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BRIDGE BUILDING ON THE PENNSYLVANIA RAILWAY WITHOUT INTERRUPTING TRAFFIC.

The freight cars of the Pennsylvania Railroad start at the eastern terminus of the road from a point on the shore of Jersey City some distance to the north of the passenger depot. The freight cars run upon a separate route until the heights back of the city are reached. There the freight and passenger lines converge, and thence both classes of trains pursue the same route to the West. The freight line, at its starting point, is half a mile or more distant from the passenger line. It is not a surface road until the high ground is reached. Through the city it is carried on wooden trestle work, with iron bridges across the streets. This feature keeps the cars out of the way, makes their working entirely independent of street traffic, and in every way is a benefit to the company as well as to the city.

It became evident that the woodwork must be replaced by a more permanent structure, and in this issue we illustrate the operations now in progress with a view to accomplishing this result. The company was in possession of a number of iron trusses eminently suitable for this work. They were used as bridges over various streams and rivers, the Juniata among others. They had served for some years as such when it was determined to devote them to this work, replacing them by other structures on the main line. Over the Juniata stone arches have been built in their place.

Owing to the swampy condition of the route, the first operation was driving piles for the pier foundations. There was insufficient head room to do this under the trestles, so the plan was adopted of cutting out a section of one track with its underpinning and setting up the pile driver in the gap and there driving piles for one-half of the pier base. This, of course, confined the traffic to a single track. After this was done the gap was bridged by a temporary structure, and the same operation was repeated on the other side of the roadway, and all was ready for the stone work. During the second period of pile driving the cars ran upon a new track built in the line of the section first occupied by the pile driver, as shown in our illustration.

Upon the base thus provided the piers of stone were erected. In building them, due regard was had to the depth of the trusses. In one instance a variation of 18 inches had to be provided for, necessitating a rabbet or step upon the top of one pier and a new level for the next. The trusses were to rest upon these, and the roadway was laid upon their upper chords.

The trusses were fastened together with fastenings of the pin or bolt type. This excellent method of constructing trusses, much more prevalent in America than in England, where riveting is the favorite type of connection, had its good features well illustrated here. By removing the pins, the whole structure of a truss was taken to pieces without any destruction of parts. The pieces were taken to the scene of work. The first step was to put them together, truss by truss, keeping them on skids and lying on their sides upon the ground. This was necessary to get all parts together, and each piece in the right place. On each side of the track false work was built for the length of one truss, or equal to the distance between the piers. Its height corresponded with that of the piers. On this the trusses were set up, two on each side. The bottom chord was first put in place, and then, by aid of further false work, the top and intermediate studs and tension rods were set up. This brought two bridges on each side of the regular roadway. The false work was taken away, and the iron work left extending from the line of one stone pier to that of the next, and supported at each end on wooden piers.

The ends of the trusses did not rest directly upon the wood. A couple of rails intervened and bore their weight directly. The object of this is to avoid friction, and so to render the lateral transfer possible. Upon the top of the iron work the full set of sleepers, each numbered, were placed. Two crab windlasses were bolted down to the lower chord level of one of the bridges or pairs of trusses. One windlass was placed at each end. A heavy tackle or blocks and falls were fastened between the bridges, running at right angles to their length and in the line of the windlasses. The end of the fall was taken to the windlass.

The next work is the demolishing of the tracks and woodwork of the trestles which are between the spans. When this is removed, all is clear for the moving. The rails are thoroughly greased well up to the trusses. No grease is placed directly between them and the rails.

They now have to be drawn in laterally and evenly toward each other until over the piers. The first strain, owing to the absence of grease on the rails, is very heavy. For about eighteen inches hydraulic jacks are used to force them from their seats. As soon as the greased portion of the rails is reached, they become amenable to the tackle. By blocking one span is locked fast, and eight men begin turning the windlasses. The blocked truss serves as an abutment. As the strain comes upon the tackle, it draws one of the bridges toward its fellow. The blocked one cannot move, so the other is gradually drawn up to its place. As soon as it reaches its position, it is jacked up. To provide steps for the jacks, heavy timbering

