

Victorian Institute of Engineers.

EXTENSION OF THE IRON RAILWAY BRIDGE OVER THE AVON RIVER AT STRATFORD.

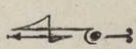
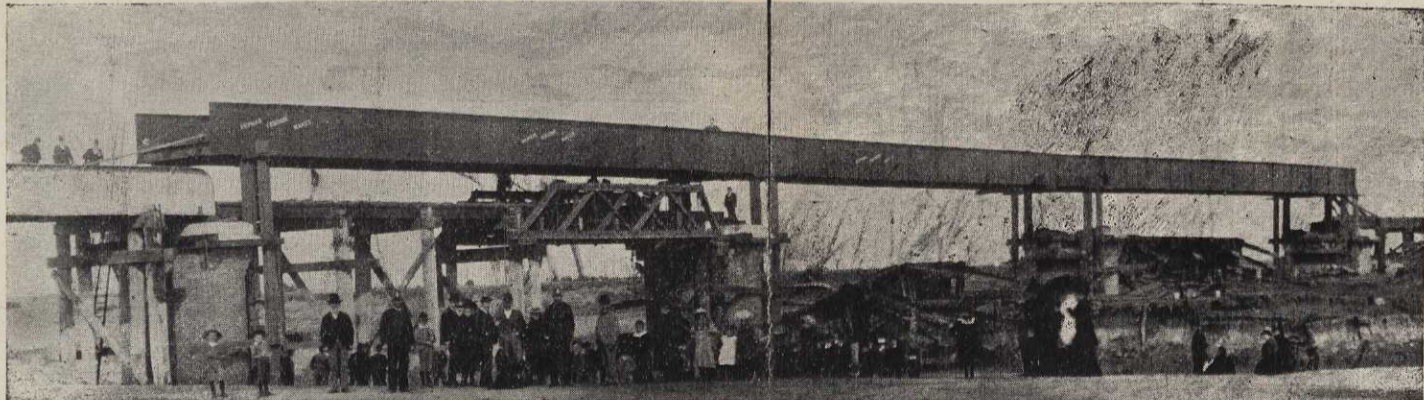
