SCIENTIFIC AMERICAN

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

Vol. LXXVIII.—No. 3.
ESTABLISHED 1845.

NEW YORK, JANUARY 15, 1898.

[$3.00 A YEAR.
WEEKLY.

THE GREAT TRAINING JETTY AT THE MOUTH OF THE COLUMBIA RIVER, OREGON.

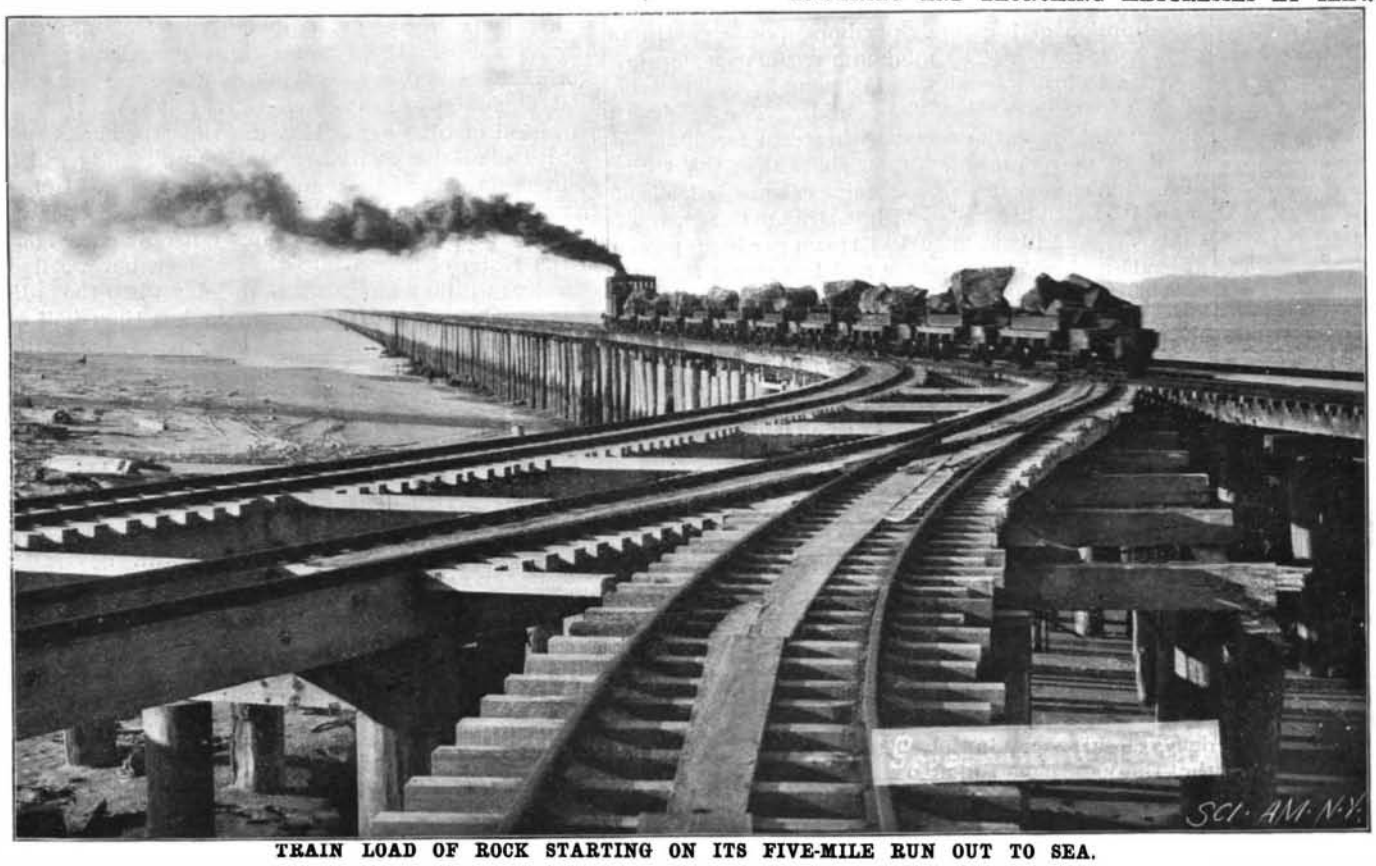
The successful completion of the Columbia River jetty and the permanent improvement which it has made in the entrance channel is another tribute to the genius of Captain Eads, the author of this method of harbor improvement. What he did for the entrances to the Mississippi his brother engineers have now accomplished at the mouth of the Columbia River.

