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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 engines that operate it, stops traffic along the whole extent of the road, while an accident to the apparatus of an electro-motor does not in any wise impede or interfere with travel on an electric road, for it may be removed from the tracks until repaired.

M. Julien could scarcely have chosen a better time for exhibiting his motor in New York City, for quite recently the largest, richest, and most enterprising of the surface roads, to wit, the Third Avenue, decided to adopt cable traction, or electrical, or any other which promises to relieve them of their costly and troublesome horse service. If, therefore, he can show that the electro-motor may be made to give as reliable and as economical service as the cable, he will find a ready market, and one capable of being developed almost indefinitely.

THE BELL TELEPHONE BEFORE THE SUPREME COURT.

The hearing in the Supreme Court of the United States of the five appealed telephone suits, which began on January 24, came to an ending on February 8. The Supreme Court then adjourned to March 7. Whatever the result, these suits will always stand pre-eminent in the history of the bar on account of the interests involved, the mass of testimony taken, and the number of decisions obtained from the different courts. The importance of the Bell patent could be no better illustrated than by the original bringing and present defense of these appealed suits. That a company should so energetically defend a patent that has only six years to run is the best comment on its value. The legal expenses of the Bell Company, spent in sustaining the 1876 patent, must be without precedent in the history of patent litigation in this country. Although two patents are cited, the 1876 patent is the one that gives the monopoly of the electric transmission of speech. It contains the famous undulatory current theory, and is the one concerning which the allegations of fraudulent granting have been made. The litigations were devoted to sustaining it.

Two weeks' time of the highest tribunal in the United States have been devoted to the mere hearing of this appeal. Among the counsel for the Bell Company, Messrs. E. N. Dickerson and J. J. Storrow figured most prominently. Senator Edmunds, Messrs. Lysander Hill, Wheeler H. Peckham, and Cansten Brown were among the leading counsel for the five appealing parties.

The decision of the court will now be watched for with great interest. The probabilities normally would be against the patent. Of late years nearly all the attempts to sustain great and oppressive patent monopolies have failed in the Supreme Court. It would seem impossible that the Bell patent could be sustained as fully as it has been in the circuit courts, if it is not pronounced quite invalid.

As now interpreted, it is a patenting of the transmission of speech by electricity. To carry out this interpretation, the hazy theory of the undulatory current has to be accepted as a legally proved fact, and as representing a patentable thing.

The patent is interpreted to grant the monopoly of a natural force. The breadth awarded to its claim compares with that refused to the patent of the telegraphic inventor, Morse. He sought for a similar judgment, but was refused.

The senior counsel for the Bell Company gave a most eloquent closing appeal for his client. His peculiarities of manner, so familiar in the circuit courts, met with a definite rebuke from Justice Harlan. Notwithstanding this, the counsel recovered sufficiently to portray, later on, in his florid style, the pitiable case of his client, whose honor he declared was impugned by those seeking to destroy his patent. Many of the attacks which he assumes as personally made upon Mr. Bell have been really aimed at the work of the Bell Company and its advisers. Mr. Bell is a man of the highest honor. If, as claimed, his patent, in its granting and sustaining, is shadowed by fraud, no implication of wrong doing is charged to Mr. Bell personally.

The establishment of what Mr. Dickerson called the "Bell Telephone Annex" of the department of justice was commented on. By it he said the resources of the United States were devoted to hunting "down this innocent man to death or destruction." The best comment on this is afforded by the futile results of former attempts at a similar end—the death or destruction of his patent. Mr. Bell's success has been such that he should feel pretty well prepared for further conflicts.

The recognition of Mr. Bell by the University of Heidelberg, "within ten miles of Reis' home," in granting him its diploma last year; the recommendation by the Academy of Paris to the French Government, to award him the Volta prize of 50,000 francs, were both eloquently depicted. Mr. Bell is said to come "writhing in agony" to his counsel for protection. He was told to await the action of the Supreme Court as his vindication, and his protests at having to endure so long were most feelingly spoken of. If Mr. Dickerson's description of his client's feelings is correct, then, if the case goes against him, his plight will be a bad one.

