practical to so form the plates that their shapes will be sufficiently near perfect to give great satisfaction.

Designs.

DESIGN FOR A FINGER-RING.—A. LOCHER and E. C. KELLY, New York, N. Y. In this ornamental design, the finger-ring is extremely diversified in its edges, owing to the forms of a cross, a seal marked I. H. S., one with pincers and hammer, etc.

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.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

(12005) H. M. K. asks: What is the chemical composition of wood, bituminous and anthracite coal, and natural and artificial gas? Is the composition of natural gas the same in the various gas-producing rocks and fields? How and in what proportion should natural gas and air be combined in order to create the most heat? Please explain this combination, and also the formation of the new compounds (and elements, if any) giving also the proportionate amounts. Is it possible for the air mixer to allow too much air to mix with the gas? How and in what way in the process of burning is heat made? Most stoves are made so that the gas and air mix before combustion, but in some stoves they do not. Is it possible to get the same amount of heat from 1,000 feet of gas in each case? Does the draft of the stove or the pressure of the gas burnt affect in any way the proper mixture of the gas and air by the mixer? What is the color of the flame in perfect combustion, and why should the color be different in imperfect combustion? What are the evil effects produced by burning gas without a flue connection? A. We may state that the chemical composition of anthracite coal is as follows: Carbon, 86; volatile hydrocarbons, 4; ash and moisture, 10. The composition of bituminous coal varies very greatly, but as a general average we would give the following: Fixed carbon, 65 to 45; volatile hydrocarbons, 25 to 45; ash and moisture, about 10. Wood kiln dry: Carbon, 50; hydrogen, 6; oxygen, 41½; nitrogen, 1; ash, 1½. Natural gas: Marsh gas, 93; hydrogen, 1 8/10; nitrogen, 3 2/10; other gases, 2. Coal gas: Marsh gas, 40; hydrogen, 46; carbon monoxide, 6; small quantities of other gases, 8. The chemical composition of all of these varies in different localities, but the above figures may be regarded as giving an approximate average. Natural gas and artificial gas both burn with the best results when they are both mixed with air in just the right proportion to give perfect combustion. The best mixture of air and coal gas is one part of gas to about five to seven parts of air measured by volume. The proportion with natural gas is about the same. It is possible for the air mixer in a burner to admit too much air. In the combustion of gas or solid fuel the hydrogen combines with the oxygen of the air to form H_2O, and carbon in the fuel combines with the oxygen of the air to form CO_2. This union of hydrogen or carbon with the oxygen of the air is what produces the heat. It is better to mix the gas and air before combustion, but it is possible to get perfect combustion if this is not done. It is also possible to get perfect combustion regardless of the pressure of the gas or draft on the stove, and so long as the combustion is perfect the same amount of heat is produced. Where the gas and air are mixed before combustion the flame is apt to be nearly colorless, and when they are not so mixed the flame is apt to have considerable color, especially if there is much carbon present in the gas. Where there is no flue connection the products of combustion escape into the room and vitiate the air.

(12006) J. M. C. asks: In all articles I ever read I have gotten the idea that a dynamo of a given current (say 10 amperes) could be run at any voltage, say 14, 25, 52, 75, or 110, and give out 10 amperes, provided lamps in circuit called for that amount. In fact, my idea has been that I could use eight 14-volt, eight 25's, eight 52's, ten 75's, or sixteen 110's, voltage varying with speed, but amperes still the same if lamps call for it. You see I figure eight amperes in circuit (about) in all the voltages, leaving 2 amperes for variation of excitation. Am I right or wrong, yes or no? A. The voltage of a dynamo depends upon the speed of the armature, which determines the number of lines cut per second. The amperes depend upon the resistance of the circuit, internal and external. If you have a resistance which allows 10 amperes to pass without overheating, you can within the limits of safety vary the speed and so the voltage, and the same 10 amperes will flow. But it is not possible to have such a range of voltage as you mention. To change from 14 to 110 volts requires eight times the speed of the armature. No armature could stand the centrifugal force of such a speed. The proposition as you make it is not practicable.