The theory of the training jetty is based upon the fact that the velocity of a given volume of water in passing through a channel in a certain time will be proportional to the area of the cross section of the channel. The smaller this cross section, the higher the velocity.

The lower reaches of the Columbia open out to a width of several miles, and the silt which is brought down the river is deposited by the now sluggish current at its broad mouth, forming in conjunction with the littoral drift of the sand a bar, which in former days was a serious hindrance to navigation. The plan of improvement contemplated the construction of a rock jetty on the south side of the entrance which should confine the outflowing tidal and river water, increasing its velocity and causing it to scour out a channel to deep water on the outside of the bar. The undertaking has been a brilliant success from the first, the improvement in the channel keeping pace with the seaward advance of the jetty. The original plans called for the construction of a pile and broken rock jetty, which should start from Fort Stevens on the southern side of the entrance and extend 4½ miles to sea. It was estimated that the total cost of the work would be $3,710,000, but the favorable conditions which prevailed, and the improved methods of work devised by the engineers, enabled them to carry the jetty nearly half a mile further to sea, or about five miles in all, and to complete the whole scheme for $2,025,650, or about 45 per cent less than the original estimate.

Before the commencement of the work there were two or more shifting channels across the bar whose depth was variable, ranging from 18 to 21 feet. It was rarely that any vessel of more than 1,300 tons register, or drawing over 21 or 22 feet of water, entered the Columbia, and the variable nature of the entrance necessitated a close watch upon the channels and an intimate knowledge of their condition upon the part of the pilots.

LOWERING AND LAUNCHING MATTRESSES AT SEAWARD END OF JETTY.



TRAIN LOAD OF ROCK STARTING ON ITS FIVE-MILE RUN OUT TO SEA.

The crossing of the bar, which required great caution at any time, became positively hazardous in boisterous weather, and the grain ships which arrived off the bar when a heavy sea was running, or the weather was thick, were liable to be detained on a dangerous lee coast for several days.

The work was commenced in 1885, and it very soon began to show a good effect upon the channel. As the work proceeded, the waters, confined by the rock work of the jetty, were prevented from flowing out toward the south and were concentrated to the north of the work. The increased velocity proved sufficient to scour out and carry to sea the intervening sand between the various channels, and a broad, magnificent entrance was formed which is now over two thousand feet wide and affords a low water depth of 30 feet. The new channel kept pace with the advance of the jetty, and now that the full five miles have been completed, the Columbia River is capable of admitting

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LOADING ROCK ONTO DUMP-CARS AT JETTY DOCK.

CONSTRUCTION OF THE COLUMBIA RIVER JETTY, OREGON.

THE GREAT TRAINING JETTY AT THE MOUTH OF THE COLUMBIA RIVER, OREGON.

(Continued from first page.)