Newark, N. J., Mechanically Considered.

A correspondent of *Engineering* describes the excursion of the Society of Mechanical Engineers to Newark, N. J., as follows:

The manufactories of Newark are seldom realized by those who have not visited them, for the city is overshadowed to some extent by its proximity to New York (nine miles). The population at present is 150,000, and it will probably be 250,000 in the next five years. It is most decidedly a manufacturing city, and (what many even of the mechanical engineers do not know) has turned out some of the finest mechanical work ever made, tools of the most delicate and exact nature, which will cut always and accurately 200 threads to the inch. Many of these were afterward examined by the visitors in Mr. Weston's laboratory, and few of them knew they were made but a short half mile distant.

A large quantity of "foreign jewelry" is made in Newark; the delicate filagree work of the Mexicans, the mosaics of the Romans, and the finely colored work of the Etruscans are all made here, and imported to New York city for sale, and fine specimens of the ancient art they are. The writer has a fine pair of Japanese sleeve buttons, and he obtained them at a Newark factory. Beautiful ancient brasses are also made here, which are even better than the originals, and Russia leather is also a product of this great city. The writer is not speaking ironically of anything but the titles, for the work is as well done as possible, and Newark manufacturers are second to none in the world, as we found out during our visit.

The first place seen was that of Hewes & Phillips, engine builders, and there much beautiful machinery was examined, and their thorough system of doing work favorably commented on by their visitors. From there we went to the Armory Hall, and enjoyed a bountiful feast, and the topical query arose then and there, numbered twenty-nine on our list, viz., "Which do you prefer, a feed pump or an injector?" The answer has not cleared the difficulty, but that could not be said of the tables. The keen air of the bay had sharpened every one's appetite, and the food was of a most appetizing character. Hence the tables were cleared and refilled time and again, until all were satisfied, and in that state were taken to the United States laboratory to witness the great inventions made by Mr. Edward Weston, a member of the society, and one of the most distinguished electricians of the day. It is due to his wonderful mind and great ingenuity that the electric light in the United States occupies the position that it does.

The writer has had the pleasure of seeing Mr. Weston's methods of reaching a result, and he is most eminently analytical and differential. He diagnoses an investigation by analysis into all its possible and probable cases, and proceeds to eliminate them one by one until he reaches the true solution. Having reached this, there are no failures, for the practical result which has been patiently worked out is thoroughly reliable. It was just this method which produced "tamadine" for making the filament in the electric light. Mr. Weston wanted to obtain a homogeneous material, and he found it. Then he threw into the process his mechanical and chemical knowledge, and now this material is readily made and the filament constructed by operators who only know the plain manipulation. These works were not long since described in your columns. Hence nothing further need be added here. Suffice it to say, they proved so extremely interesting to the visitors that it was with greatest difficulty they were started from them one hour after the allotted time, and taken to Watts, Campbell & Co.'s works, where they were again treated to a sight of beautiful mechanical work, and shown how to construct a fine and perfectly working engine.

It was again with great difficulty they were persuaded to leave this interesting place for the Clark Spool Thread Works, an enormous building, which, having outgrown one side of the Passaic River, has promptly extended itself to the outer side. There were many ingenious and interesting machines shown to us here, and not the least interesting to some of the younger members, and it must be said to many of the older ones, were the bright-eyed and roguish-looking girls who attended them. When one factory hand can detain three gray-haired veterans in the explanation of a most simple piece of mechanism, what can be expected of the younger members, who are able to produce the plea of ignorance as an excuse for lingering?

At last all were started for Mr. Weston's private laboratory, which is probably the most complete in the world, and has been visited with delight by many engineers from your side of the water. There are really four laboratories under one roof—the physical, the electrical, the mechanical, and the chemical. This building was called into existence by the demands made on this distinguished engineer for private consultation and experiment. No pains or money have been spared in its fitting up, and everything bears witness to the master mind which conceived not alone the general plan, but each particular detail. It seems to the visitor as though every emergency had been provided for, and Mr. Weston's private practice has grown to such proportions as to absorb almost his entire time. Much time could have been spent here with great profit and pleasure, but the boat must leave before dark in order to get through the drawbridges, of which there are four, without delay. The captain was found in a great state of mind, vowing we stood a good chance of remaining on board all night, but his fears were unfounded, and we reached New York city about 7 P.M., after having a fine view of Liberty with the torch and electric lights around the base in full blaze.

