THE LEIXOES BREAKWATER, PORTUGAL.

One of the most striking mechanical works is the great crane Titon, which is now at work in the port of Leixoes, Portugal, employed in placing the artificial stone blocks, 50 tons weight each, for the construction of the breakwater. "Nothing is more imposing," says a spectator, "than to see this extraordinary machine transferring itself along the rails, swinging in all directions, raising enormous blocks of stone, and sinking them slowly in the ocean to construct the walls of this remarkable mole."

The larger arm of the crane measures 46 meters from the axis of the machine, and the shorter 22¾ meters, making a total length of 68¾ meters. Its height from the center is 5½ meters, and at the extremities 0·81 of a meter. It has a counterweight consisting of solid masonry. It rests upon a circular tower, and turns upon 16 wheels of steel, in groups of 4. The vertical axis gives lateral movement to this enormous apparatus. The superior part rests upon 32 wheels, arranged in groups of 8, which run upon steel rails. Mounted upon the rear arm are two steam engines, of 50 horse power, which work the machinery of the crane. Its total weight is 450 tons, and the larger arm has sufficient strength, as we have said, to place and move blocks of 50 tons a distance of 27 meters, requiring for this operation, after the stone is fastened, 16 minutes 20 seconds from the time it is attached to the chains.

Our engraving represents the crane at work upon the mole. It was constructed by the Fives-Lille Co., France. Our engraving is from *La Ilustracion Espanola y Americana*.

ROLLING PLATFORMS AND ARMOR-CLAD BATTERIES.

The form of battery described in the following article is in accordance with the plans of Commander Mougin, in which he proposes the use of a platform rolling over an iron track. The project that he has studied admits of the putting in battery of a 6 inch

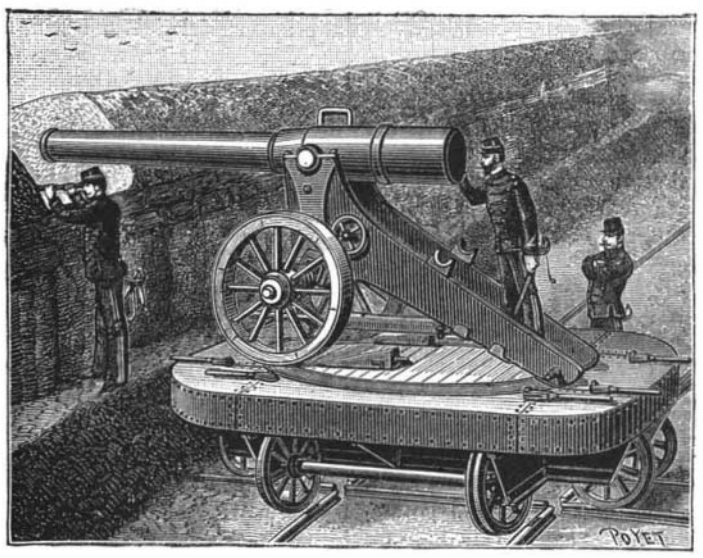


Fig. 1.—ROLLING PLATFORM.

