

SELF-PROPELLING COALING VESSEL.

WITH AUTOMATIC SELF-REGISTERING WEIGHING MACHINE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

AN interesting type of plant for coaling steamships, one possessing several novel features including a self-registering automatic weighing machine to record the quantity delivered, has been acquired recently by the Coal Trading Association of Rotterdam. This installation, which is illustrated in the accompanying photographs, was designed and constructed by Werf Custo Firma A. F. Smulders, of Schiedam, Holland, to whose courtesy we are indebted for the accompanying particulars.

The general design of the apparatus can be gathered from the illustrations. It comprises a lighter or barge containing the coal, with a carrier at the bow up which the coal conveyers travel, dumping their contents through a chute direct into the vessel's bunkers. The coaling barge is divided into ten compartments, the capacity of each of which is 60 tons, representing a total of 600 tons for the whole craft, though when loaded with a good head 700 tons can be carried. Each of these compartments is again subdivided into 10-ton bins. Extending the whole length of the hold in a tunnel beneath the compartments, above the vessel's keel, runs an endless conveyer or bucket chain, passing out at the bow on to the ladder, elevator fashion. On the summit of this ladder is pivoted a receiver,

into which the coal contained in the conveyer buckets is emptied as they pass over the end, the falling coal thence passing through the chute into the ship's bunkers. The coal gravitates through sliding doors into the conveyer buckets as they pass beneath the coal compartments of the hold, the compartments being emptied one at a time. Before reaching the bend in the tunnel to ascend the carrier the buckets pass over the automatic self-registering weighing machine; a record of the weight of the load thus being obtained. The carrier can be raised and lowered as required according to the height of the ship to be coaled, and the chute is attached to the receiver at its head by means of a universal joint, so that when once the coaling barge is moored alongside, the various bunkers of the ship can be reached with little and easy manipulation. The conveyer itself is driven by either one of the two engines by which the barge is propelled. These engines are of the compound type fed by a Scotch boiler, and drive twin screws.

The weighing machine is of the Blake-Denison type, which is officially recognized by the British Board of Trade. In action a number of buckets are accepted on the platform and weighed together, and the machine is guaranteed to weigh accurately within one per cent

of the actual load, even when the vessel lies at an angle of 10 deg. either fore, aft, or athwartship. In actual test, when a much greater angle was imposed, the accuracy was found to be in no way affected. By means of this self-registering machine the weight of coal delivered can be instantly read off when desired.

This particular coaling barge was designed for a delivery capacity of 100 tons per hour with its ladder at an angle of 45 deg. and the axle of the upper tumbler 59 feet above water level, but in actual practice this output has been considerably exceeded, a delivery of 140 tons per hour being easily attained.

In the design of this apparatus especial care has been devoted to the handling of the coal, so that it may not be broken during the transfer from the barge to the ship's bunkers, while at the same time, owing to the shape of the buckets of the conveyer, which has the appearance of a vertebrated belt, there is no loss whatever of the contents during conveyance. Coaling operations do not interfere with the loading or unloading of freight, and owing to the coal being delivered directly into the bunkers there is an entire absence of dust. Owing to the success of this barge, the Coal Trading Association of Rotterdam has since acquired a second craft of this type.

THE DEVELOPMENT OF ARMORED WAR VESSELS.—IV.

ARMOR PLATING IN THE UNITED STATES

BY J. H. MORRISON.

Continued from Supplement No. 1654, page 171.

Just before the report of the board of army and navy officers was made of the artillery experiments on the iron target, Robert L. Stevens on January 25, 1842, gave a description of the projected iron war vessel, that it will be noticed is very general in its details.

General Description of a Steam Battery or Vessel of War Proposed to be Built for the Government of the United States by Robert L. Stevens for the Defence of the Harbor of New York.

The steam battery or vessel referred to is to be constructed upon a plan entirely new, invented by the writer, and is to be shot and shell proof. She is to have greater speed than any vessel of war now afloat. The engines and propelling apparatus to be so placed that the latter shall be submerged, and the whole engine out of the way of shot from the vessel of an enemy. Her guns are to be large, and adapted to shot and shell. Her burden not less than 1,500 tons.