(12007) J. C. writes: I am making a flying machine, and have all complete with the exception of power. I am trying to use rubber bands, but cannot get the necessary power. My machine is about 6 feet long, and weighs about 7 pounds. Now, if you can help me out, you would be doing a great favor to one of your constant readers. A. With a properly designed aeroplane model you should lift about ½ pound with each square foot of surface. Elastic bands will hardly be powerful enough for a model of this size, but we think that a ½ to 1 horse-power small steam engine would more nearly answer the purpose. We can give you the address of the maker of such an engine upon application.

NEW BOOKS, ETC.

The Principles of Alternating Currents. By Edgar T. Larner, A.I.E.E. New York: D. Van Nostrand & Co., 1908. 12mo.; pp. 136; illustrated. Price, $1.50.

The man who is familiar with the mechanical and practical side of electricity, but who has not had a technical college training, is decidedly at a disadvantage in studying the principles of alternating current, owing to the scarcity of books on this subject which are not filled with complex and involved mathematics. In the preface of the present work the author states that his aim is to furnish this class of men with a non-mathematical treatise on alternating currents, but the difficulty of the task he has set out for himself is apparent on looking over the pages of the book. Undoubtedly, the use of mathematics has been reduced considerably, but nevertheless the student must be familiar with algebra and trigonometry before understanding this work. A valuable feature of the book is to be found in the exercises at the close of each chapter, which if worked out by the student will give him concrete practical examples of the principles enunciated in the preceding chapter.

Radio-Telegraphy. By C. C. F. Monckton, M.I.E.E. New York: The Van Nostrand Company, 1908. 8vo.; pp. 272; 173 figures. Price, $2.

The remarkable advances in wireless telegraphy made since the first practical application of Hertzian waves twelve years ago, have been so rapid that it has been difficult to keep pace with them. For this reason there have been many books written on this subject. The present work brings the practice up to date in a fairly comprehensive manner.

Electric Motors. Their Installation, Control, Operation, and Maintenance. By Norman J. Meade. New York: McGraw Publishing Company, 1908. 12mo.; pp. 159; 126 figures. Price, $1.

This book is particularly adapted to assist the practical man in the care and management of electric motors. The theory of electric motors is explained, and the various types are classified. The most useful part of the book is the chapter on Operating Hints, in which various handy suggestions for the care of the machines are given. Following this is a chapter on repairs, which explains how best to mend breaks and overcome defects that may arise in actual practice. The last chapter contains tables and formulas which are indispensable to the practical man. Mathematics have been almost entirely eliminated from the book.

How to Understand Electrical Work. By William H. Onken, Jr., Associate Editor of the Electrical World, and Joseph B. Baker, Technical Editor U. S. Geological Survey. With Dictionary of Electrical Terms by Joseph H. Adams. New York: Harper & Bros., 1908. 8vo.; pp. 359; illustrated. Price, $1.75.

Electricity is so much a part of every-day life that it is perfectly natural for the modern American boy to take a keen interest in every phase of the subject. The present work aims to answer all the questions the boy is liable to put. The subjects dealt with comprise not only the generation of electricity and its use for lighting, heating, power, and traction purposes, but also electricity in the home, on the farm, in the hospital, on board ship, and in various industries. The book also gives a chapter on Transmission of Intelligence, under which heading are included the telephone, telegraph, wireless telegraph, telautograph, etc. The Dictionary of Electrical Terms and Phrases makes a very useful appendix to the work. The book is copiously illustrated, diagrams being given where necessary to explain the arrangements of electrical circuits.

The Elementary Theory of Direct-Current Dynamo-Electric Machinery. By C. E. Ashford, M.A., and E. W. E. Kempson, B.A. Cambridge: University Press, 1908. 12mo.; pp. 120; 75 figures. Price, $1.

