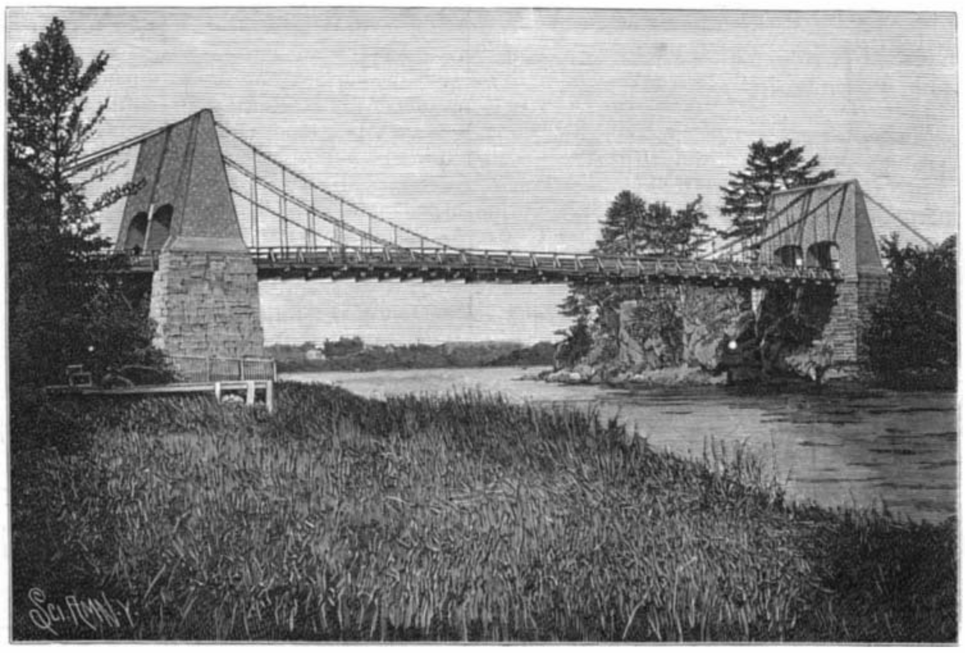
THE ESSEX-MERRIMAC BRIDGE.

BY HORACE C. HOVEY.

The Merrimac River flows for 78 miles through New Hampshire and for 35 miles through Massachusetts, and in its charming valley half a million people dwell. To-day it turns more mills than any other stream in the world, and a century ago there was more shipbuilding in its estuary than anywhere else on the continent. When it was proposed to substitute bridges for ferries a sharp controversy arose. On one side were merchants and manufacturers and such farmers as desired better means of communication. On the other were the ferrymen whose craft were in danger, the lumbermen whose huge rafts came down from the mountains to the sea, and, above all, the shipbuilders whose yards employed thousands of hands. Much was said about log jams, ice jams, and other evils, real and imaginary. Finally the party of progress won the day, and Governor John Hancock set his bold signature to bills for bridges at Newburyport, Amesbury, Haverhill and Lowell, all to cross the Merrimac. The period between 1790 and 1805 was an era of roads and bridges, during which the Legislature of Massachusetts chartered 42 turnpikes and 67 bridges, every one of which was earnestly advocated and strenuously opposed.