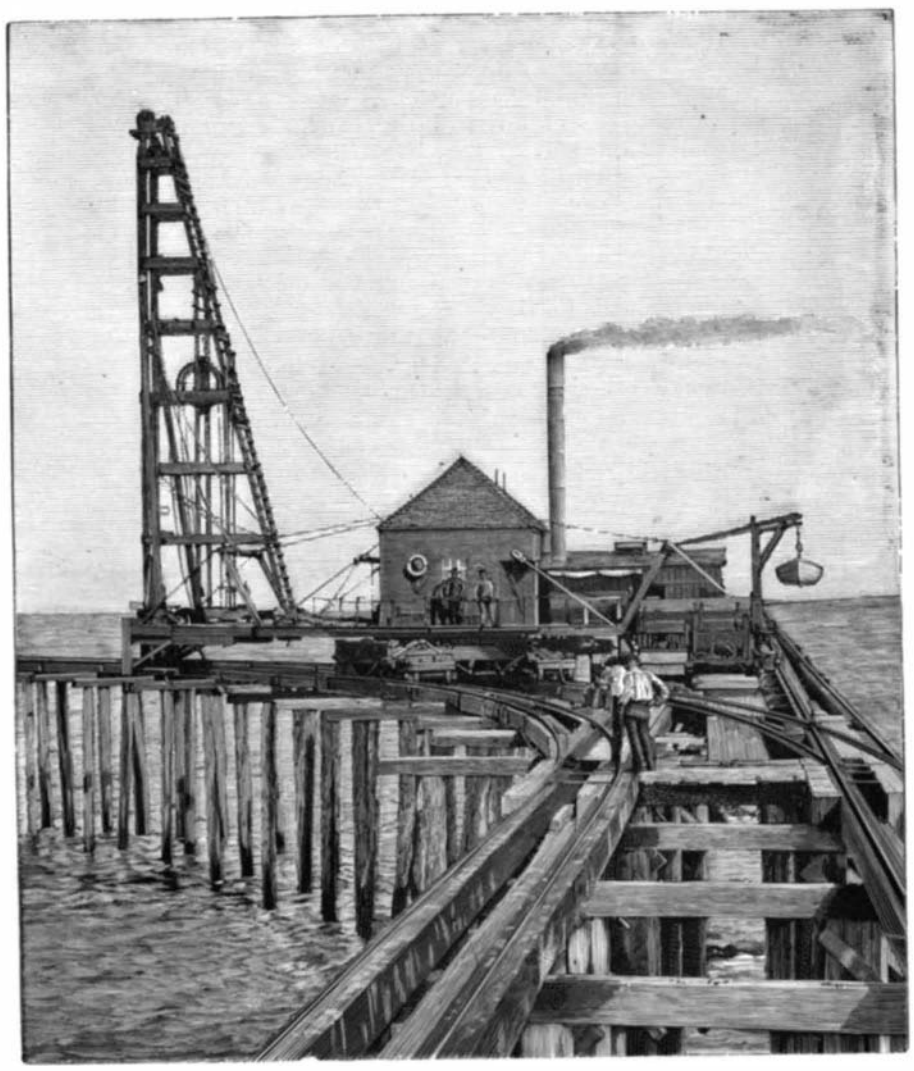
the largest ships afloat at any state of the tide or weather.

In constructing the jetty a double track pile trestle was built to carry out the mattresses and rock filling, the trestle being kept a short distance ahead of the rock. The bents were 16 feet apart and each bent consisted of four piles, the outer piles being 18 feet from center to center. The bents were capped with timber 12 inches by 12 inches and 22 feet long. The two tracks, 13 feet center to center, were laid directly on four lines of 12 inch by 16 inch stringers. The pair of piles beneath each track were braced with 6 inch by 6 inch braces, 10 feet long.