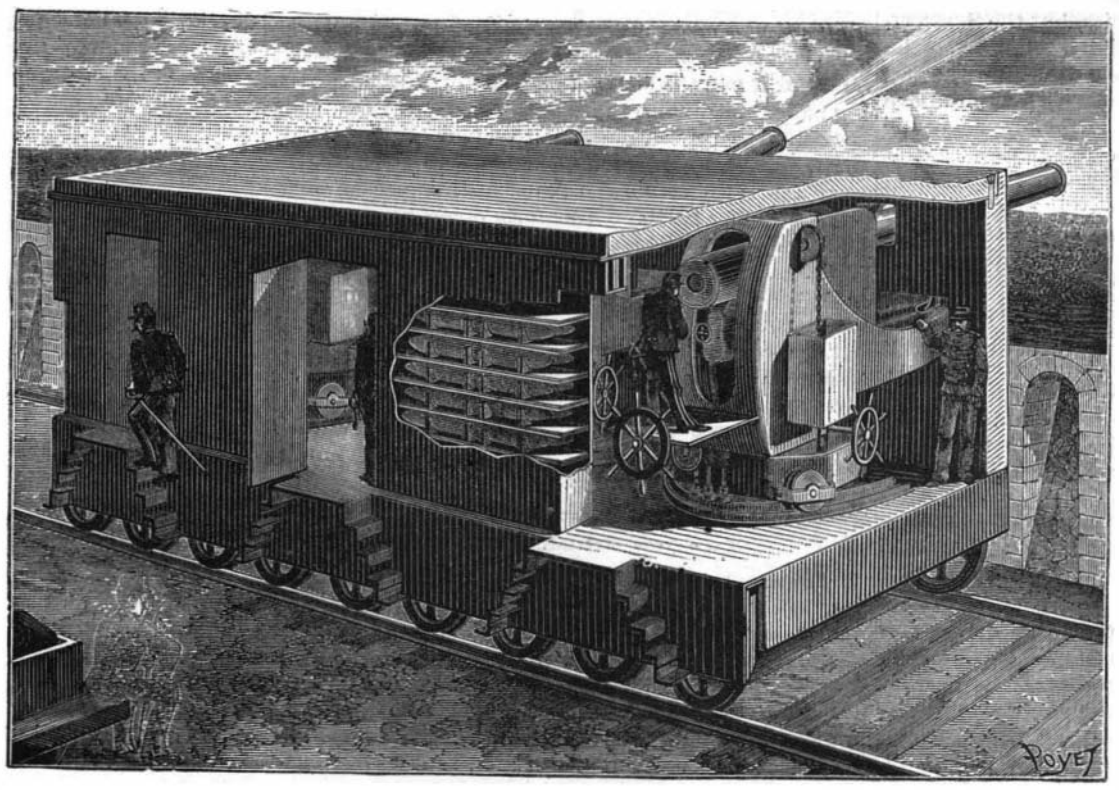


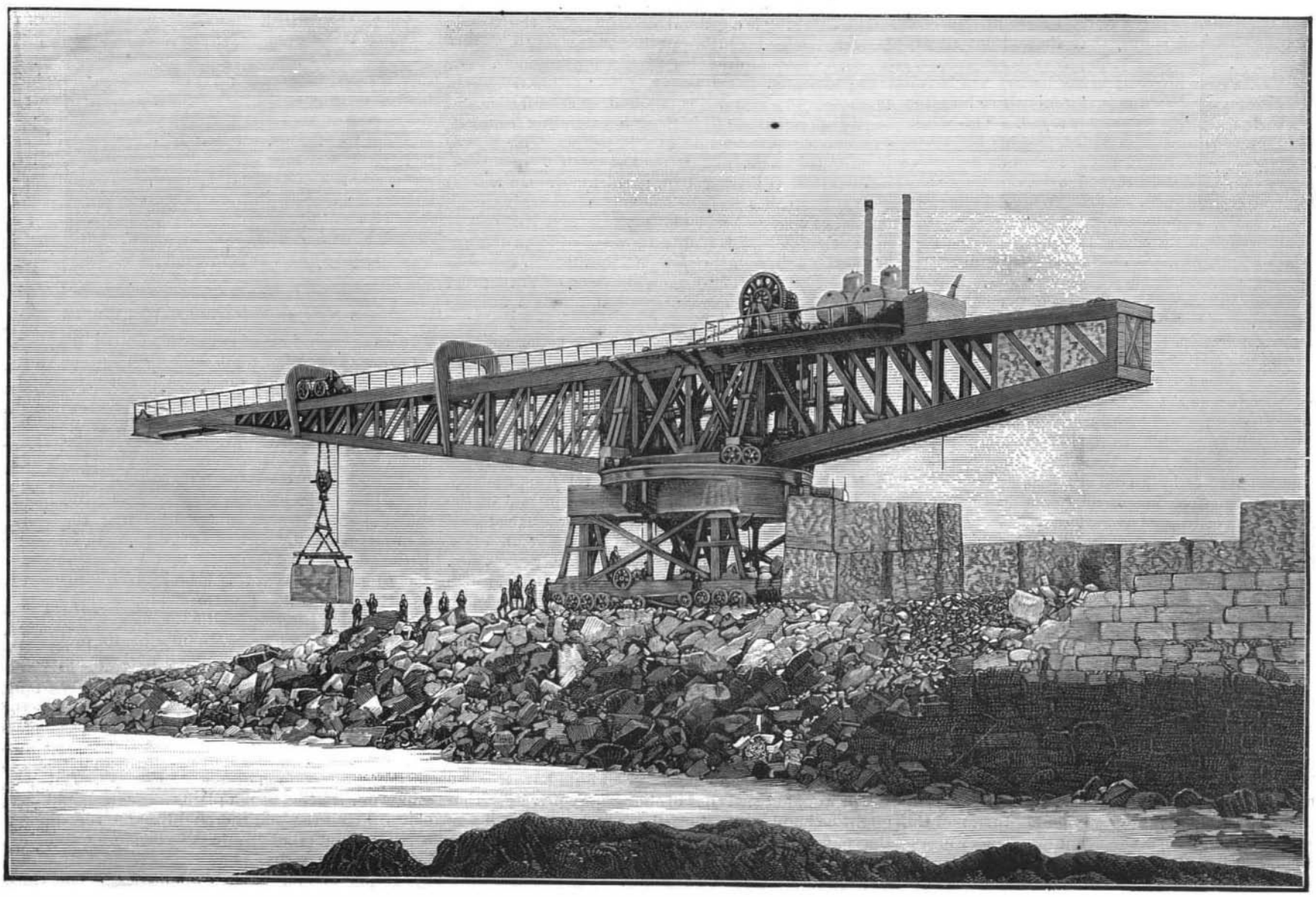
Fig. 2.—ROLLING ARMOR-CLAD BATTERY.

