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# TAMIL NADU ARCHIVES

## GOVERNMENT OF TAMIL NADU

Revenue. DEPARTMENT

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| G.O. No. / B.P. No. | 85 | Press. / Mis. |
| Dated | 10-1-1879 | ~~197~~. |

*Not to be folded or roughly handled*

85/1

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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4th December 1878, No. 1,228 R.

Railway.

Read the following papers :—

No. 24. From W. S. HARINGTON, Esq., District Engineer, Madura, to the Secretary to Government, Public Works Department, dated Madura, 18th April 1878, No. 22.

I HAVE the honor to forward, for the consideration and orders of Government, copy of a letter from the Assistant Engineer, Madura and Ramnad Tramway Survey, No. 87, dated 13th instant, submitting plans and "estimate for the portion of line 29 miles 1 furlong and 220 feet from Kilakari together with a branch into Ramnad measuring 4 miles 5 furlongs 152 feet, making a total length of line now submitted of 33 miles 6 furlongs 372 feet."

1 copy of Mr. Jenkinson's No. 87, dated 13th April 1878.
3 plans.
1 sketch of the temporary culvert.
1 estimate of Rupees 3,89,322 (with 1 sheet of abstract).
1 list of curves.
1 list of gradients.
3 appendices, A, B, and C.

2. The floods of last year noticed by Mr. Jenkinson in paragraph 7 of his letter were unparalleled, and scarcely a tank remained unbreached. It will be necessary that the channel referred to should be spanned by a bridge of great length and the surplus of the Kalari and other tanks must be carried off under the line. All these belong to the Zemindari, and a general system of grouping would have to be undertaken and carried out before the line was started.

3. The roads spoken of by Mr. Jenkinson as "running in all directions out of Ramnad" were constructed very many years ago, at whose expense is not known, but perhaps at that of the Zemindar, who in those days must have been a far wealthier man than the present incumbent, and they have been disused for a long time, and have gone to decay probably because no such thing as a maintenance allotment was known or thought of. I am at a loss to understand what Mr. Jenkinson means by "the utterly starved condition of the only road on which anything is done, that to Madura." As a fact the last 23 miles of this road into Ramnad are being metalled and are consequently in a rough and unfinished condition ; the estimated cost of this work is Rupees 1,14,400, and only Rupees 51,878 have as yet been spent ; the existing culverts are those that were built many years ago by the Revenue Department, and with repair would have answered for ordinary traffic, but will not do so for a tramway ; the remaining 45 miles into Madura have a maintenance allowance, but have been much cut up by the floods of last monsoon. Of this distance Mr. Jenkinson in a former letter approved of the last 21 miles into Madura for the tramway ; it will probably not be found impossible to carry it along the remaining 24 when thoroughly completed and repaired.

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From C. H. G. JENKINSON, Esq., A.I.C.E., Assistant Engineer, Madura and Ramnad Tramway Survey, to the District Engineer, Madura, dated Ramnad, 13th April 1878, No. 87.

I HAVE the honor to forward, herewith, a plan, section, and estimate for the portion of line 29 miles 1 furlong and 220 feet from Kilakari together with a branch into Ramnad measuring 4 miles 5 furlongs 152 feet, making a total length of line now submitted of 33 miles 6 furlongs 372 feet.

2. The Ramnad and Kilakari sections meet at a point 11 miles 102 feet from the latter place, and I have in my estimates given the quantities for each of these sections and the line after their junction called the "Main Line" separately, so that the Government may have full information as each of these divisions lie under rather different conditions.

3. I have first to call your attention to G.O., No. 1,115 W, dated 4th March 1878, in which is printed at length —

(*a*) Mr. Arbuthnott's preliminary report on the project.
(*b*) My memorandum summarizing the instructions given me by His Grace the Governor.
(*c*) My letter to you, No. 14, dated 10th February, written after my march from Madura to Ramnad, and after consultation with Mr. Lee-Warner and Mr. Nicholson.

In the latter document some of the views expressed were naturally crude, and some on further investigation have turned out to be erroneous and formed on inaccurate information, as paragraph 10 and the latter part of paragraph 13.

4. ALIGNMENT, KILAKARI SECTION.—I proceeded at once from Ramnad to Kilakari and followed the line mentioned in paragraphs 3 and 4 of the memorandum (*b*), and at once saw that it would not be wise to locate the line along it. Having crossed the overflow of the large tank at Ramnad (the Periakamoi) and turning south at Ramnad, skirting the bund of the large Chakrakotah tank, which receives the overflow from the Periakamoi tank, we should have to cross the overflow a second time below the calingulah of the latter tank, and then the line would enter a broad tract of low land where water must lie during the whole of the rainy months, and which, even in the dry weather, is very treacherous ground. It is the same backwater held up by the range of hills parallel to the coast which reaches from Tirupallani on the east to Vair Vandy on the west, having an outlet about 2 miles east of Kilakari. The boatmen at Kilakari told me that a foaming stream rushes to the sea here during the rains, and water stands so deep in the channel all the year round that a permanent ferry is required.

5. Enough has been said to account for this route through Ramnad to Kilakari being abandoned. The alternative route which I have followed starts from the south-west end of the town at Kilakari, and my object has been to meet the Madura-Ramnad line at a point as near Ramnad as possible, in order to save length and two lines of railway running nearly parallel for any distance. In accordance with paragraph 5 of my instructions, I addressed a letter, appendix A, to the Master Attendant at Paumben, and in his answer, appendix B, he disapproves of the idea of a jetty for the vessels to lie alongside, but advocates a boat pier at the south-west corner of the harbour. The line I have selected will suit this view, but I have fixed my zero point temporarily at a little distance forward from the site of the proposed pier, reserving that question for future consideration and for orders; as with the limiting radius of 1,000 feet it will hardly be possible to take up the most convenient site for a terminus and run the trains out on to the pier. I shall later on have the honor of submitting a detail survey of Kilakari and my proposals for terminus and pier.