The practicability of rendering such a vessel proof against shots and shells is not a theoretical assumption, but has been proved by the test of positive experiments. These experiments were recently made at Sandy Hook under the superintendence of John C. and Edwin A. Stevens, and in the presence of a joint board of army and navy officers appointed by the government. From their result, no doubt whatever remains of the fact that a series of wrought-iron boiler plates riveted together, and placed upon each other until the strata amount to 4½ inches in thickness, will effectually resist the force of a 64-pound shot when fired with battering charges at the distance of 30 yards. Fifteen or twenty shots were also fired at this distance, and from guns of different calibers, against a target thus constructed, and were made to strike against it within a space of about 2 feet by 4 feet; and these produced so little effect as to leave it in a fit state to protect anything in its rear against a similar force. Shells fired from the same distance scarcely indented the iron, and both shots and shells were invariably broken into small fragments.

The above-named experiments were tried under the supervision of the officers of the army and navy. At the last of these the writer, who had just returned from Europe, was present, and trials were then made upon the effect of shells of a peculiar construction, which were prepared by him. These shells are hermetically sealed, and are effectually secured from accidental explosion, either from fire or from violent concussion. They are perfectly safe, also, from injury by submersion in water. They are so constructed as to explode after having penetrated the object against which they are discharged; and being elongated, contain three times as much powder as the common shell of the same caliber. They do not require the use of mortars, but may be fired from the guns in ordinary

use. Out of twenty of these shells which were discharged into timber, or into banks of sand, nineteen exploded in the manner anticipated, rendering their action sufficiently certain, and evincing the possession of properties not possessed by any other shell, and producing effects which were actually tremendous.

It will be manifest that a steam vessel or battery, fortified in the manner described, furnished with the means of rapid propulsion, would be able to approach an adversary's vessel so securely, and so closely, as to render it nearly impossible to miss her with shells fired horizontally; and it does appear that a vessel possessing the properties above enumerated would be able to attack and destroy any fleet of steamers, or of sailing ships, as now constructed, which might be sent to attack a city or blockade a port. The part of such a vessel through which the guns are fired, having a thickness of 4 inches or 5 inches only, might have portholes but little larger than the muzzle of a gun, and yet allow it to be fired at any desired angle. These portholes may be readily protected from canister, grape or other shot by means of movable screens so constructed as to be removed and replaced with facility.

A single shell of large dimensions, and of the kind prepared by the writer, will suffice to sink the stoutest wooden vessel if exploded within her sides anywhere near the water line. The effect of such a shell upon a structure of wood was fully tested, under his superintendence, upon Governor's Island in the harbor of New York upward of twenty years ago. The experiment was made by the late Col. James House and several other officers, with the following result: A target of white oak was constructed in the strongest manner by one of the best shipbuilders. It measured five feet in thickness, and the timbers were secured together by iron screw bolts passing entirely through the whole. This target was perforated by the explosion of a single shell, a hole being made in it through which a horse might have passed. Seven timbers of white oak, each measuring 12 inches by 16 inches, were torn into shreds, and scattered to a great distance.

The foregoing plan of constructing and arming a vessel, with most of its details, has been matured for many years, and the delay in bringing it forward has resulted from a conviction that a period more favorable to its adoption than any that has heretofore occurred would arrive, and it is believed that it has now actually arrived. As a means of defense it would be cheaper than any other. In actual service her crew of all grades would not probably exceed one hundred and fifty. She would need no rigging. With anthracite as fuel she would not be rendered visible either by smoke or by sparks, and would therefore attract the notice of an enemy the less, either by night or by day, than any other vessel.

ROBERT L. STEVENS.

The following letter on the same general subject was written at a later period by John C. Stevens, a brother of Robert L. Stevens and Edwin A. Stevens, and one of the signers of the letter to the Joint Navy and Army board of August 13, 1841:

New York, January, 1846.

Mess. Gales and Seaton*: It is often asserted that in a sudden declaration of war against us by England we should be likely to get, for the first year at least, very much the worst of it, owing to her efficient preparation, and our want of it. What injury British cruisers could inflict upon our commerce I do not know, but they have merchant ships at sea as well as ourselves, and as it is a game two can play at, the advantages are not likely to be all on one side. With regard to the apprehended destruction of our cities on the seaboard, I believe this danger may be very much lessened, or perhaps entirely warded off, and at an expense comparatively trifling. The suggestion will at least cost nothing. The government in 1841 appointed a board of army and navy officers to assemble at Sandy Hook to witness some experiments to be made by my brother Edwin and myself to show the effect of shots and shells upon wrought iron, and to report the result.

