Return second-class tickets are issued at an expense of four cents. There are no first-class return tickets, and even the use of the second-class tickets must be commenced before nine o'clock in the morning, as they are intended for the use of workmen. The distance is covered in about thirty-five minutes, including stops, which average twenty to twenty-five seconds. The trains will leave about every ten minutes, and each train has one motor car and two trailers.

The motor car is given up to second-class passengers. It accommodates twenty-eight persons and the trailers accommodate forty persons. The motor cars are provided with two hundred horse power motors, enabling a quick start to be made and a high-sustained speed while running through the tunnel. The track weighs 106 pounds to the yard. The current is conveyed by a third rail. The conductor rail is supported by insulators secured to every third or fourth tie. The cars are brilliantly lighted by electricity. The trailers have ten lamps and the motor cars eight lamps and two head or signal lights. At present twenty-two motor cars have been delivered and more than double that number have been ordered. The motor cars have the usual fuse boxes, lining, arresters, etc. Westinghouse air-brakes are used and the compressors are run by an electric motor. Contact is obtained with a third rail by means of two shoes, and in the car yards overhead wires are used. A four-wheeled trolley carriage running on the wire receives the current and delivers it to a motor car by means of a cable and plug.

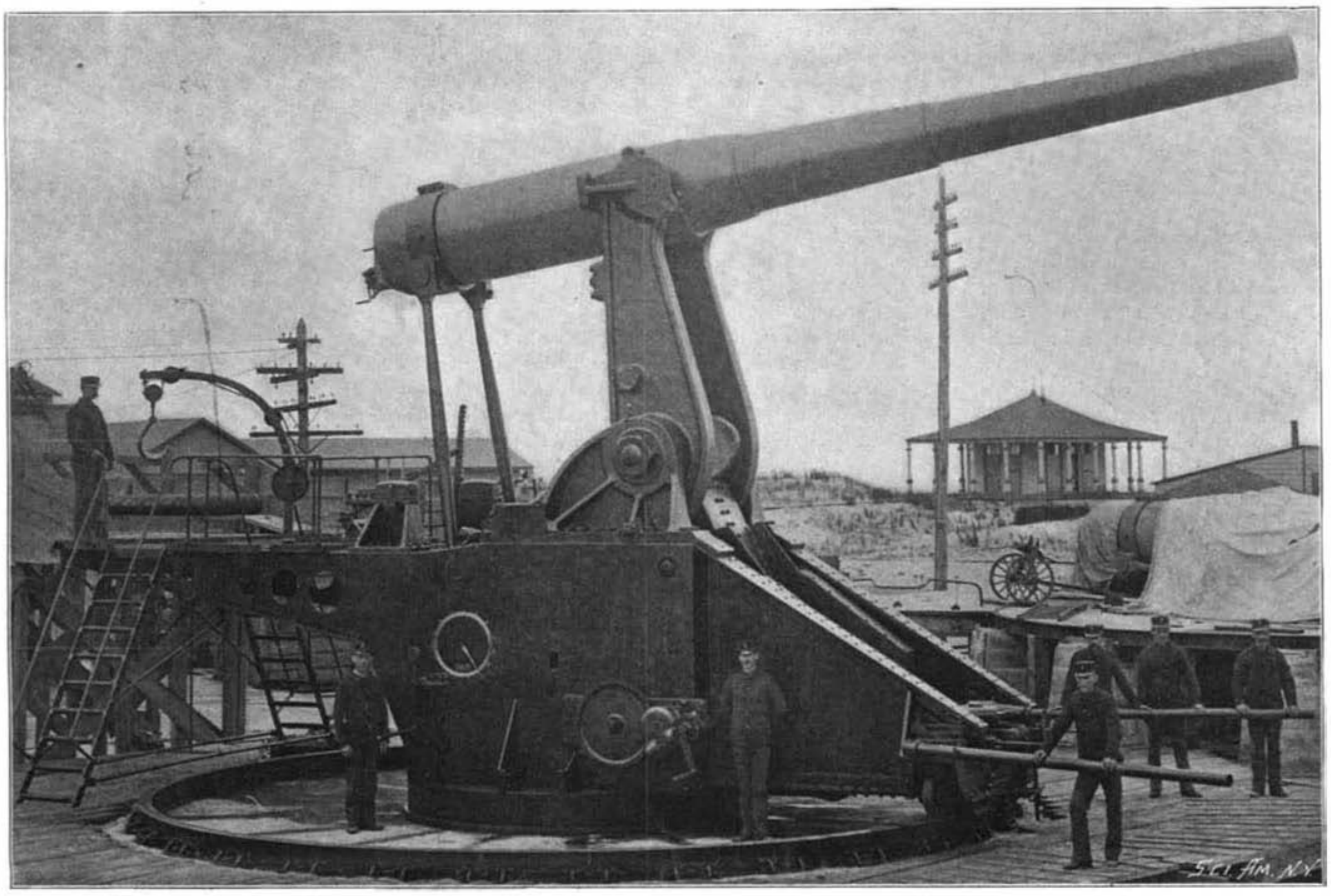
The electric power by which the cars are driven will be generated in a central power-house between the Quai de la Rapée and the Rue de Bercy. The boilers, engines, dynamos and auxiliary machinery have all been built by Schneider & Company, of Creusot. The Bercy power house will directly supply current for that portion of the road lying between Vincennes and the Louvre station. The other portion will also receive current from the main power house, but through the medium of a transforming sub-station at the Place de l'Etoile. The central station will consist of three batteries of six boilers each ; a group of 1,500 kilowatt generators furnishing a direct current at a pressure of 600 volts ; four groups of 1,500 kilowatt generators, furnishing a three-phase current of 5,000 volts and 25 periods ; various auxiliary machines, exciters, transformers, and a battery of accumulators. Normally, the direct current is used for the Vincennes-Louvre section ; but, if necessary, the three-phase system also can be called into requisition. In the sub-station, nine static transformers of 250 kilowatts each will step-down the 5,000 volt current to 860 volts. Three rotary transformers of 750 kilowatts each will feed current to the line at a pressure of 600 volts. The sub-station equipment also includes a battery of 250 Tudor accumulators of 1,800 ampere-hour capacity.