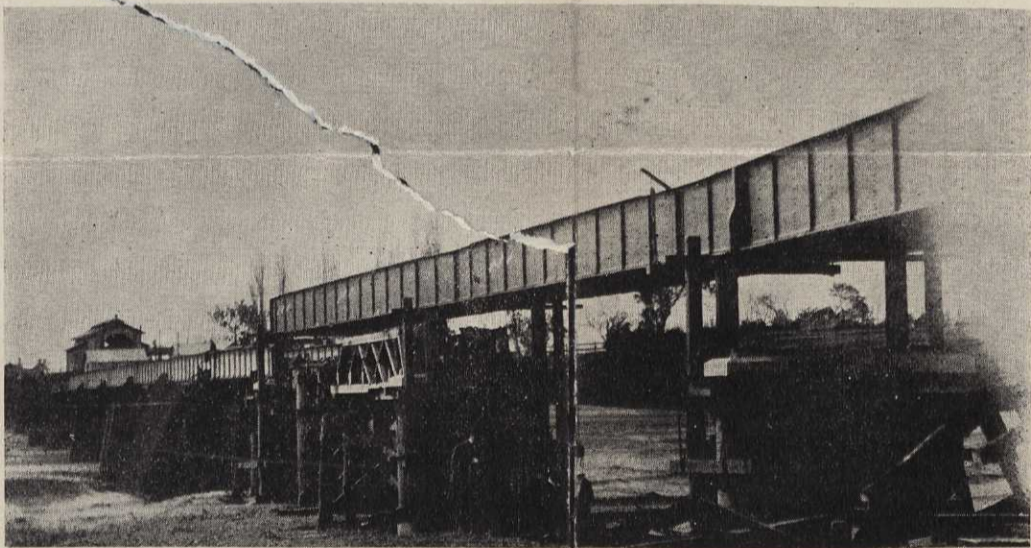
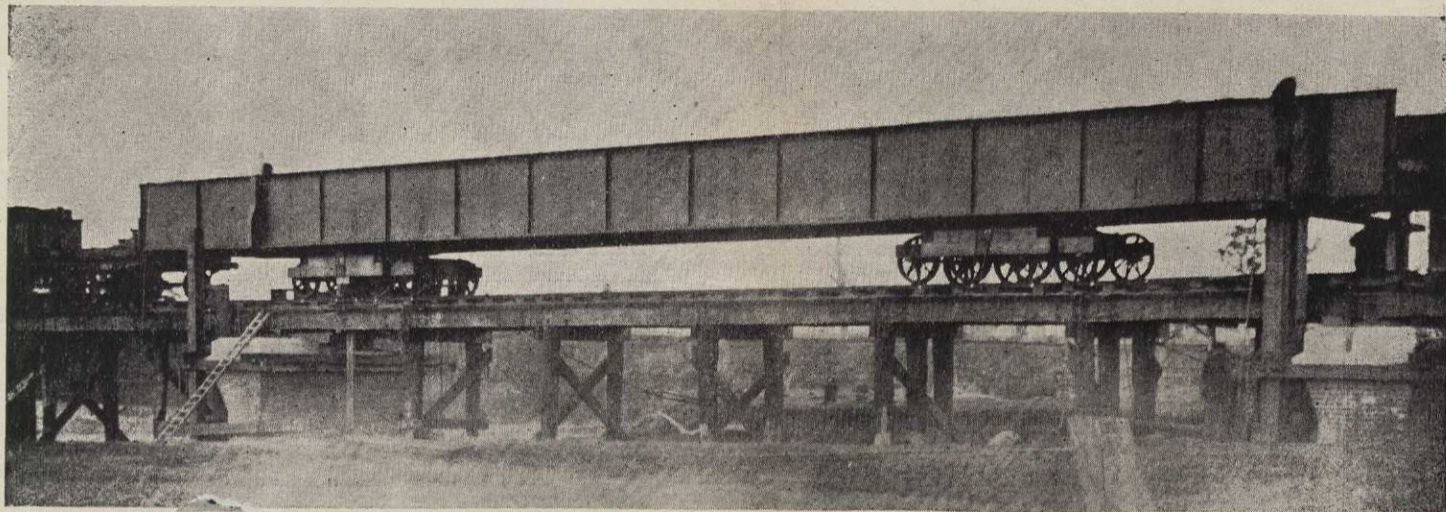
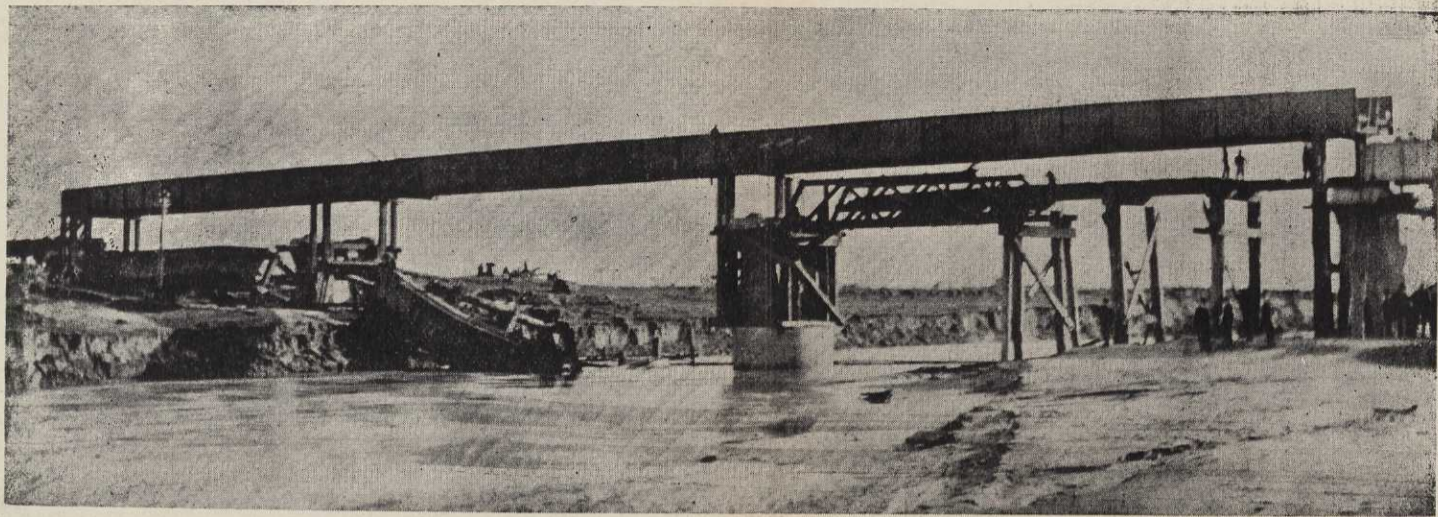
Paper by CAPT. L. H. CHASE, M. Inst. C.E., read 6th of October, 1896.