6. Starting then from the south-west end of Kilakari, near the merchants' godowns, I run along the coast for a short distance and then turn in a north-westerly direction to a low place in the sand hills, which run parallel to the coast, and are reached at a distance of 1 mile 1 furlong on the line. There are two ranges of these hills, those nearest the sea being mere sand dunes, while the second range has the appearance of being much older, the sand of which they are composed is more consolidated and has a reddish color, and grass is growing on them. There is no escape to crossing these hills, but I think I have selected as low a place as is to be found, and at all events a convenient one for the line. The summit level is reached at 1 mile 2 furlongs and 360 feet, and is 21 feet above the starting level at Kilakari at 1 mile 6 furlongs, and continues to 2 miles 1 furlong 380 feet when we are away out on a level country. These first two miles are the only part where the level of the country necessitates any great length of the ruling gradient, or runs us into much earthwork. The ruling gradient ascending the hills is 4 furlongs 560 feet, and the descending one 3 furlongs 420 feet in length. There are two curves on each gradient, one of which is of 6° curvature or a radius 955 feet, while the others have radii of 2,000 feet and over. The greatest heights in the banks are in No. 7, 6·71 feet; in No. 8, 6·51 feet; in No. 9, 7·23 feet; in No. 10, 6·75 feet; the greatest depths in the cuttings are in No. 7, 4·47 feet; in No. 8, 6·24 feet, and in No. 9, 3·73 feet. Up to and across the first sand dunes the soil is merely loose sea sand, and I have allowed slopes of 3 to 1 in this length. There is however a great deal of garden cultivation carried on in the strip between the hills and the sea, and there are several wells of sweet water. The palmyras are planted thick all over it, and were great hindrances to my work. At the second range of hills I have changed the slopes to 2 to 1 to suit the firmer soil which is continued on until the line gets fairly on to good soil capable of being well cultivated.

7. At the northern base of these hills there is as already mentioned an extensive back-water or lagoon. The road which I follow more or less from the second mile runs across it to the village of Vaighe, and is reported to be covered with water two or three feet deep in the rains. At first I followed this road but keeping a little to the right on higher ground, as shown on a black line on the plan. Afterwards I abandoned this line and followed a more direct route by the village of Vaighe, thereby saving 1,362 feet in length, but giving up the first sluice of the Kalari tank. My first and abandoned line was low in the bed of lagoon, but my line as now fixed keeps up on a kind of spur from the hills which divides this great lagoon into two parts each stretching several miles east and west, but connected by a channel at 3 to 3¼ miles on my line. Last year there must have been a tremendous flood down this channel fed from breaches



in all the tanks and by the floods poured down through the Raganath Kaveri irrigation channels. I append a letter C from the Assistant Engineer, Zemindari Division, on the subject which gives me this information. A bridge must be provided here for the railroad, though, in the absence of more precise information, it is difficult to say how large a one; of course it is out of the question to provide a bridge to carry off the waters of a flood such as last year, or even of a flood merely caused by the bursting of tanks above the line which can always be prevented by the adoption of ordinary precautions. Last year the large Kalari tank burst owing to the uncontrolled floods in the Raganath Kaveri, and as far as I can learn was the chief cause of the flood in the lagoon. There are other large tanks out to the west by Vair Vandy and Shikal under the same irrigational system, which I have no doubt burst, and may have added to this rush of water eastwards, but of this I have no information, or whither the waste waters of these tanks flow. It seems, then, certain that provision must be made on the railroad for the overflow of the Kalari tank and for that of some smaller tanks in the neighbourhood. And for this I would suggest a waterway of 60 feet. I earnestly beg leave to suggest that the dangerous position of the railroad in consequence of these possible floods should be brought to the attention of the Court of Wards, the Chief Engineer for Irrigation, and any one else who has authority in this Zemindari in order that proper steps may be taken to ensure the tanks against bursting by building open waste weirs where required, and to bring the floods in the artificial channels of the Raganath Kaveri under complete control.

8. After crossing the backwater the line passes the village of Vaighe and from there keeps close to the village track to the bund of the Kalari tank. The road then keeps along the toe of the outer slope of the bund, and there are three masonry culvert sluices to the tank under the road. I make use of the last two, but did not think it worthwhile to twist the line on to the first one. Having past the tank the road goes off at a right angle to the pagoda of Tiruvutrakosha-mangé, from thence to Yettiyel on the Madura road seven miles from Ramnad.

9. In older times there were bridged district roads, marked on the ordnance map, running in all directions out of Ramnad, but now all that remains of them are occasional culverts stand-ing in the jungle as monuments of the retrogression of the Zemindari from civilization. Some of these roads are still in a state in which little money spent on them would save them from utter ruin, but it would be no use if a small yearly provision were not made for maintenance; and that seems most improbable judging by the utterly starved condition of the only road on which anything is done, that to Madura. At Tiruvutrakoshamangé I cross one of these old roads which runs from Ramnad to Shikal, &c., and I saw there had been a cross road from the village northwards to Yettiyel. It is long since the culverts were built, and they are not in good repair now. The lime is washed out of the joints, which are as thick as the bricks. The arches are semi-circular 1½ brick thick with no abutments, and the face walls are continued some 6 feet back from the arch in a straight line. I considered that it would not be possible to turn these relics of a better time into any use as they were too far gone in ruin and the construction originally was weak.

10. So from the Kalari tank I continued straight on across a strip of paddy under that tank, and keeping near a village track going in my direction. Across the paddy the line enters land covered with babul trees until the bund of Velâvi tank is reached at 7½ miles. The village has the bund and road on one side and irrigated land on the other. I chose the bund side to save expense in land and culverts, and also as the safest place for the line in event of heavy floods, as its being there will ensure the bund being kept in repair.

11. The line is laid out so as to keep along the bund as far as is possible, and I have done the same thing at the Periakamoi tank on the Ramnad section, and also at a tank between the 14th and 15th miles. I have already done myself the honor of reporting on the repairs to the Periakamoi tank in my No. 68, dated 23rd March, and in my No. 43, dated 9th March, accompanied with a sketch of the line on the Velavi bund. I have expressed my views respecting the repairs of the tank bund which the railway runs along, and the proportion of cost chargeable to the Zemindari works and the precaution to be taken to against the bursting of the bund. The Velavi tank is under the Raganath Kaveri system, so my remarks in paragraph 7 apply to it. At 8¾ miles there is an old-fashioned calingulah with four openings of 3½ feet and a width between abutments of 24 feet.

