DEPREZ'S GALVANOMETER.

BY GEO. M. HOPKINS.

To rivet scientific facts in the mind, study and practice must proceed together. This is especially true in electricity, where a multitude of conditions are imposed for every phase of the subject.

No one can go very deeply in the study of electricity without reaching the subject of electrical measurements; certainly very little can be done in this direction without a galvanometer of some kind. Among all the galvanometers yet invented, there is perhaps none possessing all the good qualities of the one shown in the annexed engraving. It is very simple; the materials are inexpensive, no great mechanical skill is required in its construction; and its sensitiveness and accuracy are sufficient for the requirements of most electricians. Besides all this, it is perfectly "dead beat," so that no time need be wasted in waiting for the instrument to come to rest.

This galvanometer is the invention of M. Deprez, of Paris, France. It consists essentially of a rectangular coil of fine wire, suspended on strained torsional wires in a strong magnetic field.

To the base is secured, by means of angle plates, a compound U-magnet, 7 inches high, formed of three steel magnets, one-quarter inch thick, secured together and to the angle plates by bolts. The distance between the inner faces of the poles of the magnet is $1\frac{7}{16}$ inches. Two and three-quarter inches behind the center of the magnet a brass column rises from the base, and is provided near its center with an adjustable brass arm, supporting at its outer end, and exactly in the center of the space between the poles of the magnet, a hollow soft iron cylinder, $2\frac{1}{4}$ inches long, $1\frac{1}{32}$ inches in external diameter, $\frac{13}{16}$ inch in internal diameter. The top of this cylinder is even with the upper ends of the magnet. To the top of the brass column is secured, at right angles, an arm that extends over the hollow iron cylinder, and is provided with a vertical sleeve, in which is clamped a rod having on its lower end a small silver hook, arranged axially in line with the iron cylinder.

To a block attached to the base, opposite the center of the magnet, is secured a tapering spring, $\frac{1}{16}$ inch thick and $3\frac{3}{4}$ inches long, carrying at its free end a small silver hook, which is arranged in line with the axis of the iron cylinder.

A rectangular coil of No. 40 silk-covered copper wire, large enough to swing freely over the iron cylinder, is suspended by a hard-drawn No. 32 (0·008 inch in diameter) silver wire from the hook above, and is connected by a similar wire with the hook on the spring below. The upper wire is $2\frac{1}{4}$ inches long between its connections, the lower one $2\frac{3}{4}$ inches.

The sides of the rectangular coil are flat, being about $\frac{1}{8}$ inch thick and $\frac{5}{16}$ inch wide. The resistance of the coil is 150 ohms. The silver hooks are connected with opposite ends of the coil, in the manner shown in Figs. 4 and 5. Each hook is provided with a flat head, which is secured between two thick plates of mica, the shank of the hook projecting through a hole in the outer mica plate. Each pair of mica plates is secured in place on the coil by a winding of silk, which is coated with shellac varnish to prevent the plates from slipping. The hooks are arranged exactly in the middle of the ends of the coil, so that when the coil is supported in the position of use by the silver wires it will oscillate freely between the poles of the magnet and the iron cylinder. The terminals of the coil are soldered to the silver hooks. The upper hook is made a little more than a half inch long, to receive a small concave mirror (as shown in Fig. 4), which is secured in place by cement or wax. The mirror has a focus of 30 or 36 inches.

The relation of the magnet, A, the coil, C, and the iron cylinder, B, are clearly shown in Fig. 3, which is a horizontal section taken through those parts.

A glass shade protects the delicate parts of the instrument. The two binding posts which are outside of the glass shade are connected under the base with the brass column and the spring, so that the current passes from one binding post to the column, thence down the upper silver wire, then through the coil, the lower silver wire, and the spring to the other binding post.