The Gippsland Railway divides into two branches at Traraigon, one going to Maffra and the other to Sale. These two branches re-unite about a mile South of Stratford and continue as a single line to Bairnsdale. The line crosses the Avon river flats on a long timber viaduct, curved to about 20 chains radius and then continues across the River Avon on an iron bridge of six 60ft spans resting on large pile piers. These piers are all closely covered with planking to prevent top from being caught in flood time and are each provided with a heavy timber elevator. During the last few years the river has had a tendency to erode the south bank and the main stream now flows entirely outside the end of the original iron bridge leaving the old bed a desert of sand and shingle. The wooden viaduct consists of 15ft openings and when the river was in flood the timber used to catch in the piers and rapidly form a dam which carried away the piles, and stopped all traffic. After some unsuccessful attempts to get the river back into the old channel it was decided to extend the iron bridge for 300ft so as to give a free flow for the timber laden floods. The design was prepared by Mr. Fram and approved of by the Engineer of Existing lines. The design provided for four piers one of which carried one end of the existing bridge as well as one end of the extension. The superstructure was of steel with cross-girders and longitudinal planking. The piers consisted of wrought iron curbs oval in plan 18' x 14' & 2' 9" deep resting on a cutting edge. On these was built up 5ft of concrete 3' wide held down by 1½" bolts and the piers were carried up in brick, the first 20ft being held to the curb by the bolts which were extended up through the brickwork by means of sleeve nuts. The soil was excavated from the centre and in this way the curbs were made to a good foundation in hard blue clay. They were then filled up with concrete made of shingle and La Faye lime. On these foundations were built the piers which were 18' long with semicircular ends, 8' wide at the ground line, 7' at the top and surmounted by imposts of cement concrete. The piers were spaced 93' 6", 105, and 94' apart and the steel superstructure consisted of two pairs of plate girders 110' long which overhung the centre span 15' thus reducing it to 75' which space was filled by a hanging pair of girders respectively 76' 2¼" and 74' 8¾". The differences in length being due to the curve. The depth of the girders was 5' 9" and the cross girders were rolled steel beams 16" x 5"