The following are the levels:—

| | |
|---|---|
| Top of tank bund ... ... ... ... ... ... ... | 513·00 |
| Formation level of railroad ... ... ... ... ... ... | 513·00 |
| Underside of covering stones of calingulah ... ... ... ... | 513·64 |
| Floor of calingulah ... ... ... ... ... ... ... | 507·84 |

I would suggest that the 1st and 3rd piers should be removed, leaving two spans of 10 feet each, and that the floor be permanently raised to a level of 509·00.

12. After this there is nothing much worthy of notice until the junction for Ramnad by the side of the Madura road. It was unavoidable passing through some irrigated land at 9¾ miles, and at 10 miles 3 furlongs another small tank bund is skirted. At 11 miles 102 feet the

Madura road is reached, and the line turns at a right angle along it towards Madura, and a branch is taken back to Ramnad.

13. RAMNAD SECTION.—I have already reported on a great length of the Ramnad section in my No. 68, dated 23rd March, and have little more to say. The line starts in the road at the east end of the town of Ramnad at a convenient place for a continuation towards Paumben, and keeps along the side of the main road for nearly two miles. The road then winds so much that it is hardly possible to set the line out on it, but it departs from the road very far nowhere, and the value of the land is small (if indeed the line is not in the road boundaries) except in one place where it was unavoidable crossing some irrigated land. Advantage has been taken of every culvert where at all possible, but in my opinion it is a very doubtful advantage.

14. The description of the old culverts given in paragraph 9 with truth applies to those on the Madura road, and both are evidently of the same date. It would seem that no more attention has been paid to the culverts on the road which has been maintained than to those on that which has not. Every culvert is sadly cracked through the face walls and sometimes through the arch itself. The lime which was used must have been fat shell lime, and no surki added to render it in some degree hydraulic, and consequently the whole of the original plaster has gone and on the soffit of the arch the mortar has been washed out of the joints a good 2½ inches deep. Evidently no pointing has been done for years; I suppose because there is no money, and so the road is going to ruin. I cannot recommend the use of these culverts for the railway, though I have taken the line over them; perhaps the 3 feet spans might stand the pressure, which need not be laid directly on the arch, but the 6 feet spans are no use and must be reconstructed. At the one at 11 miles 3 furlongs I counted 47 bricks 1¼ to 1⅞ inch thick in a 6 feet semi-circular arch, and the remainder is mortar joints much of which has been washed out.

15. The length of the Ramnad section of the line is 4 miles 5 furlongs 152 feet.

16. MAIN LINE.—From the junction of the Kilakari and Ramnad sections the line continues along the road until over a culvert at the 12th mile. The road then bends off to the left until up to the village of Yettiyel, and then makes two short right angular turns in the village. I tried but found I could not get the line round these turns, so I went right across the irrigated land from the 12th mile and joined the road again at its second turn at my 12⅔th mile. Then passing through the village of Yettiyel the line keeps on the road along the outer toe of the slope of tank bund and over the tank sluices. Until the 14th mile the line is on or close to the side of the road, after which it again becomes inadvisable, if not impossible, to follow it. Between the 13th and 14th miles of the railroad and the 7th and 8th of the road very serious damage has been done to the road by the breaching of the large Yettiyel tank. At 14¼ miles there is a tank bund, and the line cuts off a very little corner from the tank, and at 300 feet from the bund is on the top of a 12 feet semi-arched culvert. The bund of the tank on the left is run right across the culvert, as is also the bund of the one on the left. After crossing the bridge the road turns off to the right, at right angles, and continues in that direction for half a mile. I suppose the culvert is placed there for the stream, marked on the plan, which runs alongside the centre line and comes originally from the Vaige at Peramagudi. If so the culvert is in its wrong place, and has its face parallel to the stream instead of square to it. Last year the stream, fed by tanks bursting and from a calingalah to the tank on the left of the line at 14⅔ miles, proved this and preferred to make a breach in the road as shown on the plan. This culvert is hardly worth repairing, the southern face wall has fallen down, and the flooring is broken up; the arch remains, but requires pointing and plaster. I should recommend that a new culvert be built for the road at the site of the present breach where the stream flows naturally. From this point the centre line of the railroad leaves the road, according to the suggestion in my No. 14, of February 10th, and approved by Government. It runs along the bund of the tank to the left already mentioned in paragraph 11 which requires general repairs. At the 15th mile I have provided a 6 feet waterway to admit water to the tank from the channel on the right of the line; but the old calingulah at 14⅔th miles I would destroy and have it rebuilt in the eastern bund of the tank. At 16¼ miles the line crosses the supply channel. Between the 17th and 18th miles the line is curved four times twice being with the maximum curvature of 6° to keep on the bund of the tanks at Aragudi. At the 18th mile the supply channel crossed at 16¼ miles is met with again and continues on the left until 18 miles 3 furlongs when it is re-crossed. After having filled the tank at Kiliambal I do not propose any culvert between 17 and 18 miles 3 furlongs, but to run the water down on the right of the line for the supply of the tanks on that side. At 19¼ miles the line crosses a small tank through which the supply channel runs. At the 20th mile the line meets a kind of district road, for which land has evidently been taken up by the Zemindar, coming from the main road near Pogalur, and the direction of this road is followed to the 24th mile where it branches off to the left and goes to Pathanur (Pantipatcha Curry Nelloor). The course of the tank supply channel is dotted on the plan between the 19½ and 22nd miles; at the latter point there is a tank to the left, which no doubt receives supplies from the tanks west of it, on the left of the line, which again are supplied by the channel from the Vaige at Peramagudi crossed at 26½ miles. Between the 22½ and 25 miles there are three branch tank supply channels crossed, but there is no help for it, and in such a system of connected tanks the same and perhaps worse difficulties would be met within any other location. From the 26½ mile to



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the end there is nothing worth remark except the long tank at 27¾th miles, which seems more like a canal than a tank, but it is shown as the latter on the ordnance. The line stops at a village called Padariyéndel, and the boundary of the Zemindari is only a short distance further on. The total length of line from Kilakari is 29 miles 1 furlong 220 feet, which with the Ramnad section gives a total length of line set out of 33 miles 6 furlongs 372 feet. The total length of curves in this length is 6 miles 7 furlongs 345 feet. The limiting radius of 955 feet has only been used six times, and the total length of those curves is 7 furlongs 266 feet.