De Bange gun, mounted upon a siege carriage and provided with a hydraulic brake. The platform properly so called is, as he explains it, essentially formed of a frame composed of four iron plate and angle iron girders, which intersect each other in pairs at right angles, and the extremities of which are connected by a cover of iron plate (Fig. 1).

This frame is provided with a circular channel, likewise of plate and angle iron, whose center is the virtual pivot of the carriage. Externally to this channel, the platform is covered with striated iron plate, and internally with a wooden floor. In the channel there moves a cast steel ring, which is centered by a system of guide wheels, and rests upon the bottom of the channel through the intermedium of five rollers, two of which are under the wheels of the carriage, one under the butt end, and the two others at equal distances from the preceding. When the carriage is in battery, the two wheels and the butt bear upon the ring, thus permitting of quickly giving the piece every possible direction of aim in a horizontal position. The platform is supported by four pairs of wheels, the axles of two pairs of which are at right angles with those of the other two. Owing to a very simple mechanism, it is possible, at will, to make each of the wheels bear upon the rail that corresponds to it, or to raise it a few fractions of an inch above it.

From such an arrangement, it results, in the first place, that the direction of the platform can be changed on a crossing of two tracks at right angles, and consequently can be easily moved about at the bottom of a trench; and, second, that it possesses great stability at the moment of firing, although maneuvered on a system of ordinary railway tracks spaced five feet apart.

The positions for firing are marked upon the main track by a small crossing analogous to that for the change of direction. When the piece is to be fired, the entire eight



THE LEIXOES BREAKWATER, PORTUGAL.

wheels are put in action at the same time, thus preventing the whole from getting out of true, giving the affair a wide and solid base, and preventing the car from recoiling. As the car, carriage, and gun, as a whole, do not weigh any more than a heavily loaded railway car(40,000 lb.), it requires but a few men to rapidly move the system over an iron track of the ordinary type.

The organization proposed by Commander Mongin consists of an ordinary railway running parallel with the general direction of the forts of an intrenched camp, along the glacis and beneath the fire of the gorge facings. Starting from the points where it was not covered by the masonry of the fort, this track would follow a sort of siege trench with a nearly horizontal bottom. An investment of gabions and hurdles toward the interior would sustain a glacis having an easy slope and provided with an abatis. Here and there (at intervals of 15 or 20 yards, for example) the main track would be provided with a crossing to permit of putting a movable gun in battery upon it. Near by, there would be a small siege magazine, built under the glacis.