spaced 7' 6" centres and resting just above the bottom flange and attached to the curb by angle irons. The deck was of red iron bark 7" thick in 15' lengths breaking joint. The gravel beams were of red gum. The weight of the girders was 94 tons and of the cross girders 11 tons. The writer with Inspector Down had charge of the work. The instructions were to carry out the work without interfering with the railway traffic. The pins were first built by day labour under the timber viaduct and a contract was let to Mephan Fergusson for the manufacture and delivery of superstructure. The piers were sunk without any special difficulty, except in the case of No. 4, under which was a large quantity of logs and fencing wire all of which had to be laboriously removed by divers. The superstructure was delivered in trucks at Footscray in lengths of about 40ft. The problem then arose as to how it was to be got in place without stopping the traffic. The most natural way would have been to build it on a staging alongside the wooden bridge and then cut down the wooden bridge, roll in the new one, but there was always the chance that the river would rise and sweep away both old and new together. Great difficulty was experienced in getting the logs through the bridge in flood time and it was felt that any further obstruction might have been fatal. No staging could have been built without piling, which would have involved great expense. The only other course was to build the bridge on the Stratford side of the river (the nearest available spot being 300 yards from the site) and to bring it along the line, then remove the line and old wooden bridge from beneath the new and lower it into place. The weight of the end spans was about 65 tons each and of the centre span 45 tons. As the bridge had to be brought down a grade of about 1 in 60, and then along a level, and also round a curve, it was necessary that each span should be carried on not more than two points, and it was also necessary to spread the weight over a sufficient length of line, so as not to overweight the old bridge. There were no trucks suitable for the purpose, and so the writer designed the trollies, drawings of which are shown in Plates. It will be seen that the weight is equally distributed over the four axles of each trolley, so that the weight on each axle did not exceed about 8 tons. The width of the trollies was limited by the width of the old iron bridge, the girders of which stand up above the line, and as the width between the new girders was 12' 10" it was necessary to prepare something under the floor to carry the weight. For this purpose there were built in pieces of Oregon, 18" x 18", between a pair of adjacent cross girders. In order that the bridge might travel round the curve it was necessary that the trollies should be able to revolve slightly under the bridge, and this was provided for by pivoting the bridge on one side and resting it on the other on two iron plates well greased. The height of the trollies was 3' 3" above the rails, and the bridge was packed about 9" above them on redgum bolsters, which provided the pivoting and sliding motion above mentioned. The bridge was erected in three separate parts just clear of the rails on ways with 6" dia. redgum rollers, at a level of about 3' 10" above the rails. As each span was required, after the trollies had been brought into place, the ways were extended across the rails on prepared packings and the span drawn over with two crab-winch

and tackles. Each trolley was provided with a stop on the further side which showed when the centre of the bridge was exactly over the centre of the trolley, and an observer at each trolley measured the distance the bridge had to travel, and called out every 6', so that the pulling on the crab winches could be regulated, and the bridge was brought over parallel to the centre line of the rails. The position of the trollies had been so chosen that the span when rolled on the curve would occupy, as nearly as possible, its true position. This was found by plotting a large scale plan of the new bridge and the existing old one together. The distance to be moved was so great that there would have been great loss of time in warping the bridge along, and so it was decided to use a locomotive. On the deck of each span was bolted a central wooden buffer made of 12" x 9" oregon—in the case of the first and second span 19" x 24" oregon. A flat trench was provided and fitted with a central buffer at the proper height above the rails (about 5' 9") to fit the ones on the bridge. This buffer was made of 14" x 14" oregon, and slightly curved at the end. Slots were cut under the buffers and nip-chains passed round them. When it was desired to couple on the engine the truck was pushed up to the bridge and the nip-chains fastened together with screw couplings. The extra width of buffer in the case of Nos. 1 and 2 spans was to allow for the large lateral motion due to the curvature of the line. A stop was set up on the old bridge at the exact distance to fix the position longitudinally of the first span. After each span had been pulled over the trollies, one end was lifted with 20 ton hydraulic jacks and the bolsters at that end inserted and the rollers removed. The other end was then lifted and the rollers and ways were removed. The engine then pushed up the buffer truck, which was coupled to the span, and the chocks were removed, and the span pushed down the grade and over the river into place. The arrangements for lowering must next be described. They were specially designed for the work, and consisted of oregon frames bolted round the piers. It will be remembered that while the piers above ground level were 18' x 8' they rested on oval foundations 18' x 14', so that there was a level ledge on each side. The frames were in every case fastened on the side of the pier nearer to the centre of the bridge. This helped to equalise the weight to be carried. Each frame consisted of a sill, 21' x 18" x 18", resting on the brick ledge. Near each end of this was erected a 12" x 12" post, rising to 8' 8" above the top of the bedstones, and fastened to an oregon frame which surrounded the impost. From post to post above the old bridge was fixed a cap made of 12" x 6" oregon, and fastened to the posts by fish pieces 6" x 4" so that it could slide up and down. This cap was to carry the new bridge and from below where each girder was to rest, was fixed a piece of oregon 18" x 9". The lower ends of these "rams" as the men called them, were fastened together with two pieces of 12" x 3" which enclosed two pieces of 9" x 9" oregon running from the sill to the upper frame. These rams slid up and down alongside the 9" x 9" and between the 9" 9" and the 12" posts were fixed the packings in two stacks. These stacks of packing were prevented from falling out by iron straps about 2' apart. On each ram was painted an indicating arrow and on the 9" x 9" were painted scales, marked every 3". the feet

