

SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. XXIX.—No. 3.
[NEW SERIES.]

NEW YORK, JULY 19, 1873.

[\$3 per Annum.
IN ADVANCE.]

RECENT IMPROVEMENTS IN TORPEDO WARFARE.

While foreign nations are lavishing millions upon the experimental construction of vessels, the iron decks of which will resist the fiercest bombardment, our own government is quietly testing and examining a mode of naval warfare to which the most herculean ironclad is as vulnerable as the weakest wooden ship. The submarine torpedo, as a means of defence, is already well known, and it is now but a simple matter to render a harbor impassable to hostile vessels; but while entrance to a land locked or narrow mouthed port is thus prevented, there is nothing to hinder a ship of war, lying without the roads and at a distance of several miles away, if she be armed with modern long range guns, from throwing their projectiles over all obstructions into the heart of a city or town. It is to supply this need that inventors have lately sought to combine the torpedo with a suitably constructed and submerged sea-going vessel which might be maneuvered and governed in the ordinary way, and propelled by steam or other power into the midst of an enemy's fleet, where, unseen and hence impregnable, she might proceed to sink and destroy ship after ship.

Our engravings represent two of the most formidable as well as the most recent applications of this terrible engine of war.

The first is a sketch of the Lay torpedo, which, our readers will remember, we have already alluded to as being under examination at the naval station at Newport, R. I. The hull of the craft is about thirty feet long and three feet wide, cigar shaped, and formed of water and airtight iron plates. It is divided into three compartments; one for motive power, another for machinery, and the third for electrical apparatus. The motive power consists in carbonic acid gas, compressed, in sufficient quantity to drive a pair of oscillating engines of eight horse power, and thus operate a screw for the period of half an hour, during which time the boat is designed to travel some six or eight miles. The machinery is controlled by wires leading to a battery on shore, the opening or closing of the first circuit governing the throttle, and the same on the second wire actuating the steering gear. The cable containing the wire is paid out as the boat moves, and of course there is no crew on board. The vessel is almost entirely submerged; and being painted green; is undistinguishable at short distances to the unaided eye. In the magazine are placed 500 lbs. of powder or nitroglycerin; and in the forward portion of the vessel, explosive shells are also arranged to be fired by an electric spark passing through a third wire in the cable. The explosion of the shells may be effected without injury to the boat, but that of the magazine necessarily causes her destruction.

The illustration annexed, which we extract from the SCIENCE RECORD for 1873, affords a clear idea of the general form of the vessel and her position in attacking an enemy's ship. Experiments made at Newport, some time since, proved quite successful; but of late we note that, from various causes, such promising results have not been attained. The invention was patented by Mr. John L. Lay, on the 25th of March, 1872; but as early as 1866 he had conceived the idea, and made drawings of its working portions. In 1870, at the request of the Viceroy of Egypt, a boat was

constructed from these plans and sent to that country for trial by the Egyptian Government. The examinations proving satisfactory, the inventor received payment for his design, and shortly afterwards, returning to the United States, opened the negotiations with our Government, of which the present investigations form a part. The invention has recently been made the subject of an interference suit by John A. Ballard, of Bombay, India, who claimed to have patented

after what is known as the English "bracket plate system," that is, two vessels may be said to be constructed, one within the other and of equal strength. Within the outside shell three longitudinals of immense strength run the entire length of the vessel and are connected with bars running in a horizontal direction by brackets. The whole is then covered with an iron plating, forming a distinct and perfectly air-tight bottom and sides. The different sections can be used and entered by manholes, which enable a person to pass between the inner and outer vessel from stem to stern, so as to effect repairs in case of injury. The compartments are all watertight, so that in event of grounding or other damage, only a small part of the vessel will fill. The decks are of fine plated steel, and of about half an inch in thickness. The new Fowler propeller wheel will be employed, the pitch of the blades of which can be altered as required, being worked on the eccentric plan; steering and propelling will thus be done by the same means, the rudder being merely auxiliary. The engines, now in process of construction at Roach's iron works in this city, are of the compound type, built in the most careful manner, and it is expected that the boat will be able to steam both astern and ahead at a very high rate of speed. Electric apparatus connects with the engine room and pilot house, from either of which points the vessel can be steered.