17. THE SECTION.—The line rises gradually and steadily from Kilakari and Ramnad, starting with a reduced level of 500·00 at Kilakari and 512·00 at Ramnad, the level at the junction of the lines 525·00, and at the end of the line 620·00. Thus the total rise of the main line is 122 feet in 33 miles and 6½ furlongs, and of the Ramnad branch 13 feet in 4 miles 5 furlongs. After crossing the hills at Kilakari the rise is continuous, the only descending gradients being caused by some local obstacle such as a bridge or tank bund. The grading of the line has been set very low, more so than would be wise if it were not for the almost temporary character of the line. In many parts there is no bank at all, but the ballast will be laid on the surface. The heaviest parts of the earthwork are in the Kilakari section in crossing the hills and in the Ramnad section owing to the tank bund.

The average cost of earthwork per mile is—

| | RS. |
|---|---|
| Kilakari section ... ... ... ... ... .. ... | 938 |
| Ramnad „ ... ... .. ... ... ... ... | 1,480 |
| Main line ... .. ... ... ... ... ... ... .. | 258 |
| Whole line ... ... ... ... ... ... ... ... .. | 599 |

It must be remembered that the earthwork of the Ramnad line includes what is fairly chargeable to tank repairs, and that according to the estimate sent with my No. 68, dated 3rd March, the Zemindar should contribute Rupees 743 to the expense which would reduce the rate per mile to Rupees 994. If this is considered high it must be borne in mind that it includes the approaches to a bridge of three 20 feet spans, and that a large amount is saved in the construction of the bridge. The rate of earthwork per mile must in any case be taken as very little, being only 599 over the whole line. The Kilakari and Ramnad sections and as far as Yettiyel on the main line, where the most earthwork occurs, are the only places where I have noticed anything like "black soil." But it is not like the real black cotton soil of the Deccan. It has a great deal of sand mixed with it and cuts with a grey streak, and though I have no doubt it makes bad mud and tenacious clay in the rains I am sure it cannot have all the bad qualities of black soil which make it almost impossible to make roads in the Deccan. Nor do I see how real black soil can occur here. It is generally supposed to be the result of the decomposition of trap rocks, and in the Deccan is invariably found lying on the rock from 4 to 10 feet deep in a more or less advanced stage of decomposition. Beyond the 15th mile the soil is generally red more or less mixed with sand, and on this I have laid the gradients as close to the ground as possible. In the extension of the line to Madura probably the rate of earthwork will not exceed Rupees 300 per mile.

18. BALLAST.—I propose to bring all the ballast from the sand hills at Kilakari by ballast train; the cost of leading I estimate at 1 Anna per ton per mile, which is probably a high rate. In the first three miles from Kilakari the bank will be formed of sand, and so I do not provide any ballast estimate for that portion. The cost of ballast over the whole line is Rupees 1,938 per mile. The average distance of the line from the river Vaige is 5 miles, and allowing 1 mile for filling and discharging the average lead by cart for river sand ballast would be 6 miles. This would cost 4½ Annas per ton per mile, or 6 miles by cart would equal 27 miles by railway. This distance is reached by railway at the end of the line now submitted. After this it will be cheaper to get the river sand, and I should prefer it to the sea sand; but in the event of an extension of the line we shall be able to bring the river sand up by train from Terupuvanam.

19. DRAINAGE.—The amount of waterway that must be provided is very insignificant. On the Kilakari section, where the line crosses the direction of the drainage, it is avoided by keeping on the tank bunds and over the sluices. On this length the only important waterways are a bridge of four 15 feet spans at the third mile, and two 10 feet spans over the calingulah of the Velâni tank. The superstructure of both these will be formed of timber beams; in the former the masonry abutments and piers must be built, but in the latter the masonry is there, requiring only repairs. In the Ramnad branch timber beams and wider streets will be required for 3 spans of 21 feet. In the main line some beams will be required for waterways of 10 and 6 feet to cross the tank supply channels. The line is high, and there cannot be much cross drainage, and the tanks and their supply channels collect all the water, but still in some places I would leave small drainage openings. At this season, though, it is almost impossible to say what will be required, and sometimes to say which way the water flows. As there are no rapid streams, but the drainage of the country is crossed in artificial channels, I have been considering, with a view to economy in first cost, if temporary wooden structures might not be made use of for all the waterways. In all the tank beds there are well grown babul trees, and I think we

can depend on them to carry the line over 6 feet. The abutments and piers which are in all cases low I would build of crib work made of the babul logs. For small irrigation and drainage openings palmyra trees might be used, two laid across the line, and two along it on the upstream side to protect the ballast, all held in place by babul stakes. The babul belongs to the Zemindar, and he might be asked to contribute that, and palmyra trees would cost 4 Annas to 1 Rupee. For such a construction I think it is better not to try to make drawings, but leave full liberty to the builder to work according to his circumstances, but it is absolutely necessary that a thoroughly competent man should personally superintend the construction of each culvert. To protect the toes of the banks and the ballast at small openings palmyra leaves would be found useful, and the natives of these parts from experience in repairing tanks can use these effectively.

See sketch appended.

20. For the supply of water to the engine it will be necessary to sink wells, as during the hot weather the tanks are certain to be dry except perhaps the Periakamoi tank near Ramnad. To commence with wells should be sunk at Ramnad, Kilakari, Yettiyel, Pudupatanam, and Padarayendal, averaging 11 miles apart, and all places where a good supply is certain.

21. At Ramnad and Kilakari and Padarayandel temporary sheds will be required to shelter the engines and stock, and at the two former places a small area might be roofed in to shelter perishable goods. Sheds measuring 50 by 25 nine feet high at the sides and sixteen feet at the centre would be convenient, covering an area of 1,250 square feet. The supports to be palmyra logs set 6 feet apart; the rafters, purlins and reepers to be also of palmyra, the whole to be covered in with bamboo matting and a thatch of palmyra leaves. Such sheds should be built anywhere about here for about 7 Rupees per square, as the price of palmyra trees which are to be had on the spot only averages Annas 8.

