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SCIENTIFIC AMERICAN SUPPLEMENT

No. 581.

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GREAT WAR SHIPS AND FORTS.

Are armored ships and big guns and forts necessary to an effective defense? The Senate, in favoring a preliminary appropriation of $21,000,000, has virtually said yes. It remains for the House to put in its measure. Outside of Congress, there is quite as distinct difference of opinion in regard to the general proposition among the well informed. Those who do not favor the building of a great armored fleet and costly shore works have recently been joined by Captain John Ericsson, the designer of the famous Monitor.

He makes the point that a port like New York can be successfully defended without them, and following this argument to its conclusion, those opposed to great outlays for ships and forts might logically insist that by Ericsson's admission they were unnecessary.

He says that the problem before us is how to beat off a fleet of modern war ships, whose tactics during bombardment would be that of retreating to the open sea before night.

To successfully accomplish this in the ordinary way, we should have guns capable of piercing twenty inches of armor at ranges varying from six to seven miles. As to stationary torpedoes, such mines may be countermined, and even the fish torpedo, like the Whitehead and the Lay, cannot be effectively served with hostile machine guns in play. After explaining to us the nature and virulence of our disorder, Ericsson, like a skillful physician, comes to our relief with an antidote. As may be guessed, the antidote is the Destroyer type of submarine torpedo server, and those unfamiliar with the man's history may jump to the conclusion that he is anxious for government contracts. Such a conclusion would be as unjust as it is hasty; for, to one who has seen the great maritime powers use his designs as criteria from which to remodel their fleets, who may fairly be said to have revolutionized naval warfare, and whose sands of life are nearly spent, fortunes would not compensate for failure.

He says:

"I have for a series of years studied, under special advantages, the problem of defending the harbor of New York against first-class ironclad ships. I have positive grounds for recommending the adoption of the submarine gun of 16 in. caliber, as applied in the Destroyer. This gun possesses power and capacity to expel projectiles carrying explosive charges weighing 300 lb., hence capable of shattering the hull of a Lepanto or an Inflexible. The vessel carrying the submarine gun, being protected by an impregnable breastwork of inclined solid armor plates two feet thick, backed by six feet of timber, is capable of resisting any ordnance whatever during attack bows on. I deem it important to observe that, like the Destroyer, all vessels carrying the submarine gun, whatever be their size, must be provided with steam turning gear, by means of which they can be directed to any point of the compass without backing or going ahead."

To err is human; the best calculations sometimes fail, and hence nothing which is the product of man's understanding or foresight is altogether reliable and certain. But if a man is to be judged by his works, if probability of success in the future is to be measured by that of the past, then no man is more entitled to a fair and patient hearing than Captain John Ericsson. The mode of attack which he has adopted for his Destroyer, like that of his Monitor, does not rely for success upon favoring conditions of tide and wind and shore line. He goes straight to his mark. Calculating what is the worst the enemy can do against him, what the crushing power of his heaviest blows, he devises an armor shield that will defeat the purpose under the most favorable conditions the enemy can discover. The many experiments made with heavy guns at Spezia, at Cronstadt, at Woolwich, and other points, have been carefully studied by Ericsson.

Those who believe in the efficacy of the fish torpedo principle and in dynamite guns will, no doubt, regret that the inventor dismisses them after so cursory an examination. He says: "Whitehead's torpedo, in itself a useful weapon, is carried by light, frail vessels, incapable of withstanding the fire of the hundreds of quick-firing machine guns carried by an attacking fleet.

"Well protected and pointed by a reliable method, besides being favored by daylight and the smooth water of the bay, these admirable guns could in a few hours destroy a fleet of our torpedo boats. On the other hand, our present forts and guns, assisted, if necessary, by temporary earthworks, mounted with light artillery of any caliber, could quickly dispose of the enemy's torpedo boats intended to protect the ironclad intruders against our small vessels carrying the dreaded submarine gun."

If this is true, and ordinary light artillery can stand off torpedo boat catchers, why could not the fish torpedo boat and the dynamite gun boat be protected by heavy inclined armor, like that of the Destroyer? Both the fish torpedo and the dynamite gun have a far longer range than the Destroyer's submarine gun; and those who have seen the dynamite gun and the submarine gun at work, as the writer has, will incline to the belief that the former is at least quite as reliable, while, at the same time, by no means so complicated. What splendid work the dynamite gun could do afloat with its one mile effective range, if only it could be protected against the assault of heavy guns!