The aim of this work is to explain the underlying principles of direct-current dynamos in such a logical way that one is able to gain a comprehensive knowledge of the whole subject. The statements which are made are backed up with evidence, so that one is able to understand the cause of the various phenomena described. Thus the student will be prepared to deal with new types of machinery which are constantly being brought out, owing to his thorough grounding in the main principles.

Artificial and Natural Flight. By Sir Hiram S. Maxim. New York: The Macmillan Company, 1908. 12mo.; pp. 166; 96 illustrations. Price, $1.75.

This is a very interesting and readable volume, containing many of Sir Hiram's observations and investigations into the subject of soaring and mechanical flight. An elaborate preface and introductory chapter is followed by a chapter on air currents and the flight of birds, in which the author attempts to show that the soaring flight of birds is due largely to ascending currents of air. At the end of this chapter there is a table giving the weight in pounds for each square foot of wing surface of various well-known birds. One of the most interesting and valuable chapters is that devoted to air propellers, in which some of the fallacies of inventors regarding these are shown, and some of the best forms of propellers are described. In another chapter giving hints on the building of flying machines, there is a table giving the actual and relative strengths of different kinds of wood which can be used. Sir Hiram also deals with tests of different aeroplane surfaces, and shows which are the most efficient, while there is also a chapter on "The Action of Aeroplanes and the Power Required Expressed in the Simplest Terms," in which a number of diagrams illustrate the way the air is supposed to act upon different curved surfaces. One of the closing chapters is devoted to some of the recent aeroplanes, and there is an appendix containing a description of Sir Hiram's aeroplane and the experiments therewith. We recommend this book heartily to all those interested in aeronautics.

Electrical Illuminating Engineering. By William Edward Barrows, Jr., B.S., E.E. New York: McGraw Publishing Company, 1908. 8vo.; pp. 216. Price, $2 net.

Illuminating engineering is a comparatively new branch of applied electricity, and few good books on the subject have been written. For this reason the present work will be appreciated. It is based on notes compiled by the author for use in his classes, and it makes an excellent textbook for the student of illuminating engineering.

The British Journal Photographic Almanac and Photographer's Daily Companion for 1909. Edited by George E. Brown, F.I.C. London: Henry Greenwood & Co., 1908. New York: George Murphy, Incorporated. 16mo.; 1336 pages (text and ads.). Price, $1.

This is always a welcome visitor with its vast collection of formulæ and valuable articles. It grows bigger and bigger every year, and is twice as large as the volume of 1887, which we have before us. Even the latter with its 360 pages seemed large in those days.

The Book. Its History and Development. By Cyril Davenport, V.D., F.S.A. New York: D. Van Nostrand Company, 1908. 12mo.; pp. 258. Price, $2.

The author begins his subject with rock inscriptions, and then follow marks on wood, Indian palm-leaf books, ideographs, and alphabets. The physical side of the book—its anatomy—is then considered. This is in turn followed by chapters on paper, printing, illustrations, bindings, etc. This book is one of the "Westminster Series," the volumes of which give much information which is either not available to the general public, or if available, is widely scattered.

Masonry and Reinforced Concrete. By W. L. Webb, C.E., and W. H. Gibson, C.E. Chicago: American School of Correspondence, 1909. 8vo.; 444 pp.; fully illustrated with photographs and diagrams. Price, $3.

This work, symmetrical with other textbooks of the Chicago School, discusses fully the materials used in masonry and ferro-concrete work, and their requisite qualifications, methods of testing, and simple formulæ for the calculation of all ordinary strains and stresses. Clear instructions are given for the obtaining of various special finishes and for the care in handling and placing upon which the success and permanence of all concrete work so much depends.