Terminal Stations.

22. At Ramnad or Kilakari there should be an engine pit 20 feet long near the well.

PERMANENT-WAY.—In the estimate for permanent-way I have put the rate of the iron delivered on the wharf at Kilakari at Rupees 120 per ton, which would allow about £10 f. o. b. in England, assuming cargoes at not more than 30 per ton. For sleepers I have allowed 12 Annas each which should be ample.

LAND.—The estimate for land is very small, only 48¼ Rupees per mile, but only such land as is in actual cultivation is taken account of. The width of land has been reckoned at 33 feet throughout, or 4 acres per mile. The line throughout passes through excellent land much of which might be irrigated, but is not, and all land actually in wet cultivation has been avoided as far as possible. It is sad to see so much good land utterly neglected, and this must partly be attributed to the famine of last year; but by far the larger part is never cultivated as I have learnt on inquiry from the villagers. They say it is not worth their while to cultivate the land under the Zemindari system of collecting the revenue which consists in the Zemindar taking half, or if the fancy takes him of seizing the greater share. It is to be hoped that a system of fixed assessment more in accordance with the principles of justice will soon be introduced, and that under it the land will be taken into cultivation. It is of importance from a railway point of view, as an extended cultivation means more trade, and a more prosperous peasantry will have more spare cash to expend in being carried rather than undertake the long weary walk, which all goes to swell the profits of the line. At present, though, the land can have no value and may be treated as waste land as I have done.

23. PRELIMINARY EXPENSES.—I have included under this head my own salary and travelling allowances, all the salaries of my establishment, and the sundry purchases I have made out of petty cash, over the period from February 1st to April 15th, being Rupees 67·15 per mile.

24. The survey was actually commenced at Kilakari on the 14th February, and field operations were closed on the 5th April. The remainder of the time until this date has been occupied in finishing the drawings and estimating.

25. ESTIMATE.—My estimate amounts to Rupees 3,53,929, or Rupees 10,468·11 per mile, and adding 10 per cent. for contingencies the cost per mile is Rupees 11,515.

The amount is a very small one, but supposing my estimate for permanent-way, which amounts to Rupees 7,739 out of Rupees 11,515, is sufficient, I have no doubt that a line may be laid such as His Grace the Governor described to me for the amount I have named. Such a line would be of course a mere temporary way to be improved gradually as funds become available. The bridges are all temporary, and I have no doubt that much annoyance and trouble may result in rains, more waterways may be wanted, and it may be found advisable to build some of the smaller ones estimated at Rupees 3 each on the plan of the larger ones at Rupees 25 each. The crib work arrangement for waterways is one thoroughly to be trusted to, but requires watching, to see it does not sink, and I have put up several culverts on the principle in very heavy rain and floods on the line between Arkonam and Conjeveram, and have supported girders of 12 feet span on piers such as I have proposed. The ballast and permanent-way are the only two items in the estimate which may be considered as at all perma-



nent, and the ballast I would have added to until there shall be a good 9 inches under the sleepers. The earthwork I consider cut too fine for a permanency, and as masonry culverts are built the banks should be raised and widened to a width of 14 feet.

26. TIME IN WHICH THE LINE MAY BE CONSTRUCTED.—The time of building the line need be very short, just so long as it would take to bring the permanent-way up from Kilakari and lay it. With parties working ahead at earthwork and bridges the permanent-way and ballasting should proceed at the rate of ½ mile a day, that is the line should be complete in three months. The cost of the necessary establishment for this time would probably come to Rupees 5,000 or 1·3 per cent. on the estimated cost of the whole line.

27. ALTERATIONS IN ALIGNMENT.—There are two or three places where the railway might be re-aligned with decided advantage, according to my instructions I have set the line over the road culverts, and this has necessitated crossing and recrossing the road, and in fact utterly destroying it. I have shown that the culverts are no use for the railway, and therefore I would set out the line on the north side of the road as far as Yettiyel where it becomes necessary to run on the road by the tank bund, then having crossed the road just beyond the village I would keep on south side. The Ramnad Branch from the Periakamoi tank is set out along the road, but none of the culverts are of any use. With a view to Devipatam and Paumben lines, I think it will be better to keep to the north side of the town of Ramnad and cross a mile or so of irrigated land under the big tank; I shall survey this next week. These alterations in the line would involve no extra expense if the line is kept alongside the road, but there will be the expense of land in altering the line to the north side of Ramnad. The road will be crossed twice at the fifth and seventh milestones, and it will be preserved as an independent line of communication, and with the help of the railway in bringing up the metal will, I hope, be put into good working order. There is, however, another question in the consideration of the communications of the district, viz., whether it is worthwhile to keep up two parallel lines between Manamadura and Ramnad? All the troublesome bit of road from Peramagudi might be abandoned if the railway is made, and instead of it the road marked on the ordnance map on the north side of the Vaigé from Shivaganga by Manamadura, Yelleyengoody, Ninarcovil to Ramnad be maintained, and as a set off against the expense of maintaining a greater length the low-lying piece of road between Tirupuvanam and Manamadura might be abandoned. A considerable area of country will then be fairly served with communications, and the large centres will be connected.

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No. 24-A. From W. S. HARINGTON, Esq., District Engineer, Madura, to the Secretary to Government, Public Works Department, dated Madura, 19th April 1878, No. 23.

IN continuation of my No. 22, dated 18th instant, I have the honor to forward, in original, Mr. Jenkinson's No. 88, dated 15th idem, with its enclosure, submitting in abstract a revised estimate of Rupees 3,46,016 for a permanent-way, based on information received by that officer from England.

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From C. H. G. JENKINSON, Esq., Assistant Engineer, Madura and Ramnad Tramway Survey, to the District Engineer, Madura, dated Ramnad, 15th April 1878, No. 88.

IN continuation of my No. 87, of the 13th instant, I have the honor to submit a more accurate estimate for permanent-way based on information received from England by mail last evening.