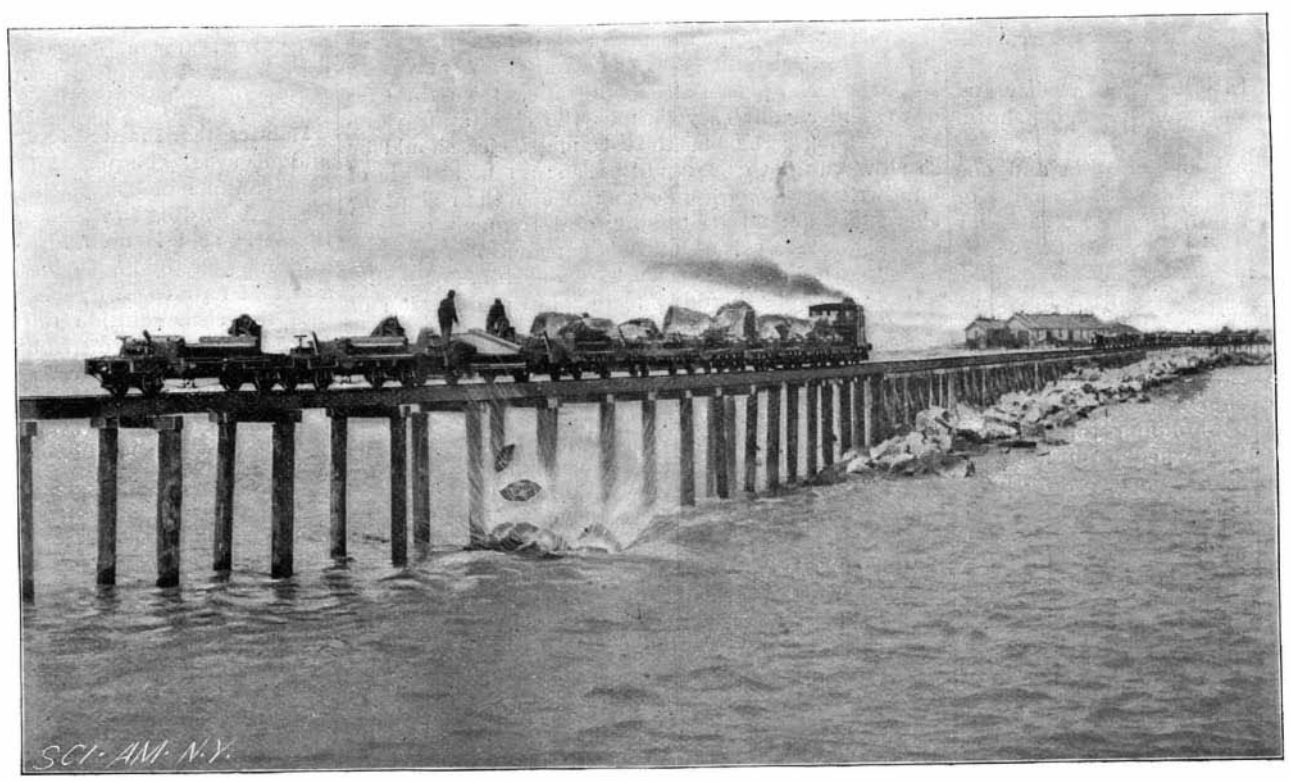
A large and powerful hydraulic or jet pile-driver was specially constructed for the work. It was carried upon four eight-wheeled trucks and revolved upon a turntable whose platform was formed of heavily trussed timbers. This platform was 17 feet long by 19 feet wide and covered both tracks, its load being transferred to the trucks by box girder transoms. A circular track of 30 pound rail was laid upon the platform and a similar track was bolted beneath the floor of the pile-driver. The latter was 64 feet long, and was so arranged that the gins, hammer, etc., at one end balanced the boiler, tank, fuel, etc., at the other end. A stout pyramidal gallows-frame was built above the track circle, from which a set of heavy hog chains led down to the ends of pile-driver floor or frame, thus relieving it of bending strains and allowing it to be kept up to level. The engine, which was placed over the track circle, turned the driver, propelled it on the rails, and hoisted and drove the piles. A pump for working the hydraulic jet was located on a platform attached to the side of the driver. From the pump the water was led by a 4½-inch hose to a V-shaped coupling, from which it was conducted by two 2½-inch branches to a couple of pipes which were loosely attached on each side of the pile by means of staples, the bottom of the pipes terminating near the foot of the pile.

When a pile was to be driven, the pile-driver was swung around, and a hoisting rope, which passed over the sheave at the top of the gins, was made fast to the large end of one of the piles on the tender. The two jet pipes were then fastened loosely down each side of the pile, and the pile was hoisted, swung round and lowered into position. The pump was then set to work, and the weight of the pile and the hammer—the latter being lowered onto the head of the pile—caused it to settle as the jets of water loosened the sand. The average rate of sinking was 10 feet per minute. When the water jet had sunk it nearly to grade, a few taps of the hammer completed the work. As soon as the pipes and hose had been disconnected, the sand closed tightly about the pile, giving it the necessary frictional resistance and bearing power. It was not necessary to build any temporary platform for cutting off the piles. This was done when they lay on the gridiron before the driving, a mark on the hammer serving to indicate during the sinking when the proper level had been reached. The driver was then swung round again to the tender, and a cap was picked up, brought round to the front, laid in place and drift-bolted, similar operations being gone through in laying the stringers and rails.