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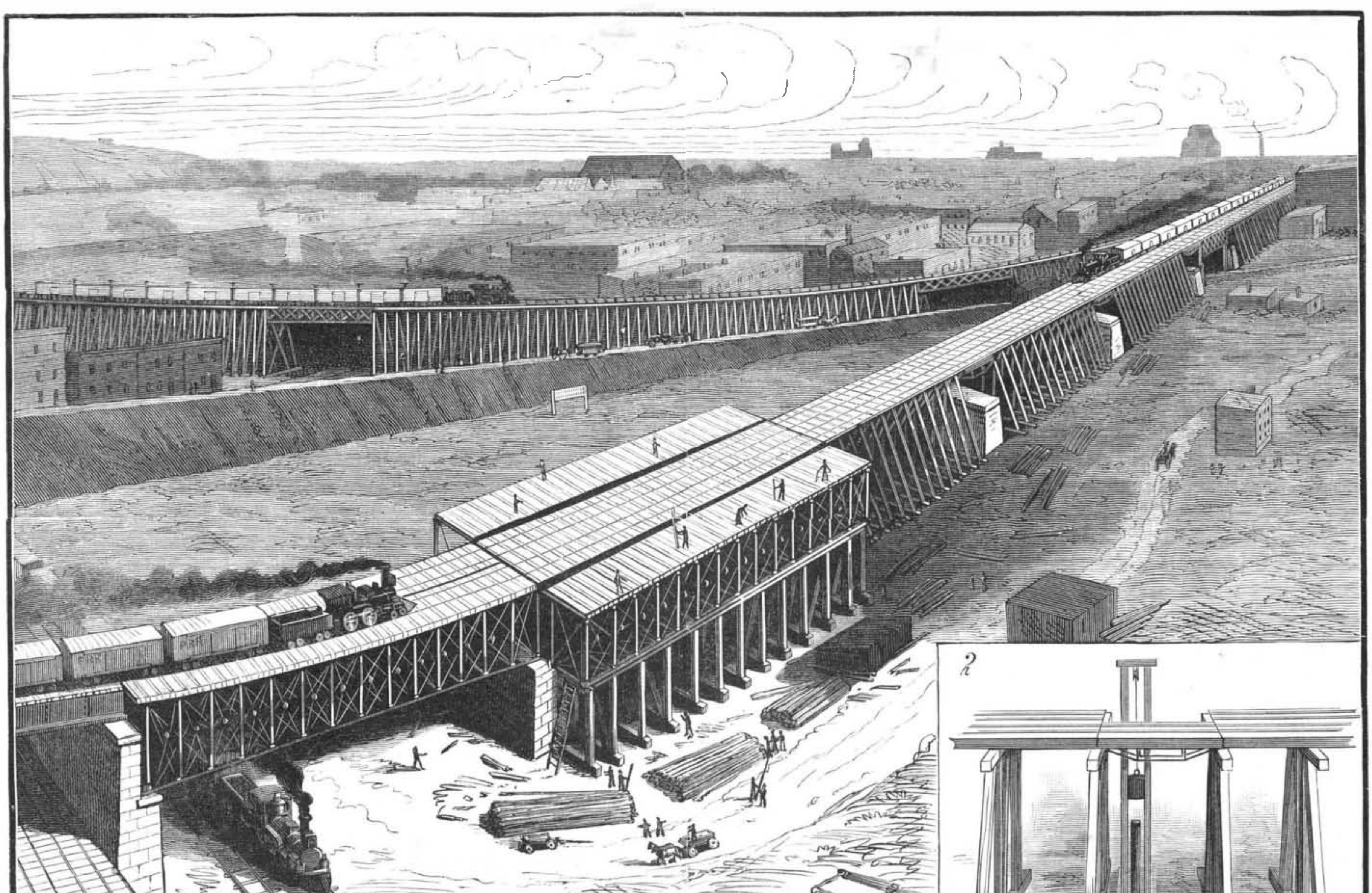

Fig. 1.—BRIDGE BUILDING ON THE PENNSYLVANIA RAILROAD IN JERSEY CITY. Fig. 2.—DRIVING PILES FOR PIER FOUNDATIONS.

BRIDGE BUILDING ON THE PENNSYLVANIA RAILWAY WITHOUT INTERRUPTING TRAFFIC.