In the engraving, the boat is shown in fighting trim. That is, her compartments are filled with water, so that she is entirely submerged with the exception of some three feet. Her three masts

are lowered out of the way, and nothing is visible on her deck except her smoke stack, low pilot house, and the heavy gun which she is to carry on her fore-castle.

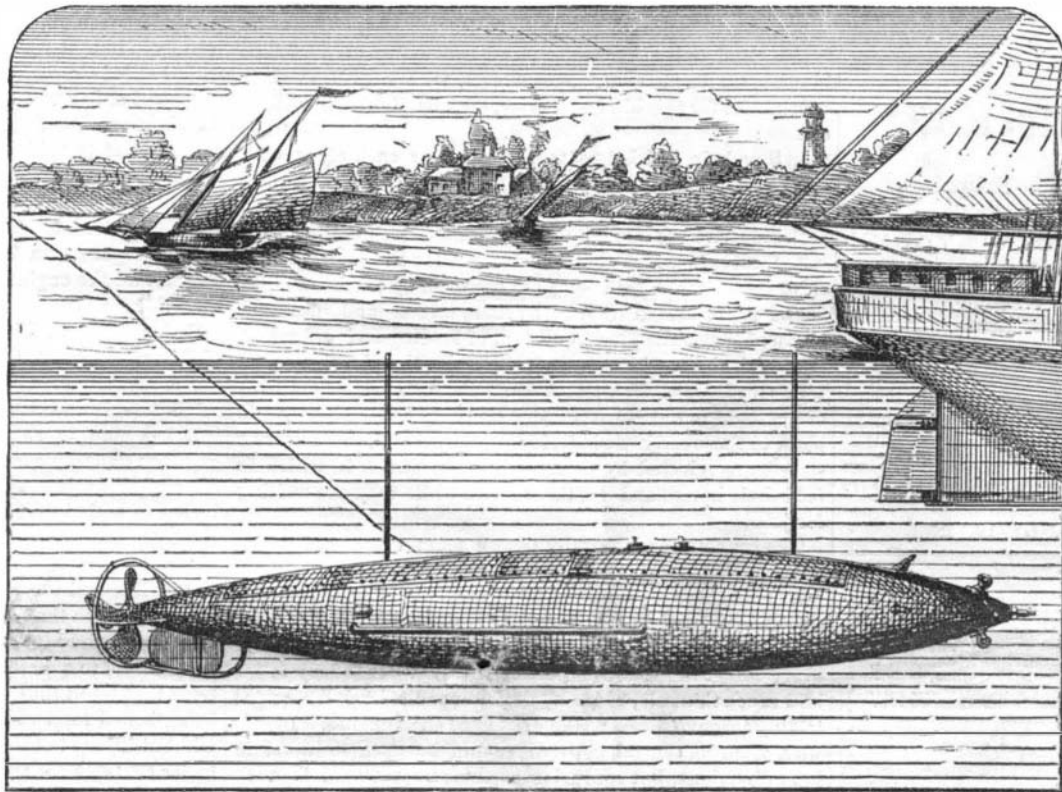
Although built with a "snout," ramming is only a secondary means of attack. In fact her bow is not a solid piece, but is built out some twenty feet in order to allow the torpedoes to be thrust forward well in advance of the boat. An opening, at a slight upward angle, extends clear through the stern, and through this the shell, placed on the end of a staff twenty feet long, is shoved. Of course, after the explosion, a ram given at full speed, accompanied by a shell from the heavy gun, would leave little probability of the attacked vessel remaining on the surface for a very protracted period. The two apertures or ports, shown on the broadside, one amidships and the other near the stern, also serve to push torpedoes from, and are used when the boat is obliged to range alongside a ship instead of meeting her bows on.