The total expense of the tunnels, viaducts, stations, etc., has been $7,400,000, and the company which has the concession has also spent a considerable sum. The concession is to run for thirty-five years.

The construction of the railroad is fully described in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1211, 1226, and 1243.

THE HOWELL DISAPPEARING CARRIAGE.

The work at the Sandy Hook Proving Ground is by no means confined to the mere test of the ballistic qualities of the army guns ; but considerable time is expended on the various gun-carriages that are submitted to the War Department. The mount is of only less importance than the gun, particularly in that class of mount which is designed to withdraw the gun behind shelter immediately upon its being fired.



TEN-INCH RIFLE ON HOWELL DISAPPEARING GUN CARRIAGE; FIRING POSITION.

The disappearing gun-carriage, which forms the subject of our illustrations, is now undergoing tests at Sandy Hook and has given fairly good results. It belongs to that type in which the gun is mounted on the extremities of two gun levers that rotate about a fixed axis. To the other extremity of the levers is attached a counterweight, which brings the gun from the loading to the firing position and assists in checking recoil when the gun is fired.

The principal parts of the carriage are : Lower roller path, rollers, upper roller path, chassis, main axle, gun levers, counterweight, main recoil cylinder, auxiliary recoil cylinder, elevating gear, retraction gear, traverse circle and traversing gear.

The distinctive feature of the carriage is the method of attaching the counterweight, there being an hydraulic and two telescopic spring cylinders, interposed between the bottoms of the levers and the weight.

When the gun is in its firing position, with the levers vertical, the counterweight, hanging freely by its upper end, from the main axle, lies in front of the gun levers, and is kept separated from them a distance of about twenty inches by the telescopic spring cylinders.

The hydraulic cylinder lies between the telescopic cylinders on the under side of the counterweight box, and is journaled to it by suitable bearings. The piston of this cylinder is attached to a cross shaft joining the ends of the levers, and in this position is withdrawn from the cylinder about twenty inches.

The general operation of the carriage is as follows : On firing, rotation of the system takes place about the main axle ; the gun moves to the rear and downward, the gun levers being caught by a ratchet when the loading position is reached. The lower end of the levers moves forward and upward, compressing the spring cylinders, and forcing in the piston of the hydraulic cylinder, thus transmitting their rotation to the counterweight. The relative motion of about twenty inches allows the counterweight to gradually acquire the full velocity of recoil and greatly reduces the shock due to the sudden acceleration of so large a mass.