The Employment of Salt for the Removal of Snow.

The current volume of the "Minutes of Proceedings of the Institution of Civil Engineers" contains an abstract of a memoir on this subject by Mr. Barabant, which appeared in a recent number of the *Annales des Ponts et Chaussees*. It appears that in 1880 Mr. D'Ussel gave a description of his first attempts to thaw the thin layer of ice in the public streets, produced by the compression of snow by vehicles in time of frost. Since that period, owing to the expenditure of nearly £200,000 in futile attempts to remove the snow in Paris in 1879-80 and 1880-81, the heavy tax has been removed from pounded salt, not suitable for ordinary purposes, enabling salt to be largely used for clearing away snow, a provision of 4,000 tons of salt having been made for this purpose in Paris for the winter of 1885-86. A regular service for the removal of snow, on its first appearance, has been organized in Paris, as it is important to clear away the snow before it has been compressed into ice by the passage of vehicles, when it is far more difficult to remove. As falls of snow rarely occur at Paris with a temperature much below the freezing point, salt may be sprinkled on the snow, producing a liquid, of which the temperature may descend to 5 deg. Fahrenheit without its freezing.

The salt should be scattered on the streets as soon as the snow begins to fall fast. The mixture is effected more thoroughly by the traffic, it does not adhere to the ground, and gradually liquefies, so that at the end of four or five hours the streets may be cleared by the sweeping machine, the caoutchouc rake passed over the footpaths, and the mixture washed to the sewers by the addition of water. This cold mixture does no harm to paved roads, asphalt, and wood pavements; but salt should not be used on macadamized roads, which are disintegrated by the frequent artificial thaws thereby occasioned. This affords another reason for discontinuing macadamized roads in large towns in France, which possess the great disadvantages of being very muddy in rainy weather or during thaws, and of discharging quantities of sand into the sewers.

The employment of salt would probably be very restricted in countries where the temperature often falls below 5 deg.; but everywhere else it furnishes the best means of dealing with snow. It has been suggested that the coldness of the mixture is disagreeable to foot passengers, destructive to boots, and bad for horses' feet; but the latter can be protected by greasing the inside of the hoof, and as the mixture should be removed directly it becomes liquid, the inconvenience, both to men and animals, is very short in duration, and very slight compared with the advantages and economy of the system.

The salt should be scattered in the proportion of about one drachm per square foot for each four-tenths of an inch of thickness of snow fallen, or a larger amount if the temperature is low. Formerly, each centimeter—0·4 in.—depth of snow falling in Paris necessitated an expenditure of over £2,400, whereas now the cost is only about £800, or a saving of two-thirds. Moreover, the use of salt dispenses with sanding the streets, which, on the arrival of a thaw, produced quantities of mud in the streets and deposit in the sewers. Further, if the cessation of interruptions of traffic by means of this process is taken into account, the indirect gain to the people of Paris must be reckoned by millions of francs. Several machines have been devised for the removal of snow, but none of them is as cheap as salt; and the author gives a comparative estimate of the cost of melting snow by steam and by salt, which shows that the method of steam would be much more expensive, besides entailing other disadvantages.

The use of salt will probably not be confined to the clearing of streets in towns, but be extended to all paved roads, to tramways, and to the approaches to railway stations and all large manufactories. Perhaps, even in France at any rate, salt might be used for dealing with snowdrifts in railway cuttings, by spreading it in sufficient quantities and sweeping thin layers successively salted.

On all paved roads over which there is considerable traffic, the use of only half the proportion of salt adopted in Paris would enable a track of 6½ ft. to 10 ft. in width to be dealt with, along which the snow would be prevented from being frozen to the ground, and thus rendering traffic almost impracticable. The small cost of the system, and the advantages to traffic, are sufficient reasons for an early and wide extension of the use of salt for removing snow.