It is expected that the vessel will be launched during the present month, and work is being pushed forward upon her as rapidly as possible. When completed, there is little question but that she will be the most destructive marine machine ever constructed in this country.

THE ERICSSON PNEUMATIC TORPEDO

A third novel form of torpedo has been devised by Captain John Ericsson, of Monitor fame, who has lately built an experimental example thereof. The following description is given in the *Army and Navy Journal*:

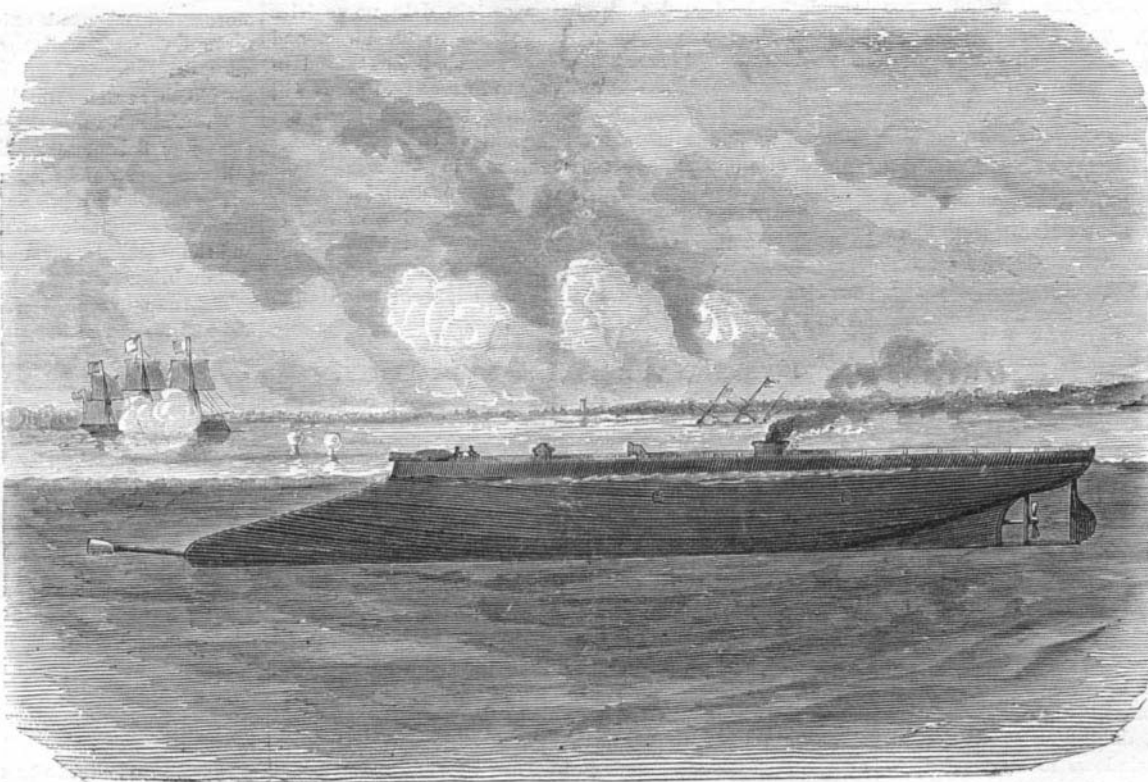
The intention is to conduct the trials at Vermland, on Long Island Sound. This estate, belonging to C. H. Delamater, Esq., has fully two miles of coast line on the west side of Long Island, thus offering admirable opportunities for testing the "aggressive" instrument. The hull of



THE LAY TORPEDO.

the device in this country as early as 1870, but the decision of the Patent Office has accorded priority to Mr. Lay.