When necessary, the materials of the abatis would be separated at the right of these firing places, so as to allow the enemy's works to be seen plainly without those inside exposing themselves. Thus established in such positions, the artillery would enjoy all the advantages of the attacking batteries. Like the latter, it would show nothing but the guns themselves. Again, the enemy might not be able to recognize its location except by observing the cloud of smoke due to the firing. The gunners would not have to fear the bursting of shells on the talus of the parapets, and most of the enemy's projectiles, which did not directly touch the material, would pass beyond without producing a useful effect. When the besieger had succeeded in regulating his firing in an alarming manner, these movable pieces would be run 40 or 50 yards to the right or left, thus obliging the enemy to modify his aim at every instant.

If the form of the ground did not permit of excavating a long trench in a straight line without its being taken by a raking fire, it would be broken up into an embattlemented form, whose rectangular parts would be covered with high traverses of a symmetrically irregular shape.

Finally, it must not be lost sight of that the carriages employed permit of an indefinite field of fire in a horizontal direction, and that they might, should occasion require it, be turned about and strongly support the firing of the fort should the enemy attempt a *coup de main* on the gorge.

Instead of continuing the track along the entire length of the attacked forts, merely 200 or 300 yard sections might be constructed to the right and left of the latter, and batteries of movable pieces be thus created that would advantageously replace the armed, annexed batteries of stationary guns.

There is no doubt that a gun which can be shifted as soon as the enemy's fire is regulated is capable of producing as great an effect as three guns occupying a stationary position, or, in other words, that such a gun will finally reduce three guns of the enemy to silence.

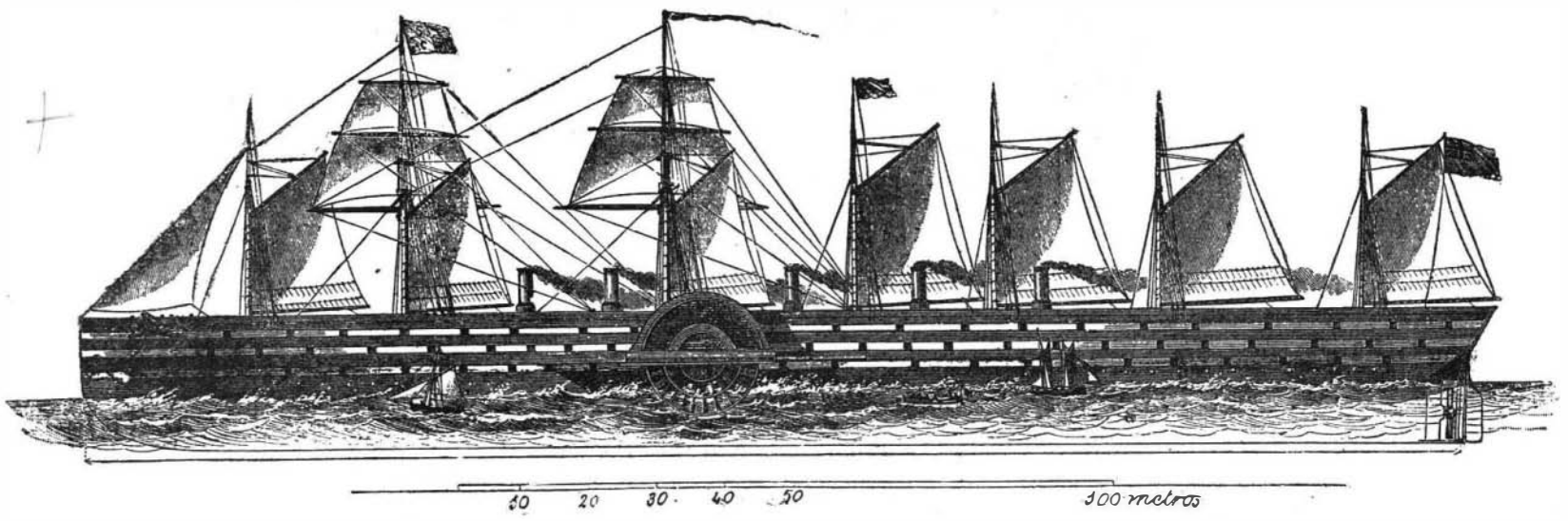
Moreover, it is possible to combine the two means of resistance to the fire of the enemy's artillery, that is to say, mobility in a horizontal position and armor plate protection. Hence the idea of armor-clad rolling batteries, which was carried out for the first time in France toward the end of the year 1870.