being numbered. The zero in every case was so placed that when the indicator came opposite to it the bridge would be just down on its bed plates. The width between the rams was sufficient to clear the outside of the old bridge and the distance between the posts to clear both old and new. The lower end of each ram was checked out to form a stop for the hydraulic jack, so that when the end of the ram rested on the sill there was just room to put the jack in the stop. When the last train had passed over the old bridge, the end stop was set up and the cap fixed on No. 1 frame. At the same time the first span was being placed on the trollies. It was then pushed over into place and the cap fixed on No. 2 frame. The span was then lifted on No. 1 and 2 frame and the bolsters removed. This gave sufficient clearance and the trollies were pulled out by means of a rope previously fixed. While the next span was being got ready, the work was begun of removing the rails and sleepers from under No. 1 span, and four screw traversing jacks were placed in position on previously prepared seats under where No. 2 span would come. When No. 2 span arrived, the end next to No. 1 span was lifted and traversed into position and coupled to No. 1. The other end was then raised and the trollies removed. This end was then traversed a little to one side to allow No. 3 span to come up. No. 3 was then brought up and the end of No. 2 was lifted and traversed into its bearing on the end of No. 3. The weight of No. 3 was then taken on the frames and the trollies removed. When any span did not come exactly where it was required it was drawn back by the engine and the rails adjusted and then it was pushed back again into its true position. The whole bridge was now resting on the frames and the rails, sleepers, ballast, and the whole of the old bridge was cut down. A piece of the old bridge was carefully removed at each pier and the remainder was pulled over with crab-winch after the piles had been sawn or chopped through. The weights carried on the frames were 30.6 tons on each of Nos. 1 and 4 and 56.9 tons on each of Nos. 2 and 3. The bridge was first lowered until all the indicators read alike the reading being 6' 9". There was a party of 5 men at each frame. All had instructions to lower 3" at a time. As each party was ready to lower they showed a green flag or lamp. When all showed the green, a signal was given and all lowered at once. The bridge came almost exactly on to its bed plates, and where there was any discrepancy a few pieces of round iron, previously prepared for the purpose, were placed on the bed plates and the bridge was lowered on them. It was then an easy matter to push it over laterally an inch or two. The frame then took the weight while the round iron was removed. Before doing the work the writer drew up a programme of the proceedings and sent a copy to each of the inspectors who were to carry out the work, with instructions to carefully consider if there was any contingency whatever that was not provided for, so that there might be no undue delay. This programme was strictly adhered to. The actual time taken was from 3.30 on Saturday; the train at 2.30 on Monday passed over the new bridge. If saving of time had been worth the expense it could have been shortened by having two trollies to every span, and also by drilling the different parties who had to work the lowering frames, for it was noticeable that the time of lowering decreased as the men had more practise. More



BRIDGE OVER AVON AT STRATFORD.