A vessel which, although not yet launched, has already attained a world-wide fame, is Admiral Porter's torpedo boat, the subject of our second engraving. The sketch, taken from the ship as she lies unfinished on the stocks at the Brooklyn navy yard, does not necessarily aim to present the details of construction with accuracy, but serves to convey a good idea of the general configuration and shape of the vessel. She is 174 feet long, 28 feet broad, and 13 deep, and is built of thoroughly tested charcoal iron. The sheathing of the hull is from three eighths to half an inch thick, and in some portions this is increased. As we explained, in a recent article on "Iron Ship Construction," this boat is built



THE PORTER TORPEDO.

the torpedo vessel, composed of steel plates, is quite small, being eleven feet long, thirty-two inches deep, and twenty inches broad. The midship section is rectangular, while the top and bottom of the hull are planes perfectly parallel. The sides are vertical from stem to stern, the water lines being moderately sharp at both ends. The displacement is greater than might be supposed, considering the small dimensions of the hull, 2,000 pounds being scarcely sufficient to balance the weight of the whole apparatus. The propellers are of the two bladed type, three feet two inches in diameter, with a pitch of five feet. Both propellers revolve round a common center, yet in opposite directions. The constructor put the hidden machinery in motion in our presence; the compressed air being admitted through a tubular cable attached to the stern of the torpedo, the propellers were instantly put in motion, revolving in a contrary direction with a velocity far too great to admit of the number of turns being counted.

The fact has never been published that Captain Ericsson submitted plans to the Emperor Napoleon, in 1854, of an armored, nearly submerged torpedo boat, propelled by steam, intended to run close to an enemy's ship and, by pneumatic power, project a cylindrical vessel containing explosive substances against the hull at a considerable depth below water line. This plan of projecting the charge Captain Ericsson has now applied to his submarine torpedo.

Scientific American.

MUNN & CO., Editors and Proprietors. PUBLISHED WEEKLY AT NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

Table with 2 columns: Description (One copy, one year; One copy, six months; CLUB RATES) and Price (\$3 00; 1 50; 25 00; 2 50).

VOL. XXIX, No. 3 . . [NEW SERIES.] Twenty-eighth Year.

NEW YORK, SATURDAY, JULY 19, 1873.

Contents.

(Illustrated articles are marked with an asterisk.)

Table listing various articles and their page numbers, including 'Aniline black', 'Answers to correspondents', 'Astronomy in the United States', etc.

PUBLISHERS' NOTICE.

All new subscriptions, or renewals of old ones, will be commenced with the new volume, July 5, unless a request to commence at some other date accompanies the order.

The volume from January to July, consisting of twenty-six numbers, may be had in sheets, by mail, at the regular subscription price, namely, \$1.50, or in substantial binding, at the office of publication, for \$3, or by mail, including postage within the States, for \$3.75.

Bound volumes of the SCIENTIFIC AMERICAN from January to July, 1873, and the SCIENCE RECORD, either for 1872 or 1873, will be forwarded by mail or express, free, for \$5. Copies of the SCIENCE RECORD for 1872 and 1873, and the first volume of the SCIENTIFIC AMERICAN for 1873, bound, will be sent for \$6.50, or delivered at the publication office for \$6.

Remit by postal order, and address MUNN & CO., 37 Park Row, New York.

STREET TRAVEL.

The following is an extract from the new charter of the city of New York, which shall be the text for a few timely remarks:

"The Common Council shall have power to regulate the use of the streets, highways, roads and public places by foot passengers, vehicles, cars and locomotives."

It has been an amusing sight, doubtless, to many who have been comfortably seated at windows looking out upon Broadway, to notice the various incidents of a block of vehicles in that great thoroughfare. But the matter, prac-

tically considered, is not one for amusement, and begins to lose much of its humor when the lookers-on venture out, and essay to cross the street. The mode of formation of one of these jams is at once interesting and instructive. The wheels of two vehicles interlock, it may be, or a balky horse causes a temporary stoppage, when, at once, all the vehicles of the line press forward from up and down the street, and pour in from the cross streets, making confusion worse confounded. This seems to be the average driver's chief aim, to press into the thickest of the jam and then engage in a wordy war.