The first experiments on a rational use of armor-clad batteries, movable upon rails, were made in the siege of Paris. Since then the question has been the subject of serious study, especially on the part of Commander Mongin. This high officer now proposes rolling armor-clad batteries that may be said to be indestructible. He thinks that the adoption of a system of trains of guns thus protected would permit of greatly reducing the artillery *materiel* necessary for the armament of detached forts.

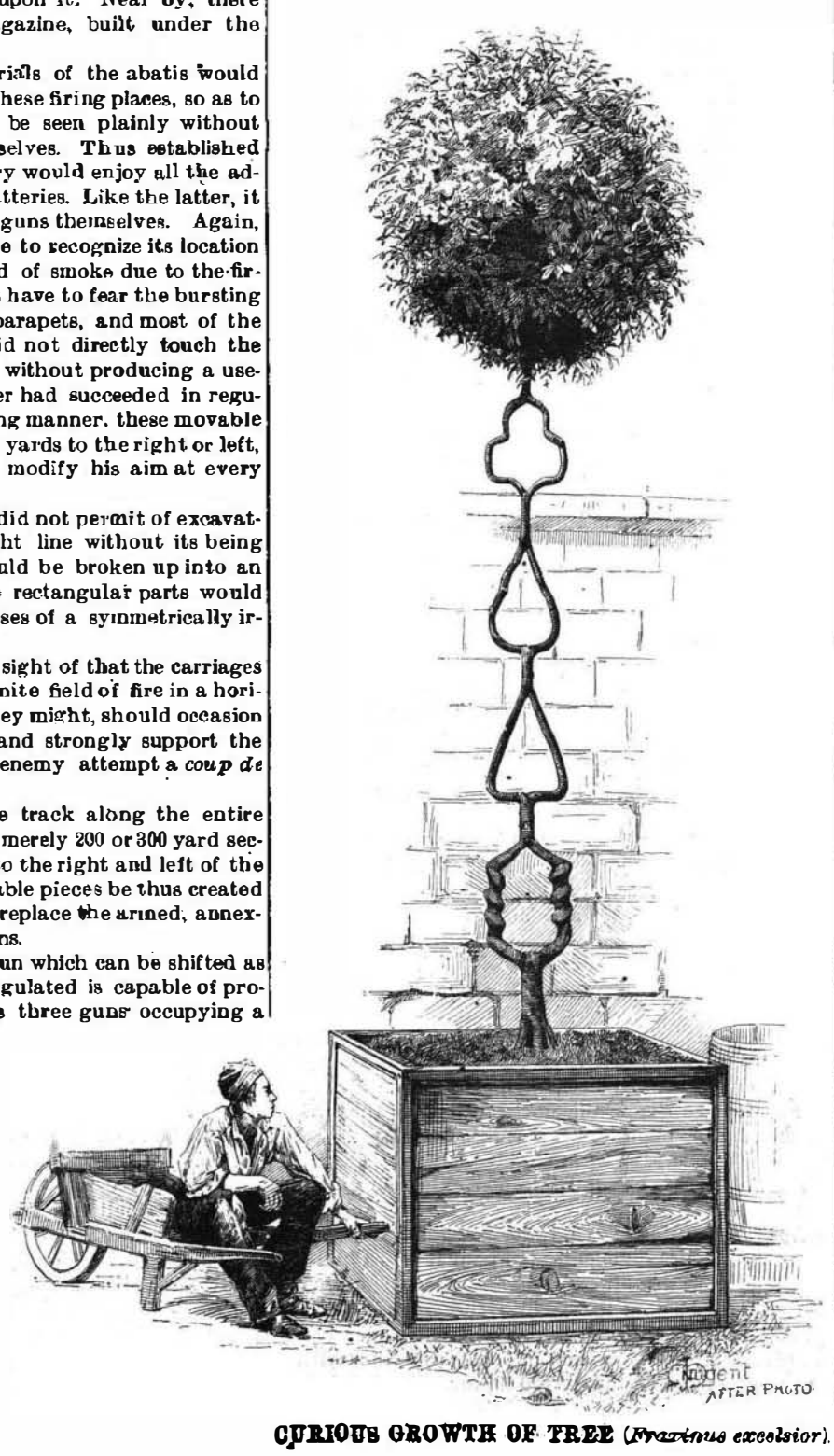
The battery of which he has formed a project may be considered, as a whole, as a hollow girder, iron clad on four of its sides, and externally capable of enduring heavy blows without being disturbed. This girder is fixed upon a strong flooring supported by nine suspended axles that permit of a side movement of the whole (Fig. 2). The axles are of steel, and are provided with iron wheels 3¼ ft. in diameter, having hard steel rims 2 in. thick. Their 8 in. journals are provided with cast steel grease boxes, connected with 25 ton suspension springs, affixed to the flooring of the battery. This flooring consists of two sole bars connected at their extremities, and between the axles, by ten small cross girders, which are themselves connected in pairs in the direction of the longitudinal axis of the flooring by ten struts. The whole, which is of plate and angle iron, is covered with a floor consisting of iron plates juxtaposed and carefully riveted to the sole bars, girders, and struts.