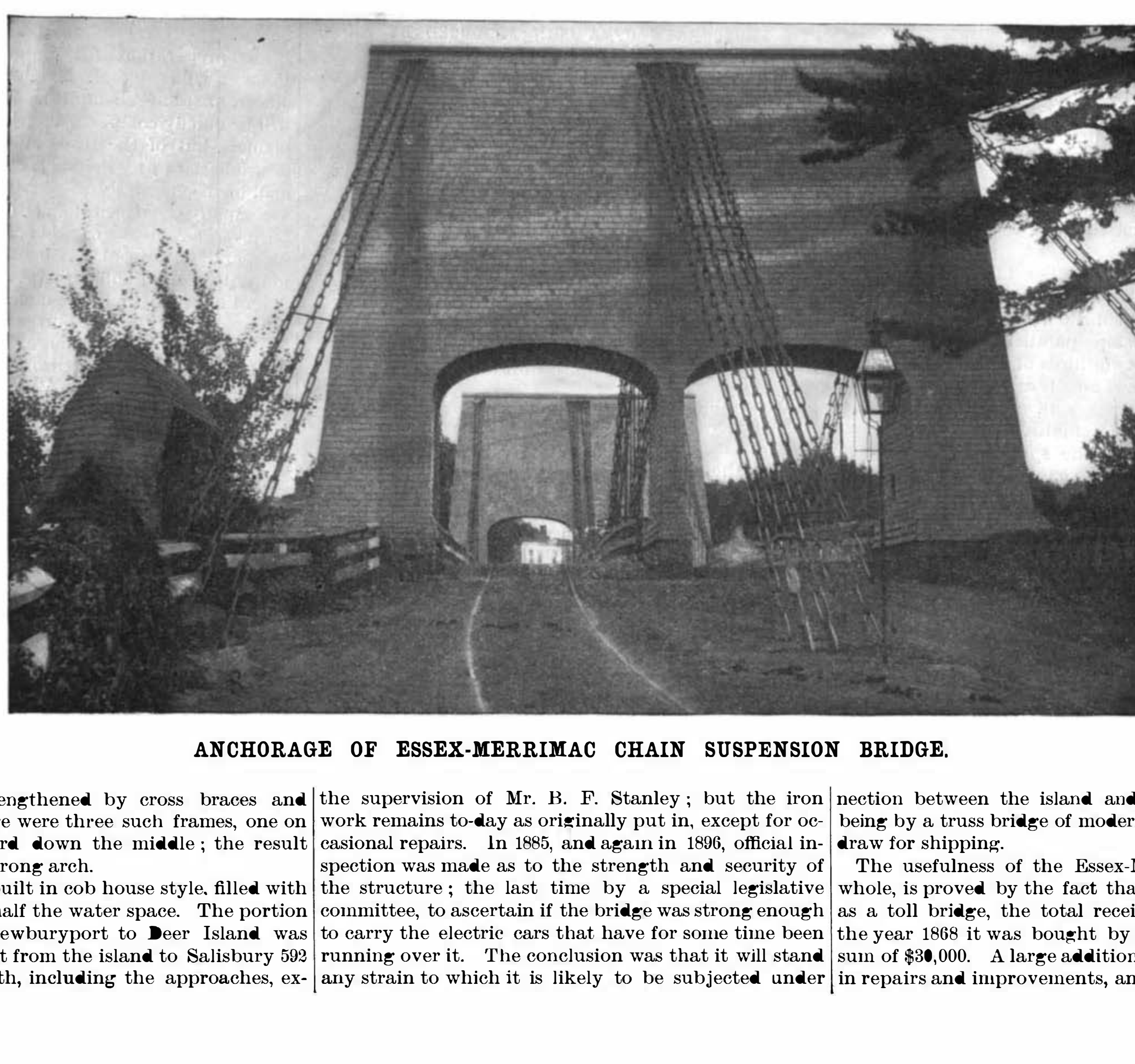


THE ESSEX-MERRIMAC CHAIN SUSPENSION BRIDGE.

Our object is particularly to describe what is known as the Essex-Merrimac bridge, crossing at Deer Island from Newburyport to Salisbury; and which has existed in two different forms, each having a bearing on the general interests of bridge building throughout the country.

The location is extremely picturesque, abounding in cliffs, wooded islands and primitive pine trees. Deer Island is now the property of Mrs. Harriet Prescott Spofford, the poetess, who has done much by landscape gardening to improve what was already so attractive. Hawkswood is adjacent, with its elegant environs and romantic legends. Near by the southern shore once stood the manse of Rev. Matthew Plant, a protege of Queen Anne; and a stone wall still stands that was built by his negro slaves imported from the Barbadoes. The fact of main interest is that the river here is 1,000 feet wide, deep enough for the largest vessels, its current strong, and its bottom extremely rocky.