Com. Stewart was at the head of the naval, and Col. Totten at the head of the army committee. A target two or three feet wide by four or five feet high, and four and a half inches thick, made of wrought-iron plates riveted together, was set up at 30 yards from the gun, that the initial velocity and of course greater effect of the shot might be obtained. Many of the different size shots, varying from 24 to 64 pounds weight, together with a number of the heavier shells, were fired into it. The shot were in every instance broken into minute fragments. No vestige of the 24-pound shot remained; of the 64-pound shot, a small core an inch or an inch and a half in diameter was left in the indentation made, the exterior surface of the ball being entirely dissipated. As to the shells, they were broken to pieces, leaving scarcely a mark to show where they had struck. A man would have been as safe from shot or shell behind this shield as if he had been thirty miles instead of thirty yards from the muzzle of the gun.

By referring to the report of the board of officers made at the time, you will find this proved. Should ocular demonstration of its truth be wanted, the government may satisfy itself by making the experiment. It can be done in half a day, and at an expense of fifty dollars. I would propose then to construct an iron shield for every gun not already protected by a battery, as an additional defence to such cities or harbors as may be deemed insecurely fortified. Those

* Gales and Seaton were publishers at Washington, D. C., of "Congressional Debates."

shields should be large enough, and no larger than necessary, to protect as many men as are required to work the gun. A shield 4 inches thick, 10 feet long, and 7 feet high, hinged together in such handy panels as to admit of being arranged in an angular or semi-circular form, and as easily set up or removed as the gun itself, would, in my opinion, be a perfect protection from either shot or shell. If this be true, then, as I aver it to be, what would be the effect of 100 or 500 guns so shielded upon a fleet of wooden vessels? If the guns be manned by Yankees and charged with hot shot or shell, those who make the trial will find it much easier to get within than without the range of such missiles.

Satisfy a man that he is safer behind this shield than he can be anywhere else within striking distance of a shot, and you will be in no want of men to work as many guns as the government may choose to furnish. What sort of a fight would a 74 (gun frigate) make with *one gun* so protected? The one presents a surface of 200 feet long by 15 or 20 feet high, and vulnerable at every point; the other a surface of ten feet by seven feet, and invulnerable. A single shell might sink the one, while a thousand would be as harmless to the other as so many eggs thrown against a wall. The weight of the shield compared to that of the ball is so great as to preclude the possibility of its being thrown down or even moved by the shock of the heaviest shot carried by a vessel of war at present. If they get heavier guns, get thicker shields. How many guns so shielded it would require to protect a harbor or city, the officers of the army and navy are best able to say. I am satisfied that the greatest bungler that ever applied a match would not fail under such circumstances to hit a ship.

Those who have witnessed the effect of an American shell fairly embedded in a wooden hull, will be at no loss to predict the fate of a vessel pierced by such a missile. The cities might have their guns and shields as they have their fire engines, ready at the ringing of a bell to take the station previously assigned them. The wharves and shores of New York and New Jersey in an hour's time might bristle with cannon more difficult to dismount or silence than ever pointed at a foe. No forts and but little expense of either men or money would be required. Companies would be formed as fire companies are, ready and willing to serve as many guns as the government or city would furnish them. The weight of a target 10 feet long, 7 feet high, and 4 inches thick, which at the distance the guns would probably be fired would be thick enough, will weigh 7,500 pounds, a little more than a load for a good four-horse team. Its cost would be \$750. To protect one hundred guns would cost \$75,000. What a fort constructed of stone, and much less efficient, with all its paraphernalia, etc., would cost I do not know; perhaps ten or twenty times as much.

In the stone fort the wide embrasures render the guns liable to be dismounted. With the iron there is no such danger. The aperture need be but little larger than the muzzle of the gun, to give a much wider range than can be had from any embrasure. The iron defence has another advantage: its front may be changed or its position shifted to any spot rendered by circumstances more desirable. Less than one-half inch of iron will protect a soldier from a musket or rifle shot. A breastwork to cover a front of 500 feet might be carried in twenty ordinary wagons, and set down or taken up with as much facility as a gun and its carriage can be placed in or removed from its position. There is iron enough in the country to make in one or two months' time as many shields as would be required. It is true, the simple riveting together of iron plates of any thickness, the most common blacksmith can execute. Every town or exposed place might have a gun or fort of its own. Fortunately for us, we wish but to repel the attack of others.