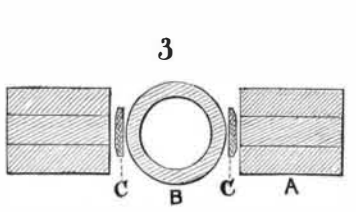
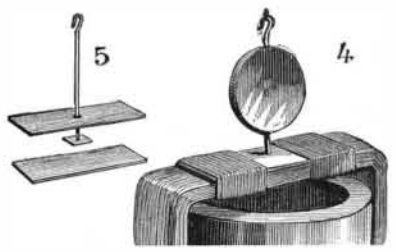


Fig. 3.—HORIZONTAL SECTION OF MAGNET, COIL, AND CORE.



FIGS. 4 and 5.—DETAILS OF DEPREZ'S GALVANOMETER.

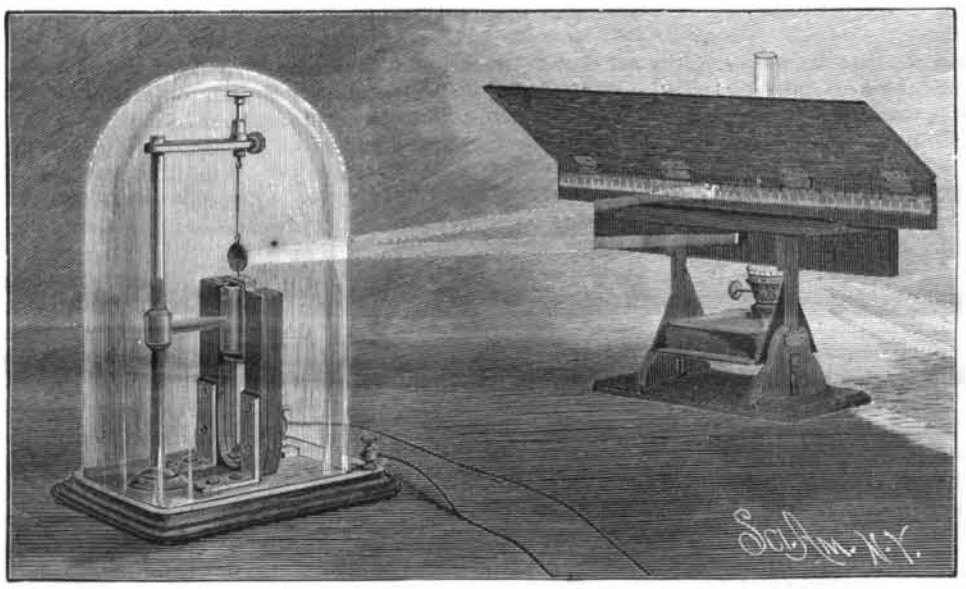


Fig. 2.—ARRANGEMENT OF GALVANOMETER AND SCALE.

The silver wires are placed under considerable tension, and the coil is adjusted to a central position by turning the hooked rod at the top of the instrument.

When an electrical current is sent through the coil, it tends to assume a position at right angles with a line joining the two poles of the magnet, the amount of displacement of the coil from its normal position depending on the strength of the current. As the deflection for a very light current is small, a beam of light reflected from the concave mirror is employed as an index. The scale is arranged as shown in Fig. 2, the light being projected from a lamp, supported at the proper height behind the scale, through a slit below the scale and on to the concave mirror. The mirror reflects the beam on to the scale. The mark at the center of the scale is 0, and arbitrary numbers, running upward regularly, are arranged on the marks on opposite sides of 0. The common paper scale used by draughtsmen answers for this purpose.

When the coil is at rest, the light spot remains at the center of the scale; but when a current passes through the coil, the beam moves steadily forward and stops without oscillation, the distance through which it moves depending of course, on the strength of the current. The coil is returned to its normal position by the spring of the silver wires.

By employing shunts in the usual way, heavy currents may be measured by the aid of this instrument. The sensitiveness of the instrument is so great as to indicate a current when the ends of two No. 18 copper wires connected with it are placed on opposite sides of the tongue.