Severe conditions were imposed that were meant to be prohibitory. One of them was that the span of the main arch should be 160 feet, or three times as great as any other then in America. This was met by what was known as Palmer's arch, invented and patented by Timothy Palmer, an architect of Newburyport, and which was afterward used for a span of 194 feet over the Schuylkill, and for one of 244 feet over the Piscataqua—the figures as given by Mr. Palmer. For this invention he got a gold medal and $100 in cash. What he did was to imitate in timber the familiar voussoir of the stone arch, by means of king posts ten feet apart, in radii of a circle of which the curved timbers which they joined formed the circumference. Each quasi-voussoir was further strengthened by cross braces and curved planks. There were three such frames, one on each side and a third down the middle; the result being an extremely strong arch.



ANCHORAGE OF ESSEX-MERRIMAC CHAIN SUSPENSION BRIDGE.

Solid piers of logs built in cob house style, filled with rock, occupied fully half the water space. The portion of the bridge from Newburyport to Deer Island was 438 feet long, and that from the island to Salisbury 592 feet; the entire length, including the approaches, exceeding 1,000 feet. The total amount of timber used was 6,000 tons, of which only about 1,000 were in the bridge itself, the remainder being in the enormous log piers. From that quantity of material twenty ships of the old style could be built; and had the logs stood end to end, they would have reached 50 miles. The exact cost of the bridge was $36,398. The receipts from tolls in the last year of its life came to $5,553; the charges being one shilling and sixpence for a chariot or other vehicle, twopence for a horseman, and two-thirds of a penny for a foot passenger; the latter being equal to an English halfpenny, or to one cent in federal currency. In 1809 it was decided that the Palmer bridge was unsafe and it was sold at auction, to be taken down as soon as another could be built in its place. For the foregoing facts we are mainly indebted to researches just made by Hon. O. B. Merrill.

The new Essex-Merrimac bridge was hung from chains—an invention patented by Mr. James Finley, of Fayette County, Pa., in 1808, who in that year built one on that plan over the Schuylkill. This, as we are informed, has since been taken down; which would leave the Essex-Merrimac chain bridge, built in 1810, as the oldest suspension bridge in the United States. The contractor and superintendent was John Templeman, Esq., of Washington, D. C.; the master carpenter was Samuel Carr, of West Newbury; the blacksmithing was done partly by Mr. Hall and partly by Mr. Williams. The woodwork was wholly rebuilt in 1869 under the supervision of Mr. B. F. Stanley; but the iron work remains to-day as originally put in, except for occasional repairs. In 1885, and again in 1896, official inspection was made as to the strength and security of the structure; the last time by a special legislative committee, to ascertain if the bridge was strong enough to carry the electric cars that have for some time been running over it. The conclusion was that it will stand any strain to which it is likely to be subjected under legitimate conditions. The only disaster that ever befell it was in the intensely cold winter of 1827, when the accumulation of snow and ice hindered the free play of the links, also causing the chains to rest unevenly. Four of them gave way under a heavy load drawn by six oxen and two horses and driven by two men. The men and one horse escaped, but the other animals were drowned. No fears are felt of any repetition of such a mishap. The chain bridge consists of a single arch of 226 feet span, with 40 feet as its greatest elevation above the river. The abutments are 49 by 25 feet at the base, and are 37 feet high; built of rough split granite, each block weighing one or two tons, and all firmly united by iron bolts. The quantity of stone used was 4,000 tons. On the abutments stand framed towers of stout oak timbers, capped with saddles to support the chains whence the flooring is suspended by a series of stirrups. The bridge was originally single, but is now double, with two arched entrances at each end. There were at first ten chains, but there are now twelve, in four groups of three chains each, and each group is held from swaying apart by numerous iron dogs and other contrivances. The material is the best Norway iron, in bars an inch square, bent into links each 3 inches wide and 26 inches long. Each chain is 516 feet long, measuring 256 feet along the catenary curve between the towers, the sinking of said curve being one-seventh of the length of the span. The entire weight of the twelve chains is about thirty tons. The chains are tripled as they cross the saddles at the top of the towers. On reaching the ground their ends are made fast by shackles to links that project from a network of subterranean chains, which slope for 29 feet as the cables descend from the tower, and then sink vertically for more than 10 feet. Each link holds two, three, or more links, the last in each series being driven between two blocks of stone and secured by a transverse iron bar. Thus an enormous claw is made, each link in which helps all the rest, evenly distributing the strain over the entire abutment it grasps. Mr. Stanley, who has inspected this peculiar anchorage, says that every link is embedded in puddled clay so hermetically as to prevent corrosion, the calipers showing no sign of shrinkage during all these years. We are also assured by Capt. C. M. Pritchard, superintendent of highways and bridges for Newburyport, that the average annual cost of repairing the iron work has not exceeded five dollars during the past ten years. He regards the bridge as in every particular a model of ingenuity and a safe as well as elegant specimen of art handed down to us from the first decade of this century.