Travelers who wish to reach the ferries over the North River have experiences from which they would gladly be delivered. A jam exists, we will suppose (and it is readily supposable), on one of the longitudinal streets, and a close line of horses and vehicles is to be seen, unbroken at the crossing. As the head of the line advances a foot or so, all the followers do the same, each horse's nose being kept well up to the vehicle in front; and the impatient traveler, if he will cross, crawls under horses, through mud and mire that are appalling, at certain seasons.

This sort of thing has long ceased to be a joke, and there is plenty of room for regulation of the travel if good can come of it. Let us first examine the present system, or want of system. The principal business of a down town street, considered with reference to its vehicles, consists in loading and unloading trucks, and conveying merchandise in other trucks along it. The streets, with regard to their capabilities for this kind of service, may be divided into three classes:

- 1. Streets in which two trucks can pass each other with trucks on either side backed up against each curb.
2. Streets through which only one truck can pass, when both sides are occupied by trucks backed against the curbs.
3. Streets in which there is no room for the passage of a third truck, when both sides are occupied by trucks at right angles to the line of travel.

The conclusions naturally drawn from these statements will be:

I. That there are many streets in which the travel of vehicles should be permitted to take place only in one direction. Excepting Broadway, this regulation would apply to nearly every street in the lower part of the city. It is easy to see how much this rule, of itself, would expedite business, and at trifling inconvenience to the drivers of the vehicles. Broadway, from its central position, should be open to travel in both directions, but confusion in this street would be very much lessened by arranging one side for vehicles going up, and the other for those moving in an opposite direction.

II. That there are many streets in which trucks should not be permitted to take positions at right angles to the street for the purposes of loading and unloading, and that in no street should these operations be carried on so as to obstruct the sidewalks. There are several ways in which loading and unloading could be readily effected without encroaching upon the streets or sidewalks: by having courts in warehouses into which the vehicles could be driven; by excavations under the sidewalks opening upon the streets and leading to vaults below, through which goods could be drawn and delivered; or by using cranes and hoists projecting from upper stories of the warehouses. Other means will probably occur to the reader, but those who would be affected by the change might well be trusted to find out the means. Only let the regulation be issued that, after a certain date, no vehicles shall be allowed to stand at right angles to the street and that no obstructions to the sidewalk shall be caused in loading or unloading, and it is easy to foresee that plans will be devised so that the business of the merchants shall not suffer. So radical a change demands, of course, the most careful arrangement of details, and nothing but a mere outline is here attempted. It scarcely admits of doubt, however, that regulations of this nature, rigidly enforced, would effect a change, in the crowded and impassable condition of our down town streets, that would excite the admiration of all our citizens and might, in time, even elicit feeble admiration from the drivers.

INVENTION THE MOTHER OF NECESSITY.

We have always labored under the impression that the only individuals who ever reversed the old saw: "Necessity is the mother of invention," and made it read "Invention is the mother of necessity" were those infatuated geniuses who too often squander their worldly goods in fruitless efforts to carry out impracticable schemes. We have been mistaken, for we have encountered one of those instances in which the inventor, after having worked out his machine, to his satisfaction, in his brain, discovered himself placed by his invention in dire necessity for material for its physical embodiment. He was not a landsman, afflicted with chronic impetuosity, but a sailor, and an officer of a cruising whaler. His device, which, by the way, is quite an ingenious machine for cutting up blubber as it comes from the animal, necessitated the employment of many cog wheels and other gear, for which, ordinarily, metal would be employed. But at sea one cannot carry a foundry, and besides, no iron or

steel was to be had; and even if it were, no tools were probably at hand to get it in shape. Finally, after sundry trials, the huge bones of the whale were thought of, and from these, harder and stronger than ivory, by the aid of a common lathe and a few chisels, a number of cog and bevel wheels, rods, etc., were made, which, for accuracy and neatness of execution, will compare favorably with the work of many professional model makers.

The model, thus ingeniously constructed, was brought to this office a few days since, and letters patent applied for on the device. It affords fresh evidence of that persevering energy which is inherent to all inventors, and, besides, proves that a mind capable of conceiving a useful and valuable idea is never at a loss to devise means, even from the most slender and least promising of resources, for carrying the same into execution.