Two end panels and two intermediate stays divide the battery into three compartments, each containing one gun. The armor in front consists of two 16 in. thick plates of rolled iron connected all the way up by a mortise joint, and containing three embrasures at a minimum distance apart of 13 ft. from axis to axis, which are provided at the top and throughout their entire length with a rabbet 6 in. in depth. The prime cost of an armor-clad rolling battery amounts to but $80,000—a sum to which must be added the cost of three 6 in. guns.

These batteries may be advantageously employed during the course of the operation of defending the *enciente* of a place or the intervals between the forts of an intrenched camp. They are likewise of a nature to constitute the elements of a siege park of great power. It is even permitted us to foresee the coming of the day when they will make their debut upon our fields of battle.—*La Nature.*



THE STEAMSHIP GREAT EASTERN.



CURIOUS GROWTH OF TREE (*Fraxinus excelsior*).

CURIOUS GROWTH OF TREE (*Fraxinus excelsior*).

In this country the artificial training of shrubs and trees has not attained that degree of perfection that is observed in the countries of Europe. This is due probably to the fact that the gardens and parks abroad have been, many of them, kept in a most perfect state of cultivation for years, and even for centuries. Italy is especially noted for the beauty of form and design that has been imparted to the garden by the use of trimmed shrubs and hedges. This style of gardening has been extensively followed in nearly all the countries of Europe; and although there is no pretense at courting nature, this has, nevertheless, asserted itself, and age has added to this method a dignity which greatly heightens its original effect.

At Versailles, at Fontainebleau, at the Imperial Gardens in Austria, and in Germany, this same style is to be found. In England, also, we observe the same effect, not so much in the public gardens as in the private parks.

At Haddon Hall there are two quite celebrated box-wood trees, one representing a ship and the other a peacock of heroic size. At Chatsworth, near by, there are many curious shapes to be found. The tree shown in the accompanying cut is at present in the Jardin d'Acclimatation, in Paris. By examining the part nearest the ground, it will be observed that it originally consisted of five separate trees grafted together, which were successively divided and grown together again, producing the curious loops and forms observable in the illustration, which is a faithful delineation, taken directly from a photograph of the plant itself.

THE GREAT EASTERN.

This steamship, which for more than a third of a century has remained the largest ever constructed, was designed, about 1853, by the distinguished engineer Brunel, for the trade between England and Australia. It was calculated that a ship could be built having sufficient capacity to carry enough coal for the round trip in addition to a great many passengers and a paying cargo. She was built by J. Scott Russell at his works in Millwall, London, and was ready to be launched in November, 1857, but could not be moved until the following January. Even that early in her history her unlucky star assumed the ascendency, and in all her subsequent wanderings seemed ever present.

When launched, her cost was $3,831,520.

The Great Eastern is 692 ft. in extreme length, 83