These shields, together with such a steamship as the government has authorized R. L. Stevens to build, will put it in our power. A steamship or battery, such as he is about constructing, impenetrable to shots or shells, and capable of moving with greater rapidity than any other ship afloat, will in my judgment be more than a match for the largest fleet of wooden vessels that England or any other power can bring into the bay, or against the city of New York.

JOHN C. STEVENS.

The introduction of the bill in Congress for the construction of this armored vessel was made in February, 1842, and in two months had become a law. This appears to be a very short time for such a measure carrying an appropriation of money, to be before Congress, but there was as much, if not more, interest taken in the subject by the navy and war departments to see the experiment made, than there was for any private interest to be served. There was also some agitation of war with Great Britain at this time by the politicians and contractors over the question of the Oregon boundary. There was an effort made during the progress of the bill through the House of Representatives to have a provision inserted requiring

that the iron from which the vessel was constructed should be wholly of American manufacture but this failed to meet the approval of that legislative body. The larger machine tools for the working of the material used in the building of the vessel and machinery, and some of the heavier plate iron to be used in the structure, were imported from Great Britain.

In the summer of 1843 work was begun in excavating for the drydock in which to build the vessel, and considerable of the necessary cutting was through solid rock. This dock was about 300 feet long and 120 feet wide. There were also brick buildings erected for machine shops and a boiler shop, alongside the drydock, for preparing the material for construction before its erection in the basin. The vessel as now designed was to be an iron hull of 250 feet by 40 feet by 28 feet deep, and to be constructed of plate iron of an average thickness of one-half inch. The angle iron frames were to be 6 inches deep, and from $\frac{3}{4}$ inch to $\frac{1}{2}$ inch thick, and spaced two feet apart, except under the engines and boilers. There were to be four or more condensing engines, with four iron boilers, wrought-iron main shafts, and an artificial blast for the boiler furnaces operated by an independent engine. The motive power was to be below the water line of the vessel, and operating twin screws. The armor plating, at and above the water line as then proposed, was to be $4\frac{1}{2}$ inches thick. It was intended to fit the vessel with a large Paixhan or shell gun, to be located in the bow of the vessel on the main deck, and to be protected from the enemy's shot and shell by a bombproof covering.

The plan for the building of this vessel was in readiness for the commencement of the work by the fall of 1844, but nothing seems to have been done under the contract. Otherwise we find that in the spring or summer of 1845 work was begun in the yard on the iron-hull steamboat "John Stevens," an account of which is given in the SCIENTIFIC AMERICAN SUPPLEMENT of October 28, 1905, in article on "Iron and Steel Hull Steam Vessels of the United States," and the vessel completed for service in May, 1846. The official report of the bureau of construction of the Navy Department for 1845 says regarding the war steamer: "At Hoboken, N. J., iron steamer has been contracted for"; for 1846 to 1851 inclusive, "At Hoboken, N. J., iron steamer, building suspended"; and for 1852, "Stevens iron steamer at Hoboken, N. J., in progress of construction." While the official reports do not indicate that there was any work of erection from the original design, still it has been stated that there was a short length of keel, and a few frames erected, after the "John Stevens" was finished. If so, this was as far as the construction work ever got in the early stages.

That the improvement made in the naval gun had much to do with the delay in building this vessel is without doubt. There had been very little if any change made in our naval artillery from the close of the war of 1812 to the period under review. With the addition of steam vessels to our navy began a period of progress in the armament of our naval vessels. In 1841 an improved "Columbiad" of a different model from the Paixhan gun was introduced into the service, and a battery composed of 10-inch and 8-inch guns of this type were placed on each of the steam frigates then completed; and a few years later this type of gun was further improved with increased weight and greater power. During the Mexican war there were three or more naval vessels fitted with shell guns. There were also the two 12-inch wrought-iron guns on the naval steamer "Princeton." The desire to know of the efficiency of these guns during the Mexican war may have been one of the causes of the later delay in commencing operations on the vessel. In 1844 Prof. Daniel Treadwell introduced in this country the principle of the "hooping" of naval guns. A 12-inch Columbiad gun was cast at South Boston, Mass., in 1846 that was "hooped." The wrought-iron gun was no longer taken into consideration for experiment, after the explosion on the "Princeton" of one of her 12-inch wrought-iron guns. This gun was forged at the works of L. B. Ward & Co. in New York city, the only works fitted with tools to do such heavy forging at the time. We thus see that the first steps had been taken in producing an improved type of gun for the naval service, prior to any work being commenced in the erection of the iron armored war steamer. The experiments with these later types of guns destroyed all confidence formerly felt in the $4\frac{1}{2}$ -inch armor proposed for the vessel. These experiments with cast-iron guns were continued for a long period and at frequent intervals; discouragements and failures followed for a few years, but they finally developed in about ten years in the Dahlgren gun and later the Rodman gun. The rifled cannon was not produced in Europe until about 1855.