The whole weight commonly supported does not exceed 150 tons, whereas the bridge was calculated to support fully 456 tons. Its extreme flexibility is not regarded as a source of danger, provided that the cars pass at a moderate rate of speed, as they are always required to do.

It will be understood by the reader that the chain bridge is only from Newburyport to Deer Island, the connection between the island and the Salisbury shore being by a truss bridge of modern style with an ample draw for shipping.

The usefulness of the Essex-Merrimac bridge, as a whole, is proved by the fact that, during its existence as a toll bridge, the total receipts were $302,276. In the year 1868 it was bought by Essex County for the sum of $30,000. A large additional sum was expended in repairs and improvements, and it was made free to the general public. Another proof of its utility is the fact that it has been taken as a model for so many other bridges elsewhere. It is of interest, in this connection, to note that, in 1828, a second great chain bridge was constructed between Newburyport and Salisbury, at a point below Carr Island, with five spans, the longest being about 150 feet, and the entire bridge measuring 1,000 feet. It was subsequently bought by the Eastern Railroad, and removed, with the exception of the massive granite piers, to make room for a structure on another plan better adapted to the purposes of the railroad. Thus the old Essex-Merrimac chain bridge is left as the solitary specimen in New England of a style of suspension bridge that has served its intentions admirably, and may still be found preferable to the wire bridges under certain circumstances.