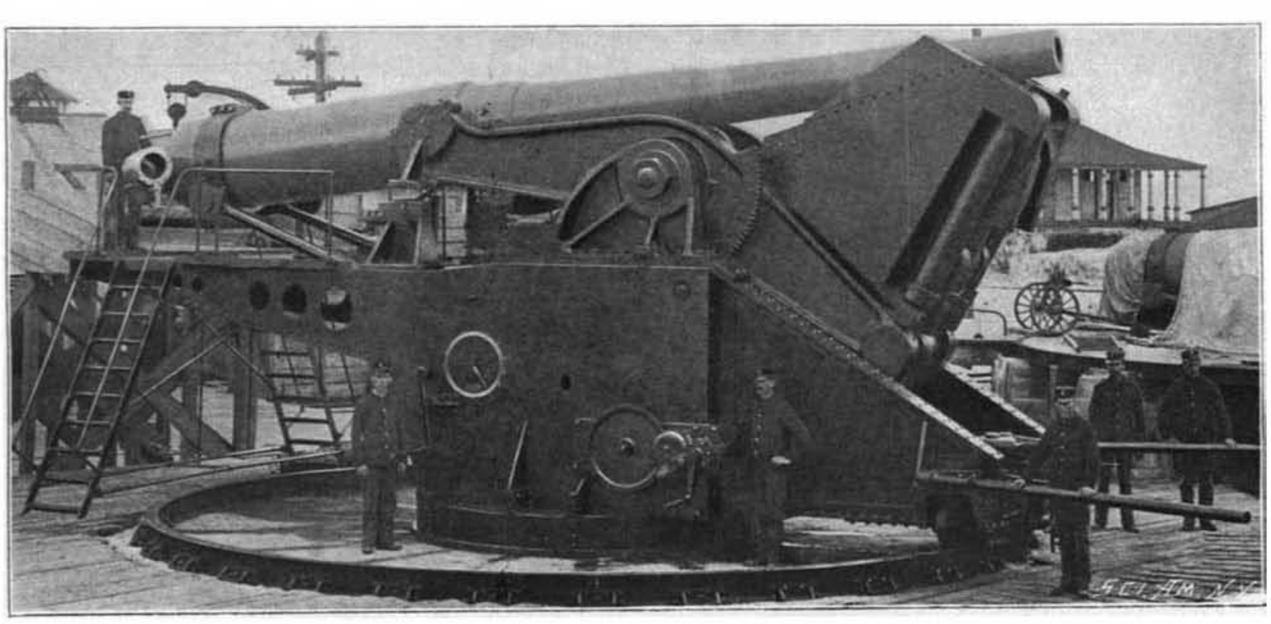
In the firing position nearly the total mass of the counterweight is suspended from the main axle, but during the recoil of the system, as the lever arms rotate from the vertical position, the weight is gradually transferred to them until in the horizontal position they carry practically the whole mass.

When the gun is loaded the ratchet holding the gun levers is released, the counterweight, due to its preponderance over the gun, moves downward and backward, carrying the system into the firing position ; as the gun levers approach the vertical, the mass of the counterweight is again transferred to the main axle, and the telescopic springs force the lever arms away from the counterweight.

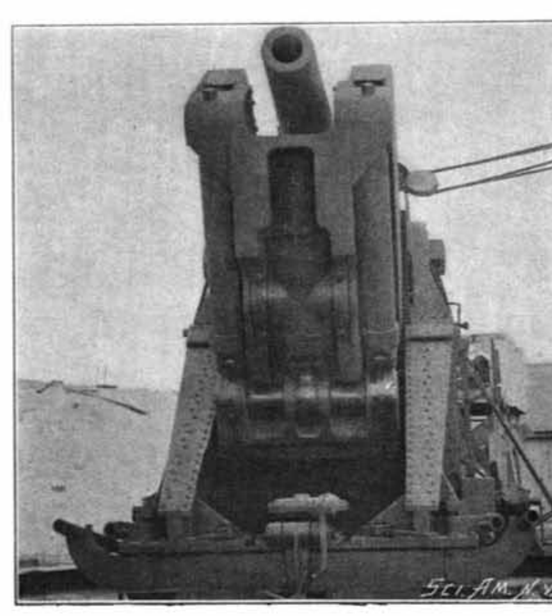
The main recoil cylinder is mounted in trunnion bearings between the chassis below the main axle ; its piston being attached to the counterweight. When the gun is fired the piston is withdrawn ; the oil passes through ports in the piston head from front to rear, forming the hydraulic brake, which absorbs the greater portion of the energy of recoil due to firing.