(*Continued from first page.*)

is arranged at each end. The rails are removed and the trusses are lowered into their place.

The blocking is now taken away from the other span and the windlasses are again turned. The trusses which first moved are now the abutment for the strain, and the other span is drawn in to its place over the pier and close beside the first. It is jacked up, the rails removed, and it is lowered to its seat.

The ends of the four trusses rest upon wall plates. One set of plates are arranged with rollers to admit of motion under changes of temperature.

When the spans are in place and resting upon the wall plates, the rails are spiked down on the ties. The latter are very heavy and placed very close together, but a few inches of space intervening between them. They act not only as sleepers, but as a sort of floor, in case of derailment of cars.

Sunday is selected for the moving. All traffic must be stopped during the operations, which makes the selection of this day a necessity. About four hours are required to execute the work, and some twenty men do it all. Each span weighs about one hundred and fifty tons. The operation is now in progress, and span by span the old trestle is being replaced by the more elegant iron and stone structure, which for many years to come will carry the Pennsylvania's freight through Jersey City far above the heads of its citizens.

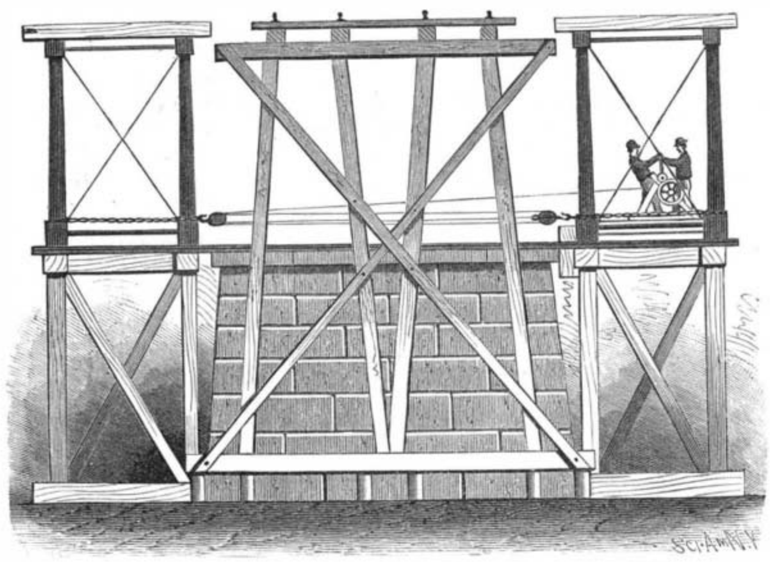

Fig. 3.—MOVING BRIDGE SPANS ON PENN. R.R. IN JERSEY CITY.

The Nordenfelt Submarine Torpedo Boat.

This peculiar vessel was lately tried officially at Southampton, England, with some success. The *Engineer* says:

The Nordenfelt was built by the Barrow Shipbuilding Company. The main engines are double compound, with two high and two low pressure cylinders, and four cranks equally spaced 90 deg. from each other. Steam is supplied by two boilers, and very special precautions had to be taken to prevent not only the entrance of water down the funnel when the vessel is submerged, but the leakage of smoke out of the furnaces, which would quickly stifle her crew. All this has been effected in a most ingenious way. The boat, if left to herself, would always float with a considerable portion out of the water. Direct force is required to sink her, and that is provided by two screws with vertical shafts, one in a recess at the bows, the other at the stern, by which she is forcibly screwed down into the depths of the sea. The moment these screws stop revolving she comes to the surface. Steam is supplied when she is under water on the system suggested many years ago by Dr. Lamm, and used in America for propelling street cars. If the pressure in a boiler is lowered the temperature falls, and part of the sensible heat of the water becomes converted into latent heat by evaporation. The two boilers contain about 27 tons of water. The pressure of the steam is, let us say, 160 lb. above the atmosphere, or 175 lb. absolute. The corresponding temperature is 371 deg. Fah. Now, the engines will work well with steam having a pressure of 50 lb. above the atmosphere, or 65 lb. absolute, the temperature of which is 298 deg. In falling from one of these temperatures to the other, each pound of water gives out 371 deg.−298 deg.=73 units. There are 60,480 lb. of water, and $60,480 \times 73 = 4,415,040$ units. Each pound of steam at 65 lb. pressure will represent 904 units, and $\frac{4,415,040}{904} = 4883$, nearly, pounds of steam of 50 lb. pressure, which can be supplied after the ship has been submerged. Assuming that her engines use 20 lb. of steam per horse per hour—a very high estimate—we have $\frac{4883}{20} = 244$ horse power for one hour. But when submerged the speed is very slow and she requires little power to work her, so that she readily stores energy enough to remain for as much as three hours under water. The air contained in the hull is ample for breathing purposes for that time. There is of course no reason why the pressure should not be as much as 200 lb., or even more. We have said enough to show that with a pressure not greater than that carried in most modern steamships, power enough can be stored up for all practical purposes.