2. From this I arrive at a rate of Rupees 124-5-0 per ton all round for the iron of the way.

3. I find that by some inadvertence the rate for sleepers has been put at 8 Annas each instead of 12 Annas as I intended. Your letter, No. 32, of 11th instant, forwarding the letter of the Deputy Conservator of Forests, Madura, was opened after the estimate was despatched; this price of Rupee 1-8-0 per sleeper (the sleeper measures just 1 cubic foot) seems to me very high, and to that I must add 5 Annas per sleeper for carriage from Madura which would bring the price up to Rupee 1-13-0.

4. I find the price of sleepers measuring 7 inches × 2½ inches × 6 feet stated in England at 1*s.* 6*d.*, and of a sleeper 9 inches × 4½ inches × 6 feet 6 inches at 2*s.* 6*d.*, so I should expect to get those I want at 2*s.*, and adding 33 per cent. for exchange, freight and landing charges the price at Kilakari Rupee 1-6-0. The deduction from this is obvious.

5. I therefore decline to go beyond the rate of Rupee 1-6-0 per sleeper delivered at Kilakari until I have better information, and I am of opinion that the sleepers should be had much nearer my first rate of Annas 12 corresponding to the English 1*s.* 6*d.* in a country where labor is cheap. We must probably look to Ceylon or Burmah for the supply of sleepers where the forests are near the coast as it is the inland transit that forces the price up so high.

6. The alteration in price of permanent-way I have found it necessary to make brings the estimate up to Rupees 4,82,115, or 14,261 per mile.

No. 24-B. From W. S. HARINGTON, Esq., District Engineer, Madura, to the Secretary to Government, Public Works Department, dated Madura, 24th April 1878, No. 29.

I HAVE the honor to forward, for your consideration and orders, copy of letter, No. 91, dated 20th instant, from the Assistant Engineer, Madura and Ramnad Tramway Survey, with five enclosures in original as per margin. The estimate is for machinery for the line, the plans and estimates for which were submitted with my Nos. 22 and 23, dated respectively 18th and 19th idem.

Copy of a letter from the Assistant Engineer, Madura and Ramnad Tramway Survey, to the District Engineer, No. 91, dated 20th April 1878, with the following enclosures:—
1. Estimate of materials and fittings for 10 miles of railway for light mineral traffic without any stations.
2 and 3. Estimate No. 2 (for size No. 2); plan also sent.
4. Estimate No. 3 (for size No. 3).
5. Rolling stock and machinery.

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From C. H. G. JENKINSON, Esq., Assistant Engineer, Madura and Ramnad Tramway Survey, to the District Engineer, Madura, dated Ramnad, 20th April 1878, No. 91.

I HAVE the honor to forward, herewith, an estimate, amounting to Rupees 1,49,810 or Rs. 4,431 per mile, for machinery for the line, the plans and estimates for which I have lately submitted. The items of the present estimate are those things which would be absolutely required in the event of our opening a portion of the line at this end, and on which I think we might get along until a junction is effected with the South Indian Railway at Madura. If that is delayed beyond a year or 18 months of course further expense for tools and shops must be incurred. A sum must be provided in the estimate for a lock-up godown for these tools and stores, say Rupees 2,000, but I have not included it in the estimate as the amount is very uncertain, and in Ramnad or Kilakari we could certainly hire a house at first at a low rental.

2. The prices in the estimate are taken from lists just received from England with 15 per cent. added for exchange and 25 per cent. for freight, landing charges, &c., making a total of 40 per cent. added to the English charges.

3. In England for rough estimating locomotive engines are taken to cost £100 per ton of weight with from £100 to £200 added to the total. In this way I have arrived at the cost of the 10-ton engines.

4. I have the pleasure of forwarding, for the information of the Chief Engineer, description of two small engines with estimates for railway by Messrs. Ransomes and Rapier of London. These are very light, but the information is interesting for comparison with my estimate. Thus estimate No. 3 amounts to £792 per mile which may be put at Rupees 11,000, to which should be added my Rupees 3,000 for the extra weight of rail in my estimate, total 14,000. Add 2,729 for earthwork, ballast, &c., as per estimate, and we get a total of Rupees 16,729 per mile, and adding 10 per cent. for contingencies on Rupees 11,808 to correspond with my estimate we get a grand total of Rupees 17,900 per mile. The items of machinery and stock in Messrs. Ransomes' estimate amount to Rupees 4,921 per mile, while my estimate is Rupees 4,431 per mile, making a total of Rupees 18,692 per mile, and I venture to put forward that my line, imperfect as it is, will prove more useful. It must not be forgotten either that there is a certain amount of special pleading to be discounted from such estimate as those of Messrs. Ransomes and Rapier, while I am free from that so far as pecuniary advantage is concerned.

5. I am glad to be able to send a printed sheet of engine size No. 2 with a sketch of the steam carriage. For estimate No. 3 the locomotive is built on the usual model, with a saddle tank, on six wheels, that is two pair of driving wheels, coupled under the boiler and trailing wheels under the foot-plate; a description of the engine and duty to be done is attached to the estimate.

6. The duty of these engines seems to me to be stated moderately, and I find that with a good line and 80 lbs. average steam pressure on the cylinders the No. 2 size with coupled wheels should draw 36 tons at 10 miles per hour up 1 in 200 and the No. 3 size 45 tons. I have allowed 25 lbs. per ton train resistance in this calculation which would cover friction, resistance of a curve 955 feet radius, and gravity.

7. I apprehend, however, that 45 tons would not be considered by Government as a fair load for the style of railway contemplated which is to be capable, according to my instructions, of taking the ordinary narrow gauge trucks weighing 2 to 2½ tons per wheel.

8. For this duty a 10-ton engine on four or six wheels would be well adapted, and if on four wheels would not be too heavy for the 30 lbs. rail. Such an engine with 10" × 15" cylinders, 80 lb. cylinder pressure and 33" drivers would have 135 tons up 1 in 200 at 10 miles per hour. A grate area of 8 square feet could be provided, with a heating surface of nearly 490 square feet.

9. In my estimate of stock I have only provided for vehicles which would weigh full on an average a total of 350 tons, so that a train would generally weigh under 100 tons; for this an 8-ton engine would be sufficient, and I think such an engine might be made with 8" × 12" cylinders, on four wheels coupled 24" diameter, which should be able to haul 94 tons up 1 in 200, on which is a curve of 955 feet radius at 10 miles per hour; and that it might be provided with 6 square feet grate area. However, the only gain in such an engine would be saving £200 in the cost, while the loss of power is serious.