Two independent chains of gearing mounted on the two cheeks of the chassis engage in circular racks on the gun levers and serve as a means of lowering the gun from firing to loading position during practice drills.

The gun is elevated and depressed, either in the loading or firing position, by means of a band and two arms connected with two racks ; the racks, actuated by



HOWELL DISAPPEARING GUN; GUN DEPRESSED.



FRONT VIEW.

spur gears, move in guides fastened to the inner faces of the cheeks.

In their report of the tests which have already been made, in which 26 rounds were fired with a 10-inch gun mounted on a carriage of this type, the Board states that, in the final firings for rapidity and accuracy, the general working of the carriage was satisfactory, although the loading angle was too great and the traversing mechanism was too slow and uncertain. The retraction mechanism was also criticised as being too slow, while the height of parapet required is twice as great as that of the service gun. "The great merit of the carriage," says the report, "is the absence of sliding parts."

A SIMPLE ROTARY PUMP FOR LIGHT SERVICE.

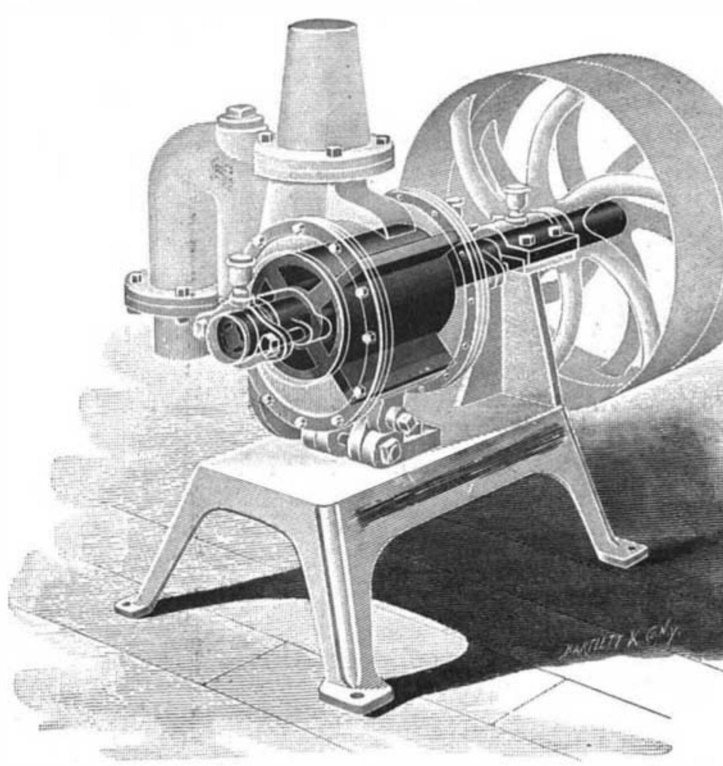
The Taber rotary pump, made by the Taber Pump Company, of Buffalo, N. Y., is an ingenious pumping apparatus which is intended for light service where a large amount of liquid is to be pumped against moderate pressure. It performs its work with but a small expenditure of power and in a comparatively short time.

The pump consists essentially of an outer shell inclosing a piston-cylinder which is provided with open ways or valve slots. Sliding valves, which are constructed with overlapping inner arms, are arranged in the ways so that they are forced through the piston by contact with the abutment and do not drop by gravity. Hence the pump can be operated at very slow speed to pump correspondingly as much liquid as at maximum speed.

Owing to the peculiar construction of the valves there can be no back lash and no lateral motion; as the driving shaft rotates, the valves pass in and out, back and forth through the cylinder, following the lines of the interior of the shell and creating a vacuum. The pistons are self-adjusting and compensating, and their operation is not dependent upon springs, cams, or similar devices.

A noteworthy feature in the construction is the absence of all gearing, the power being directly applied to the driving shaft through the medium of a belt and pulley or directly-attached engine or motor. The pump is positive in its action and does not depend upon speed to create the necessary vacuum. So large are the valve openings that the clogging of the moving parts is well-nigh impossible.