The Nordenfelt arrived in Southampton last July. The time which has elapsed since has not been wasted. She has had a deck fitted to her by Messrs. Oswald, Mordaunt & Co., and various modifications and additions have been made to her machinery and fittings as deduced from accumulating experience.

She is 125 feet long by 12 feet beam, and displaces when entirely submerged 230 tons, her displacement when light being 160 tons. Her engines indicate 1,000 horse power, and drive the boat at a speed of 15 knots when light, and of course on the surface. She has an under-water speed of about 5 knots. The midship section is a circle; any other section will show two arcs of a circle, and the vertical line passing through the center of such section will be the chord of the arcs. In order to maintain the strength of the hull in unison with the midship section, which is round, a deck has been placed on a spreader where the arcs become small at each end. The spaces under these decks are divided by bulkheads into tanks, which, being filled with water or emptied, affect the balancing and displacement of the vessel. The coal bunkers are in the center of the boat, and therefore interfere little with the fore and aft position of the center of gravity. The center of gravity of the boat in its most unstable condition is 6 in. below the center of the boat, and the metacenter in its most unfavorable position is 2 in. below the center of the boat. This means that the vessel will not capsize unless forcibly deflected more than 180 deg. from its upright position. Properly handled as regards coal and water ballast, the boat is more than sufficiently stable. She carries about 35 tons of cold water in her tanks, and, as we have said, 27 tons of hot water in her boilers. This 27 tons of water is expected to give off, as we have just explained, sufficient steam to drive the boat a distance of 20 knots. The 35 tons of cold water, when pumped out, make her sufficiently buoyant to be seaworthy on the surface. The fact that the 27 tons of hot water can be blown out in five minutes does much to promote the safety of the crew. The cold water is pumped out by three pumps, each of which has a 3 in. diameter discharge pipe, and, for security, these pumps have separate engines. The coal bunkers hold 8 tons of coal, and one ton will drive the boat 100 miles at a speed of ten miles per hour. At a speed of 8 to 9 knots per hour, the 8 tons of coal will drive the boat 1,000 miles. Should a great distance be intended to be traveled, twenty additional tons of coal can be carried in the cold water tank. The boat could steam from England to Constantinople by coaling at Gibraltar. In fact, she could steam to India or any other distance.

The sinking propellers are operated by separate engines, which are entirely under the control of the captain, and he can by them force the boat under water or allow her to rise to the surface; or by giving different speeds to the bow or stern propeller, depress the bow or stern as required, and thus cause the boat to maintain the horizontal position. An automatic arrangement exists whereby, should the captain not stop these engines at the right time, they will cease to act at a depth to be arranged.

The boat is steered by steam, the engine for which is also controlled from the forward conning tower, which is in communication with the stokehole and engine room by speaking tubes. In the conning tower are instruments to show the depth, the level, and the course. The boat is lighted by candles. The crew consists of captain, mate, two seamen, engineer, assistant, and two firemen, also a cook. Each man has a separate bed. In addition to the fittings of a submarine boat, the Nordenfelt carries masts, side lights, compasses, anchors, etc., as an ordinary surface vessel. She is registered under the Board of Trade and passed and classed at Lloyd's. There are two torpedo tubes placed in the bow, and there is a place provided for two spare torpedoes. It is proposed to arm the boat with two 2 lb. Nordenfelt quick-firing guns. The conning towers are round, 2 ft. 6 in. diameter, and of 1 in. steel.