The coil is carefully wound over a form covered with paper, each layer of wire being varnished with shellac varnish as the work of winding progresses. When the coil is complete, the coil, together with the form, is heated in a warm oven until its varnish becomes hard throughout the coil.

The concave mirror may be purchased from the optician, or a very fair mirror may be made by cutting a small disk from a double convex spectacle lens of 60 or 70 inch focus, and silvering it. A simple and quick way of silvering a small surface consists in scraping from the back of a piece of ordinary looking glass all of the silvering, except a patch of the size of the mirror to be silvered. A small drop of mercury placed on the patch soon loosens it, so that it may be slid from the glass and transferred to the disk. The disk must be perfectly clean. After the patch is in position on the disk a piece of tin foil is placed on the back of the disk, pressed down firmly, and allowed to remain long enough to absorb all of the surplus mercury. It is then removed, and the transferred silver will be found adhering strongly to the disk.

The various dimensions above given are taken from an almost exact copy of a Deprez galvanometer made by Carpentier, of Paris. The copy operates admirably.

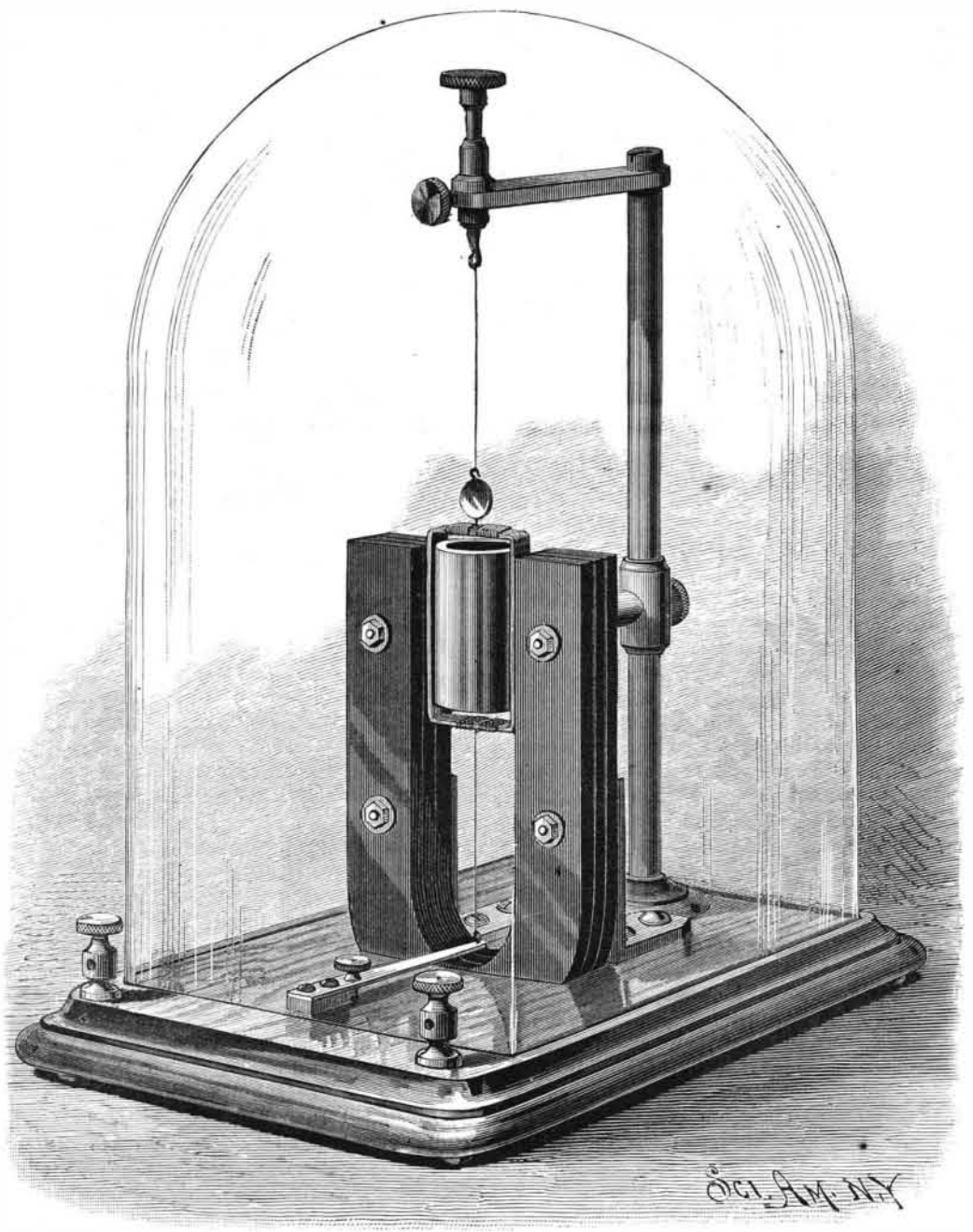


Fig. 1.—M. DEPREZ'S "DEAD BEAT" GALVANOMETER.

It is probable, however, that a considerable deviation from these dimensions might be made without seriously affecting the value of the instrument.

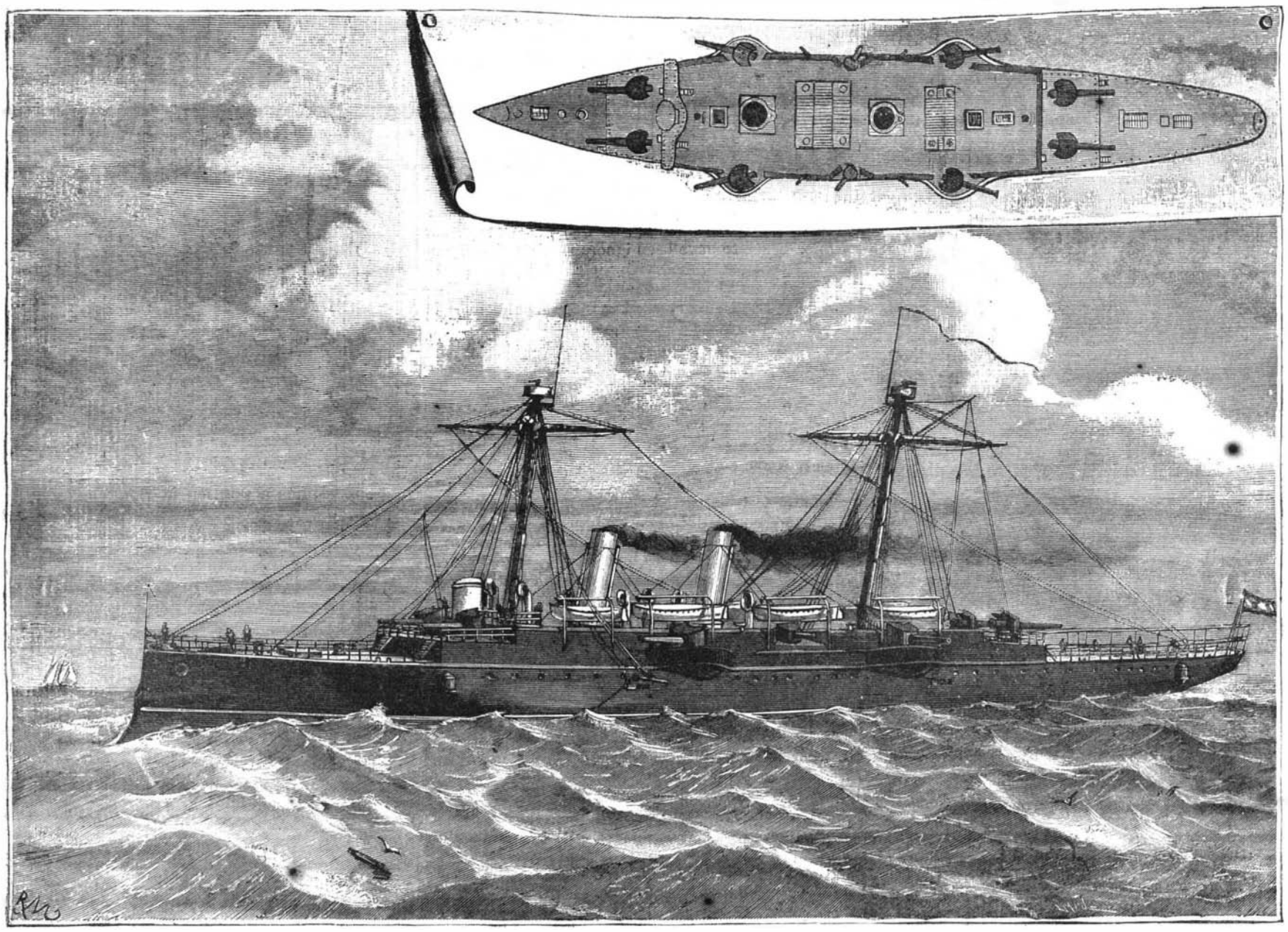
THE NEW SPANISH WAR STEAMER REINA REGENTE.