After a certain length of trestle had been completed, the brush mattresses or fascines were built and sunk to the bottom. The object of the mattresses was to form a foundation for the rock, hold it together and prevent it from sinking piecemeal into the sand. They were laid in two long strips, each 20 feet wide, one beneath the trestle and one adjoining the trestle on the north side. The inside mattresses were lowered from the floor of the trestle and sunk by piling rock upon them. They were 20 feet wide, 64 feet (the length of four bents) long and 5 feet thick. Those on the outside were 20 feet by 20 feet in area and 3 feet in thickness. They were all built of brush and poles, with five or seven stops alternating in direction on the layers of brush and securely fastened by wire or rope to the poles. The placing of the outside line of mattresses in position necessitated the construction of special launching cars. These consisted of flat cars on which frames or platforms measuring 20 by 24 feet were carried upon rollers. The mattresses were brought to the site on these cars and, by means of a tripping gear and tripping lines, the platform was given a sufficient pitch to slide the mattresses off into the water.



THE JET PILE-DRIVER USED IN CONSTRUCTING THE TRESTLE.



DUMPING ROCK AFTER MATTRESSES HAVE BEEN LAID IN PLACE.

The rock for the jetty was quarried on the banks of the Columbia River and towed in barges to the docks at the shore end of the structure. Here it was hoisted by steam derricks onto self-righting dump cars, of the pattern shown in the front page engraving, which carried from five to eight tons each. These were made up in trains of ten or a dozen cars and hauled out to the end of the jetty, where the rock was dumped onto the newly laid mattresses. The dumping was done by means of a rack and pinion, and was so expeditious that two men could dump twenty cars of rock in five minutes. When the jetty was nearing completion, three spurs were run out for the purpose of protecting the shore line. The first two were washed out by heavy surf, but the third attempt was more successful, and a substantial breakwater now extends from a point near the commencement of the jetty proper across the dock in a southeasterly direction a distance of about half a mile.

In a work of this magnitude the total quantities of material reach remarkable figures. In the present case the material in the jetty and its groins includes over half a million lineal feet of piling, nearly four million feet of sawed lumber and about one million tons of rock.

The construction of this important work has served to call public attention to the rapidly growing commerce of the Northwest, and the part which the Columbia River with its tributaries is destined to play in developing the States of Oregon, Washington, Montana and Idaho. This wonderful river drains a territory fully four times as large as all the New England States combined. For a distance of 560 miles from its mouth there is but one serious obstacle to navigation, the Cascade Rapids, and this may now be passed by way of the splendid lock recently completed by the government engineers. There is every reason to believe that the dream of John Jacob Astor, the founder of Astoria, at the mouth of the river, will ultimately be realized, and that its growth will rapidly entitle it to a leading position among the centers of commerce on the Pacific coast. Our thanks are due to Mr. M. J. Kinney and Mr. Robert Gibson, of Astoria, Oregon, for the illustrations and data used in preparation of the present article.

A Cheap Ruby Lamp.

An inexpensive dark room lamp may be easily made from an empty tin (a one pound French coffee tin does admirably). One inch from the top, and parallel with it, by means of a small file, cut a slit 3 inches in length, and quite underneath it cut another one parallel with the bottom of the tin, 1 inch from it, and the same length as that above it (3 inches). Now, from the ends of the slits already made cut two slits (which, if properly done, will be parallel to each other), so as to take a square quite out of the side of the tin. A double piece of ruby fabric is now to be glued over this square hole. Now in the center of the bottom a circular hole of ¾ inch in diameter is to be cut (by means of a flat file or an old knife). A piece of tin, ½ inch less in width than the diameter of the tin, is to be bent in the shape of a V, with a piece protruding on each side. This is now to be soldered inverted to the bottom of the tin, over the hole, so as to prevent any light escaping from the hole, which is for the purpose of ventilation. A tin tack is now to be driven through the lid of the tin (point inward) and its head soldered to the lid of the tin. By pressing a night light or small piece of candle on the point of the tack, and placing the tin in its lid, we have an inexpensive ruby lamp. When required for use with isochromatic plates, fasten a piece of yellow fabric over the ruby by means of elastic bands at top and bottom. The brighter the tin is inside, the better, for the sides then act as a reflector.—Photographic News.