PLATES ILLUSTRATING PAPER BY CAPT. L. H. CHASE.

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DISCUSSION ON IRON BRIDGE OVER THE AVON RIVER, AT STRATFORD.

The President (Prof. W. C. Kernot) said it seemed to have been a very nice operation requiring very careful arrangements, and it was satisfactory that the programme previously drawn out should have been found practicable from beginning to end. Problems of the sort referred to, viz., renewing bridges without interrupting the traffic, arose now and again. The Railway Department were to be congratulated upon having accomplished the work without any hitch or trouble.

Mr. J. T. V. Anderson asked if it was on account of economy that the contract for construction and erection was not let altogether in one tender.

Capt. L. H. Chase explained that it was not entirely due to economy. They made it a practice, where they had to interfere with the traffic, of doing the work themselves. It saved much trouble with contractors. There was also much work to be done that could not be designed beforehand.

Prof. Kernot mentioned that this timber bridge was built many years ago. It seemed to have stood satisfactorily. It seemed strange that the behaviour of the river had so changed and that piles should be so continually swept away.

Capt. Chase said he did not know the reason of the river leaving its original bed, but since it had left the iron bridge and had got in to the 15' spans the trouble had begun. It was attributed by some to a cut which had been made higher up the river.

Professor Kernot: It is curious that the changing of the river bed has caused so much trouble. The river at Yarra Glen is taken through 15' spans, and there is no such trouble there. Was the velocity of the Avon greater?

Captain Chase: The velocity of the Avon River is 10 or 12 miles an hour. In this case the river keeps eating away and undermining its banks, which were vertical in many places and 16ft. high, and the trees thus undermined were swept down by flood.

Mr. Anderson: Was any attempt made to train the river, at the site of the bridge, by piling?

Captain Chase: No. The river bed had such a great depth of shingle. It would have been very expensive to have driven piles. There is another bridge just above this one, belonging to the Shire, which might give trouble any day, and they (the Shire) did not know what to do to save it.

Mr. Anderson: This is similar to the experience in New Zealand.

DISCUSSION ON IRON BRIDGE OVER THE AVON RIVER, AT STRATFORD.

The President (Prof. W. O. Rennie) said it seemed to have been very nice operation requiring very careful arrangements, and it was satisfactory that the programme previously drawn out should have been carried out practically from beginning to end. Problems of the sort referred to, viz. removing bridges without interrupting the traffic, arise now and again. The Railway Department were to be congratulated upon having accomplished the work without any hitch or trouble.

Mr. A. T. V. Anderson asked if it was on account of economy that the contract for construction and erection was not let altogether in one tender.

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Prof. Rennie mentioned that this timber bridge was built many years ago. It seemed to have stood satisfactorily. It seemed strange that the elevation of the river had so changed and that this should be so completely swept away.

Capt. Chase said he did not know the reason of the river leaving its original bed, but since it had left the iron bridge and had got in to the 150 ft. spans the trouble had begun. It was attributed by some to a cut which had been made higher up the river.

Professor Rennie: It is curious that the changing of the river bed has caused so much trouble. The river at Yate Glen is taken through 15 spans and there is no such trouble there. Was the velocity of the Avon greater?

Captain Chase: The velocity of the Avon River is 10 or 12 miles an hour. In this case the river keeps cutting away and undermining its banks, which were vertical in many places and 150 ft. high, and the trees thus undermined were swept down by flood.

Mr. Anderson: Was any attempt made to raise the river at the site of the bridge, by piling?

Captain Chase: No. The river bed had such a great depth of siltage. It would have been very expensive to have driven piles. There is another bridge just above this one belonging to the State, which might give trouble any day, and they (the State) did not know what to do to save it.

Mr. Anderson: This is similar to the experience in New Zealand.



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