After the failure of the "Princeton's" wrought-iron gun, there was considerable attention given to strengthening the naval gun. About the same time iron-hull steam vessels were receiving more attention in Congress, and in 1846 there was a report made by the naval committee of the House of Representatives

recommending iron in the construction of all naval vessels on account of its strength combined with lightness, economy in repairs, and the advantage that it will to a considerable degree obviate the destructive effects of Paixhan or hollow shot." One of the provisions for these vessels was to be their capacity to carry an armament equal at least to six of Treadwell's wrought-iron guns of 12 inches caliber. Various proposals were made to construct these vessels, one of which was from John Ericsson to build a steamer of 1,200 tons, with his submerged propellers, for \$330,000, with all her armament complete. This measure did not get any further than the committee. It had too much iron and steam, with further modern improvements about it.

There were other causes than the improvement of naval ordnance at this period that contributed to the delay in the prosecution of the work on this vessel. There were a number of officers of the higher rank in the service who were opposed to the introduction of steam vessels in the navy, and who said at the time, "We are being steamed to death." As for an iron-hull, armored, steam war vessel, that was the height of folly; it was too much of the engineer's vessel to suit them. Some of these officers still retained this opinion at the opening of our civil war. Any progress that brought steam and an engineer into the naval service gave this element the nightmare. There were several engineers from the merchant service who entered the naval service about 1844, but on account of the exactions of the service at the time they passed in their resignations in about a year, and left the navy for more pleasant employment. The engineers in the navy had their own trials on board the vessels at this period. Besides these naval officers, there were the rival interests at the time, that were engaged in bringing the screw propeller forward as a means of propulsion to steam vessels; and last, but not least, the advocates in private life of wooden-hull steam vessels for our navy. This combination of interests made their power felt at Washington soon after the contract was made for the armored vessel. Commodore Perry was sent to the scene of strife during the Mexican war, and Col. George Bomford died in 1848, so that the contractor lost the aid and counsel of these advisers in the earlier stages of the work.

That the factor of politics entered into the business, there is no doubt. The opposing interests put impediments in the way of carrying forward the enterprise, through official channels and otherwise, and it was not until 1852, when the dominant political party of the country at the time came once more into full control of both the executive as well as the legislative branches of the government at Washington, that the friction of opposing interests had almost entirely lost its effect, and the enterprise was again placed on good ground by a renewal of the contract, and a little later a further appropriation of money by Congress for the vessel. The contractor was in no sense a novice in the game of politics.

There were never, so far as known, any accusations made of "honest graft" in this contract, as the contractor was so much in love with his profession, that its ruling spirit raised him above the speculative government contractor. It was viewed in the light of an investment, as a waste of public money in promoting a visionary proposition. This was not the condition surrounding most of the large contracts made by the Navy Department during this period, for Senator Thomas H. Benton in his "Thirty Years' View" says of this time: "A powerful combined interest pushes forward an augmented navy, without regard to any object but their own interest in it. First the politicians who raise a clamor of war at the return of each presidential canvass, and a cry for ships to carry it on. Next the naval officers are always in favor of more ships, to give more commands. And third, the contractors who are to build these ships."

(To be continued.)

The best flour milled in this country undergoes an aging process before being placed on the market. The treatment causes it to absorb more water and bake a larger loaf and show improvement in many ways over the freshly-milled flour. The storage and other charges add materially to the cost of the flour, and experiments have been conducted for some time to bring about the same result in some more economical manner. An electrical apparatus has been recently perfected, by which this aging process is done in a few minutes. The result is accomplished by allowing the flour to come in contact with ionized air. The apparatus designed for the purpose comprises a generator, an air pump, and a make-and-break device operated by the same movement as the pump, all mounted on one base. At every stroke of the pump there is an electrical discharge brought about by the breaking of an arc in the interior of the pump, and the air thus ionized is conducted to any part of the mill through pipes, and is brought in contact with the finished product by being passed through the reels and agitators through which the flour passes as it comes from the mill.