A SOLITARY female vulture had dwelt for twenty-five years on the Blotschorn, in the upper Valais, Switzerland, and escaped countless attempts at capture. Recently during severe weather, a poisoned fox left below the cliff proved a successful bait, and the bird was found dead. The body was stuffed and placed in the museum at Lausanne. It measured across the wings, 88½ inches. It is possible that one or two solitary specimens still remain, but it is quite certain there is no nest, and the species is believed to have disappeared from Swiss territory.

Japanese Laborers.

Consul Jernigan, of Osaka, reports as follows to the Department of State:

It may be said, emphatically, that there is great poverty among the lower classes in Japan, the inheritance of long centuries of superstition and despotism. With a population of 37,000,000, living on an area of 150,000 square miles, two-thirds of which are mountains and hills, unsuited for agricultural purposes, labor will continue, for a long time, to be cheap and abundant. A good laborer can be hired for 15 to 25 cents per day, and he will work from 6 A.M. to 9 P.M. and board himself. The laborer don't wear many clothes, and often appears in a suit that would excite the envy of the stanchest dude.

In Japan's progress, other and newer fields will present themselves for the employment of Japanese laborers, a subject of primary consideration for those in authority, for unless some outlet is found, native or foreign, labor will be without employment, which has ever been a disturbing element to the peace and prosperity of nations.

A laborer's house is mostly one story and contains not more than two or three rooms, in addition to a small room each for cooking and bathing purposes. The floor of the rooms is about one foot from the ground and covered with soft, thick straw mats, which are kept very clean, for the Japanese always take off their sandals or clogs when entering the house. Furniture is not used at all in a real Japanese house, except a small table about a foot high and fifteen inches square, which is only called into requisition at meal time, the family sitting on the mats like tailors on their benches. The bedding consists of soft, thick cotton quilts spread on the mats. A laborer's house, including everything connected with it, will not cost more than $100 in gold. In such houses ventilation and warmth seem never to be considered, for the paper partitions and slides are only protected in cold and stormy weather by strong wooden shutters, fitting badly, and through which the wind and rain find little difficulty in entering. And there are neither stoves nor grates in such houses, for the materials employed in building are so inflammable that it would be dangerous to use them. In the place of stoves and grates there are braziers filled with heated charcoal, and at night the brazier, when the weather is cold, is covered with a kind of earthenware and placed under the quilt, the latter being protected from the fire and heat by a wooden grating. Though labor is cheap in Japan, and its reward discouraging, though the laborer is unfamiliar with the comforts which surround the home of the workingman in my own country, I believe that the Japanese laborer is the happiest and best contented being I ever saw. If his pan and cup are filled with rice and tea, he appears the very embodiment of happiness, and over all the ills of life "victorious."

The agricultural implements, as well as machinery of almost every description in use by the Japanese, are of the most primitive origin, but attention is now beginning to be directed to the advantages of modern inventions, though labor is still so cheap and abundant in Japan that such inventions have not yet been received with remuneration in the markets, and there is not any sufficient demand to stimulate shipments of machinery and agricultural implements to this country, except to fill special contracts. The outlook, however, is more encouraging than in former years, and a nation that is fast becoming an important factor in the commerce and diplomacy of the world must soon afford a market for the appliances of modern civilization.

The Flood in China.

A large area of country in China has been overflowed, and the reports of the loss of life and the suffering consequent on the disaster are appalling. Originally a beautiful and populous district of 10,000 square miles, the afflicted area is now covered with a sea of waters. The reports state that at least 3,000,000 of people are homeless and deprived of everything. The loss of life is estimated at three-quarters of a million souls. The Chinese business centers and government circles are greatly disturbed, and are endeavoring to do something to mitigate the evils consequent on the disaster. The reports as regards figures are hitherto little more than conjectural, and the extent of harm may be either over or under estimated.

WE see it stated that the Chicago, Milwaukee & St. Paul has under consideration a plan for working some forty pneumatic gates at crossings in Minneapolis by an air compressor in the shops. A pipe line will tap a storage and equalizing reservoir in each cabin, and connect with the compressor, and cooling and drying tank in the shops. It is not proposed to lay the pipe below frost.