ELECTRO-MOTOR VS. CABLE TRACTION.

Those who have been in upper Eighth Avenue, New York city, recently, may have noticed a car, similar in most respects to the ordinary street car, save that it moves over the rails without the aid of horses or any other visible agents of propulsion. This is the Julien electro-motor, now experimentally at work, brought here last fall by its designer, Mr. Edmond Julien, and who, it is said, has had no little success with it on the European continent, notably in Belgium.

Mr. Julien, like others who preceded him in the development of the electro-motor, discards the system of electrical mains, both surface and aerial, carrying his electrical energy aboard instead of picking it up while *in transitu*.

The accumulators are placed in apertures in the sides of the car, and connected up with the driving wheel apparatus by wire in the ordinary way. They are charged from an electrical generator, working in the car stable, and are ranged in tiers on either side of a siding in the depot. The car is then run in on to this siding, the exhausted accumulators are taken out of it, and those that have been re-enforced thrust into the places left vacant. It is hard to see how this operation could be more conveniently or expeditiously accomplished. It is the custom of the horse car managers to run their cars into the stables at certain intervals; "swinging," the operation is called, and is necessary in order to afford drivers and conductors opportunity to get their meals.

The Julien car, with its accumulators freshly charged, is good for a seven hours' run; indeed, there is sufficient energy aboard to increase this to ten hours, but it has been found inadvisable, for reasons well understood by electricians, wholly to exhaust electric accumulators of this type. The car moves along Eighth Avenue with an ease only disturbed by the irregularities of the track, and so far as speed is concerned, is limited only by the exigencies of transit through a populous thoroughfare. The round trip over the course, a distance of five miles and a half, occupies about three-quarters of an hour; the car being run slow purposely, so as not to interfere with the regular business of the road.

It is stopped and started by a simple arrangement, the same being an electric switch and an ordinary brake combined; the latter pressing against the wheels immediately after the electric current is cut off from the driving wheel apparatus.

The weight of the car when ready for work is thus distributed:

Car.....	2,570 kilogrammes.
Accumulators	1,120 "
Wheels.....	560 "

This makes a total weight of 4,250 kilogrammes, which is something less than five tons. A Siemens motor of horizontal type is used, this, under ordinary circumstances, making 1,000 revolutions a minute. There is but one driving axle, which is worked by flexible cables running in slotted pulleys, which get their energy from a shaft connected by belting to the motor engine.

Mr. Julien describes the elements of which his batteries are composed as consisting of 19 plates, 9 positive and 10 negative, insulated by rubber. The positive plates are four millimeters thick, and weigh each 655 grammes. (A millimeter is 0·03937 of an inch, and a gramme 1-24 of an ounce—15½ grains troy.) The active matter counts in this for 165 grammes. The negative plates are three millimeters thick, and weigh 450 grammes, of which 150 grammes is active matter. These elements therefore contain 2,700 kilogrammes (a kilogramme is 2 lb. 3 oz. 4·65 drachms, or 2·206 pounds avoirdupois), say 26 per cent; including the liquid and the recipient, the gross weight per element is 14 kilogrammes. Ebonite boxes are the receptacles of the elements, which are joined in pairs. The elements in each of these batteries are placed in tension, the electrodes of the elements of the batteries being soldered. In selecting railway apparatus, certainty and reliability comes even before economy.

Hence, it is not enough to show that one class of motor is cheaper than another, but as well that it is quite as reliable. The promoters of the Julien type of electro-motor claim that it is cheaper than cable traction, and bring forward a formidable array of figures in support of the assertion. But is it as reliable? This is, of course, a difficult question to answer with anything like certainty, because of the comparatively limited experience had with the electro-motor. On the other hand, cable roads have for some years been in active and continuous operation; in populous districts, too, where the service is exacting, and where apparatus subject to frequent disarrangement, or even occasional mishap of a serious nature, would prove too costly, however cheap it might be had. It is true, however, as the promoters of the Julien system point out, that an accident to a traction cable, or to the en-