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Pipe joint, flexible, C. H. Jenkins	910.687
Pipe system testing plug, J. Simon	910,966
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Planter attachment, J. K. DeJong	910,793
Planter marker, corn, D. Loudenslager	910,831
Plow, J. Buchanan	910,496
Plow, A. G. Erickson	910,803
Plow, O. Fischer	910,999
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Plow, sulky, G. Warner	910,752
Pocket holder for hand bags and similar receptacles, T. F. McMahon	910,713
Polishing machine, felly, O. Allen	910,634
Pool register, pin, N. A. Archibald	910,769
Post mold, C. S. Wert	910,620
Potato digger, W. Strait	910,601
Power transmitting mechanism, F. Bucherer	910,901
Power transmission gear, J. H. Williams	910,623
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Printing machine feeding and separating apparatus, M. H. Mann	910,557
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Printing press, rotary, F. M. Turck	910,610
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Pulley, H. J. Gilbert	910,527
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Pump, Enos & West	910,802
Pump, cleaning, R. L. Dutton	910,516
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Rail joint, G. A. Weber	910,618
Railway, J. J. Martin	910,559
Railway air brake safety hose coupling, K. Rath	910,579
Railway and vehicular device for purposes of amusement, P. Marshall, et al	910,702
Railway crossing, W. Corliss	910,786
Railway signaling mechanism, L. H. Craft.	910,911
Railway tie, G. S. Denglar	910,512
Railway tie, R. H. Fishbaugh	910,521
Rake tooth, steel, W. Kouns	911,017
Rat trap, C. M. Harrington	910,532
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Razor strop, F. L. Pinney 910,855,	910,856
Razor strop, E. E. Deputy	910,916
Razor stropping device, W. J. Miles, Jr	910,563
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Sash lock, H. H. Akers	910,482
Sash lock, W. E. Petrie	910,850
Sash lock, C. L. Gano	911,004
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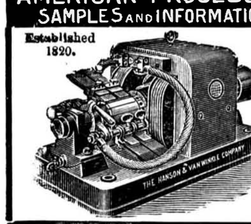

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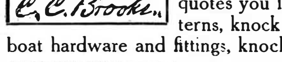

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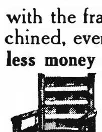

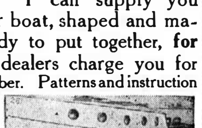

I can also sell you semi-built Mission furniture shipped you flat **in sections,** not in pieces, so you save two-thirds. Ask for Catalogue No. 7 showing our full line.

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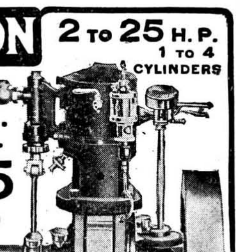

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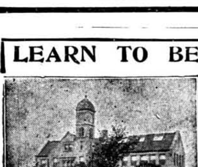

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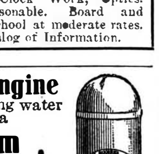

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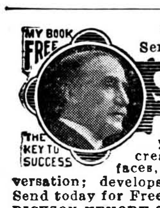

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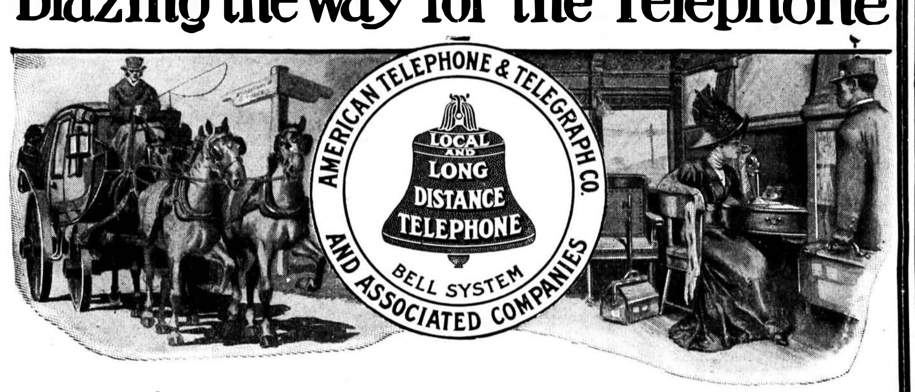

The World's Greatest Business Romance

FROM the stage-coach days of the Bell Telephone to the present—when one calls up from a Pullman attached to the eighteen-hour special in the Union Station at Chicago—is not a very long span of years. There are women whose youthful beauty has hardly faded who remember the first chronicled tests of the new Bell toy.