Pumps of this type are capable of discharging from 25 to 600 gallons per minute, depending upon the size of the pump, character of the liquid, and height to which it is to be forced. The pumps are adapted for use in connection with hot or cold, thick or thin liquids, and have been long successfully used in breweries, chemical works, soap factories, tanneries, creameries, oil mills, and packing houses.



ROTARY PUMP FOR LIGHT SERVICE.

The Diamonds of Steel.

It has not hitherto been suspected that our great metallurgic establishments were manufacturing precious stones. Yet nothing is more certain. It is true this has been done without intention, and without knowledge at the time.

Its possibility, however, might have been anticipated when M. Moissan made his experiments, ending with the artificial production of the diamond. He obtained this gem by suddenly cooling under high pressure the cast metal saturated with carbon. The same conditions are realized to a greater or less extent in the blast furnaces for manufacturing special steels, by sudden cooling of the fused metal under elevated pressure. In this class of steels there must be diamonds, microscopic without doubt, and Prof. A. Rossel, of the University of Berne, has been conducting experiments in the laboratory of inorganic chemistry for the purpose of ascertaining whether such diamonds really exist.

Already his conclusions have been presented to the Academy of Sciences, but one of his principal collaborators, M. Leon Franck, has recently prepared a detailed statement of the methods employed and the results obtained.

A considerable number of steels of various production have been examined and treated in the same manner. They all yield the same evidence. From a piece of compact steel a portion of about three hundred grammes was cut out and treated with nitric acid. The insoluble residue consisted principally of carbon, especially in the state of graphite, combinations of silicium, etc. It was washed with water and then boiled three times with fuming nitric acid, which partially dissolved it. They even obtained a dilution of the density of 1·8 by washing and successive additions of fluor-hydric acid; then of fuming sulphuric acid. There remained only graphite, which was washed, dried, and dissolved with potassium chlorate. This long series of operations was commenced again, for it was deemed necessary to pass the residue through the whole series of treatment that has been explained. At last, the chemist had the satisfaction, after a treatment of boiling sulphuric acid, of finding a deposit that could not be attacked.

The residue finally obtained with so much trouble fell to the bottom of a vessel filled with a heavy liquid as methyliodide. With the aid of a strong microscope, minute, transparent octahedrons were discovered, which burned on a leaf of platina, and in a current of oxygen, disengaging carbon, and almost without leaving ash. The proof was ample. M. Rossel had really discovered diamonds in steel.

The higher the temperature at which the steel has been made, the more diamonds it contains. This accords with the noted experiments of M. Moissan. It is probable also that the hardness of the metal increases with the number of diamonds it contains; in reality, they are the cause of its hardness. It is curious to observe that these diamond octahedrons are easily broken, so that in the steels worked, forged or rolled, only the débris of crystals were found.

In a still more interesting trial, M. Rossel believes he has ascertained that the ordinary casting is not the best dissolvent of the carbon and that, in view of the results, the method suggested by M. Moissan can be improved and perfected. The trial to which we allude took place on a loup, that is to say, on a block of metal mingled with scoria, which is formed at the lower part of the blast furnace when the operation is not perfect. This loup has been brought from a furnace of the factory of Esch-sur-l'Alzette in Luxembourg. It contained, among other things, a large quantity of crystalized graphite, and the washings isolated a large number of diamonds; all much larger than those that had been found in ordinary steel. One, that received the pompous name of the "Star of Luxembourg," measures more than five-tenths of a millimeter in thickness. Half a millimeter, perhaps, cannot yet compete with the "Star of the South," or with the "Regent"; but it must not be forgotten that it is a diamond procured artificially. Before long the blast furnaces of Luxembourg may be able to vie successfully with the commonplace mines of the Transvaal, where they are content to pick up what nature has already provided.—Le Diamant.

Utilization of Photographic Plates.