10. Of course the great difficulty with these small engines is to keep a good supply of steam up in ascending a long gradient which depends on grate area, heating surface, and storage room for the steam; for it is necessary to keep the boiler full while the engine is doing its heaviest work, and also the combustion is not so perfect in the contracted area of the small grates, and deductions must be made on this account from the duties I have given above, when the length of ruling gradient is protracted.

11. I much regret I have not my notes of the American Railways with me, they are in Bombay, in which are several examples of such engines as we require and which I have seen working. The Americans have, from the nature of their circumstances, paid more attention than the English to Pioneer Railways with considerable success, and their largest locomotive firms have made the production of strong, light, and cheap engines specialities of their business; and I would look to them for practical examples and modify them to suit English ideas.



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No. 236.

MEMORANDUM.

THE undersigned has the honor to return the surveys and estimates prepared by Mr. C. H. Jenkinson for a portion of the Madura-Ramnad Railway with a "Note."

MADRAS,
29th May 1878.

(Signed) C. J. SMITH, Major, R.E.,
Offg. Consulting Engineer for Railways.

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*Note on the Madura to Ramnad Surveys and Estimates.*

PRELIMINARY EXPENSES.—The actual expenses appear to have been taken; when estimating for other such extensions Rupees 150 per mile may be allowed for "preliminary expenses."

LAND.—The average prices paid for land in the Madura District suggest the following approximate rates for an estimate of this kind:—

| | Rs. |
|---|---|
| Irrigated land, 1st quality ... ... ... ... ... | 250 |
| Do. do. 2nd do. ... ... ... ... ... | 200 |
| Dry land ... ... ... ... ... ... ... ... ... | 60 |

The allowance for trees seems moderate.

EARTHWORK.—The rate allowed ought, it is thought, to be sufficient for first construction, but if the banks have to be maintained or turfed, as would seem very necessary in a coast district, the rate is low.

MINOR WATERWAYS.—Admitting the expediency of first opening such a line on waterways of the description proposed by Mr. Jenkinson, it seems open to question whether they could be laid in for the estimated rates. Such a point cannot, however, be dealt with in this office without further information. It appears that 37 minor waterways have to be provided. With no height of bank or depth of foundations given it is difficult to estimate the masonry required. The masonry actually built in 189 culverts of 2 feet span on the Madras-Cuddalore Section of the South Indian Railway averaged 23·3 cubic yards, and of 48 culverts of 4 feet span 62·9 cubic yards.

| | Rs. | |
|---|---|---|
| A 6 feet girder bridge in 3 feet bank would probably cost | 430 | |
| A 2 feet culvert ... ... ... ... ... ... | 150 | Taking average banks. |
| A 4 feet culvert ... ... ... ... ... ... | 300 | |

It is probable, therefore, that were it ever deemed advisable to build masonry waterways the lineal feet allowed for in Mr. Jenkinson's estimate would not cost more than Rupees 12,000.

BRIDGE, FOUR 15 FEET SPAN, 60 LINEAL FEET.—This work would probably be built for Rupees 3,000.

TWO SPANS OF 10 FEET.—This might be approximately estimated at Rs. 1,000.

THREE SPANS OF 21 FEET.—This perhaps might cost Rupees 3,000 with a 5 feet bank.

To build permanent waterways would not, therefore, as far as can be judged, cost more than Rupees 20,000.

The question raised by Mr. Jenkinson of using old and inferior masonry must be decided very much by the class of line to be opened. None but sound brick-work, well covered over, will stand the vibration of passing trains however light.

BALLAST.—The rate allowed for packing ballast, if by this is meant packing and straightening the permanent-way when strung out, fished and spiked, is too little. Rs. 55 per mile will be found a safe estimate. This would increase Mr. Jenkinson's estimate by Rupees 45 per mile.

SLEEPERS.—Allowing 8 for a 6 yard rail giving an approximate spacing of 2 feet 4 inches between centres and 1 foot 6 inches at the joints, 2,346 would be required; it would be wise to allow 5 per cent. for defective sleepers giving a total of 2,463 per mile. Mr. Jenkinson allows 2,515, a safe estimate. The rate seems barely sufficient. At Colombo a creosoted fir sleeper (in 1876) 9 feet 9 inches by 10 inches by 5 inches cost 3·68 Rupees or rather more than 1 Rupee per cubic foot. In Johore teak they cost 4·29 or 1·4 per cubic foot nearly. On the South Indian Railway creosoted fir half round cost 2 Rupees each. Jungle timber in Tinnevelly in scantling cost 1-8-0, in the rough 1·40 per cubic foot, jungle wood piles at Satoor cost Rupees 1-7-0 per cubic foot.

Measuring 6 feet by 10 inches by 5 inches.

It is thought that Rupees 1-8-0 would be a safe rate to allow in an estimate for the sleepers required.

RAILS.—The weight of rail allowed thus compares with that on lines of a similar class :—

| | Maximum wheel weight. | Rail. lbs. |
|---|---|---|
| Muttra Hathras ... ... ... ... ... | 2·65 | 30·00 |
| Conjeveram ... ... ... ... ... ... | 3·25 | 35·50 |
| South Indian wagon stock ... ... ... ... | 2·40 | ... |

for this Mr. Jenkinson allows 30·00.

Allowing 60 lbs. per yard forward, about 47 tons of rails would be required. Allowing for plates, bolts and spikes, the actual weight would amount to tons 51 nearly to which it would be wise to add 2 per cent.; this for an estimate would give 52 tons, or for 34 81 miles 1,810 tons. Mr. Jenkinson allows 1,784 tons. The proportion given for State Railway metre gauge is as follows :—

| | |
|---|---|
| Rails 40·3 lbs. per yard ... ... ... ... ... ... | 64·64 |
| Fish plates ... ... ... ... ... ... ... | 2·25 |
| Do. bolts ... ... ... ... ... ... ... | 0·86 |
| Spikes 4 inches ... ... ... ... ... ... ... | 1·71 |
| Fang bolts ... ... ... ... ... ... ... | 1·39 |
| Total tons ... | 70·85 |

LAYING PERMANENT-WAY.—The experience gained on the South Indian Railway points to a rate of 100 Rupees per mile for laying permanent-way.