Remembering that date—1876—and all the marvelous development since, one fact stands out:

The companies comprising the Bell System have had no help. They have had to *invent* and *pioneer their way* from the very start, blazing the path for all the rest of the world.

The steam-boat and railway revolutionized methods of travel. The telephone took the place of nothing previously existing.

First, Alexander Graham Bell invented the telephone. His friend, Watson, enthusiastically prophesied that in 1900 there would be 100,000 telephones in use.

There are upwards of 4,000,000 instruments on the Bell lines now.

The first switchboard used by the original Bell Company was made of a piece of plank. For the whole period of development the Bell system has been building and throwing away switchboards by the millions of dollars' worth—blazing the way for America's wonderful telephone career.

The only company willing to pioneer the field had to invent the switchboard before any practical intercourse was possible. It had to invent the apparatus leading to and carrying from the switchboard.

Then it had to invent the business uses of the telephone and convince people *that they were uses.* It had no help along this line.

As the uses were created it had to invent multiplied means of satisfying them. It built up the *telephone habit* in cities like New York and Chicago and then it had to *cope satisfactorily* with the business conditions it had created.

It has from the start *created the need* of the *telephone* and then *supplied it.*

In all this pioneering and inventing, still going on, this company has had to *soundly finance* every undertaking, to keep its securities valuable as a basis of the immense credit necessary to build such a national institution on lines that would prove *universal and lasting.*

People who look upon the universal telephone of to-day as indispensable must look upon the universal telephone of to-morrow as even more so.

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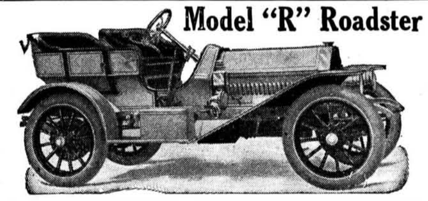
Model "R" Roadster



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—And that is just as true of an automobile as it is of any machinery you use in your business.
—Sometimes in the manufacturing business, it seems wise, for reasons of expediency, to buy cheaply. But there is too much demanded from an automobile to expect a cheaply bought car to give satisfaction even temporarily.
—As is the case with other machinery, when you are ready to part with it, you will find your cheap automobile nothing but a pile of junk and your pocketbook suffers by a many times multiplied percentage of depreciation.
—You should exercise the same common sense and business judgment in buying an automobile that you would use in any business investment.
—Don't be misled by the extravagant claims made for very low-priced cars—nor the claims made for a very high-priced car.
—The features of the GLIDE are revolutionary and distinctive when the price is considered. They are built in, made an integral part of the car.
—None of them are found in very low-priced cars. But few of them are found in very high-priced cars.

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—The power plant is a 4-cylinder (cast separately) 45 actual not theoretical) H. P. *Rutenber* engine. This is a grade *never found* in the widely heralded *low-priced* cars. The *price alone* makes it *possible* in the Glide.
—An improved form, selective type of transmission which *eliminates jerks* when *starting* and *jolts* when *stopping.*
—A bevel driving gear of *ample* size—held always in *mesh* by *its own special bearings.*
—Vanadium steel springs which do away with the need of *shock absorbers.*
—A double-hinged hood—power plant instantly accessible.
—An *improved* type of multiple disc clutch that *cannot* get *out of order.*
—A lubricating system which is *positive*—requiring *no* attention.
—A *double* set of brakes—*distinct* from the axle—internal expanding and external contracting—will hold the car on any grade.
—34 x 4½ tires all around—Wheel base—120 inches.
—All the features of the Glide are built in. It wouldn't be a Glide if it didn't have them *all.*
—There is no more graceful car made. Its appearance suggests strength, reliability and that quiet purposeful performance which gives it the name—Glide.
—Detailed information will interest you if you are seeking a standard car of the best type at a price fixed at the point of safety. Write us today. We invite comparison and an opportunity to demonstrate.

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