BOILERS AND BOILER OWNERS.

At about 9 o'clock on the morning of June 22, a boiler, at the Old Duncan Salt Works, Bay City, Mich., exploded with great violence, injuring two men, it is supposed fatally. The part of the boiler which gave way, says our informant, was the crown sheet, over the fire box, which collapsed from pressure, and the whole front of the fire box, with the fire grates, was blown out. The boiler was of the locomotive pattern, and was almost worn out from long use. A gentleman who lives in that vicinity told us that the rivets which originally headed the bolts which held the crown sheet in its place had either rusted or burned off, and that all that held the sheet was the thread in the plate. Added to this were a corroded safety valve and the absence of anything in the shape of a gage. That there was plenty of water in the boiler there is, probably, no doubt, and the accident is undoubtedly attributable to the age of the boiler and the lack of the proper steam indicator. The building is a complete wreck, and the engine and boiler are in a sadly demoralized condition.

Commenting on this, a valued correspondent, Mr. J. E. E., of Pa., who was on the spot immediately after the occurrence, says:

"There is an invention wanted; it is a salamander and ironclad man to run old and worn steam boilers without gages or indicators, of which the safety valves and pumps are out of order. The boilers have from one half to two inches of scale internally, and a similar thickness of mud in the bottom of the boiler. All the stay rods are rusted or eaten off. The iron armor of the man must be so constructed as to withstand the weight of an ordinary steam boiler or two, as well as that of the falling debris of a mill; it will also be required to stand the test of being blown (with the man inside) to a height of 100 feet in the air and the fall from that height into the ruins of an old mill, and then of being boiled for two hours in water or steam, and all this without injury to the occupant, as it often is the case that the boiler contains hot water and steam when it goes off. Such an invention would find ready sale among the owners of old oil and salt wells, where hundreds of boilers remain idle until eaten with rust, and then they are expected to stand 150 lbs. on the inch or burst. Such an invention might have saved the lives of two men yesterday at Bay City, Mich."

UNDERGROUND RAILWAYS IN AMERICAN CITIES.

The city of Baltimore now boasts of the possession of a splendid underground railway, the first ever constructed in this country. From all accounts, the new works are highly creditable to the city and the enterprising individuals under whose auspices they have been executed. Two distinct lines of tunnels have been made at Baltimore, at an expense of some five millions of dollars, whereby nearly all of the various railways now centering in the city have their tracks united. The conveniences of the public and the mercantile facilities of the city are thus greatly improved.

The Underground Railway consists of the Baltimore and Potomac tunnel, of which the western portal fronts on Gilmore street, whence it extends in a northeasterly direction through the city, under some twenty-nine streets and avenues, emerging at North avenue, where it joins the track of the Northern Central Railway.

The Union Tunnel extends, from tide water at the Canton portion of Baltimore, northerly and then easterly under some thirteen streets and avenues to the Northern Central Railway.

The total length of the Baltimore Underground Railways is 3 1/2 miles, of which about two miles are closed tunnels, and the remainder open cuts, over which the streets are carried on bridges.

The tunnel arches are from 22 to 23 1/2 feet high and from 26 to 27 feet wide, five rings of brick thick, backed with rubble masonry. Only a portion where the ground was soft and springy required the invert arch. The springs of the arches are of masonry.

The Baltimore Underground Railway passes through the finest section of the city, where the people of wealth and fashion reside; but no one is disturbed, and the streets and avenues are not in the least interfered with.

Passengers from New York to Washington can now pass through Baltimore by the new Underground Railway, thus shortening the time of transit from twenty to forty minutes. The tracks of the Philadelphia, Wilmington and Baltimore, the Northern Central, the Baltimore and Potomac, and the Western Maryland now connect with the Underground Railway.

It will be remembered that the Legislature of this State at its recent session granted concession for an underground railway in this city, to extend from the Battery under Broadway to Central Park, a distance of five miles, with a branch under Madison avenue to Harlem river, a distance of six