COST OF PERMANENT-WAY.—At ruling rates for iron it is thought that 100 Rupees per ton would be sufficient to allow. The prices quoted marginally are those at which the Madras Railway Company have effected their last purchases. It would, it is thought, be safer to allow for a proportion, say 25 per cent., of the permanent-way being led by cart at 3 Annas per ton mile. In practice it has been seldom found feasible to run all out telescopically.

*Madras Railway.*

£6-10-0 for steel rails.
Engineering for 22nd March 1878 gives iron rails at 5-15-0 to 6£ per ton.

LEADING PERMANENT-WAY.



STATIONS.—Judging from prices paid in Tanjore and South Arcot 10 Rupees per 100 square feet is a fair rate to allow for shedding.

A 9 feet well 21 feet deep actually cost the South Indian Railway Company Rupees 350 to sink and complete; this is no doubt a high rate; Rupees 250 would be a fair estimate. A permanent timber stage for raising water cost the South Indian Railway Company 173 Rupees.

ROLLING STOCK.—The Muttra Hathras engine with six wheels, four coupled, weighs 13·7 tons full, having a maximum wheel-weight of 2·65 ton on each driving wheel.

The diameter of driving wheels is 2 feet 6 inches, diameter of cylinder 9 inches, stroke 14 inches, cost in India £1,183. The tractive force of such an engine compares with that of the South Indian Railway engines, assuming the same steam pressure, as 2 to 5. The latter take easily 30 loaded vehicles when the ruling gradient does not exceed 1·200 at a speed of 15 miles an hour. The load of such an engine as described above might be, it is thought, estimated at 12 South Indian Railway wagons loaded; the limit of wheel-weight will however permit a more powerful engine than this. The rate allowed in the estimate is thought ample.

VEHICLES.—The prices suggested by Mr. Jenkinson thus compare with those paid by the South Indian Railway :—

| | | Mr. Jenkinson. | South Indian Railway. |
|---|---|---|---|
| | Composite ... ... ... ... | 5,620 | 4,356 |
| | Third-class ... ... ... ... | 3,780 | 2,791 |
| | Brake-van ... ... ... ... | 2,380 | 3,317<br>1,639 |
| | Low-sided open goods ... ... ... | 950 | 1,058 |
| | High-sided open goods... ... ... | 1,020 | 1,133 |
| | Covered goods ... ... ... ... | 1,290 | 1,417 |
| STATION MACHINERY. | Sheer legs and 20 ton winch ... ... | 1,820 | ... |
| | Weigh bridge 10 tons ... ... | 1,400 | 1,030 |
| | Platform weighing machine for 5 cwt. | 630 | Small size. 142 |

There are two items of the estimate in which the provision appears to call for further remark :—

(*a*) Waterway.
(*b*) Rolling Stock.

On the South Indian Railway extending from Madras to Tuticorin the following are the figures showing the provision of waterway exclusive of all bridges aggregating 60 lineal feet and upwards :—

| | Lineal Feet. Per Mile. |
|---|---|
| Madras-Cuddalore ... ... ... ... ... ... ... ... | 21·4 |
| Cuddalore-Tanjore ... ... ... ... ... ... ... ... | 18·0 |
| Trichinopoly {Tuticorin / Tinnevelly} ... ... ... ... ... ... | 17·5 |

Mr. Jenkinson allows inclusive of all waterways, great and small, 295 feet in 33·8 miles, being at the rate of 8·7 feet per mile.

The distance is small for such a comparison, but in contemplating the possibility of eventually making the line permanent though light this point should not be lost sight of.

Mr. Jenkinson only allows for eight passenger carriages and for four covered goods which presumably would be available for passengers also. It seems questionable whether more passenger vehicles are not required, and whether covered goods might not therefore be substituted for such of the low-sided goods as are not indispensable for ballasting. No special trucks for this purpose have been provided for in the estimate.

It will be seen that so far as the information at the disposal of this office goes, the total sum allowed by Mr. Jenkinson appears ample to provide for what the estimate contemplates.

Mr. Jenkinson provides for no turn-table or "triangle" (run round), and it is thought when the line is opened the provision for station machinery will probably be found inadequate.

The enclosed tabular statement shows in comparison the original estimate of Mr. Jenkinson and that as amended in this office.

MADRAS,
29th May 1878.

(Signed) C. J. SMITH, Major, R.E.,
Officiating Consulting Engineer for Railways.

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No. 25. ORDER THEREON, 4th December 1878, No. 1,228 R.

MR. JENKINSON'S plans and estimates will be referred to the Consulting Engineer for Railways for report, in view to the project for a light railway between Madura and Paumben being prepared for submission to the Government of India.

2. The Collector of Madura will submit through the Board of Revenue a report upon the traffic in passengers and goods which may be looked for, supported by such statistics as may be available. In connection with the passenger traffic, care should be taken to ascertain the number of emigrants who have passed across to and from Ceylon from the Madura ports since January 1876, when the South Indian Railway was opened to Tuticorin.

3. The Collector will also report upon the population and the land revenue of the taluks which form a belt twenty miles in width on either side of the proposed line, and he will state whether any funds in the Madura District, or in the Shivaganga and Ramnad Zemindaris, can be made available to cover the interest on the estimated outlay.

(True Extract.)

Colonel, R.E.,
Joint Secy. to Govt., P.W.D.,
Railway Branch.

To the Consulting Engineer for Railways.
" Revenue Department.
" Board of Revenue.

Exd. C. Howarth.
Spare Copies

Revenue D.P.W.
No. 166

RAILWAY.

Govt. of {1878} Madras.

PUBLIC WORKS

To

THE CONSULTING ENGINEER
FOR RAILWAYS,
&c., &c., &c.

Dated December 4th.

Issued

Recd. 8 Jan 79 Encl.

G. O., 4th December 1878, No. 1,228 R.

DECEMBER.

Nos. 24-25.

Mis. 4085
10 Jan 79.

85

*Madura and Paumben Railway.*—Mr. Jenkinson's plans and estimates for the — referred to the Consulting Engineer for Railways for report.