Another magnificent vessel has been added to the Spanish navy, being a cruiser of the first class, Reina Regente, constructed on the Clyde, under the direction of the Spanish Minister of the Marine, by Messrs. James & George Thompson, naval constructors.

The principal dimensions of the Reina Regente are as follows: Extreme length, 335 ft.; extreme width, 50 ft. 7 in.; depth, 32 ft. 6 in.; normal draught, 20 ft.; when loaded, 26 ft.; normal displacement, 4,800 tons. She has two screws, and triple expansion engines, which give 7,000 indicated horse power for normal draught and 12,000 horse power for forced draught. Calculated velocity of the vessel, 20½ knots per hour.

The hull is of steel, best quality, and is divided into compartments by means of water tight bulkheads. She has three decks, and is protected by armor varying from 3 to 4½ in. The stem, stern, rudder, etc., are of steel. She has a capacity of 1,200 tons of coal, sufficient to drive her a distance of 12,000 to 13,500 knots. She is provided with electric lights, telegraphs, and all the latest accessories for a vessel of the first class. She carries twelve small boats, of which three have steam. Her armament consists of four Hontoria cannon of 7 in., six of 4¼ in., six Hotchkiss guns, and various other repeating small arms. She has five torpedo tubes—two in the bow, one in the stern, and one on each side.

Our engraving shows a general view of the Reina Regente, also a plan of her battery deck.—*La Ilustracion Espanola.*



THE NEW SPANISH WAR STEAMER REINA REGENTE.

Chicago Cable Roads.

The North Chicago Street Railway Company has laid one mile of tunnel on Clark Street for the new cable line. The tunnel is of steel and continuous, and the manholes, which are of new pattern, are placed every 31½ feet. A 9 inch sewer pipe, opening every 300 feet into the main sewer, is laid between the tracks, into which a pipe runs from each manhole, affording complete drainage. The engine to be located on Clark Street, near Division, is to be of the Corliss type, 2,000 horse power, and built by Messrs. Robt. Wetherill & Co., Chester, Pa. The winding machinery is of new design, with a compensating arrangement to take up the wear on the drums. The pulleys which carry the cable are 18 inches in diameter.

The New Woodward Colliery.