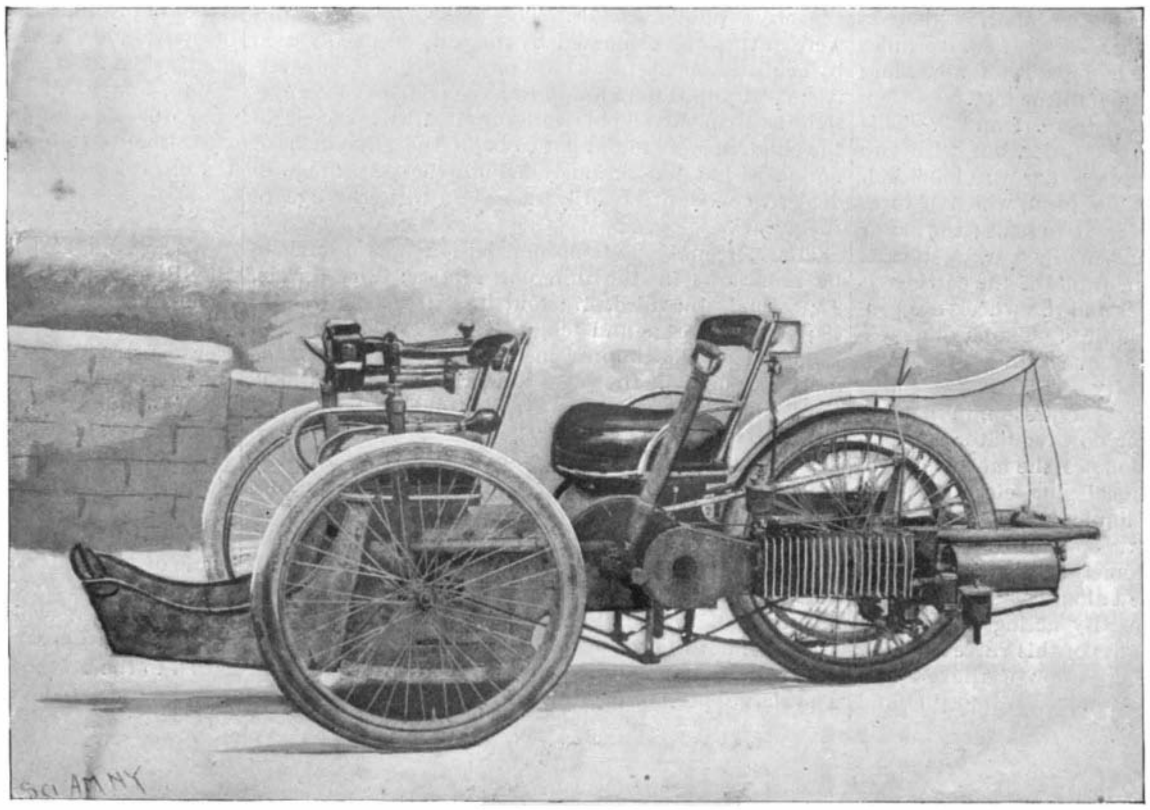


Fig. 1.—THE BOLLEE GASOLINE CARRIAGE.

THE DION, BOUTON & COMPANY TRICYCLE AND THE BOLLEE CARRIAGE.

The newspaper advertisement of the Michelin combination offering 100 Dion, Bouton & Company tricycles and 200 Bollee carriages for sale at auction has called attention again to these vehicles, the manufacturers of which were the first to solve the difficult problem of devising an automobile locomotive apparatus for one or two persons that should be simple, strong, and of a sufficiently low price to bring it within the reach of those who hesitate to spend eight hundred or a thousand dollars for such an object.

We think it well, therefore, to give a description of the tricycle as well as of the carriage.

The Dion, Bouton & Company Gasoline Tricycle (Fig. 3).—The frame of the machine is the same as that of an ordinary tricycle, and upon the rear tube is bolted the motor, with a special suspension designed to deaden vibrations. The motor is vertical, has a single cylinder, makes four revolutions and is of about one-fourth horse power. The cooling of the cylinder is effected through numerous transverse projections. The motive parts, connecting rod and crank, move in a reservoir containing oil. The driving axle, at its place of exit from the reservoir, carries a pinion that engages with a wheel keyed upon the rear axle of the machine.

The gasoline is contained in a polygonal reservoir, A, of a capacity of from two to three quarts, situated under the saddle, and which at the same time performs the office of a carbureter. To this effect, it is provided with two cylindrical cocks, a part of the surface of the first of which (that to the left) is formed of wire gauze that displaces itself opposite an aperture through which filter the air and the vapors of gasoline that constitute the detonating mixture. The composition of the mixture may be regulated by the different positions of the cocks. From the first cock, the mixture passes into a second or distributing cock controlled by the handle, J, mounted upon the horizontal tube of the frame, and which sends it to the motor through a tube that traverses the carbureter. The latter is completed by a chimney, I, whose height is regulatable according to the level of the gasoline, and which serves to lead air to the surface of the latter in order to quicken the evaporation.

The detonating mixture enters the cylinder through an ordinary clack valve placed upon the side in the valve box, and which opens automatically under the influence of the suction. After the explosion, the gases make their exit through an eduction valve controlled by a cam fixed upon the driving shaft. The eduction pipe divides into two parts, one of which runs directly into an exhaust consisting of a simple cylinder, fixed under the tube that carries the motor and provided with three orifices for the escape of the gases; the other part is continued by a worm that extends through the entire length of the carbureter and serves to reheat the gasoline.

The ignition is effected through two accumulators inclosed in a box, F, fixed under the horizontal tube of the frame. These accumulators are charged to about two amperes, and suffice, despite their small size, to give a useful effect for a continuous run of 100 hours. They are recharged by means of three bichromate batteries.

The electric circuit of the tricycle is established in the following way: The wire starting from the positive pole of the accumulators is screwed to one of the terminals of the handle bar, and thence passes into the interior of the latter as far as to the handle, M, which performs the office of a commutator. It is afterward fixed to a terminal near the preceding and then runs to the Ruhmkorff coil that is situated to the right beneath the large rear tube. The negative wire runs directly from the accumulators to the coil. The wire starting from the bobbin and ending in the explosion chamber enters the latter through a porcelain ignition tube screwed into the wall. The spark forms between two platinum wires, one of which constitutes the extremity of the wire of the coil and the other is simply fixed to the side of the motor.