The following method has been given by which photographic plates, which have been fogged or accidentally exposed to the light, may be utilized for making glass positives or lantern slides. A solution is made up of 100 parts distilled water, 6 parts bromide of potassium, and 50 parts chloride of copper. The plate is exposed for one or two minutes at one foot distance from an ordinary gas flame and by orange or red light, is placed in the preceding solution for eight or ten minutes, then washed fifteen minutes in water and dried in the dark. Under the action of the bath, the bromide of silver in the plate is changed to chloro-bromide. The plate is then printed under a negative for twenty to thirty seconds in daylight, or from two to five minutes at one foot from a gas flame; it is then developed in the following bath:

Water.	1,000 parts.
Hydroquinone	10 "
Sodium carbonate	100 "
Bromide, 10 per cent solution	1 to 3 "

The ingredients are dissolved in the order indicated. If desired, an ordinary hydroquinone developer may be used, adding a considerable amount of bromide. After development, rinse and fix in a 15 per cent hypo solution, or preferably a fixing bath of 1,000 parts water, 150 parts hypo, 50 of sulphite of soda, and 50 of common salt; the fixing lasts about ten or fifteen minutes, after which the plates are washed, as usual, and dried.

Incandescent Gas Light.

The Photographische Chronik warns its readers, says The British Journal of Photography, against tables of the comparative chemical action of various kinds of light, when an incandescent mantel is used for a standard light. "Lux," a Dutch contemporary, has given the following information concerning the solutions used for the preparation of gas mantels, and it will be seen that the light varies considerably according to the salts used.

FOR WHITE LIGHT.

Zirconium oxide	40 per cent.
Lanthanum oxide	40 "
Thorium oxide	20 "

FOR ORANGE LIGHT.

Lanthanum oxide	40 per cent.
Thorium oxide	30 "
Zirconium oxide	27 "
Didymium oxide	3 "

FOR YELLOW LIGHT.

Lanthanum oxide	40 per cent.
Thorium oxide	28 "
Zirconium oxide	30 "
Cerium oxide	2 "

FOR GREEN LIGHT.

Thorium oxide	50 per cent.
Lanthanum oxide	20 "
Erbium oxide	30 "

The mantel is afterward stiffened with a solution of water glass. Concerning the intensity of the light which may be obtained with gas mantels, if we take 60 candles as the equivalent of a mantel, 1020 candle power may be had from 17 mantels, which, with suitable reflectors, may be increased tenfold, say 10,000 candles in round numbers. By diffusing the light with paraffin paper screens a loss of 20 per cent results, but if we place two rows of 6 mantels each on one side of the sitter, and a row of 5 mantels on the shadow side, there still remains sufficient light to obtain full exposure in a few seconds.

Aerial Telegraphy.

M. Tomassina, who has been making a number of experiments in aerial telegraphy, has invented a device to prevent the interception of a message by an intermediate apparatus, and has communicated his results to the Académie des Sciences. The fact that the message may be intercepted constitutes one of the chief drawbacks of the system. M. Tomassina proposes to overcome the difficulty by using a method based on the fact that the distance to which the electric waves may travel depends upon the interval between the two spheres of the oscillator, and by thus regulating the length of spark the limiting distance of the signals may be determined beforehand. To the first transmitter is added a second, whose manipulator sends an irregular series of waves quite out of connection with the waves sent by the first transmitter; the second set of waves is regulated for a zone of action which is somewhat smaller than that of the first. In this way a receiver placed on the zone of the second set will receive only a confusion of signals, and the message cannot be read. It is only possible to read the signals of the first transmitter when the receiver is placed outside the zone of action of the second. The security will be greater as the two zones approach each other.

Discovery of Standard Weights of Ancient Rome.

The excavations that have been in progress for some months past upon the site of the ancient forum at Rome have resulted in quite a curious discovery. Under a large, square flagstone there were found three weights of twenty, thirty, and one hundred Roman pounds dating from at least two centuries before our era. These weights, which are of irregular elliptical form, are of dark green marble and provided with a bronze handle in order to facilitate their manipulation. In the opinion of Signor Giacomo Boni, who is superintending the excavations, these are the most ancient specimens of standard Roman weights known, and, since they are perfectly well preserved, without the least fracture, they will permit archæologists to re-establish the entire metrology of primitive Rome. They have already been compared with the weights now in use, and it has been found that the ancient Latin pound was exactly 325 grammes (10 ounces and 75 grains). The weights, moreover, are well proportioned according to the numerical indications that are engraved upon the stone and that are still legible. The 20-pound weight represents exactly two-thirds that of the 30-pound one and one-fifth of the largest, which weighs 30 kilogrammes and 250 grammes (about 66½ pounds).—La Nature.