The greatest mine of the anthracite regions will be the new Woodward colliery near Wilkes-Barre. It is being developed by the Delaware, Lackawanna, and Western R.R. Company, who have a tract of about eight hundred acres at that point. The main shaft was commenced in 1881, and is the largest opening in the anthracite fields, being 12 × 55 ft. in size. There are four hoisting ways, one pump way, and an air way, the latter two being a portion of the southern division. The shaft is entirely timbered. As the surface is somewhat unstable a rock foundation was found necessary, and solid masonry four feet thick was recently put in to a depth of nearly eighty feet. The shaft was sunk to the Red Ash vein, which was cut at a depth of ten hundred and forty feet. In going down to this seam, the sinkers cut through the same veins as are found in that vicinity, and in some instances the thickness was surprising. The array of coal in this shaft was pronounced the most extensive in the Wyoming region. The quantity of water in this opening is very great and will require three Knowles pumps to keep it clear. The air shaft is located about one hundred yards from the main opening. The shaft is 10 × 37 feet in size, has two hoisting ways, and cuts the Red Ash vein at one thousand and three feet. This shaft is timbered, and now remains idle and full of water, pending surface improvements.

Two immense ventilating fans of about forty feet in diameter are to be constructed for these shafts. For the first hoisting ways of the main shaft, first motion engines of 24 in. cylinders and 48 in. stroke are now being arranged, while those for the lower hoisting ways are direct acting, with 24 in. cylinders and 60 in. stroke. The two conical drums are 14 and 16 ft. in diameter. Engines of the same size as those at the main opening are being located at the air shaft. Over thirty cylindrical boilers will be required to furnish the power for the vast amount of machinery of the mine. The guides are now being inserted in the main shaft, and about three hundred and fifty feet of water still remain to be pumped out, when the sump will be cut in the Red Ash vein. Lodgments will be cut for the Knowles pumps, three being required for each orifice. The immense trestling from the main shaft to the site of the breaker is nearly completed. It is nearly six hundred feet long, and at one point is over one hundred and thirty feet high. The foundations for the immense double winged breaker are being constructed, and have the appearance of being natural terraces. The breaker, which is to be commenced at once, will be one hundred feet wide, will consume 1,150,000 ft. of lumber, and the capacity will be 3,000 tons per day. In order to furnish a foundation for the breaker, a large creek was turned inland about seventy feet for quite a distance, at a great expense. The gangways of the mine will be opened up as soon as a place can be arranged to stock the coal. The colliery will probably be in full working order within a year, and employment will be furnished about twelve hundred hands. The surface buildings are nearly all contracted for. The head house of the main shaft is one hundred and one feet high, and is just completed. W. H. Storrs and T. H. Carey are the superintendents of the mine.—*Coal Trade Journal.*

Ingenious Financiering.

One of our foreign contemporaries relates the following method adopted by the people of Guernsey for providing themselves with a new meat market, which they very much needed, but had not the means at hand to pay for it. But they were determined to have the market, so £4,000 was voted to defray the cost, and notes were issued by the authorities for that amount, and were guaranteed on the "whole of the property of the island, said to be worth four millions." A singular provision was introduced, which rendered these notes worthless outside of Guernsey, and so they were never exported. They were one pound notes, and were numbered from 1 to 4,000. With them the contractor was paid; he paid his workmen in the same money, and those that supplied him with materials. Tradesmen took them for goods, landlords for rent, and the authorities for taxes. "In due season," to quote from Jonathan Duncan, "the market was complete. The butchers' stalls, with some public rooms constructed over them, were let for an annual rent of £400. At the first year of tenancy the States called in the first batch of notes, numbered 1 to 400, and with the £400 of real money received for rent redeemed the £400 of representative money expressed by the 'meat market notes.' At the end of ten years all the notes were redeemed through the application of ten years' rental; and since that period the meat market has returned a clear annual revenue to the States, and continues to afford accommodation without having cost a farthing in taxes to any inhabitant."

Over Sixty-seven Miles an Hour.

On Nov. 16 a Michigan Central train on the Canada Southern division, having on board a number of directors and officials, ran from St. Clair Junction to Windsor Dock, a distance of 107 miles, in ninety-five minutes, being at the rate of over sixty-seven and a quarter miles per hour.