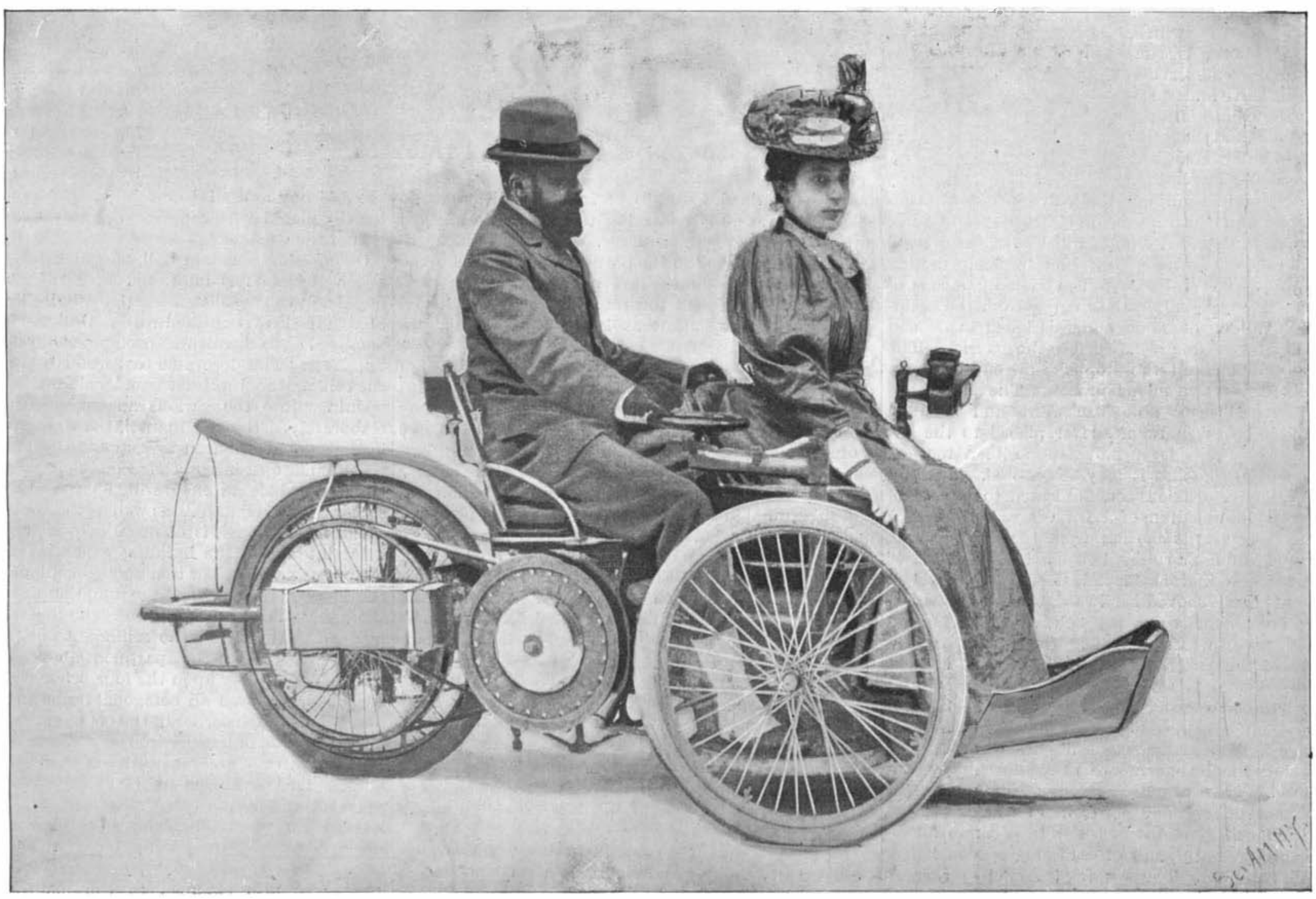


Fig. 2.—VIEW OF A BOLLEE CARRIAGE IN SERVICE.